

XI International Conference on Goats



Gran Canaria, Spain 2012



# BOOK OF ABSTRACTS

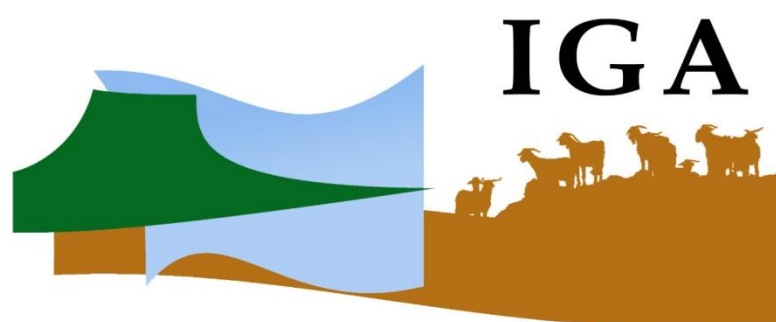


# BOOK OF ABSTRACTS

## XI INTERNATIONAL CONFERENCE ON GOATS

Gran Canaria, Spain, 23-27 September 2012

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Supervised by





## INVITED TALKS

- Use of local alternative feed resource based strategies holds promise for improving efficiency of goat production systems and for equipping them to better cope with the ongoing climate changes ..... 2
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# **INVITED TALKS**



**Use of local alternative feed resource based strategies holds promise for improving efficiency of goat production systems and for equipping them to better cope with the ongoing climate changes**

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Currently there are many reasons that justify the urgent need to develop sustainable strategies to improve the efficiency of livestock production systems in different agro-ecological zones. The increasing demand for animal products owing to urbanization, growing developing economies and growing populations, paralleled by continuous and rapid degradation of rangelands, increasing energy and fuel prices, and frequent climate extreme are serious threats for the agriculture sector and for the livelihoods of rural populations. The low quality feedstuffs and range vegetation form a major part of the diet of small ruminants, sheep and goats. In absence of appropriate supplementation with concentrate feeds, which lately have become very expensive, available feed resources fail to satisfy the maintenance requirements of small ruminants. Goats are present in most production systems in tropical and temperate zones. It is qualified as opportunistic domestic feeders that using a selective behavior can collect more nutrient dense diets than sheep. It can also better digest fibrous feedstuffs and better tolerate the presence of some secondary compounds in the diet than other ruminant species. These interesting characteristics explain the efficient use of panoply of local alternative feed resources (AFR) including fodder trees and shrubs, tanniniferous and saponins-containing feeds, and a wide range of agro industrial by-products (AGIBP). Rumen manipulation using bioactive natural compounds particularly tannins and saponins proved efficient in improving goat performance and productivity, and also these bioactive compounds served successfully as alternative anthelmintic products. Several strategies based on integration of AGIBP-based feed blocks and pellets in diets have also been tested on goats with good production response. The uptake of these strategies by smallholder has also been encouraging. For strategies to be successful in the field, these should be simple and cost-effective. In addition, effective participation and good coordination among scientists, technicians, extension people and local organizations (e.g. farmers' associations, non government organisations, etc.) are vital for the adoption of the AFR-based strategies. This paper presents these feeding strategies, collated from recently published literature and those that originate from the first author's laboratories. The production responses of goats, raised under different tropical and temperate conditions, to these feeding strategies are also discussed. We also provide some recommendations that can help boost the role of this animal species in different production systems and can also equip the goat production systems to better cope with climate changes.



**Out-of-season control of reproduction in subtropical goats without exogenous hormonal treatments**

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Some breeds of goats originating from or adapted to subtropical latitudes display seasonal variations of their annual rhythm of reproduction. The reproductive seasonality causes a seasonal production of goat-derived products affecting producers, goats' meat and milk industry and consumers. A good knowledge of the annual rhythm of reproduction, as well as the identification of the major environmental cues controlling this rhythm in both males and females, are necessary to draw new and sustainable techniques to induce a synchronized reproductive activity outside the natural breeding season and therefore to increase the out-of-season availability of the goat-derived products. This knowledge allows to control caprine reproduction without the use of exogenous hormones, and to develop techniques adapted to the environmental, economic and social characteristics of the breeding systems. Thus, in this review we will first describe the annual breeding season of male and females goats raised under subtropical latitudes. We will then describe how photoperiod was identified as the major environmental factor controlling the timing of the annual breeding season in goats raised under these latitudes and how photoperiodic treatments can be used to induce the sexual activity of male goats during the period of sexual rest. Finally, we will describe how these photo-stimulated males were used to induce and synchronize the sexual activity of anestrus goats maintained in intensive or extensive management conditions by means of the male effect. In subtropical latitudes, the use of the male effect performed by using photo-stimulated bucks constitutes an original and sustainable way to control goats' reproduction.



### **Zoonoses: how to control them**

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Zoonoses are infections that spread naturally from animals to humans. Most of the zoonoses diagnosed in goats are transmitted by close contact of man with goats and are occupational diseases that principally affect breeders, veterinarians and slaughterhouse workers. Others are airborne diseases and affect people living in the vicinity of caprine herds. But some of them are foodborne diseases which are mainly transmissible from animal to man through contaminated food or water. Finally others are transmitted by vectors, and climate changes may possibly modify the vector distribution and competence, and allow the propagation of the infections in disease-free countries. Prevention and control measures are proposed to limit further epidemics or to allow the containment of outbreaks. These measures may depend of several factors as the economic consequences of the animal disease, the local situations, the epidemiology of the zoonoses, the presence of the infection in wild fauna, as well as the resistance of the microorganism in the environment. In this review, the clinical signs in animals and humans of the main caprine zoonoses as well as the route of transmission of the agents and the control measures are reported. In addition four abortive diseases, Brucellosis, Chlamydiosis, Q fever and Rift Valley Fever are more particularly analyzed in order to determine the factors that contribute to the choice of the control strategies.



### **Goat Nutrition Based on Grazing**

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More research has been conducted with goats in confinement than on pasture or rangeland; however, most nutrients consumed by goats throughout the world are derived by grazing. There are a number of considerations unique or of special relevance to grazing goats. There are no evaluated methods of predicting feed intake or the activity energy cost of goats while grazing, and development of accurate means will be challenging given the variable conditions under which goats are raised. The activity energy cost of grazing goats can have profound effect on energy required and available for production. In both confinement and grazing settings, high productivity of goat genotypes intensively selected for traits such as growth or milk production can be achieved only with conditions facilitating high nutrient intake. Goats are able to consume a diet considerably different in nutritive value than the average of vegetation available, but insufficient research has been conducted to allow accurate prediction of the composition of the diet actually consumed. Equations to project negative and positive associative effects among feedstuffs in goats have been proposed, but evaluation experimentation is lacking. Previous nutritional plane can have substantial effect on energy required by goats, with marked fluctuation in nutritional plane during the year for grazing relative to confinement settings. Likewise, based on some findings with sheep internal parasitism appears to have considerable effect on both energy and protein needs, the impact of which may increase in the foreseeable future as anthelmintic resistance increases. Plant secondary metabolites such as condensed tannins can have variable effects on conditions that influence performance by goats, although substantial negative impact may only occur with diets primarily of plants with high levels rather than more common diets of multiple plant species. In summary, there are numerous areas concerning the nutrition of goats while grazing where increased knowledge is needed, which in part relates to research challenges in grazing settings. Hence, efforts should focus primarily on conditions affecting nutrition that differ between grazing and confined animals.





### **Methods to Improve Fertility: Flock Management, Embryo Transfer**

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Fertility in goats can be improved by natural methods (male effect and feeding) and by Assisted Reproductive Technologies (ARTs). The principal ARTs used in goats are: Artificial Insemination, embryos produced in vivo using multiovulation and embryo transfer (MOET) techniques, in vitro produced embryos (IVPE) and reproductive cloning using Somatic Cell Nuclear Transfer (SCNT) and embryo cryopreservation. Hormonal treatment to control and synchronize oestrus and ovulation is an essential technology in implementing the rest of the ARTs. In goats, AI and in vivo and in vitro embryo production are used to increase goat reproductive efficiency, genetic improvement of the animals, transport genetic material in a safe way and to preserve genetic resources for possible use in the future. Goats have been the principal domestic animal of choice for biomedical research especially for production of recombinant proteins secreted in milk. In recent years several studies have been done on transgenesis and cloned goats. However, ARTs need to be applied in healthy individuals to improve reproductive parameters. Poor animal health status, malnutrition and miss-management lie behind a reduction of fertility in spite of the techniques used.



**Building a combined targeted selective treatment scheme against gastrointestinal nematodes in tropical goats**

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The design and validation of a combined targeted selective treatment (C-TST) scheme to control gastrointestinal nematodes (GIN) of goats under tropical conditions is described. A survey performed on 1585 goats (older than 4 months) from 103 small holder subsistence farms from tropical Mexico (Yucatan), showed the classical over-dispersion distribution of the GIN fecal egg excretions (FEC) indicating that most goats had a low excretion of eggs and only a few had high FEC. A second stage of the survey (20 farms) tested the association between FAMACHA© and packed cell volume (PCV) (n = 638) as well as FAMACHA© and FEC (n = 627). The survey showed that FAMACHA© was a good tool to identify anemic animals but no association was found with their FEC. As a result, we proposed to combine FAMACHA© with body condition score (BCS) to identify adult animals at risk of high GIN infections. The FEC was used to identify goats needing AH treatment. The TST scheme was surveyed in a goat farm (mean 138 adult goats/year) in Yucatán, Mexico for 6 years (8,292 events recorded). In that period, the mean number of goats left without AH treatment was high (57.4%). Meanwhile, nearly 30% of the goats needed only one treatment per year. Less than 15% of the goats required more than 2 treatments per year. Besides, the AH doses were distributed amongst small number of animals every month throughout the year. We conclude that under the browsing conditions of Yucatan, Mexico, the combination of BCS, FAMACHA© can be used as a screening procedure to identify animals at risk of severe GIN infections. Then, the FEC using 750 EPG as a threshold for the AH treatment reduced the number of goats treated/year without negative consequences on the goats.



**The diagnosis of mastitis and contagious agalactia in dairy goats**

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This article reviews the diagnosis of mastitis in dairy goats. The benefits and shortcomings are discussed of both indirect diagnostic methods, such as the California mastitis test and somatic cell counts, and direct strategies, such as bacteriologic isolation and PCR identification. The important role of mycoplasmas in causing mastitis in regions where contagious agalactia is endemic makes their detection mandatory in routine diagnostic practice, despite complicating and lengthening protocols. In this context, we discuss both the conditions to be met prior to sampling and the analytical conditions of the sample along with the features of each diagnostic method.



### **Goat welfare, new field of research and opportunity for future developments.**

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Why should the 11<sup>th</sup> International Goat Conference have to deal with the issue of animal welfare and related questions in research and ethics? Does goat breeding practices, goat milk and meat or hair production raise specific concerns related to welfare or ethics? Our aim is to propose a non exhaustive scope of questions and knowledge related to goat welfare. Goat breeding practices are highly diverse over the world and it might be difficult to identify common welfare problems between various major producing goat countries. In addition, the recent world trends with economical uncertainty, fast market fluctuations and increasing prices of animal food, weights heavily on production costs. Then it might appear superfluous or even provocative to focus on animal welfare questions such as those intensely debated in industrialized countries. Indeed, the actors in the alimentary chain often take this recent issue as the additional and ultimate constraint that might lead them to end their activity. Nevertheless European institutional policy or even large commercial companies adopt welfare recommendation or good practice charts that impact on farmers' practices. The present paper is organised into three sections. The first one presents a brief history of the general interest for animal welfare and describes the evolution of European animal welfare policy, This choice does not imply a deny for similar societal concerns in other geographical areas, it simply reflects the combined cultural, historical, economical imprinting and constraints that lead us to extend our interested from almost exclusive zoo-technical knowledge to animals' conditions of life. The second section provides a few hints about the evolution of research publications on animal welfare. A rather crude data bank analysis of publications over the 1972-2012 period, indicated 28.546 publications with "animal welfare" as a key word, a further combination with "farm" (i.e. farm animal welfare") provides 7.659, that is 26% of total publications on animal welfare. Over the same period of time 177 publications used "goat" as a key word (1.77% of total number). The incentive research program focused on the evaluation of welfare level has been promoted by European Union is also described. Likely due to the relative importance of total goat size in Europe as compared to other species (large cattle, pig or poultry) and likely to the "green public image" of goats, the case of goat farming has not yet been specifically tackled by European institutions. In the third section a few goat breeding practices were selected on the basis of the adaptive challenge they represent since adaptation has been taken as a serious challenge for welfare status. A first category of welfare problems gather various adaptative challenges, it is illustrated by three situations: heat stress, difficulty to express natural behavior, digestive adaptation and related metabolic challenges, including milk production, triggered by food regimen. The second category of welfare issue is illustrated according four current husbandry situations formerly recognised as associated with zoo-technical problems and now identified as inducing pain. Two situations are somehow related to metabolic challenges: rumen acidosis and mastitis; the two others are the most critical in respect to pain and stress: pain occurring around slaughtering and during the time transportation. Some elements of current knowledge pointing towards follow-actions for welfare improvement are mentioned along with brief presentation of



### Invited Talks

benefits lines of action. Along this section, one might discover that some of the so-called “former zoo-technical topics” are now “reopen as welfare subjects”, but at the time they were initiated they could neither be “welfare oriented” nor perceived as such since this field of research was not established as it is now. Along this review article, an effort will be made to present welfare problems as occurring in both industrialised and emerging countries; in the latter, extensive breeding practices are still more common but might raise critical welfare situations that might appear less obvious to an observer framed by surrounding intensive farming practices common in highly industrialised and urbanised countries.



### **Immunity in young goats**

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Goat kids are hipogammaglobulinemic at birth due to goat placental structure. This fact has a huge influence in goat kid management and health. For more than 30 days, goat kids are dependent of immunoglobulins absorbed during the first 48 hours of life. In the last years some research groups around the world have focused in increase the knowledge about how and when goat kid immune system (specially innate immune system) develops. Recent advances related how the immunoglobulin's are transferred into the blood from gut in goat kids and how the management of colostrum feed period can modify the health goat kid status. New attention to minor immunoglobulins (IgA, IgM) has been done, and a new research focused in how much colostrum minor proteins are absorbed and which role in the innate immune system they can play. After colostrum period, milk or milk replacer suckling period has an influence in the innate immune system, overall on the complement system. New advances have been incorporated in the literature about the influence of fatty acids (specially omega 3) on immune system in the recent years. Big efforts have been done in activity complement system assays in goats, showing one more time the importance of develop assays specific for goats.



### **The characterization of goat genetic diversity: towards a genomic approach**

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The investigation of genetic diversity at molecular level has been proposed as a valuable complement and sometimes proxy to phenotypic diversity of local breeds and is presently considered as one of the FAO priorities for breed characterization. By recommending a set of selected molecular markers for each of the main livestock species, FAO has promoted the use of common tools across projects, with the aim of permitting a meta-analysis of datasets on molecular genetic diversity that otherwise would be local and highly fragmented. A joint analysis of two large goat microsatellite datasets produced by the Econogene Consortium and the IAEA-CRP-Asia Consortium has been attempted within the EU Globaldiv project, to produce a picture of goat diversity across continents. Results indicate the presence of a decreasing gradient of diversity from the domestication centre towards Europe and Asia, as well as a clear phylogeographic structure at the continental and regional levels and limited genetic differentiation among local breeds, particularly in Asia. The whole genome sequencing of livestock genomes and the development of SNP panels that assay many thousands of markers at a rather low cost permit the use of genomic technologies in all livestock species, goats included. Preliminary data from the Italian Goat Consortium indicate that the SNP panel developed in this species is highly polymorphic. The existing panel can be improved by integrating additional whole genome sequences of goats from different geographic localities, representing the areas of the domestication event(s) and of unique agro-climatic adaptability. Part of this effort is being achieved by international projects (e.g. EU FP7 NextGen and 3SR projects), but the contribution of a larger number of samples (i.e. as in the recently-launched 1000 cattle genomes initiative) is needed to reach a fair representation of the global diversity in goats. The SNPs and whole genome sequences are initiating the era of population genomics in goats through the application of genomic approaches to population genetics, offering new strategies to investigate complex and difficult to measure traits. For example, the comparison of patterns of diversity among the genomes in selected groups of animals (e.g. adapted to different environments) and the integration of genome wide diversity with new GIScience-based methods are able to identify molecular markers associated with genomic regions of putative importance in adaptation and thus pave the way for the identification of causative genes. Goat breeds adapted to different production systems in extreme and harsh environments will play a fundamental role in this process. High throughput/low cost sequencing technologies also permit the analysis of the entire





### Invited Talks

mitochondrial genome, thus achieving maximum resolution, and are now the common standard format for the investigation of human maternal lineages. The preliminary analysis of complete goat mtDNA genome supports a single Neolithic origin of domestic goats rather than multiple domestication events in different geographic areas.



### **Improvements in goat milk quality: a review**

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The new methods developed for increasing goat milk and cheese quality, such as the introduction of plant by-products in the goat diet, the development of new sensors for quality control or the development of new added value products, have led to increased interest in specific studies focused on the suitable ways of increasing goat milk and cheese quality and consumption. This review focuses on recent studies related with improvements in goat milk quality and provides an overview of the possibilities that have been tested and confirmed as promising results.



### **Responses of dairy goats to heat stress and strategies to alleviate its effects**

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Goats are considered more tolerant to heat stress compared to dairy cows because of their greater sweating rate and lower body weight: body surface ratio, which allows greater heat dissipation. Dairy goats kept under heat stress (HS) in climatic chamber decreased their DMI by 30%, doubled their water consumption, reduced their milk yield by 10%, and produced milk with lower contents of fat and protein. Despite the reduction in DMI, digestibility, retained N amount, blood NEFA, and blood glucose levels did not change in HS goats. Lower insulin secretion after feeding as well as muscle degradation are possible mechanisms to maintain the blood glucose levels under HS conditions. The microarray of blood revealed a change in the expression of 113 genes (mainly regulating fat metabolism), which might be related to the immune functions of blood cells under HS. The metabolomic study of urine by the nuclear magnetic resonance indicated differences in the concentrations of lactate, alanine, acetate, pyruvate, creatinine, and taurine. Milk of HS goats had different coagulation properties, which could have an important impact for cheese industry. Dairy goats supplemented with 4% fat during summer had lower rectal temperature and greater milk fat content. Similarly, soybean oil fed to goats kept under HS in a climatic chamber increased milk fat content, vaccenic acid, and conjugated linolenic acid. As an additional strategy, cooling by spraying could reduce HS symptoms and improves the goat welfare.



### **Status and trends of goat breed diversity at global level**

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Goats were domesticated about 10,000 years ago in Southwest and Central Asia. Today, they have spread globally, however, 71% of goats can be found in developing regions. Goats are of major economic significance for smallholders in the South, particularly in ecologically marginal areas such as drylands and mountains, where other domestic animals cannot easily be kept. They are of limited importance in Northern agriculture, though some high-yielding dairy breeds have been developed in Europe and spread globally. Similar shares of goats are kept in grazing, mixed rainfed and mixed irrigated livestock production systems, but only 1% of goats are kept in landless systems, indicating the close link of breeds to the land. FAO's global breed database in the Domestic Animal Diversity Information System DAD-IS (2012) contains population data of 1176 goat breeds. Of these, 48% are local breeds reported by one country only, 9% are regional transboundary breeds reported by several countries from one region, and 43% are international transboundary breeds, reported by countries in several regions. However, with the exception of few widely distributed breeds, goat breeds are much less widespread outside their home areas than either cattle or sheep. The majority of local breeds are found in Europe (36%), Asia (33%) and Africa (17%). The same regions report about 25% each of regional transboundary breeds. Africa has the highest share (26%) of international transboundary breeds, followed by Asia, Europe, Latin America, and the Caribbean with equal shares of about 15%. The risk status of 241 goat breeds is unknown; 80% of those are local breeds, indicating the low status of characterization and surveying of local breeds in many countries. 817 breeds are reported not being at risk; 67% of those are transboundary breeds. 40 breeds are in critical state, and 44 are endangered; most of those are local breeds and from Europe. 16 local breeds, all from Europe, are reported to be in conservation programmes. 18 local breeds are extinct; a lower share than for other mammalian species. Most of the extinct breeds were from Europe, where goats have been replaced by cattle during the intensification of agriculture. The paper will give more insight in these trends. It will further highlight the special adaptation traits of goats, such as heat and disease tolerance, which allow them to support rural livelihoods in marginal environments. Their diverse products, such as meat, milk, fibre and skin, serve as subsistence and create income. The close link to the land, adaptability and the multiple products and services they provide are critical components for the sustained use of the world's goat breeds.



### **Chevon Quality Enhancement: Trends in Pre- and Post-Slaughter Methodologies**

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Goat meat (chevon) consumption has increased in the US primarily due to the growing immigrant population. Chevon may be the choice of health-conscious consumers because of its healthier fatty acid composition. However, chevon consumption among mainstream consumers has suffered from the misperception that it is inferior in quality to beef, lamb, or pork. Researchers have studied several pre- and post- slaughter methodologies to enhance chevon quality. This paper will review the research trends and methodologies that show promise to further improve quality characteristics and nutritional properties of goat meat, and thereby changing the perception of chevon among western consumers. Among preslaughter factors, minimizing animal stress is an important step to quality goat meat production, as stress can affect muscle metabolism and negatively influence meat quality characteristics. Diet can have a marked effect on nutritional properties of goat meat, particularly fatty acid profile. Feeding goats a concentrate diet results in a higher level of oleic acid, but lower linolenic acid in the longissimus muscle, compared to raising goats on a hay diet. Diets containing high antioxidant levels, such as when supplemented with brown seaweed extract, result in increased color stability of chevon cuts. Administration of a growth promoter such as bovine somatotropin does not influence meat quality characteristics or pre-rigor  $\mu$ -calpain, m-calpain, and calpastatin activities. Several post-slaughter methodologies have been studied and proven to be beneficial. It is well-established that aging chevon retail cuts significantly improves tenderness, and that aging for more than 4 d may not result in significant additional improvement. Caselife of chevon cuts is comparable to that of beef, lamb, and pork cuts. Postmortem electrical stimulation has been reported to significantly accelerate postmortem glycolysis and improve tenderness of chevon. Subjecting deboned chevon cuts to hydrodynamic pressure processing or calcium chloride injections has been shown to significantly improve quality characteristics, particularly tenderness. Retail managers can play important roles in popularizing fresh chevon through planned aging and attractive packaging and display. With emerging markets for goat meat and meat products in the US, there will continue to be a critical need for research on pre- and post-slaughter methodologies in goats that may have potential to change perception and further expand existing market for chevon.



**Goat breeding in low input production systems: integrating values and modern breeding technologies for improving intrinsic robustness**

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Low input production systems operate on long-term values of supporting stable livestock production through efficient and sustainable combination of various production resources to achieve the desired production objectives. Strategies of goat breeding in low-input systems that emphasize on more robustness are a challenge now more than ever, owing to global environmental changes. Naturally, the low-input systems are exposed to heterogeneous environments, low feed availability and varied stresses. Global environmental changes exacerbate these scenarios due to drastic variation in weather conditions, epidemic pressures, and feed availability, among others. Therefore to improve robustness, breeding should aim at increasing versatility of the goats to the changing environments. Characteristics of goats that enhance their robustness are under influence of a wide range of biological mechanisms which are not yet exhaustively explored to be able to optimise breeding programs for low- input production systems. Breeding for robustness ensures efficient resource use. The targeted quantitative traits are complex since they are influenced by many genes at many loci as well as the environment. In low-input goat production systems, there is a large influence of varying environmental conditions (both temporal and spatial) on performance. Therefore, interaction between genes and the environment is highly envisaged. In this case, environmental conditions and genes found to influence a given trait in one environment will not always be the ones found in another. Most modern breeding technologies that can be used to improve intrinsic robustness have received little utility in low input production systems. Genomic selection is considered a high through put tool for genetic improvement of complex traits. However, it has never been utilized in these systems. Reproductive technologies that facilitate rapid dissemination of superior genetics in populations have achieved low utility. While these technologies may not have out rightly been outlawed, values espoused in low input production systems limit their use. It is therefore important that the concept of goat breeding for improved intrinsic robustness is discussed from the stand point of the values of the production systems and in view of incorporating modern technologies of animal breeding in these systems.



**The role of modelling in evaluating goat production system: example of a dairy goat herd simulator that generates individual variability in response to management.**

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The objective of this paper is to show how a herd simulator that generates the individual variability in response to management can improve the evaluation of production systems. The herd simulator is based on a conceptual model combining a decisional sub-system and a biological sub-system. The decisional sub-system accounts for the decision-making process by linking the farmer production project and the technical operations on animals with the concept of functional group (FG). A FG is defined as a group of animals managed by the same rules relative to feeding, reproduction and replacement management. The biological sub-system is based on a set of individual goat models simulating biological dynamics throughout lifespan, in response to feeding. The goat model explicitly incorporates the regulations that drive the energy allocation among physiological functions. The herd simulator was used to test the effect of an overfeeding strategy (OF), a simplified overfeeding strategy (SOF) and a production potential increase strategy (HP), compared to a reference simulation (REF). The results at herd level showed that OF, SOF and HP strategies increased the mean herd milk production and feed efficiency to the same extent, due a dilution effect if production fixed costs by the quantity of milk produced. At the individual level, the simulator enables to visualize the individual variability behind the herd performance. It also enables to describe the types of individuals generated by the simulated strategies regarding their level of body reserves mobilization. Compared to the OF strategy, the SOF strategy led to greater proportion of individuals at equilibrium regarding the mobilization level required to express their production potential. The single feeding plan in the SOF strategy compensated the effect of overfeeding. The HP strategy seemed to be the best compromise: it led to the greater herd production and efficiency increases and to a low level of biological risk. These results showed that aggregating performance at herd level can mask differences in the individual biological processes. Studying the individual variability behind the herd performance can improve the evaluation of management strategies. Further developments of the herd simulator open promising perspective to study the role of individual variability, especially when the herd faces environmental fluctuations.





### **Strategies for the genetic improvement of South African Angora goats**

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Selection of Angora goats over the past decades have focused on traits related to fitness, bodyweight and fiber production. Research for genetic improvement of the Angora has been based on quantitative selection and more recently molecular technology has been applied. Although considerable progress has been made at increasing fine mohair production, the inability of Angora goats to survive sub-optimum conditions has become a concern. Selection emphasis on fine fibre production resulted in unthrifty animals due to the unfavourable positive genetic correlation between body weight and fibre diameter. Breeding objectives and selection criteria were re-evaluated, resulting in a selection index (SI) aimed at increasing body weight, decreasing fibre diameter and maintaining fleece weight. Quality traits were investigated and evaluated for inclusion into the SI. Despite the use of the SI, the South African Angora industry is still hampered by the loss of young goats. The survivability of young animals is directly correlated to birth and weaning weights, and the poor growth rate of the Angora goat breed has been well-documented. DNA marker information will assist conventional selection by increasing selection accuracy, improving the rate of genetic improvement and leading to a better understanding of the physiological background of traits. An improved linkage map of the Angora goat genome was recently developed, using microsatellite markers. The genetic diversity of South African Angora goats was estimated simultaneously. The extensive production systems in South Africa pose a challenge for pedigree integrity, and a microsatellite panel was constructed for parentage verification. This panel is currently used to estimate the impact of inaccurate parentage allocation on EBV estimation and sire rankings. Selection for chromosomal fragments contributing to genetic variation of quantitative traits will lead to increased genetic progress and offers the opportunity to improve understanding of and exploit phenotypic variation. Putative quantitative trait loci associated with fleece and growth traits have been identified in the South African Angora goat population, and are currently being fine mapped. The current goat SNP chip does not include any Angora or other fibre-producing goat breed, and transcriptome sequencing of the South African Angora goat genome is underway using dermal and epidermal tissue to gain insight into the genes involved in fibre quality traits.

# **ORAL COMMUNICATIONS**



N-25

**Using legume/grass combination pastures to improve goat production  
sustainability in the Southeastern USA**

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The objectives of this experiment were to determine pasture quality changes, animal health, performance and carcass quality when goat grazed multi-culture grasses (annual rye grass and wheat; RW), and grasses in combination with legumes (Berseem clover; BC, Australian pea; AU, Hairy vetch; HV). Twelve paddocks (2 replicates), 0.202 hectares each were planted, where two paddocks represented each grass/legume combination. Forty-eight growing kids stratified by BW and were randomly assigned to each paddock ( $n = 4$ ). Animal performance and forage quality were monitored monthly starting from February through May of 2011. Multi-culture forage dry matter (DM) production in February, April and May 2011 was higher in RW + BC than other forage combinations. However, forage DM production in March was significantly different in the following order: The RW + AP + HV + BC > RW + AP + HV > RW + AP > RW + BC > RW + HV and RW combinations ( $P < 0.01$ ). There was a forage sampling time x multi-forage combination interaction ( $P < 0.01$ ) for CP and NDF. Animal grazing on multi-culture forage (RW+ HV + AP) had greater ( $P < 0.01$ ) BW, carcass and shoulder weights in March, April and May 201 than other forage combinations. All animals grazing four forage combinations (RW+AP+HA+BC) and RW alone had lowest BW gain and carcass production compared to other forage combination. The soluble protein, P, K, Na, Cl, Fe, Cu, Zn contents remained similar with varying species of legume forage combination, but CP, ADF, NDF, crude fat, ash, Ca, Mg, S, Mn, and lycine were varied. Mean fecal egg count (FEC) for growing meat goats were tended to be higher ( $P = 0.17$ ) for RW than for other combinations. These results indicated that growing goats consuming combination of legumes with grass forage over grass alone could benefit to maintain optimum weight gain and carcass production as well as minimized parasites infection rate when grazing these pastures.



N-48

**Relationship between milk urea level and intestinal digestible protein balance in dairy goats**

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The relationship between milk urea level (MUL) and intestinal digestible protein (PDI) balance was evaluated using mean treatment data ( $n = 21$ ) from 5 balance experiments conducted on lactating Saanen goats ( $n = 106$ ) kept in individual metabolic cages. On average, dry matter intake (kg/d), milk yield (MY, kg/d) and MUL (mg/dL) were  $2.40 \pm 0.44$ ,  $3.95 \pm 1.01$ , and  $33.0 \pm 15.5$ , respectively. The main dietary composition (% on DM) of the treatments ranged from 12.9 to 21.4 CP, 30.2 to 39.9 NDF and 28.8 to 47.6 NFC. PDI balances were estimated as the difference between allowances of PDI with nitrogen as limiting factor (PDIN) and PDI requirements. PDIN concentration of each dietary ingredient and individual PDI requirements were estimated according to INRA (2007). On average, PDIN balance (g/d) was  $39.5 \pm 75.8$ . Individual milk samples were analysed for MUL using the pH-differential technique (ISO 14637: 2006). Data were statistically analysed using linear regression procedure of SAS. Dietary CP strongly affected MUL ( $MUL = 5.1 \times CP - 48.3$ ;  $P < 0.001$ ,  $R^2 = 0.79$ ), but not MY ( $MY = -0.11 \times CP + 5.70$ ;  $P < 0.139$ ,  $R^2 = 0.11$ ). Close relationship existed between MUL and PDIN balance ( $MUL = 0.19 \times PDIN \text{ balance} + 25.9$ ;  $P < 0.001$ ,  $R^2 = 0.94$ ). In conclusion, these results showed that MUL can be utilised as a tool to evaluate protein feeding adequacy also in dairy goats. Particularly, when PDIN allowances are closed to requirements MUL should be closed to 26 mg/dL.



N-64

### **Mixed grazing system with cattle to increase goat nutrition and performance at pasture**

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Grazing management systems using mixed sheep and cattle have previously showed better performances of one or both species, mainly attributed to complementary feeding behaviour of the species and to a reduction of host infection by gastrointestinal nematodes. Mixed grazing systems involving goats and cattle have been much less studied and, therefore, are the purpose of this experience. Mixed goats and cattle grazing continuously natural pasture, were compared to goats reared alone, either when the goats were infected or not, and four treatments were carried out: goats mixed with heifers infected (MI) or not (MNI) and goats control grazing alone, infected (CI) or not (CNI). The 4 treatments were tested for 2 years, with 6 successive bands of animals reared at pasture for 3 months each and on 2 different plots (P1 and P2) with the same stocking rate and ratio. The experiment have involved 6 bands of 8 groups of 6 goats each (i.e. 288 animals) and 8 groups of 2 heifers. Intake and digestibility *in vivo* of the diet were measured individually for the goats (based on faecal methods), as well as their live weight (LW) and average daily gain (ADG, g LW/d) and the production of herbage and their characteristics. The intake of goats was higher in mixed grazing compared to control for the infected goats MI and CI (61.7 vs. 55.0 g OM/LW0.75,  $P < 0.01$ ) and for the non-infected goats, MNI and CNI (66.4 vs. 61.8 g OM/LW0.75,  $P < 0.01$ ); whereas the digestibility did not varied significantly for MI and CI (0.704 vs. 0.702) and for MNI and CNI (0.704 vs. 0.687). The ADG of the goats were also higher in mixed grazing than in control, whatever the infection status (43.25 vs. 32.44 g/d for MI and CI and 31.68 vs. 17.91 g/d for MNI and CNI). By another way, the biomass was less important on the paddocks with mixed species compared to the control paddocks and the total global production per day (g LW/kg herbage DM) also shows better results than the control (2.04 vs. 1.91 g LW/kg DM for MNI and CNI and 1.91 vs. 0.56 g LW/kg DM for MI and CI). These results suggest that mixed grazing could be used for nutrition and enhanced performance, in addition to the management of the residual biomass and the lower impact of gastrointestinal nematodes, on the performance of goats. This is a very promising method for the production of alternative grazing goats, which is of major importance in global demand for animal products, especially in hot regions.



N-90

**Blood Immunoglobulin concentration (IgG and IgM), Chitotriosidase activity and complement activity of kids and lambs raised with milk replacer and powdered cow milk**

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Feeding with milk replacers (MR) have been widely used in rearing goat kids and lambs. The advantages of this system are: reducing milk feeding, labor costs and simplifying management. On the other hand, whole powdered milk (CM) could be a good feeding source due to it is cheaper than milk replacers; however there is no information about their use on growth and immune parameters of goat kids and lambs. For this reason the aim of this study was to evaluate the effect of feeding source on IgG, IgM, Chitotriosidase activity (ChT), complement system activity (total and alternative) and weight evolution on goat kids and lambs. In this study 12 goat kids and 12 lambs (males and females) were divided in two groups (MR and CM groups). Blood samples were taken each day from birth to 5 days after that and at days 20 and 35. Weight was recorded twice weekly. The IgG and IgM concentration were determine using a commercial ELISA kit, while ChT was measured using a fluorescence assay and the Complement System activity (total and alternative) was measured according to the hemolysis rate. Results showed that there were no differences in IgG and IgM concentration or complement system activity (total and alternative) between feeding sources in both species. In reference to ChT, no differences were observed, except for the CM group which recorded higher ChT than MR group at day 35. Finally, no weight differences were found in the studied period, although lambs obtained a higher weight than goat kids at day 20 and 35 after birth. In conclusion, CM did affect neither immune parameters nor weight evolution, so feeding with whole powdered cow milk can be considered as a safe and economical option to raise goat kids and lambs.



R-6

**Energy distribution in maintenance of immunity and reproduction with special reference to melatonin in Indian goat *Capra hircus***

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Immunity and reproduction both are highest energy demanding processes and energy distribution for both has never been studied in any ruminant. For temperate goats monsoon is stressful due to heavy rainfall, humidity, temperature; thus increasing pathogen invasion during grazing. Being short day breeder they breed during winter when temperature is very low which is stressful and even fatal for them. Thus aim of the present study was to note energy distribution between general immunity and reproduction of Indian goat in a sex and season dependent manner correlating it with melatonin, known for its immunomodulatory, anti-gonadotrophic actions. Desired tissues and blood (in heparinized vials) were collected from randomly chosen goats (male & female, n=10). All parameters were estimated following standardized protocols. Results were analyzed by Two-way ANOVA and Neumankeul's Test. Our results suggest that, immune parameters (%SR of thymocytes, splenocytes, TLC, DLC, circulatory IL-2 level) were significantly high ( $P < 0.01$ ) in males and females in monsoon (July-August) and winter (i.e. Dec-Feb, only reproductively active phase of females) but didn't show any sex dependent variation throughout year. Male reproductive parameters ( $3\beta$ -HSD, testosterone) were almost static throughout year indicating their yearlong reproductive activity. But, in females,  $3\beta$ -HSD, estrogen were significantly high ( $P < 0.01$ ) in winter. Thus, to cope up with energy demand to maintain immunity and reproduction during winter, lymphoid tissues and gonads stored glycogen, which, was significantly ( $P < 0.01$ ) low in female gonads and lymphoid tissues during winter in comparison to other seasons and to the males, signifies the elevated utilization of energy. To confirm the same glucose (circulatory, tissue, % uptake by tissues) was checked and was significantly high ( $P < 0.01$ ) in females at gonads and lymphoid tissues during winter in comparison to males. Total cholesterol measured in blood, lymphoid organs and gonad as a gross marker for steroidogenesis showed a significant decrease ( $P < 0.01$ ) in females than males during winter. Expression of Melatonin receptors (MT1, MT2) significantly ( $P < 0.01$ ) increased in thymus of both sexes during monsoon, signifying immunostimulatory role of melatonin. In conclusion, the immune organs are not only acting as local power houses (storage and utilization) of body but also helps to maintain reproduction in synergism with gonadal steroids especially during winter.





R-32

**Effects of semen preserving condition on the quality of flow cytometric sexing sperm of Xinong Saanen dairy goat (*Capra hircus*)**

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The objectives of the study were to determine an optimal short-term preservation method for transporting fresh semen to the sorting site. Prior to flow cytometric sorting, semen was collected by artificial vagina from two bucks ( $n = 2$  ejaculates per buck) was diluted in either a Tris-based-traditional diluent (TRIST) or Tris-based- modified diluent (TRISM) stored at 5, 15 or 19°C for 12 or 24 h. Sperm characteristics were assessed during preservation and after sorting using a high-speed cell sorter modified for sperm (SX MoFlo, USA). The average sorting rate for the X or Y sperm was 3,500-4,500 sperm/s. X and Y sperm were collected simultaneously into 10 mL centrifuge tubes, pre-soaked with 1% BSA in a TRIS sheath fluid, containing 1 mL warm, filtered XY TALP and 20% egg yolk (v/v). Both sorted (X or Y sperm) and control (unsorted sperm) from the same buck were charged and packed in 0.25 mL straws and cooled using the Control Rate Freezer (IVM, France). The semen straws were transferred to liquid nitrogen for evaluation. Progressive motility rate and acrosome integrity of stored and sorted sperm were assessed after freeze-thawing (1 min, 37°C). The results showed that the sperm progressive motility (80-82%) for semen preserved in TRISM at 19°C for 12 h before sorting was significantly higher than that at 5 or 15°C for 12 h. The semen preserved more than 12 h was not suitable for flow cytometric sexing. After sorting, the sorted frozen-thawed sperm (X,  $71 \pm 9.1\%$ ; Y,  $69 \pm 7.2\%$ ) at 19°C recorded significantly ( $P < 0.05$ ) more intact acrosomes following thawing than the sorted at 5 or 15°C for 12 h. There were no significant differences in the post-thaw sperm motility between the control (unsorted) and sorted X and Y sperm of semen preserved at 19°C for 12 h. The individual buck also had no effect on the post-thaw sperm motility. In conclusion, the buck semen treated with the two diluent at 19°C could be transported to the sperm sexing center in 12 h without affecting the sorted sperm quality, the sorting purity of X and Y sperm was 85% and 87%, respectively.



R-34

**Influence of cumulus cells attachment during in vitro fertilization of in vitro matured goat oocytes**

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Considerable research into IVP technology has been undertaken to enhance embryo production. The objective of the present study was to assess the influence of cumulus cell presence when not attached to oocyte during IVF on embryo development and to evaluate the possibility of using oocytes found denuded at collection to produce embryos. Throughout five collections of slaughterhouse goat ovaries, all oocytes presenting a homogenous ooplasm were selected. Most (1316) were cumulus oocyte complexes (COC) while some (n = 381) were already denuded at collection (DOC). COC and DOC were washed and placed in wells containing 50 oocytes in 500  $\mu$ L of maturation medium (TCM 199 supplemented with 10 ng/mL EGF and 100  $\mu$ M/mL cysteamine). Matured oocytes were incubated with frozen-thawed semen in SOF, containing 10% heat-inactivated sheep serum, 40  $\mu$ g/mL gentamicin and 5  $\mu$ g/mL heparin. Some oocytes were denuded on purpose (DOP) by vortex before IVF. After fertilization, all presumptive zygotes were denuded by vortex and cultured for 8 days in groups of 25 in oil overlaid droplets of 25  $\mu$ L of SOF medium supplemented with 10% FCS at 48 hpi. The proportions of oocytes that cleaved and developed to the blastocyst stage were assessed at Days 2 and 8 post-insemination, respectively. Cleavage rate and blastocyst yield were compared using ANOVA followed by Tukey's multiple comparisons. The cleavage and blastocyst rates calculated from total oocytes were lower for DOC (33%  $\pm$  1.6; 11%  $\pm$  2.1, respectively, mean  $\pm$  SEM) as compared to COC (76%  $\pm$  3.5; 59%  $\pm$  4.4). However, when equal numbers of COC and DOC (25/25) were mixed at the start of IVM (COC DOC IVM), the overall cleavage and blastocyst rates were similar to COC (67%  $\pm$  1.4; 44%  $\pm$  3.6), indicating that the presence of DOC is not detrimental to COC and that COC could rescue some DOC. When DOC and COC were mixed equally for IVF (COC DOC IVF), the rates were significantly reduced (57%  $\pm$  2.3; 39%  $\pm$  1.2) compared to COC alone. Removal of cumulus before IVF (DOP) resulted in a tendency to reduce cleavage and development rates (69%  $\pm$  4.3; 46%  $\pm$  3.9) as compared to COC. This tendency was not observed when unattached cumulus cells (DOPCC: 72%  $\pm$  4.7; 52%  $\pm$  4.3) or equal number of COC were added to DOP during IVF (DOPCOC: 70%  $\pm$  2.8; 52%  $\pm$  5.0). Collectively, these data suggest the possibility to use denuded oocytes to increase *in vitro* production of goat embryos and that unattached cumulus cells added during IVF may help denuded oocytes to be fertilized.



R-56

**Influence of cool storage before freezing on the quality of frozen-thawed semen samples in Majorera bucks**

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The aim of this study was to determinate the semen quality of frozen-thawed samples that were chilled for up to 2 days before freezing. The ejaculates ( $n = 12$ ) from six Majorera bucks were collected, pooled and divided into six aliquots. The first aliquot (C, control) was frozen in liquid nitrogen using a conventional protocol to reach a final concentration of  $400 \times 10^6$  spermatozoa/mL, 12% egg yolk and 4% glycerol. The remaining five aliquots were diluted with a chilled extender (Tris-glucose and 12% egg yolk) and cooled at 4°C as follows: R1, the semen was cooled for 1 hour; R6, the semen was cooled for 6 hours; R12, the semen was cooled for 12 hours; R24, the semen was cooled for 24 hours and R48, the semen was cooled for 48 hours. After the chilling period, a second extender was added (Tris-glucose, 12% egg yolk, 8% glycerol) to reach a final composition similar to aliquot C, and then the semen samples (R1, R6, R12, R24 and R48) were frozen in liquid nitrogen. The post-thaw sperm quality was assessed in 20 straws from each experimental group. After freezing-thawing, the total sperm motility (approximately 60-65%) in the semen chilled for up to 24 hours did not show any differences from the samples frozen by the conventional cryopreservation method (62.2%); however, the post-thaw sperm motility showed a significant decrease (35.1%;  $P < 0.01$ ) in the samples chilled for 48 hours before freezing. No significant differences were detected in the percentages of abnormal sperm cells (range: 5.0-9.2%) among the fresh semen, the control group and the frozen samples after the different cooling times (R1, R6, R12, R24, R48). Finally, the post-thaw percentages of damaged acrosomes showed a distribution similar to the sperm motility, with mean values ranging between 10.8% and 15.5% in the C, R1, R6, R12 and R24 aliquots, but notably higher (> 30% of damage acrosomes) in the R48 group. The results clearly demonstrated that cooling the semen up to 24 hours before freezing did not produce a decrease in the semen quality when was compared with semen frozen by a traditional procedure. Therefore, freezing of buck semen that had been previously chilled for up to 1 day could be an alternative as effective as the traditional method of freezing semen. The limitations associated with the transport of frozen semen could be overcome by the use of cooled semen.



E-8

**Smart drenching and FAMACHA integrated training for sustainable control of gastrointestinal nematodes in small ruminants**

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The objective was to assess the impact of Smart Drenching and FAMACHA Integrated Parasite Control training in the United States on the ability of goat producers to control and manage gastrointestinal nematodes (GIN) on their farms. GIN are the most serious problem affecting the health and productivity of goats throughout much of the world, the United States (US) and especially in the southern US region. Although many species contribute to the overall problem of GI parasitism, *Haemonchus contortus* (barber pole worm) is by far the most prevalent, pathogenic, and economically important one in most of the US. Control programs for *H. contortus* typically rely on frequent treatment with anthelmintics, but the intensive use and virtual total reliance on these drugs has led to the development of drug-resistant worm populations, threatening grazing small ruminant production globally. The serious problem posed by multiple-drug resistant parasites emphasizes the need to develop and implement sustainable methods of worm control that minimize use of anthelmintics, thus preserving the efficacy of the few drugs that remain effective. In response, the Southern Consortium for Small Ruminant Parasite Control (SCSRPC) investigated several methods for sustainable GIN control. The Smart Drenching concept together with FAMACHA validation has been in use in US since about 2003. The SCSRPC has been a pioneer in validating this approach in both goats and sheep. In 2008, the consortium published an educational resource manual on Integrated Parasite Management for farmers, extension agents and veterinarians in the United States. The printed training manual along with a complete electronic resource available at the SCSRPC website ([www.scsrpc.org/flashf/flash.htm](http://www.scsrpc.org/flashf/flash.htm)) contains information and training modules for FAMACHA and Smart Drenching. Farmers in 48 states have received training in Smart Drenching and FAMACHA for sustainable control of gastrointestinal nematodes. More than 25,000 FAMACHA charts have been distributed. There is evidence that the success of this Integrated Parasite Management training program has been immense as; 94% of farmers surveyed felt that it improved their ability to control parasites, 74% reported reduced parasite problems, and 88% felt that they had saved money by deworming their animals less often and had fewer animal deaths. In conclusion, goat producers in the United States have clearly indicated they benefited from the training.



N-44

**Faecal microbial and coccidial milieu of probiotic supplemented beetal kids under stall-fed conditions**

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A feeding trial was conducted on 24 beetal kids of five days old to study the effect of probiotic cultures on the intestinal microflora and diarrhoea incidences from April to December 2010. The 24 kids were randomly distributed in four groups (with 6 in each) i.e. *Lactobacillus acidophilus* (PL), *Saccharomyces cerevisiae* (PS), combination of the two (PL+S) and Control (no probiotics). The dose of probiotics was 0.2% of body weight and fed in diet for eight months. The faecal samples were collected from all the animals individually at monthly intervals for up to 8 months under aseptic conditions. The determination of lactose fermenter (LF), non-lactose fermenter (NLF), *E. coli* (EC), and total bacterial count (TBC) was done by using specific media. During pre-weaning period, the probiotics had significant effect ( $P < 0.01$ ) on non-lactose fermenters (NLF) and total bacterial count (TBC). The bacterial load was calculated using Pour plate Technique and expressed in Log<sub>10</sub> values/g of fresh faeces. During the pre-weaning period, control group had significantly ( $P < 0.05$ ) higher microbial population in terms of NLF and TBC than PS and PL+S, whereas, value of PL falls in-between the two. During the post-weaning period also NLF and TBC was significantly higher ( $P < 0.05$ ) in control than other three groups, with non-significant differences among themselves. The lactose fermenter and *E. coli* were not differed significantly among groups. The coccidial load was not affected by probiotics supplementation in different groups over control during entire study period. The diarrhoea incidences were significantly higher ( $P < 0.01$ ) in control, both during the pre- and post-weaning period. From the present study it can be concluded that dietary inclusion of probiotics creates a congenial intestinal environment and reduces diarrhoea incidences, essential for efficient growth under stall-fed conditions.



P-3

**Effect of vegetal extracts on Cryptosporidiosis and Coccidiosis in goat kids fed with milk powder until weaning**

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Diarrhea from birth to weaning in young calves, lambs, and goat kids is a major problem for livestock. It causes economic losses and additional work due to treatments in the hope of a cure. Several diseases are involved in this symptom, particularly cryptosporidiosis and coccidiosis. A trial was conducted on goat kids to assess the activity of a mix of plant extracts, commercially named Oilis LD on the control of cryptosporidiosis and coccidiosis. 70 Alpine and Saanen goat kids, born in the same breeding farm, were randomly assigned to the treatment group and to the control group according to their date of birth and their breed. Goat kids were placed in 2 collective contiguous cases, on straw. Trial period run from birth to 7 months of age. Distribution of Oilis LD from 3 days of age to weaning: 0,8% in milk powder from 3 to 15 days of age, and then 0,6% in milk powder from 16 to 68 days of age. Growth performances were evaluated by individual weighing of animals each month from birth to 7 months of age. Oocysts were sampled in feces and counted using Heine colouring at 17 days of age for cryptosporidia and Mac Master cell at 36, 55, 87 and 119 days of age for coccidia. Oilis LD improved significantly goat kids' growth. Live weight was significantly higher ( $p < 0.01$ ) from 3 months to 7 months of age in Oilis LD group compared with control group. Difference in weight was 2.4kg (+7.3%) at the end of the trial in favour of Oilis LD group. Regarding cryptosporidia, there was no excretion at 17 days of age. Animals were not infested thus it was not possible to draw any conclusion about the potential effect of the product on this parameter. Coccidia oocysts excretion was very low during the 4 first months of life. At 119 days of age, which corresponded to excretion peak, Oilis LD reduced coccidiosis oocyst excretion in the faeces (-43.9%). Because of absence of cryptosporidiosis, further work is needed in field conditions to evaluate Oilis LD effects on this pathology. Nevertheless, Oilis LD enabled a good management of coccidiosis with improved growth and decreased oocyst excretion.





P-4

**Effect of vegetal extracts against *Cryptosporidium Parvum* in goats with artificial infection**

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Neonatal diarrhea in young calves, lambs, and goat kids is a major problem for livestock. It causes economic losses and additional work due to treatments in the hope of a cure. Several infectious agents are involved in this symptom, including a parasite very difficult to control, *Cryptosporidium parvum*. A trial was conducted on goat kids to assess the activity of a mix of plant extracts, commercially named Oilis LD on the control of *Cryptosporidium parvum*. 22 goat kids, from the same breeding farm, were randomly assigned to treatment group (12 animals) and to control group (10 animals). The 22 goats were artificially infected at 3 days of age (= d0) with a dose of 10exp6 infecting oocysts of *Cryptosporidium parvum*. Experimental period ran from d0 to d15. During this period, goats received milk replacer individually from d0 to d10 and in a collective bucket from d10 to d15. Control animals received only basal diet while treated animals received basal diet + 520 mg of Oilis LD/d/kid from d0 to d5. General health and diarrheal status were recorded daily. Each dead goat was necropsied. Feces were collected in order to count *Cryptosporidium parvum* oocysts by immunofluorescence at d0, d2, d6, d8, d10, d12 and d14. During the 5 days of complementation with Oilis LD, no mortality was observed in treated group while 20% was observed for untreated animals. At d4, proportion of sick animals was decreased by 54% and frequency of diarrheal symptoms was decreased by 38%. Necropsies showed that all dead animals were affected by digestive lesions located in small intestine, which was in accordance with *Cryptosporidium* infection. Oocyst excretion was reduced in treated group by 32% from d4 to d6 (excretion peak) and by 71% from d8 to d14 (remission period). After artificial contamination with infectant *Cryptosporidium* oocysts, Oilis LD enabled a better management of parasite and its effects: mortality, sick animals, and oocyst excretion were decreased.



N-24

**Effect of feeding tannins-containing pine bark on growth performance, rumen fermentation, digestibility, and carcass traits in Kiko-cross goats**

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Twenty-two Kiko-cross meat goats (*Capra hircus*; 27.46 kg) were used to quantify animal performance, feed efficiency, rumen fermentation characteristics, dry matter (DM) digestibility, blood parameters, and carcass traits in condensed tannins (CT)-containing pine bark (PB) supplemented goats during 83 d experimental period. Experimental treatments included: the control diet – 0% PB and 30% wheat straw (WS; 0.17 % CT DM; n = 8); 15% PB and 15% WS (1.6% CT DM; n = 7) and 30% PB and 0% WS (3.2 % CT DM; n = 7) as fed. Freshly dried PB and WS were finely (1.5-3 mm) ground and incorporated in the grain mix portion of the diet to provide 0, 16, and 32 g CT/kg DM in 0, 15, and 30% PB diets. Goats were individually housed indoors in pens (1.2 m<sup>2</sup>). Data were analyzed by the Mixed model procedure of the SAS for completely random design. Linear and quadratic effects were determined utilizing poly-nominal orthogonal contrasts for equally spaced treatments. There was no difference in initial BW, hay intake and DM digestibility among treatments; however, final BW ( $P = 0.06$ ), ADG ( $P < 0.001$ ), grain mixture intake ( $P < 0.001$ ), total DMI ( $P < 0.001$ ) and G:F ratio ( $P < 0.04$ ) increased (linear) as the level of PB supplement increased in the diet. Added ground PB linearly decreased NDF, ADF and lignin ( $P < 0.01$ - $0.001$ ) digestibility as well as molar proportion of ruminal acetate, acetate/propionate (A/P) ratio and ammonia level. There was no difference in HCW, transport shrink, dressing percentage, 12th rib fat thickness, LM area, body wall fat, leg circumference, loin, and kidney fat, but empty BW ( $P = 0.17$ ) and cold carcass weight ( $P = 0.06$ ) tended to increase in goats fed 15 and 30% PB. Breast, sirloin and trim traits increased (linear,  $P < 0.01$ ) with addition of PB. The CT-containing PB has the potential to increase ADG and carcass traits by altering feed efficiency and rumen fermentation with no adverse effect on animal health and DM digestibility.





N-46

**The effects of body size, diet and seed characteristics on seed recovery of  
*Dichrostachys cinerea* and *Acacia nilotica* seeds**

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Dense woody rangelands provide a limited amount of forage to grazing animals because they are difficult to penetrate and have reduced grass layer compared to open structure. The leaves, pods or fruits of many woody plant species form an important diet of livestock due to their high nutritive value and as a result, browsing or grazing animals may consume fruits/pods during dry season and disperse seeds via faeces. The causes of woody plant encroachment have been attributed to several factors including heavy grazing by livestock, patchy rainfall, climate change, and fire suppression. These studies have not yielded a broad understanding of the problem and an integrated approach to manage increasing woody plant encroachment. However, it is generally believed that recruitment of tree seedlings is the limiting step in the encroachment of woody plants. The objective of this study is to determine the effect of animal species (goats, sheep and cattle) and body size, diet (low versus high quality) and plant seed characteristics on passage rate and effectiveness of animal seed dispersal of *D. cinerea* and *A. nilotica* seeds. Each animal in all animal species received 1000 *A. nilotica* seeds and 1000 *D. cinerea* seeds mixed with feed. Seeds were recovered from the dung until there were no seeds. Analysis of variance procedure from SAS for the completely randomised design was used. Diet had a significant effect on seeds recovered from goats and sheep ( $P = 0.01$ ). No significant effect was observed from interactions ( $P > 0.05$ ). Similarly, animal species (goats and cattle) showed a significant effect on seed recovery ( $P = 0.03$ ). Diet was nearly significant ( $P = 0.21$ ) compared to other effects or interactions. In conclusion, animal species and diet have the potential to facilitate woody plant encroachment through dispersal of viable seeds.



N-112

**Nature vs. nurture in the consumption of tannin-rich plants in goats**

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Many Mediterranean brush species have developed a wide array of plant secondary compounds that deter herbivory. In particular, *Pistacia lentiscus* contains ca. 20% of polyethylene-binding tannins (PEG-b-t), mostly hydrolyzable tannins, on DM basis. In contrast, *Phillyrea latifolia* contains less than 3% of PEG-b-t, mostly flavanoids. In a first study, we showed that, on a yearly basis, *P. lentiscus* forms 15% of diets ingested by Damascus (Shami) goats, but only 5.6% of diets ingested by Mamber (Baladi) goats, whereas *P. latifolia* is eaten equally by the two breeds (25% of DM ingested). However, we did not find differences between breeds in the salivary binding capacity of tannins. In a second set of experiments, we found that Damascus goats were more resistant to mixed-species L3 larvae of gastro-intestinal nematodes (GIN) than Mamber goats. Ingesting 1 g kg BW<sup>-1</sup> of *P. lentiscus* tannins reduced fecal egg counts to almost 0 in both breeds but, when subjected to a worm challenge, Mamber goats significantly increased their intake of *P. lentiscus*, i.e., self-medicated, whereas Damascus goats did not. Intrigued by these behavioral differences, we carried out a cross-fostering experiment, where does from the two breeds raised their own kid or a kid from the other breed, substituted at birth. While kept indoors, does were fed with hay and concentrate, and all kids had equal preference for *P. lentiscus* and *P. latifolia*. After does and kids were turned to pasture, kids bred by a Damascus doe increased their preference for *P. lentiscus*, in contrast with kids which were educated by Mamber does, regardless of their breed. These results indicated that: i. learning (nurture) has a major effect on selective behavior and mothers transmit feeding behaviors to the next generation; ii. pain due to sickness is individual and resistance to sickness has a genetic basis (nature), which may explain the need for self-medication in Mamber but not in Damascus goats; iii. Damascus goat exhibit passive self-medication and Mambers exhibit active self-medication against GIN. Our data suggests a difference between the way foraging habits are acquired in health (nurture) and in sickness (nature).



N-115

**Mid-term conditioned aversion in goats grazing in olive tree fields**

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With the aim of allowing the selective grazing of goats in olive tree fields, conditioned averted does were moved to a simulated and to a commercial olive tree field. Food aversion was elicited by using lithium chloride (LiCl) in ten dry Murciano-Granadina goats. Does were randomly assigned to 2 treatments: C (water blank) and AV (200 mg LiCl/kg BW). A single dose of LiCl was orally administered by a drenching gun. No more LiCl was administered throughout the study; however, one goat needed an extra dose on d 9 to re-establish the aversion. Two months after establishing the aversion learning, groups were exposed to simulated olive trees, placed in a rye-grass prairie, for 30 min (d 59, 90, 121, 182 and 420) and on a commercial olive tree field with natural weeds for 30 min (d 146, 211 and 363). A year after the induced aversion, AV group still presented less preference (approaching, eating, and climbing) for olive leaves compared to C does during grazing (AV,  $58 \pm 22$  s; C,  $1296 \pm 171$  s;  $P < 0.05$ ). The same feeding behavior was observed under both simulated and commercial olive field conditions. In conclusion, 200 mg LiCl/kg BW was enough to induce an effective mid-term (14 mo) conditioned aversion in goats to olive leaves, allowing them to graze in olive tree fields. The use of LiCl was considered as a useful tool for selective grazing and use in ecological bio-agriculture system.



## R-13

**Viable offspring after successful non-surgical embryo transfer in goats**

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The objective of this study was to investigate the feasibility of non-surgical embryo transfer in goats. Toggenburg donor goats ( $n = 2$ ) were superovulated following standard procedures and the uterus was flushed for embryo collection, nonsurgically via transcervical, seven days after estrus/mating. Viable embryos were aspirated to a central of three columns of holding medium in a tomcat catheter, by using a 5 mL syringe with 2 mL of medium. Non-lactating, pluriparous Toggenburg does ( $n = 10$ ) were synchronized for ET; suitable recipients received either a pair of embryos ( $n = 2$ ) or one embryo each ( $n = 2$ ), in a total of six embryos transferred. Corpora lutea were detected one day before embryo transfer (D6) by transrectal ultrasonography to select suitable recipients. Embryo transfer (ET) was performed using a novel procedure, which consisted of: insertion of a number 2 Collin speculum into the vulva and vagina, cervix localization using a light source, and immobilization by an Allis forceps. A number six urethral catheter, humidified with holding medium, was inserted into the cervix using a mandrel and the cervical rings were gently transposed. After loss of resistance, the urethral catheter was moved laterally to reach the uterine horn ipsilateral to the ovary bearing the CL. Then, the mandrel and Allis forceps were removed, a syringe/tomcat was attached to the urethral catheter, embryos were transferred into cranial uterine third, and the urethral catheter was finally removed. Recipients that had ovulation in only one ovary were used to test the efficiency of embryo deposition. The time spent from speculum insertion until its removal was less than three minutes, whereas the time to transpose the cervix was inferior to one minute. Pregnancy diagnosis by ultrasonography 23 day later revealed that all ET were successful in reaching the desired uterine horn. The two recipients that received two embryos became pregnant and gave birth to three kids. These first results may encourage the use of this technique, since it was observed that embryo transfer can be successfully performed using non-surgical procedures in goats.



R-14

**Study of different methods to reduce the postpartum period during the anoestrus season in Mediterranean goat females**

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This work was designed to determine which treatment, including melatonin alone or associated with progestagen pessaries, is able to induce oestrous during the seasonal anoestrus in early postpartum Mediterranean goats. For this purpose, thirty-two pregnant female goats were used. After birth, they were distributed at random into three groups depending on the submitted treatment. Females group that received melatonin implants 7-10 days after birth ( $n = 11$ ), group of females that were also treated with melatonin implants as the previous one and with intravaginal pessaries ( $n = 11$ ) and a third group, without any hormonal treatment, that it was used as control group ( $n = 10$ ). Before teasing, females were isolated from males for about 45 days starting on the date of the first birth. Entire males were fitted with marking harnesses. Progestational treatment was performed for 11 days, immediately before teasing, using intravaginal sponges impregnated with 45 mg fluorogestone acetate (FGA, Chronogest®, Intervet S.A., Salamanca, Spain). Oestrous behaviour was recorded by direct visual observation daily and the females marked by bucks, also were considered in oestrous. Ovarian activity and ovulation rate were determined by the presence of *corpora lutea* observed by transrectal ultrasonography ten days after oestrous detection. No differences between control group and treated groups on oestrous activity (75%) ( $P > 0.05$ ) was observed. Nevertheless, the melatonin treated groups showed an 82% of oestrus activity and the control group a 60% of oestrous activity. Ovulation rate at the first detected oestrous was not different between groups ( $1.77 \pm 0.1$  *corpora lutea*) ( $P > 0.05$ ). This result indicates that the male effect could be a useful tool to induce oestrous activity at postpartum during the anoestrus period. Nevertheless, further studies are required to determine if the treatment with melatonin allows increase reproductive performances in relation to the male effect alone. This work was supported by Grant PETRI 95-0964.OP from C.I.C.Y.T. and RZ2010-00001-00-00 from I.N.I.A.-C.I.C.Y.T. (Spain).



R-19

**Long versus short term progesterone treatments effects on synchronized estrous characteristics and fertility in goat on Colombian high altitude tropics**

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The aim of this study was to evaluate the effect of duration of treatment with medroxyprogesterone acetate (MAP) on estrus synchronization and fertility in goats. Forty eight goats type Saanen (crossbred), were divided randomly into four groups (n = 12). For groups 1 and 2 the length of treatment with MAP (50 mg) was 16 days, while for groups 3 and 4, the duration was 6 days. In groups 2 and 4, an analogue of PGF<sub>2α</sub> (5 mg, Dinaprost) was administered 24 hours before insertion of sponge. All groups received a dose of human chorionic gonadotropin (250 IU of hCG) at sponge withdrawal. The timing of sponge removal was the same for all groups. Blood samples were taken to determine progesterone concentrations by radioimmunoassay on days -6, -4, -2, 0, 2, 4 and 6 (Day 0, sponge removal). There were significant differences for the variable animals in heat, being group 4 (short course) the one that had the lowest percent (50%). There were no significant differences between treatments for the variable interval at estrus and length of heat. Best results are evident for the pregnancy rate in the short course treatment 91.66% (group 3) and 83.33% (group 4) than for longer treatments 75% (group 1) and 66.7% (group 2), likewise, for conception rate in which long treatment group 1 (81%) and group 2 (72.7%) had lower percents, compared to short-term treatment group 3 (91.6%) and Group 4 (100%). From day -6 and at sponge removal time, progesterone levels were found at lower concentrations on long-term treatment exposed group. We conclude that short treatments have comparable effectiveness to induce heat, to that of long-term treatment in goats, is also observed that although short-term treatment achieved a lower prevalence of heat, this last is more fertile than heat observed in females exposed to long-term treatment, is proposed the sub fertility phenomena observed in long term treatments may be due probably to the presence of subluteal levels of progesterone at the time of sponge withdrawal on such treatment scheme.



R-58

**Superior pregnancy rates with the transfer of open pulled straw-vitrified versus conventionally cryopreserved embryos in goats**

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Two separate studies were conducted in the course of which 94 morphologically intact blastocysts, collected by transcervical flushing from superovulated pluriparous Boer goat does were cryopreserved either by open pulled straw (OPS) vitrification or by conventional slow freezing. Embryos of each doe were assigned to both methods. For OPS-vitrification the method of Vajta et al. (1998) was slightly modified (El-Gayar et al. 2008 *Cryobiology* 57, 191–194). It involves exposure of the embryos to a medium containing 10% dimethyl-sulfoxide (Me<sub>2</sub>SO) + 10% ethylene glycol (EG) for 1 min, followed by 20 s in medium containing 20% Me<sub>2</sub>SO + 20% EG. After aspiration into thinly drawn-out straws, the straws were plunged directly into liquid nitrogen. Conventional freezing comprises equilibration in M2 medium containing 1.4 M glycerol and cooling in 0.25-mL straws at a rate of 0.3 °C/min as described in Nowshari and Holtz (1993, *J. Anim. Sci.* 71, 3403–3408). Embryos of both treatment groups were transferred to synchronized recipients (2/recipient) within 2 h after thawing. The surrogate mothers were diagnosed for pregnancy 5 weeks later and, if gravid, permitted to carry to term. All embryos were recovered after thawing. Within the 2-h period from thawing to transfer OPS-vitrified embryos had the appearance of flawless, expanded blastocysts, whereas conventionally frozen–thawed embryos had not quite reached full re-expansion. Of 25 recipients receiving OPS-vitrified blastocysts, 22 (88%) kidded with average litter size 1.5. Of 22 recipients receiving conventionally frozen–thawed blastocysts, 10 (45%) kidded with average litter size 1.8. Thus, embryo survival in vitrified blastocysts amounted to 67%; in conventionally frozen–thawed blastocysts to 42%. The difference in kidding rate between the two methods was statistically significant ( $P < 0.01$ , Chi square-test). All kids born were viable, their birth weight being within the range typical for the population. The results indicate that, for the cryopreservation of caprine blastocysts, OPS vitrification is more suitable than conventional freezing.





P-8

***In vivo* effects of sericea lespedeza (*Lespedeza cuneata*) on *Haemonchus contortus* in goats**

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Due to increased prevalence of anthelmintic resistance in sheep and goat gastrointestinal nematodes (GIN), there is a critical need for alternative control methods. Sericea lespedeza (SL; *Lespedeza cuneata*) has been shown to have activity against small ruminant GIN, but the mechanism of action has not been determined. Three experiments (Exp) with Spanish or Boer crossbred goats were designed to study the effect of feeding SL leaf meal pellets fed for 10%orts in confinement on *Haemonchus contortus* larvae during establishment (Exp 1; 75% SL; mature bucks group fed; n = 8/treatment) and after establishment (Exp 2; 75% SL; mixed sex kids individually fed; n = 18/treatment) or fed at 0.9 kg/head/day while grazing (Exp 3; 75 and 95% SL; young bucks; n = 10/treatment). Control animals in each study were given commercial forage-based pellets. A total of five adult female *H. contortus* recovered from the abomasum of two animals from each treatment group in each experiment were examined for evidence of surface damage using scanning electron microscopy. There was no evidence of damage on worms processed from Exp 1, indicating little effect of feeding SL pellets on establishment of *H. contortus* larvae in mature goats. There were constricted folds and a disheveled cuticular surface on two worms (40%) and damage on the cuticular surface on one worm (20%) from the 75% SL leaf meal pellet treatment group in Exp 2, with no damage observed on control worms. In Exp 3, all five worms (100%) observed from both the 75% and 95% SL leaf meal pellet treatment goats (but not control goats) showed a disheveled surface. As previously reported, fecundity of worms in Exp 2 and 3 was reduced ( $P < 0.05$ ) by SL, and total adult worm numbers were reduced ( $P < 0.05$ ) by SL in Exp 3. Together, this work suggests that SL may have a direct effect on the cuticle of female *H. contortus*.





P-12

**Integrated control of goat gastrointestinal parasitism: an example in the humid tropics**

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Gastro intestinal nematodes (GIN) are one among the major causes of small ruminant loss of production. During the last half century, the GIN control relied mainly on the systematic use of anthelmintics, presented as suppressive or preventive. These methods have led to the wide spreading of anthelmintic resistant strains of parasites, especially within the humid and sub-humid tropics. Hence a recent survey showed that GINs are resistant to Benzimidazoles, Imidothiazoles and Avermectines in most of goat farms in Guadeloupe. The GIN Integrated control represents a new approach for the GIN control. It consists in using several methods aimed at shifting the host – parasite balance in favour of the host. The three main axes are 1) reinforcing the host, through nutrition, vaccine or genetic selection; 2) decreasing the risk of infection, by the pasture management, the herbivore species associations, and all means decreasing the infective larvae density; 3) finally, using targeted treatments in order to extend the efficiency of the last available drugs. Among other, epidemiology, physiology and nutrition, genetics, immunology, phyto-pharmacology as well as pasture management are involved in designing such integrated control of gastrointestinal parasitism. The goat farmer might choose within a tool box the different means he can combine for a better result. The choice will depend upon the availability, the efficiency, the cost, the need of social co-operation or technical or scientific support, and the interaction between tools. To date, our team have already tested several components of such an integrated GIN control system and is currently studying the interactions between the most promising ones.



P-20

### Can hazel-nut peels be used to control gastrointestinal nematodes in goats?

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The use of tannin-rich (TR) resources with anthelmintic (AH) properties is one of the main alternatives currently explored to complement and/or to replace the exclusive use of chemical AH drugs to control gastrointestinal nematode (GIN) infections in ruminants in order to prevent the diffusion of AH resistances in nematode populations. The bulk of the previous data on the subject relates to TR Legume forages. However, the possible use of some agro-industrial by-products which are rich in bioactive plant secondary metabolites (PSMs) (eg condensed tannins) are worth to be examined for their potential AH activities. The general objective of the current study was to evaluate the potential effects of by-products of the hazel nut industry when used as nutraceutical against GIN species in goats, relying on both in vitro and in vivo trials. The in vitro results relied on a Larval Exsheathment Inhibition Assay (LEIA) and showed a strong effect of hazelnut's endocarp (peels) extracts on *Haemonchus contortus* larvae, even at the lowest applied concentration (150µg/ml). Then, an in vivo assay was performed in two groups of eight goats experimentally infected (D0) with 5000 larvae of the abomasal species *H. contortus* and 3,500 larvae of the intestinal species *Trichostrongylus colubriformis* in order to confirm the in vitro results. One group of 8 goats was offered *ad libitum* hazel-nut peels (endocarps) for 8 days (from D36 to D48 PI), the other group being used as control. The excretion of nematode eggs (EPG) and the PCV values were measured twice weekly throughout the study. On D49, the goats were slaughtered and the abomasa and small intestines were taken to measure the worm number and the fertility of female adult nematode for each species. The hazel nut peels were eaten by the goats up to 350 g/d. No differences were measured in PCV but the consumption was associated with significant decreases in EPGs on D41 (-54%) and D48 (-65%). These changes were not related to any statistical differences in the worm populations in the abomasum and small intestine. They were mainly explained by significant decreases in the fecundity of female worms, this decrease being significant for *H. contortus* while non-significant effects were measured on the intestinal species (*T. colubriformis*). These results suggest that TR by-products of the "nut" industry can be exploited in ruminant production to improve the control of parasitic GINs.



P-25

**Goat breeds may differ in their self-medication strategies when parasitized with gastro-intestinal nematodes**

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Goat breeds differ in their behavior towards tannin-rich plants: on the Carmel heights of Israel, *Pistacia lentiscus*, containing 20 % of PEG-binding tannins, forms 17 % of the DM ingested by Damascus, but only 6% of the DM ingested by Mamber goats. *P. lentiscus* tannins are deleterious to nitrogen balance but act as anthelmintics. Therefore, like many natural chemicals, they are either toxins or drugs, depending on dose and duration of the treatment. This prompts the question: do goats learn to self-medicate by modifying intake of the plant when they are afflicted with gastro-intestinal nematodes? We examined if infection with gastro-intestinal nematodes (GIN) - 10,000 L3 of mixed-species larvae triggers an increased consumption of tannin-rich *P. lentiscus* in 29 young goats that were exposed, before and during infection, to hay only or hay plus *P. lentiscus*. The infection was characterized by a decrease in plasma cell volume value ( $P < 0.005$ ) and a decline in growth rate ( $P < 0.01$ ). The consumption of *P. lentiscus* resulted in a sharp decrease in fecal egg count compared to the hay diet ( $P < 0.0001$ ). On the other hand, feeding with *P. lentiscus* impaired the protein balance of the goats, as evidenced by decreased blood urea concentration ( $P < 0.0001$ ). A preference test between hay and *P. lentiscus* revealed that infected Mamber goats consumed more *P. lentiscus* than non-infected counterparts (3.2 and 3.7 g DM kg BW<sup>-1</sup>,  $P < 0.02$ ) but this effect was not significant in Damascus goats (3.6 g DM kg BW<sup>-1</sup> for both treatments). Infected goats with previous exposure to *P. lentiscus* did not eat more of the plant than non-infected counterparts (approximately 3.6 g DM kg BW<sup>-1</sup> for both,  $P < 0.5$ ), but infection with previous exposure to hay did result in increased consumption of *P. lentiscus* (2.9 and 3.6 g DM kg BW<sup>-1</sup>,  $P < 0.01$ ). Our results suggest that: 1. Goats that routinely ingest *P. lentiscus* in great amounts demonstrate passive self-medication through high and constant consumption of anthelmintic tannins; 2. Goats with less propensity to consume *P. lentiscus*, such as Mamber goats, exhibit active self-medication behavior and increase the consumption of the plant only when the worm load increases; 3. Active self-medication can be explained by the neophilic behavior of sick animals and 4. self-medication of GIN-afflicted goats is a complex process, encompassing previous foraging habits affected by breed and education.



P-2

**Contribution of mammary epithelial cells to the immune response during early stages of a bacterial intramammary infection**

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Mastitis is an inflammation of the mammary gland, usually due to bacterial infections. Although it receives considerable attention, the early steps of the host response remain poorly defined. Particularly, it is unclear how the mammary epithelial cells (MEC), a first barrier against the pathogens, respond to infection. Indeed, it is difficult to differentiate between the contributions of MEC and infiltrating immune cells to gene expression profiles of mammary tissue during mastitis. The current investigation first examined the innate immune response of MEC, using a non-invasive RNA sampling method, combined with laser capture microdissection to produce gene expression profiles. A second objective was to analyse the expression of SAA3, an acute phase protein considered as a sensitive marker for detection of mastitis. We have, recently, shown that, in goats, Milk Fat Globules (MFG) provide a unique source of RNA to study the *in vivo* regulation of gene expression in MEC (Brenaut *et al.*, submitted). This non-invasive RNA sampling method was used during the time course of an experimental intra mammary infection (IMI) with *S. aureus*. Experiments were performed using sheep microarrays (Agilent) to compare gene expression patterns before infection, at 12, 18 and 24 h post-infection. Some pertinent genes were validated using real time PCR. Our results were confirmed using microdissected MEC which can be considered as the gold reference to analyze the MEC transcriptome in their physiological context (Bevilacqua *et al.*, 2010). We show that at 18h post infection MEC secrete large amounts of cytokines and chemokines to stimulate recruitment and activation of inflammatory cells. They also express factors contributing directly to fight infection, including acute-phase proteins such as SAA3. Taken together, our results underline the coordinated induction of inflammatory response by MEC following infection. Furthermore, we have demonstrated unambiguously that SAA3 is rapidly and specifically expressed by MEC. In summary, we first demonstrate *in vivo* how MEC orchestrate innate immune response during an IMI to *S. aureus* in the goat species. Besides, the production of SAA3 by MEC, in the early stages of IMI, provides a sensitive indicator for early detection and therefore, treatment of mastitis. We report here new opportunities to assess the dynamics of gene expression in the mammary gland, thus providing significant advances in the understanding of MEC immune capacity.



P-16

***Sericea lespedeza* in a goat kid rearing feeding system with the intent to restrict  
coccidiosis**

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The objective of this study was determine whether *Sericea lespedeza* might be effective in restricting coccidiosis in goat kids, and to use this forage in a system aimed at rearing goat kids to be the optimum weight of 25 kg, for mating at 7 months of age. The trial was conducted at the Hatfield Research Farm, University of Pretoria, South Africa using goat kids born in the Saanen milking herd. The goat kids were removed from their mothers at 3 days of age and put into elevated kid nursery pens. There were two treatments and each treatment was split into two groups. The first treatment was split into Group A and Group B which were the control groups and were not fed any *Lespedeza* or given any treatment to prevent coccidiosis. The goat kids in Group A were purposefully infected with coccidia and those in Group B were allowed to acquire a natural infection of coccidia. The second treatment was split into Group C and Group D which were fed a starter meal containing *Lespedeza*. The goat kids in Group C were purposefully infected with coccidia, and those in Group D were allowed to acquire a natural infection of coccidia. Preliminary results appear to indicate a possible decrease in coccidia oocyst count in goat kids fed *Sericea lespedeza*.



P-34

### **Sodium Dodecyl Sulfate to inactivation Caprine Arthritis Encephalitis virus in DMEM**

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The Caprine arthritis-encephalitis Virus (CAEV) is a lentivirus of goats with worldwide distribution. CAEV infection can result in synovitis, arthritis and mastitis in adult goats and encephalomyelitis in kid goats. In the majority of industrialized countries, CAE is considered one of the most devastating diseases in dairy goats and it represents an economic problem for goat farming in several European countries. The primary route of CAEV transmission in goats is from dam to kid through ingestion of colostrum/milk containing CAEV. Traditionally, prevention of CAEV transmission for eradication protocols include removal of kids from infected dams prior to consumption of colostrum, and the administration of heat inactivated colostrum/milk or feeding colostrum replacers and segregation. However, heat inactivation of colostrum/milk can be time consuming and not amicable for environments without electricity or heat source. Previously it was demonstrated that the antimicrobial effects of Sodium Dodecyl Sulfate (SDS) could be efficacious in inactivation of Human Immunodeficiency virus (HIV-1) in milk at 0.1 %. Moreover goats fed milk spiked with 1% SDS suffered no ill effects with regard to immune or nutritional status. Therefore we set up to determine if varying percentages of SDS could inactivate a known amount of CAEV spiked in to pooled goat colostrum. DMEM (Dulbecco's Modified Eagle Medium) was spiked with CAEV (10<sup>5</sup>TCID<sub>50</sub>), then the DMEM was treated with varying amounts of SDS (1% solution) to a final concentration of SDS of 1%, 0.1%, 0.01% and 0.001%. Residual viral particles (TCID<sub>50</sub>) were enumerated utilizing the virus titration assay on goat synovial membrane cells following removal of SDS utilizing centrifugation. At an SDS concentration of 1% and 0.1% resulted in 99.99% reduction of the virus input titer TCID<sub>50</sub>, while a final concentration of 0.01% and 0.001% failed to provide significant reduction of the input titer. Preliminary results demonstrate that a concentration of 1% and 0.1% of SDS in DMEM spiked with CAEV results in effective inactivation of CAEV. Future studies include in colostrum assay and *in vivo* efficacy studies.



P-41

**Immune refocusing in Caprine Arthritis Encephalitis Virus (CAEV) vaccine: a strategy to overcome deceptive imprinting**

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Disproportionate numbers of pathogenic microbes that exist as compared to those that we have effective vaccines for are concerning. Moreover, many currently vaccines have limited strain specificity. Pathogens evade host immune responses by the induction of strain specific responses towards immunodominant determinants. The propensity of induction of host immune responses toward non-protective or strain specific determinants (decoys), leads to the deceptive imprinting. Deceptive imprinting occurs during infection and immunization, leading to consumption of the host immune responses and a failure in protective immunity. The purpose of our work is to overcome deceptive imprinting through modulation of epitope immunodominance via the employment of immune refocusing in vaccine design. Utilizing the CAEV vaccine model, immune refocusing allows for redirection of immune responses away from decoys towards neutralization epitopes. Our first generation CAEV refocused immunogen (SU-M) two N-linked glycans inserted into mapped decoys in to the surface glycoprotein (SU). Immunization with SU-M resulted in a 2.5 fold increase in type-specific and cross reactive neutralizing titers and reduced recognition of glycosylated decoys. Results are an example of desirable modulation of epitope immunodominance via immunization. Moreover, following high dose heterologous challenge goats who received the Immune refocused antigen had significant reductions in CAEV induced pathology. Our first successful immune refocused immunogen in a well characterized lentivirus animal model is evidenced by demonstration of modulation of decoy responses and the subsequent increase in the induction of protective immune responses following vaccination. Data on other vaccines developed for prevention of CAEV disease in goats will also be discussed.





A-6

### **Body condition estimation by lumbar or sternal palpation on goats**

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In order to evaluate body condition on goats compared lumbar palpation or sternal palpation and compared scale 1 to 5 or 1 to 10 compared with a mathematical body condition index, 65 adult goats were used. Each goat was revised by 3 people using a blind method to qualify lumbar, sternal scale and 1 to 5 or 1 – 10 with a day difference. For mathematical index thoracic perimeter, length and tall were measured using the following equation: Body condition = (thoracic perimeter + length + tall)/live weight. For statistical analysis a correlation and regression test were used. The correlation coefficient was high in 1 – 10 scale  $r = 0.710$  than in 1 – 5 scale  $r = 0.651$ . In México people use the 1 -10 scale for school, services, games, etc. Then, it is better accepted in comparison with a scale with half points. The body condition index has a higher correlation coefficient than thoracic perimeter  $r = 0.943$  versus  $r = 0.780$  respectively ( $P < 0.01$ ), then these index will be in goat farms. The regression equation for body condition index and live weight was  $Y = 74.85 + (-6.367) (x)$ . By these results it is possible conclude that in México a body condition scale from 1 – 10 is more efficient that 1 – 5 and it is possible to use the body condition index as a better method than palpation.





A-22

**Set up of a sampling strategy for the collection of animal-based welfare indicators during milking**

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We hypothesised milking time to be the period of the production process that allows observers to have closer contact with dairy goats, hence being the ideal location/time to assess certain animal-based welfare indicators. However, for the development of a practical welfare assessment scheme, observing all the animals during milking would be too time consuming. The aim of the present study was to define a sampling strategy that can reduce the observation time and at the same time produce a valid and unbiased result. We observed milking in two farms (Farm1: 303 goats; Farm2: 141 goats). In each farm, goats were housed in two pens, so we had a total of four pens (191 and 112 goats each in Farm1; 65 and 76 goats each in Farm2). We collected data on lameness, body condition score, cleanliness, teat and udder abnormality and overgrown claws. Data were compared by chisq test. We found significant differences (at least  $P < 0.01$ ) between farms for all the observed variables, except for lameness ( $P = 0.08$ ). Within each farm, no differences between pens were recorded. A minimum of 3 to a maximum of 6 milking groups were formed from each pen, depending on the size of the milking parlour. We compared the prevalence of each welfare indicator in the whole pen with its prevalence in each milking group. In most cases, each single milking group did not statistically differ from the whole pen, and the central groups were able to better reflect the welfare situation of the whole pen. However, a clear and often significant increase of the prevalence of lameness was observed in the last milking groups. Our preliminary results suggest that a reliable sampling strategy can be used during milking to gather information about the welfare condition of dairy goats, thus reducing the time needed for data collection. When more than one pen is present in a farm, it seems that one pen can give sufficient information to represent the whole farm welfare level for the considered variables, provided that observations are carried out on the central milking groups. This seems particularly important for lameness. Further observations in more farms are required in order to confirm this hypothesis.



A-31

**The effect of glycerol and Propylene Glycol addition in the pasteurization of colostrum on goat kids immune passive transfer**

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In order to ensure a correct immune passive transfer, colostrum feeding is crucial during the first hours after birth. Ruminant placenta is not able to transfer an enough amount of immunoglobulins, and in addition the immature immune system of the neonate is not competent to produce its own Ig during the first weeks of life. The destruction of pathogenic microorganisms and the reduction of endogenous milk microbiota have traditionally been carried out by pasteurization. The glycerol and propylene glycol are used as co-solvent in pharmaceutical or cosmetic industry to improve antibacterial activity of products. In order to test the immune passive transfer using pasteurized colostrum with addition of glycerol and propylene glycol, we used 12 goat kid divided in 4 groups; pasteurized colostrum (CG), pasteurized colostrum with 14% glycerol (GG), pasteurized colostrum with 14% propylene glycol (PG) and pasteurized colostrum with 7% glycerol and 7% propylene glycol (GPG). The IgG, IgM, IgA and chitotriosidase activity were measured in the kids blood. No differences between CG and GG groups were found in immunoglobulins and chitotriosidase activity. Both groups showed a normal evolution in all the studied parameters. However PG and GPG kids showed disease signal in the first 12-24 hour after birth. In conclusion, glycerol addition could be an acceptable option in newborn goat kids, however propylene glycol addition was considered unsuccessful in these animals.



A-53

### **Effect of local anaesthetics and non-steroidal analgesics on performance of hot-iron disbudded beetal kids under stall-fed conditions**

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With an objective to assess the performance of kids under different regimes of disbudding, 24, farm born beetal kids of equal weight and parity, aged 14-15 days, were randomly divided into four groups i.e. D0, DL, DM and DL+M, with 6 in each group (3 males and 3 females). All the kids were disbudded by hot-iron method as per standard procedure. The group disbudded without any medication was designated as D0 (Control). Before disbudding, the kids of DL group were medicated with Lignocaine (2%) ® 1 ml/bud as corneal nerve block, and of DM group, Meloxicam ® 0.25 mg/kg body weight by I/M route. In the DL+M group, both Lignocaine and Meloxicam at above dose and route, was used. The body weight of kids was recorded in the morning hours before feeding and watering at fortnightly intervals up to 90-days. The data pertaining to daily milk, feed and fodder intake were collected by offering weighed amount of milk, concentrate and roughages to each animal and taking records of daily residue in case of concentrate and roughages. Recorded body weight and milk, feed and fodder intake was used for calculation of different performance indices like Average Daily Gain (ADG), Feed Conversion Ratio (FCR) and Protein Efficiency Ratio (PER). During the 1st fortnight, kids of DM group gained significantly higher ( $P < 0.05$ ) body weight than DL+M. Later on there was no differences in the body weight gain up to 5th fortnight. The ADG was significantly ( $P < 0.05$ ) higher in DM, lower in control and DL+M, with value for DL falls in-between the rest groups during 1st fortnight. During 3rd fortnight, the ADG was significantly higher ( $P < 0.05$ ) both in DM and control over DL+M or DL group. The average ADG during the entire study period was same in all treatment groups. The FCR was significantly ( $P < 0.01$ ) better in DM during 1st, 3rd, 4th and 5th fortnight over DL or DL+M group. The average FCR over a period of 10 weeks was significantly ( $P < 0.05$ ) better in DM and DL over DL+M or control. The PER was significantly higher ( $P < 0.01$ ) in DM during the 1st, 3rd, 4th and 5th fortnight followed by DL and DL+M over control. The average PER was non-significantly higher in DM, DL and DL+M over control by 24.86, 22.70 and 17.84%, respectively. From the present study, it can be concluded that disbudding after pre-medication with non-steroidal analgesics improved performance in the beetal kids.



E-36

### **Raising goats as adaptation process to prolonged drought incidence at the Coastal Zone of Western Desert in Egypt**

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The Coastal Zone of Western Desert (CZWD) is a hot dry area of < 150 mm annual rainfall, the area had faced 14 successive years of drought from 1995-2011. Field survey has been carried out with the Bedouins in the area, to assess the effect of such prolonged drought incidence on their socioeconomic vulnerability and livestock production systems. The study covered 182 breeders in the area, extended from Alexandria East (new reclaimed lands) to Libyan border West (rain-fed area), and Siwa (desert oasis), during the summer of 2011. The Bedouins had adopted different processes to cope with the long drought period, based mainly on the diversification of their farming system. The habitants of the rain-fed area (West) and the oasis whome affected more by the incidence of drought, had to take some radical means on their flocks, one of which is reducing their flock size by 37% (from 248 heads in 1995 to 155 in 2011). The other mean was to rely more on raising goats than sheep. Goats / sheep ratio has raised from 50% in 1995 to 76% in 2011 in the oasis and from 0.27 to 0.29 in the rain-fed area, over the same period. Twenty percent of the breeders in the oasis raised only goats. However, in the new reclaimed lands, with the availability of the green fodder and crop residues, the breeders increased their flocks from 152 heads in 1995 to 214 in 2011, mostly with sheep. Thirty nine percent of the breeders there raised only sheep. Annual household income from goats represented 17.4% of the total flock income in the rain-fed area in 2011, mainly from selling mature does. While it was 9.3% in the new reclaimed land; fattening lambs were the major source of family income. The annual income from goats in the Oasis was up to 40.1% of the total flock income. Furthermore, goats contribute significantly to the nutritional status of the householders in the rain-fed area. Family (of 21 members) consumed, in average 3.4 heads of goats annually, plus 4.3kg of milk daily in 2011 vs. 0.68 head of goat, in the new reclaimed area. Siwa Oasis rely, on goats for their meat consumption, (4.1 heads / family of 16 members) and 3.8 kg of milk/daily. Goats raising seems to be an effective adaptation process to cope with the prolonged drought incidence in the studied hot dry conditions.



E-37

### **Features and Benefits from Grazing Angora and Cashmere Goats on Temperate Pastures in southern Australia**

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Since European settlement of Australia the predominant grazing pressure on pastures have come from sheep, cattle, horses and rabbits. Livestock graze pastures predominantly established on ancient and nutrient poor soils. Legumes were introduced to improve the productivity and longevity of native and improved pasture systems by providing low-cost nitrogen inputs. Numerous exotic plants have become established, and consequently many have experienced ecological release, and expanded over large areas. The evidence on the actual dietary choices of fibre producing goats grazed on various pasture types in temperate Australia are summarised. Changes in pasture characteristics due to increased stocking rate were minimised on pastures grazed by goats but the grazing of sheep caused larger and faster changes and the pastures were damaged at the highest stocking rate. Goats did not always select the same herbage material as sheep, changed their selection between seasons and were not less selective than sheep. Goats generally ate weeds which had high nutritional value. Goats ate a variety of exotic weeds placing them at a competitive disadvantage compared with pasture species. Goats also altered the composition and structure of improved pasture which favours subterranean clover, improved soil cover and more stable botanical composition. There are a wide variety of benefits which can arise from the use of goats in weed control programs. The few economic studies of using goats in weed control compared with conventional methods are favourable to the use of goats. The following issues must be attended to for efficient goat grazing: 1) farmers need training into nutrient requirements of goats; 2) fencing and yards must be appropriate and properly maintained; and 3) appropriate stocking rates, herd health and animal welfare practices must be used. A more diversified grazing ecosystem using goats should provide benefits in sustainable pasture management and weed control in southern Australia.



E-54

**Growth and educational role of 4-H and FFA Youth Market Goat Projects: A case study from Georgia, USA**

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This case study provides testimony to the benefits of supervised market goat projects to youth development and to growth of the local goat sector. From 2000 through 2011 the number of youth participating in the Georgia National Fair (GNF) market goat exhibition increased from 12 participants and 19 animals in 2000 to 456 participants involved with 971 animals in 2011. The first GNF market goat show was open to adult exhibitors as well as youth. Over the next six years the proportion of youth among participants increased from 10 percent to 99 percent. There was also a trend for an increase in younger youth (less than 9 years of age). Attracting features of youth market goat projects include: (1) relative low animal purchase price, (2) minimal investment in facilities and feed, (3) ease of handling, (4) project is relative short term, (5) opportunity to grow a breeding herd, (6) opportunities to exercise self-discipline, responsibility, and record keeping skills, (7) the joys and sorrows of competition build character, and (8) an income producing opportunity. Initially the Georgia National market goat show was terminal in structure so all goats entered in the live show were slaughtered and premiums paid according to carcass merit as well as live placing. This approach was viewed by the coordinators as an opportunity for exhibitors to learn more about the final product and goat carcass composition. In 2006 the decision was taken to restrict the market goat project for youth only, to create an official state show, introduce a record book competition, and to eliminate the carcass component. Growth of the market goat project has provided the opportunity for goat owners in the state and region to enhance income by selling animals for youth livestock projects rather than sell them only to the local market. This created an addition economic opportunity for many meat goat producers. An ad hoc committee composed of agricultural extension agents and agricultural education teachers, GNF officials and Extension specialists meets once a year to set rules and guidelines for record keeping, animal identification, classes and divisions, and they select judges. All indications point toward further increases in participation at the state level with more than 1000 expected in 2012. An increase number of local market goat shows is occurring as project participation increases. Standing-room-only crowds at the state show characterize the level of interest.



E-56

### **Evolution of production costs, incomes and economic margins in Murciano-Granadina breed farms. Prediction equations**

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For five years, the Spanish goat sector is affected by a profound crisis derived from higher food prices at the same time of falling sales prices of production. In the Spanish goat farms are highly dependent on feed mills, but in addition also depend heavily on dairy industry. This has resulted in a significant loss of viability of farms in recent years and this scenario creates much uncertainty for farmers to make business decisions and technicians to provide advice. The aim of this work is to expose the evolution of technical and economic indicators in semi intensive and intensive dairy goat farms of Andalusia (Spain). These indicators are related to the costs, incomes and economic margins. A second aim is to elaborate prediction equations which can help decision making. To achieve the proposed objectives, technical and economic data from 2006 to 2010 of 11 Murciano-granadina breed farms have been analyzed. The mean values per farm and year of technical indicators included in this paper are the following: Grazing area (24.6 ha), Present goats (322), Workforce (1.20 persons), Milk production (395 L per goat) and Sold kids (5.9 kg per goat). Concerning economic indicators, the mean values per farm and year are the following: Sold milk price (€ 0.56 per L), Sold kid price (€ 4.36 per kg), Operational expenses (€ 160 per goat), Structural expenses (€ 81 per goat), Aids (€ 15.8 per goat), Total incomes (€ 276 per goat), Difference between total incomes and expenses (DTIE) (€ 35 per goat), Share of sold milk income to respect the total incomes (79.5%). Equations have been obtained by applying the panel data regression model. The output variables of the model are three: DTIE per present goat, DTIE per Liter of sold milk and in the DTIE per Unit of workforce. DTIE per goat increases € 0.68 when goat production increase 1 liter. DTIE per goat decreases €1.13 when the forage expense increases € 1, and decreases € 1.35 when the concentrate expense increases € 1. Concerning DTIE per unit of workforce, it increases €59 when Goats per unit of workforce increases 1, and it increases € 1276 when Sold milk price increases € 0.01. But, a remarkable result is the importance of the Share of sold milk income to respect the total income when it increases 1%, the DTIE per goat decreases € 2.62. This last result indicates that farmers should take more attention to incomes from sales of kids in order to increase the farm viability.





A-18

**Mechanical milking efficiency under alternative and simultaneous pulsation in Murciano-Granadina goats at late lactation**

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The aim of the work was to study the effect of pulsation (simultaneous vs. alternative) on the milking efficiency of Murciano-Granadina goats. Two 8 days experiments were carried out (one with high pipeline and other with low pipeline) with a latine square design where 42 goats at late lactation were milked (2 similar groups regarding to yield and parity). The experiments were divided in two halves of 4 days and every group was milked during every half using a different treatment: AP (alternative pulsation) or SP (simultaneous pulsation). Variables were recorded at days 4 and 8 (the last day of every treatment). Milking parameters for both experiments were 40 kPa of *vacuum* level, 90 pulsations/min of rate and 60% of ratio. Variables regarding to milking efficiency recorded were performed using Lactocorder® (Switzerland): machine milk (MM, kg); machine stripping milk (MSM, kg); hand stripping milk (HSM, g); residual milk (RS, g), total milk (TM: MM + SM), machine milk time (MMT: time since attachment of cluster to machine stripping start). *Vacuum* fluctuations at short milk tube (VF, kPa: *Maximum – minimum vacuum*) were performed with a Pulsotest (deLaval®, Sweden). Recorded variables and their relation to pulsation were performed with a linear mixed model (Proc. Mixed, SAS, V.9.2., 2002) considering the fixed effects of day (2 levels: 4, 8), treatment (2 levels: AP, SP). Random factor was the animal. The interaction of day and treatment was not significant for any variable and not considered in the final model. The most relevant results were Higher VF recorded at SP (9.9 vs. 7.5 kPa in Highpipeline; 2.8 vs. 2.6 kPa in Lowpipeline). Pulsation was significant ( $P < 0.05$ ) for MM and TM variables in high pipeline experiment (but they were not significant in low pipeline experiment). Highest values were registered with SP (MM: 1.18 vs. 1.25 kg; TM: 1.27 vs. 1.35 kg, respectively). The pulsation was not significant for any other variable at any experiment. It was concluded AP did not improve milking efficiency in Murciano-Granadina goats at late lactation and more experiments at early lactation should be carry out in order to obtain definitive conclusions. A complete lactation experiment should be carried out in order to test if higher VF resulted at SP can affect sanitary status of mammary gland. This study was supported by project AGL-2006-06909 (Spain).





A-39

### **Is vasopressin involved in milk synthesis and milk ejection?**

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We have earlier shown that suckling increases plasma levels of both arginine-vasopressin (AVP) and oxytocin (OT) in goats. Furthermore, intravenous infusions of AVP increased milk flow and milk fat content in goats. Lactating goats subjected to dehydration or to infusions of AVP showed similar plasma levels of AVP and AVP-immunoreactivity could be demonstrated by immunocytochemistry in the mammary gland. WHY? AVP has two well-known physiological functions. At low levels it acts as a water saving hormone in the kidneys and at high levels it is a potent vaso-constrictor increasing blood pressure. However, it is also released during labor and it constricts the smooth muscle cells in the uterus. Is it possible that AVP has a similar action in the mammary gland, i.e. constricts the myoepithelial cells? In a series of studies we have now investigated the effects on milk synthesis and milk ejection of different doses of AVP injections and compared it to OT injections or combined injections of AVP and OT. Three series of studies have been performed and in each study 8 lactating goats have been used. On treatment days, the goats were hand milked to empty the udder and then AVP, OT or a combination of AVP and OT was injected into the jugular vein. Two minutes after the injection the goats were milked again to empty the residual milk. Three blood samples were collected: before milking, after milking, and after injection of OT, AVP at a low or high level or in combination with OT. Without hormone injections the residual milk volume was low (10-20 g), after OT injections it increased 10 times and after a low dose of AVP it increased 4 times. A combined injection with OT and low dose AVP gave a similar response as OT alone. When AVP was injected with presser doses the same response as with OT was received. In addition, both OT injections and AVP injections at the high level increased the fat content in the residual milk. In conclusion; at high levels vasopressin injections caused a milk ejection reflex similar to that of oxytocin. The physiological implication may be that when no water is available the goat will produce some milk for the kid.



A-44

### **The Complement System of the Goat**

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Complement is a central component of the innate immune system which is involved in host defense against infectious agents. The complement system may be activated by three different pathways: the classical, the lectin and the alternative pathway. The complement system in mammals has been well described, and it is clear their complement systems are very similar, however, there are scanty research studies on goats. The aims of the present study were to contribute with new knowledge developing an efficient haemolytic assay for goats, affordable and easy to find worldwide; and to isolate the major complement system proteins from goat plasma, in order to raise antibodies to develop quantitative assays. The isolated proteins were C1q, the first protein involved in the classical pathway, factor H, because of its importance in the regulation of the alternative pathway, and C3, the most abundant protein which forms part of all three pathways. The main results were: 1) The commonly used sheep erythrocyte sensitized with rabbit antibodies were not sensitive to lysis by goat serum, but the combination of human RBC plus rabbit antibodies was the best option found for goat complement assay. A buffer based on HEPES instead of the classical veronal (barbitone) was developed. 2) Three proteins were isolated from goat serum: factor H, C1q and C3 and these were compared with the corresponding human proteins. A novel affinity chromatography technique was developed for isolation of factor H. In conclusion, human RBC plus rabbit antibodies were a suitable option for haemolytic assays, as well as the new buffer based on HEPES. The isolated proteins are similar to the human counterparts.



A-52

### **Availability and uptake of colostral antibodies in goats**

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This investigation was conducted to gain insight into the importance of early colostrum intake in goat kids. Eleven pluriparous Boer goat does separated from their offspring after parturition were milked out in 50 mL-portions 0, 12, 24, 36 and 48 h post-partum (pp). From each portion a sample, ridded of fat and casein by centrifugation and incubation with chymosin, was analyzed by the Radial Immune Diffusion method of Mancini et al. (1965, *Protides Biol. Fluids* 11, 370). In the first milking the average concentration of IgG1 was 149 mg/mL; in subsequent milkings it was 53, 15, 7 and 4 mg/mL, respectively. A similar trend was observed for IgA, IgM and IgG2, with initial mean concentrations being 3.66, 7.18 and 4.78 mg/mL, respectively. Among fractions of a milking no significant differences were recorded. In a separate experiment kids from 10 pluriparous twin bearing does were randomly distributed to 3 groups provided with colostrum 0, 4 or 8 h after parturition. For two days blood samples obtained by jugular venipuncture from dams and kids and milk samples were collected at 4, respectively 8 h intervals, thereafter at weekly intervals until weaning after 8 weeks. Ig was analyzed as described above. In kids serum levels of Ig increased rapidly to peak 20 h after first colostrum intake and waned thereafter to reach a low point after 3 weeks (IgA and IgM), respectively 4 weeks (IgG1 and IgG2). Thereafter, levels of IgM and, more so, IgG2 rose again, continuing beyond the 8 week-experimental period. In maternal blood a short pp-decline was followed by a slight continual incline. In milk Ig-concentration followed the pattern described above. In kids receiving colostrum with a 4 h delay, serum levels of IgG1 recorded throughout the 8 week suckling period was 81% of that of kids supplied with colostrum immediately pp. In case of an 8 h delay it was reduced to 44%. Corresponding data for IgA were 130% and 67%; for IgM 83% and 83%; for IgG2 100% and 100%, respectively. In conclusion, ideally every kid should get a share of the first pp-filling of the udder; whether it is the first or the last to suckle does not matter. A 4 h delay in colostrum intake does not seriously impair Ig uptake; an 8 h delay, however, makes a difference, especially with regard to the serum IgG1 level. No impact of the time of first colostrum intake on growth rate or health status of the kids was noticed.



G-5

### **The complete goat genome and effects of artificial selection on goat genome**

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1. The complete goat genome. The high quality reference genome of the domestic goat which is generated by sequencing a series of DNA libraries including 100bp~40kb library using the Illumina GA II, together with the optical mapping technology. The N50 of the contig and scaffold are 18.7 Kb and 3.06 Mb, super-scaffold is over 17 Mb. The assembly corresponds to 91% of the estimated genome size. Finally, 95% of the total genome sequence was placed onto the 30 chromosome and validated by RH map. We annotated 22,175 genes, most of which are supported by our RNA-seq or EST data. Comparative transcriptome study of the secondary and primary hair follicle plucked from Nei Mongol Cashmere Goat show ~900 genes were differential expressed including keratin associated proteins (KAPs), some of which were confirmed using microarray based method. 2. The effects of artificial selection on goat genome. Worldwide, many breeds demonstrate the vast genetic variability that exists in goat. This variation has been captured in global food and fiber markets through widely distributed meat, milk and cashmere or mohair production. In total, 44 individuals were selected on behalf of meat/milk/fibre breeds and re-sequenced for 5X depth to mine effects of artificial selection on goat genome. All the PE101bp reads was mapped back to the reference genome using SOAP2, and we got an average coverage of ~80% for each goat. Then, SNPs were separately called by SOAPsnp and GWTK for all individuals. We identified about 9 million SNPs among each goat genome. The rates of heterozygosity is about 0.3%, which is higher than other livestock. Approximately 75% of modern goat breeds have retained an effective population size in excess of 300. This suggests a highly heterogeneous pre-domestication population was recruited, and the genetic bottleneck which took place was not as severe during the breeding scheme of goat.



G-13

**Mutations at the caprine melanocortin 1 receptor gene are associated with coat color in Spanish goats**

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Genetics of coat color in goats is not well understood. A recent survey involving the melanocortin receptor 1 (MC1R) gene revealed that black pigmentation of Murciano-Granadina goats is associated with a Trp residue at position 267, while caoba goats are homozygous for the Cys allele. Similarly, copy number variation at the agouti signaling protein (ASIP) gene has been associated with a white coat in Saanen and Girgentana breeds. Other associations have been reported, but in general they are difficult to replicate across breeds. Herewith, we have sequenced six pigmentation genes (MC1R, ASIP, TYRP1, TYRP2, KIT and TYR) and identified 21 single nucleotide polymorphisms (SNP). Genotyping of thirteen of these SNP in 590 goats from the Iberian Peninsula, Canary Islands, Italy, Morocco and Tunisia has revealed the existence of a phylogeographic pattern i.e. individuals tend to cluster according to their geographic location rather than their coat color. Principal Component Analysis of the data showed that Canarian breeds group with their North African counterparts, a feature that is consistent with historical and linguistic data. As a whole, these results suggest the existence of a marked genetic heterogeneity and low selection pressure for phenotypes related with pigmentation in goats. Besides, we have investigated the segregation of MC1R alleles at the within breed level (Murciano-Granadina, Malagueña and Canarian breeds). Photographic records were obtained to document the pigmentation status of each goat and MC1R genotypes were determined by sequencing. This approach has allowed to confirm the causality of the Cys to Trp mutation for the black/caoba coat in the Murciano-Granadina breed. We have also found two additional causal mutations that explain the inheritance of the red vs. black coat in the Canarian Palmera breed and of the red vs. blonde colour in Malagueña goats.



G-48

**CONBIAND network: scientific cooperation for biodiversity studies in goat breeds from Ibero-America**

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The CONBIAND network is a scientific society integrated by researchers involved in biodiversity, sustainability and conservation biology. A research consortium was established within this network to investigate the genetic relationships among Iberian and Creole goats, and how they relate to colonization history. The main objective of the BioGoat Project is to study the genetic signatures of Iberian breeds, primarily taken to the Americas through different dispersion routes which covered the territory from the Caribbean Islands and South-Western United States all the way down to Patagonia. In this study, Iberian, African and commercial goat breeds were included in different analyses to assess their influence on Creole goats. Overall, 65 goat populations from different origins, represented by 2,500 animals, were analysed with twenty-four microsatellite markers. The genetic differentiation between populations was moderate, with a mean  $F_{ST}$  of 0.13. The neighbour-net constructed with the DA genetic distances indicates that Creole populations from Argentina, Bolivia and the goat populations from USA group in the same cluster integrated by Iberian populations (from Spain and Portugal). Cuban Creole goats grouped with the populations from the Canary and Cabo Verde Islands, closer to the African populations cluster. Clustering of populations and estimates of the proportions of individual genomes deriving from their inferred clusters were obtained using the model-based clustering program Structure. Assuming the existence of two ancestral clusters, the populations from the Iberian Peninsula and most Creole goat populations grouped in the same cluster, while the Brazilian, Canarian, Cuban and Arapawan populations formed another cluster. With three ancestral clusters, the Canarian, Cuban and Arapawan populations grouped in the same cluster. Assuming a higher number of ancestral clusters led to further division and grouping of the populations. The results obtained in our study suggest a clear influence of the Iberian populations on Creole goats, while the Cuban Creole goat is more influenced by Canarian breeds. The ANOVA and Factorial Correspondence Analysis results showed that the proximity of most Creoles to their Iberian ancestors is stronger than their relation to the commercial goat breeds. Despite the time frame since the end of the colonization period, the genetic influence of Iberian breeds in Creole goats is still very evident.



## G-80

**AlphaS1-casein deficiency due to defective genotypes induces a chronic ER stress and deep changes in milk composition, signing a singular secretion mode in goats**

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The extensive polymorphism recorded at the CSN1S1 locus was shown to influence goat milk composition and its technological properties. A deficit in alphaS1-casein is responsible for the accumulation of immature caseins in distended rough endoplasmic reticulum (ER) cisternae of mammary epithelial cells (MEC). This triggers a chronic ER stress which in turn induces an adaptive unfolded protein response (UPR). Our data strongly suggest that alphaS1-casein interacts with the other caseins as from the ER and that this complex is required for their transport to the Golgi. A differential proteomic analysis (2D-DIGE) of milks from goats of extreme genotypes (A/A vs. O/O) at the CSN1S1 locus revealed the over representation of ER-resident proteins in O/O milks, strongly suggesting a singular secretion mechanism for this genotype. In addition, goats of A/A genotype produce fat globules larger in size and displaying significant differences in MFGM composition, including both MFGM proteins and polar lipids. The effects of the genotype at the CSN1S1 locus on the profiles of oligosaccharides (OS), which are also built within the ER where both lipids and caseins are synthesized, have been investigated. The milk free OS were profiled and their structures elucidated. A relationship between genotypes at the CSN1S1 locus and milk OS expression was observed, demonstrating the influence of genotypes on OS structure and composition. Finally, using different functional genomic approaches, we succeeded in highlighting the general dysfunction occurring in MEC from alphaS1-casein deficient animals, and in identifying genes contributing to the adaptive UPR and proteins involved in the transport between the ER and the Golgi apparatus, as well as enzymes participating to the biosynthesis of lipid droplets, the precursors of MFGs. Taken together our results demonstrate that a close mechanistic relationship exists between biosynthesis and secretion pathways of the main components of milk: casein micelles, milk fat globules and oligosaccharides. We definitely demonstrated the relevance of the goat model as an experimental system to unravel the underlying mechanisms and to appraise the possibility to dissociate these biosynthesis pathways in order to modulate selectively one or the other. A large part of this work was funded by ANR (Genanimal program) and APIS Gène.





## M-23

**Effect of grazing level on a Mediterranean shrublands in milk fatty acid composition of Payoya goats**

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Information about consumption of Mediterranean shrublands pastures and its relationship to the quality of goat products is scarce. The aim of this study was to evaluate the effect of livestock production system according to grazing level on Mediterranean shrublands, throughout their lactation period from January to May, in milk fatty acid composition of Payoya dairy goats. 17 farms in the Sierra de Cadiz (Andalusia, Spain) were selected and surveyed to characterize feeding systems from January to May. According to the percentage of energy needs covered by grazing, farms were classified into three groups: LG (low,  $n = 4$ ), MG (medium,  $n = 10$ ) and HG (high,  $n = 3$ ) grazing. In this period, milk samples were collected from the main tank and analyzed for fatty acids contents. The percentage of C16:0 ( $P = 0.035$ ) was significantly higher in milk from MG and HG farms compared with milk from LG farms, while the percentage of C18:0 ( $P = 0.003$ ) was significantly higher in HG farms than in MG and LG farms. Percentages of the nutritionally desirable FAs ( $\alpha$ -linolenic acid,  $P = 0.007$ ; C20:5 n-3,  $P = 0.017$ ; total n-3 PUFA,  $P = 0.031$ ) were significantly higher, while the n3:n6 ratio was lower ( $P = 0.001$ ) in milk from MG and HG groups, when compared with milk from LG group. In addition, a positive correlation was obtained between the percentages of net energy obtained from grazing and the contents of several n-3 FAs ( $\alpha$ -linolenic acid,  $r = 0.36$ ,  $P = 0.001$ ; C20:5 n-3,  $r = 0.28$ ,  $P = 0.012$ ; C22:5 n-3,  $r = 0.28$ ,  $P = 0.011$ ; total n-3,  $r = 0.33$ ,  $P = 0.003$ ), while a negative correlation was obtained with the n-6:n-3 ratio ( $r = -0.45$ ,  $P = 0.000$ ). CLA isomers contents were not affected by the grazing level. The content for the most studied FAs varied significantly throughout the experimental period. In conclusion, the highest level of grazing has had a positive effect on the quality of milk from Payoya breed, with higher amounts of functional components (n-3 fatty acids).



M-28

### **Effect of pasture type compared with hay diet on dairy goat milk fatty acid composition**

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The objective of the present study was to examine the effect of grazing on different pasture types and hay feeding on dairy goat milk fatty acid (FA) composition in early and late grazing season. Eighty goats were grouped according to genotype and lactation, and randomly divided into two groups (Early and Late) with approximately 8 weeks difference in mating and kidding dates. Goats within each of the two groups were further allocated to four forage treatment groups: R, forest rangeland pasture; C, cultivated pasture; HH, high quality hay; HL, low quality hay. The goats in Early were subjected to forage treatments in early grazing season, while the goats in Late received the forage treatments 8 weeks later. The most abundant FAs were C16:0 and C18:1c9 followed by C14:0 and C18:0. The milk proportion of the short and medium chained fatty acids (C6:0-C14:0) and C16:0 was higher ( $P < 0.0001$ ) in Late than in Early grazing season, whilst the proportion of long chained FAs (C18:0, C18:1c9, C18:1t11, C18:2c9, 12, C18:2c9t11 and C18:3c9, 12, 15) were lower ( $P < 0.001$ ). Goats grazing R yielded less milk (1.5 vs. 2.0 kg/d,  $P < 0.001$ ) but with higher milk fat content (46 vs. 37 g/kg,  $P < 0.001$ ) than C. The milk from goats on R had lower ( $P < 0.01$ ) proportion of medium chained FAs (C10:0-C14:0) and C18:2c9, t11 but higher ( $P < 0.05$ ) proportion of C18:0, C18:2c9,12 and C20:0 than C. Grazing compared to hay gave milk with lower proportion of medium chained FAs (C12:0-C14:0) and C16:0 but higher proportion of the long chained FAs C18:0, C18:1t11, C18:3c9, 12, C18:2c9, t11, C18:3c9, 12, 15, C20:0 than hay feeding. Higher supply of energy may explain higher proportion of de novo synthesised low and medium chained FA and lower proportion of long chained FA on C than on R, whilst higher supply of FA from mobilized fat may explain higher milk proportion of long chain FA in Early than in late season. Moreover, goats on pasture had likely higher supply of FA from dietary fat, which explain higher milk proportion of the long chained FA than on hay.



M-29

### **Concentration of sialyloligosaccharides in colostrum and milk from two Italian goat breeds**

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Milk oligosaccharides provide numerous important biological functions, such as prevention of pathogen binding to the intestinal epithelium and nutritive source for beneficial bacteria. Aim of this work was to study the oligosaccharides profile and content in colostrum and milk in two Italian goat breeds. Individual samples of colostrum and milk were obtained from 20 Maltese (M) and 15 Garganica goats (G). Each goat provided one sample at the following stages: Colostrum 0h (immediately after kidding); Colostrum 24h; early milk (day 7th) and mature milk (day 30th and 90th). The samples, from the morning milking, were immediately frozen at -20°C. The most representative sialic acids of goat milk, that are 3'-sialyllactose (3'SL), 6'-sialyllactose (6'SL) and disialyllactose (DSL) content (mg/L), were evaluated using HPAEC-PAD. Statistical analysis was carried out by one-way ANOVA (SAS 9.1.3). The differences among breeds were analysed by Duncan multiple range test. The results clearly showed a breed effect at each lactation stage on the oligosaccharides content. G breed showed in colostrum the highest content of 3'-SL both at 0h (253.9 vs. 201.3 mg/L) and 24h (328.5 vs. 249 mg/L) and the highest content of 6'-SL both at 0h (174.3 vs. 136.9 mg/L) and 24h (200.9 vs. 144.1 mg/L). DSL content was the highest at 0h (197.9 vs. 104.9), and the lowest one at 24h (126.4 vs. 228.1 mg/L). Also in early milk, G breed showed the highest content of 3'-SL and 6'-SL, but the lowest content of DSL (94.5 vs. 153.2 mg/L). The concentration of 3'-SL decreased significantly ( $P < 0.01$ ) and progressively from Colostrum-24h to mature milk (90 d) in G breed, while in M breed decreased from Colostrum-24h to early milk (7 d) and after increased progressively in mature milk (30 and 90 d). The content of 6'-SL decreased progressively from colostrum-0h to 30 d and increased from 30 to 90 d in both breeds. The DSL content decreased progressively from Colostrum-0h to mature milk (90 d) in G breed; contrarily, in M breed it decreased from colostrum-24h to 30 d and after increased at 90 d. The content of sialyloligosaccharides significantly changed during lactation's stages between the two goat breeds, where G breed showed meanly highest values. Considering the oligosaccharides profile, similar to human milk's, goat milk may represent a chance for use in the infant milk formula.



M-59

**Sensorial texture, odour, flavour and taste characterization of raw goat's milk semi-hard cheeses made with artisan kid rennet paste, vegetable rennet (*Cynara cardunculus*) and a mix of both**

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Vegetable rennet is traditionally used in the production of sheep's milk cheeses this paper examines its use in the production of goat's milk cheese to increase consumer choice. It is analysed the effect of thistle rennets prepared with flowers from four sources, artisan kid rennet paste (AKR), a mixture of plant rennet and AKR (KPR), and genetically engineered chymosin (GEC) on the sensory profile of a goat's cheese. Plant rennets were prepared from blossom heads of the cardoon thistle. These plants were collected wild (PW) or harvested (PH). The flowers were either cultivated in the same year as cheese was made (N) or had been harvested the previous year (O). All these coagulants, including the mixture of animal rennet and thistle flower, are used in traditional Canarian farmhouse cheeses. The cheeses were made in an experimental plant, in triplicate, using raw goat's milk, the only variable being the type of rennet used (AKR, KPR, GEC, PWO, PWN, PHO and PHN) and the amount of rennet was adjusted to coagulate the milk in the same time in all batches. KPR rennet was a mixture of AKR and PWN rennet. Cheeses were ripened for 20 days. Cheese yield, gross chemical composition of cheeses and whey, pH, and Aw were analysed in triplicate and the sensory profile determined by seven expert judges. The type of rennet used had a significant effect on whey chemical composition because whey from cheeses made with vegetable rennet, including KPR, had higher percentage of protein. No effect was observed on cheese yield, gross chemical composition, pH or Aw. Sensory tests showed a good differentiation ( $P < 0.05$ ) of cheeses. Cheeses made with cardoon flowers (PWO, PWN, PHO and PHN) presented higher scores for surface and moisture-in-mouth, adhesiveness, bitterness, and persistency attributes than those of cheeses made with animal or genetically modified rennets; KPR cheeses had intermediate characteristics between those made with animal and plant rennet. All cheeses made with plant-rennet presented floral odour and flavour notes. Cheeses made with AKR rennet presented the highest overall intensities for odour and flavour. Kid's rennet odour and flavour was only detected in AKR and KPR cheeses. Fermented fruits and citrus notes were detected only in GEC cheeses. Cheeses made with old flowers (PWO and PHO) showed lower scores for odour/flavour intensities and floral attributes than those made with new flowers (PWN and PHN). PHO cheeses had ammoniacal and sulphurous notes.



A-14

### **Prediction of heat production in Boer goats using heart rate**

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Measurement of heart rate (HR) is often used to predict heat production (HP) by livestock in settings with unrestricted movement. Because of differences among individual animals in factors such as stroke volume that affect cardiac output, most accurate prediction of HP from HR is achieved by application of HP:HR determined for each individual animal. However, measurement of HP:HR is time consuming and requires considerable equipment. Therefore, it is of interest to determine the decrease in accuracy from predicting HP based on the average HP:HR of a group of animals. In this regard, HR of 163 Boer goat bucks was used to predict HP based on the HP:HR for each animal vs. the average ( $5.63 \pm 0.098$  kJ/kg BW<sup>0.75</sup> per heart beat). Average body weight and age of bucks were  $41.5 \pm 0.68$  kg and 164 days, respectively. Animals consumed a 50% concentrate pelleted diet *ad libitum* ( $1.56 \pm 0.426$  kg/d) during two buck performance tests, 84 days in length. HP:HR was determined once over a 1 day period while in metabolism cages with a head-box respiration calorimetry system to measure O<sub>2</sub> consumption and production of CO<sub>2</sub> and CH<sub>4</sub>. HR was measured at the same time using a Polar RS 400 monitoring system (Polar Electro, Lake Success, NY). HP predicted based on the average HP:HR was moderately correlated with that based on individual HP:HR ( $r = 0.55$ ;  $P < 0.05$ ). When using the average HP:HR, 21.7% of the bucks had HP not different from the estimate using individual HR:HP. The number of animals with maximum error of 5, 10, 15, and greater than 15% was 29.6, 22.6, 14.3, and 11.8% , respectively. When using the average HP:HR to calculate HP, the percentage of under- and overestimates was similar (9.6 vs. 9.5%, respectively,  $P = 0.91$ , SE = 1.033). However, the distribution pattern of HP observations differed ( $P < 0.03$ ) between method of determination, with means of 561 and 565 kJ/kg BW<sup>0.75</sup> and SD of 56.5 and 85.4 for use of individual and average HP:HR, respectively. These results support the advantage of using HP:HR of individual animals to predict HP from HR, but suggest potential use of average ratio in some instances, such as with large expected treatment differences in HP.



A-25

**Characterization of acid-base balance in desert goats (*Capra aegagrus hircus*)  
subjected to stressful conditions**

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Studies on the influence of water deprivation under heat stress condition on the state of acid-base balance in desert goats are scarce. Current study was carried out on 5 bucks of Aardi goats with mean body weight of 25-30 kg and 10-12 month of age. Study parameters included; meteorology, thermophysiology, in addition to blood and urine samples. All these parameters were collectively monitored after 72 hours period of euhydration (EU), dehydration (DE), rehydration (RE), as well as at day 10th post rehydration. Daily temperature-humidity index values averaged  $87.3 \pm 0.27$ , which could suggest that goats used in the present study were under heat stress conditions. Water deprivation coincided with such conditions led to noticeable divergences ( $P < 0.05$ ) in both body temperature (from  $39.54^{\circ}\text{C}$  during EU stage to  $40.10^{\circ}\text{C}$  during DE stage) and respiratory rate (from 66 breath/min during EU stage to 70 breath/min during DE stage). These divergences had generated remarkable imbalances ( $P < 0.05$ ) in the acid-base system of desert goats. In response to the tachypnea, noticeable decreases ( $P < 0.05$ ) were observed in venous blood partial pressure of carbon dioxide (from 37.1 mmHg during EU stage to 30.9 mmHg during DE stage), as well as the concentrations of bicarbonate (from 22.7 mmol/L during EU stage to 19.5 mmol/L during DE stage), base excess (from -1.76 mmol/L during EU stage to -3.73 mmol/L during DE stage), and total bicarbonate (from 23.8 mmol/L during EU stage to 20.5 mmol/L during DE stage). Meanwhile, increases ( $P < 0.05$ ) in the anionic gap (from 25.7 mmol/L during EU stage to 62.5 mmol/L during DE stage), partial pressures of oxygen (from 40.3 mmHg during EU stage to 50.56 mmHg during DE stage), and oxygen saturation (from 68.7 % during EU stage to 79.0 % during DE stage) were recorded in water deprived goats. Surprisingly, however, blood pH (with 7.40 during EU stage and 7.43 during DE stage) and urine pH (with 7.41 during EU stage and 7.37 during DE stage) remained unchanged ( $P = 0.08$  and  $P = 0.15$ , respectively) and within its physiological range throughout the study. Ten days post rehydration were considered sufficient for all measured parameters to eliminate the carryover effect of water deprivation. Current results clearly substantiate the great capability of desert goats in adjusting their physiochemical functions to ameliorate the stressful effects that induced by water deprivation under heat stress condition.





A-35

### **Hemogasometric parameters of Brazilian Native Goats under thermal stress conditions**

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Brazilian native breeds were developed under hot conditions and it is believed that they strongly use thermoregulatory mechanisms to maintain homeothermy. However, these mechanisms can have a negative effect on other organic functions which can disturb homeostasis and productive performance. Respiratory thermolysis is an efficient way to eliminate excessive heat load, but it can cause acid-basic disequilibrium. So, with the aim of evaluating the effect of induced thermal stress, 10 Canindé goats were maintained in the sun, in a semiarid region, for 24 hours, during six weeks, in the hot and wet season. At 0500, 1300 and 1800 h rectal and surface temperatures were taken besides respiratory rate and a blood sample, to measure hemogasometric parameters. The animals were weighed every day, at the beginning and at the end of the data collections. An ANOVA procedure, as well as regression and correlations analysis from SAS was used. Body Temperature (BT) didn't vary along day time, but respiratory rate (RR) was strongly affected with means of 22.3; 162.38 and 40.46 movements per minute, respectively at 0500, 1300 and 1800 h, showing that the animals utilized this way to dissipate heat. Rectal temperatures averages at 0500, 1300 and 1800 h were 38.11, 40.05 and 39.12°C, confirming the situation of thermal stress at 1300. Blood pH didn't vary with this factor, with means of 7.427, 7.487, 7.439. However, to maintain acid-basic equilibrium, the animals with higher respiratory rates produced more  $\text{HCO}_3^-$  and mobilized a higher amount of basis, as shown in the regression study. The estimated regression equation between RR and pH was:  $\text{pH} = 7.4 + 0.00096 \text{ RR}$  ( $P > 0.05$ ), which comproves that the high RR had no effect on blood pH. Other regression equations found were:  $\text{PCO}_2 = 38.40 - 0.021 \text{ FR}$  ( $P < 0.01$ );  $\text{PO}_2 = 32.53 + 0.039 \text{ FR}$  ( $P < 0.01$ );  $\text{HCO}_3^- = 23.96 + 0.010 \text{ FR}$  ( $P < 0.01$ );  $\text{BCEF} = -0.47 + 0.0058 \text{ FR}$  ( $P < 0.05$ ).  $+ 0.010 \text{ FR}$  ( $P < 0.01$ );  $\text{BCEF} = -0.47 + 0.0058 \text{ FR}$  ( $P < 0.05$ ). Body weigh was reduced during thermal stress exposition. It was concluded that although the animals had largely utilized respiratory losses in heat stress situations, they were able to compensate this effort and maintain acid-basic equilibrium, an important factor for their health and production. However, heat stress caused a reduction in body weight, confirming that despite the compensatory adjustment, even native breeds must be protected from extreme weather conditions.





A-40

### **Physiological responses of Swedish lactating goats to prolonged heat exposure**

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This study was conducted to evaluate the physiological responses of Swedish domestic goats (*Capra hircus*) to prolonged indoor heat. Global climate change may become a challenge for production animals due to expected unfavorable climatic conditions such as increased ambient temperatures. Goats adapted to tropical or dry climate regions have been in the focus of scientific enquiry but little work has been done on Nordic goat breeds and their physiological responses to heat. Therefore, seven goats (Mean  $\pm$  SE:  $2.4 \pm 0.2$  years) in their first (3 animals) and second (4 animals) lactation were exposed to daytime room temperatures of  $32.8 \pm 0.3^\circ\text{C}$  (night-time  $20.1 \pm 0.1^\circ\text{C}$ ) over 15 days after an initial two-day period under moderate thermal conditions ( $17.3 \pm 0.6^\circ\text{C}$ ). Measurements were taken daily at 08.00 (THI-index:  $63.7 \pm 0.5$ ), 11.00 ( $75.7 \pm 0.5$ ) and 17.00 ( $78.7 \pm 0.3$ ). Recordings from 17.00 were analyzed using two-way analysis of variance (ANOVA) with fixed effects of lactation and day and the interaction term. Results showed that rectal temperature (RT in  $^\circ\text{C}$ ) was significantly lower during the last three days ( $40.2 \pm 0.1$ ) compared to the first three days ( $40.6 \pm 0.1$ ) of heat exposure ( $p=0.003$ ) and respiration rate (RR in bpm) was also lower (last days:  $140.0 \pm 3.2$ ; first days:  $166.5 \pm 2.9$ ;  $p=0.001$ ). Contrary, there was no effect of days on morning RT ( $p=0.317$ ). Furthermore, RT was lower in first lactating goats ( $40.3 \pm 0.1$ ) compared to goats in second lactation ( $40.6 \pm 0.1$ ;  $p=0.038$ ) but the opposite effect was observed for RR (1st lactation:  $156 \pm 3.6$ ; 2nd lactation:  $147 \pm 4.2$ ;  $p=0.047$ ). There was no significant effect of lactation on the other variables measured (skin temperature, skin hydration, milk osmolality). In conclusion, after 15 days of heat exposure, RR and RT were slightly lower than during the first days of heat. Although water was available ad libitum, goats did not maintain body temperature during heat and did not fully recover during night compared to control days. Goats in second lactation seemed more affected by heat in terms of RT responses but this was not reflected in RR.



G-7

**Study on the variability of the caprine CCR5 gene**

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Maedi visna virus (MVV) and caprine arthritis encephalitis virus (CAEV) are a heterogeneous group of infectious agents affecting sheep and goats; they belong to the family of Retroviridae, genus Lentivirus which includes the human immunodeficiency virus (HIV). A genetic basis for resistance to lentivirus infection has been supposed and Chemokine (C-C motif) Receptor 5 gene (CCR5) has been considered one of the main sources of genetic resistance to HIV in humans. Recently, one CCR5 variant characterized by a 4-base deletion has been described in the ovine CCR5 promoter region. This mutation alters the binding site for octamer transcription factors reducing the expression of the receptor and the proviral levels. In our study, a survey to describe the previously unreported caprine CCR5 sequence was carried out. Twenty Camosciata breed blood samples were analyzed: four amplicons comprising the partial promoter region, Exon 1, Intron and Exon 2 (which includes the CDS and the 3'UTR region) were sequenced and aligned considering the ovine CCR5 (GenBank FJ008056.1) as a reference. Seventeen alleles were detected and five haplotypes were inferred using PHASE software. No departure from Hardy-Weinberg equilibrium was found ( $P > 0.05$ ). Six alleles, one of them characterized by a 2 bp insertion (4421\_4422TC), were found in the promoter region (4463 G > A, 4788 C > G, 5171 C > A, 5305 C > T, 5638 C > T), six in the Intron region (6415 T > C, 6816 A > C, 7034 C > T, 7266 T > C, 7412 T > C, 7448 T > C) and four in the 3'UTR (8598 C > T, 9161 C > T, 9332 G > A, 9353 G > C). Only one mutation was detected in the CDS at position 8121 T > C (ATA > ACA) resulting in the amino acid change I198T. The promoter allele 5305T (C > T) could represent, according to in silico analysis using TFSEARCH software, a possible additional site of interaction with transcription factors. The determined caprine CCR5 sequence was submitted to GenBank (accession number HQ650162). The deletion described in the ovine gene was not found in goats; nevertheless, the caprine CCR5 resulted moderately polymorphic and this will allow to perform a case-control study to discover possible associations between the detected haplotypes and resistance to CAEV in goats.



G-12

**Present status of the Spanish dairy goats breeding programs**

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Spain has the second larger goat population among the countries of the European Union. It is also relevant its position with respect to goat biodiversity with 23 breeds officially recognized; 22 of them native of which 17 are endangered and 7 well established. Alpine is the only foreign breed integrated in the National Catalogue of Breeds. Most of them are dairy breeds and only a few are meat oriented or double purpose. Presently, only dairy breeds have breeding programs in operation. Meat breeding programs do not exist in this country. This presentation is a survey of the present status of the dairy goat breeding programs in Spain, prepared by a consortium of geneticists responsible for the technical direction of these programs. A comparative description of these programs is given, indicating the sources of information available, the infrastructure and methodologies used and the main results obtained, pointing out the weaknesses and strengths observed and the challenges for the future. Five of the Spanish dairy breeds of goats, Murciano-Granadina, Malagueña, Florida, Payoya and Cabra del Guadarrama, in order of census importance, have well developed breeding programs; while Majorera, Tinerfeña and Palmera are starting to establish the identification of animals and the milk and genealogy recording necessary to set up breeding programs. Some recommendations are given, as conclusions of this work, in respect to the development of the national dairy goat breeding programs in a context of great genetic, ecological and market diversity. These proposals are based on the experience, previously gathered in Spain, that the competitiveness of the local breeds depends on their adaptation to the ecosystems where they are raised and on the recognition of the quality (both sensory and healthy) of their products.



G-23

**Reference gene selection for qRT-PCR normalization: Application for influence of yeast supplementation of milk goat diet on antimicrobial peptides gene expression in milk somatic cells**

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One of the promises of the nutrigenomics is potential impact of food components on the human or animal genome. On the other hand companies inform about health promoting properties of yeast cultures. The aim of the study was to evaluate the yeast culture supplementation effect (*S. cerevisiae*) on the genes of immune system expression and to investigate the expression stability of six top-ranked candidate reference genes in goat milk somatic cells. The study was conducted on 18 goats of Polish White Improved and Polish Fawn Improved breeds divided into control (n = 9) and experimental (n = 9) groups, analogous to each other, according to age and breed of goats. The based diet of control group consisted of corn silage, wilted grass silage and concentrates, supplemented with a mineral and vitamin mixture. The supplement of yeast culture was added to the concentrate mixture fed to the experimental group (10 g/day/goat). To eliminate the influence of stage of lactation and milk yield (metabolic rate) on parameters studied, the milk samples was taken on day 7, 30, 80, 120 and 180 of lactation. The milk somatic cells obtained from 1L of milk taken from each goat served to isolation of RNA. The quantitative Real-Time Reverse Transcription PCR method was used to establish the expression level of BAC5, BAC7.5, HAMP, LF, LYZ, GBD1, and GBD2 genes. The following genes as reference ones were validated: GAPDH, 18S rRNA, ACTB, PPM, RPLPO, UBO. The row data expression of Bac5 and Bac7.5 genes showed the differences between control and experimental group. However, all reference genes showed greater expression variability than target genes in analyzed samples, thus the appropriate interpretations of obtained results is difficult and further searching of reference genes in milk somatic cells is needed. Research was realized within the project "BIOFOOD – innovative, functional products of animal origin" no. POIG.01.01.02-014-090/09 co-financed by the European Union from the European Regional Development Fund within the Innovative Economy Operational Programme 2007 – 2013.



G-66

**Effect of calcium sensitive casein genotype on milk yield, composition and renneting properties of Sarda goat**

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With the aim to assess the relationships between polymorphism at the calcium-sensitive casein genes and yield, composition and renneting parameters of caprine milk, 200 Sarda goats, genotyped at the CSN1S1, CSN2 and CSN1S2 genes, were utilised. Milk samples were collected and daily milk yield was recorded at monthly intervals to determine: fat, protein, pH (IDF 141C:2000) and coagulation properties (Formagraph instrument). Data were submitted to a repeated-measures three-way GLM procedure; in the model CSN1S1, CSN2 and CSN1S2 were the random effects and only genotypes with frequencies higher than 4.0% were included. The following genotypes were considered: at the CSN1S1 locus AA, AB, AF, BB, BF and FF; at CSN2 AA, AC, CC and C01; at CSN1S2 AA, AC, AF, CC, CF and FF. Milk yield, which varied in a range of 1,135 to 790 g/d, was influenced by the effects of CSN1S1 (AA and BB > BF and FF) and CSN1S2 (AC and CF > FF). As regards milk composition, the CSN1S1 genotype affected milk fat (AB > BB > BF and FF), protein (AB > BF > AF) and pH (AF and FF > BB). The CSN2 genotype showed significant differences in protein (AA > AC > CC > C01) and pH (AC > CC). At the CSN1S2 locus, significant differences occurred only for fat (AC and CC > AA and CF). Fat and protein varied between 3.67 and 4.21 g/100 mL and between 4.60 and 5.03 g/100 mL, respectively; the pH value varied between 6.67 and 6.71. Clotting time ( $\tau$ ) was affected only by CSN2, showing shorter mean times for AC and CC (12.88 and 13.04 min) than AA (14.47 min). Curd firming time (k20) and curd firmness (a30) were influenced by all the three genes and varied between 1.90 and 2.74 min and between 47.4 and 35.2 mm, respectively. The CSN1S1 AB genotype displayed the lowest values of k20 and the highest of a30, the FF genotype was opposite. The CSN2 C01, CC and AC genotypes displayed decreasing values of k20, while CSN2 AC had the highest values of a30. The CSN1S2 locus showed the highest values of k20 in the AA genotype and of a30 in AC and CC. In conclusion, this study demonstrated the relationships between calcium-sensitive casein genes and milk traits and provided useful information in order to improve genetic selection and differentiation of productions.



**M-41**

**Shelf life of smoked goat chorizo prepared with “variety meat”**

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By-products generated from goat slaughter such as blood and viscera have potential for use in food formulation however, they are frequently and improperly disposed into the environment, generating public health problems. The aim of this study was evaluated the viability of a meat product (smoked chorizo) formulated with blood, viscera, goat meat trimmings, pork fat, seasonings and spices, determining the most appropriate packaging type (vacuum or polyethylene film of low density) for conservation in storage at  $4 \pm 1^\circ\text{C}$  during 90 days. Vacuum packaging retained the microbiological and chemical of the smoked chorizo for a higher time (63 days) than the LDPE packaging film (41 days). The pH values in the vacuum-packed product had greater reduction during the storage, probably due the development of anaerobic microorganisms such as acid lactic bacteria. The levels of oxidation of goat chorizo were more pronounced in the packaging of polyethylene film, highlighting the role of oxygen in the oxidative development. The smoked chorizo packed in film showed a greater reduction in moisture levels, which resulting in an increase of the ash, lipids, collagen and shear force with time of storage. Although the storage time and type of packaging might have affected the chemical and microbiological smoked chorizo, no significant difference was found for the sensory attributes evaluated with the storage time, showing the sensory stability of the product. The use of goat blood and viscera in the preparation of smoked chorizo is a viable alternative considering the microbiological, nutritional and sensory quality of this product.



M-45

**Effects of hot season and electrical stimulation on meat quality characteristics of goat *longissimus dorsi* muscle**

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The effects of transportation during the hot season and low voltage electrical stimulation (90V) on physiological, and meat quality characteristics of goats were assessed. Twenty male local breed goats (one year old) were divided into two groups: six hours transported animals during hot season (42°C day time temperature) and non-transported animals. Goats were blood-sampled before loading to transport and prior to slaughter. Electrical stimulation was applied 20 min postmortem to 50% randomly selected carcasses. Ultimate pH, shear force, sarcomere length, myofibrillar fragmentation index, expressed juice, cooking loss and CEI L\*, a\* and b\* colour were measured on samples from *Longissimus dorsi* muscles. Electrical stimulation and transportation for six hours had a significant effect on quality characteristics of meat samples. The transported goats had higher plasma cortisol ( $P < 0.01$ ), adrenaline, nor-adrenaline and dopamine concentrations ( $P < 0.05$ ) than non-transported goats. Muscles from electrically-stimulated carcasses had significantly ( $P < 0.05$ ) lower ultimate pH values, longer sarcomeres, lower shear force value, higher expressed juice and myofibrillar fragmentation index than those from non-stimulated ones. Electrically-stimulated meat was significantly ( $P < 0.05$ ) lighter in colour than non-stimulated based on L\* value. Meat from transported goats had significantly higher ultimate pH, expressed juice, shear force, but significantly lower sarcomere length. These results indicated that subjecting goats to transportation for six hours under high ambient temperatures can generate major physiological and muscle metabolism responses. This indicates that effect of stimulation may reduce deterioration effects of transportation on meat quality of goats.



**M-50****Meeting defined carcass weight and supply chain delivery schedules for cross bred meat goats in southern Victoria**

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The factors that significantly affected the production and carcass weight of Boer x Australian feral derived goats slaughtered near 10 weeks of age for 'capretto' kid meat markets were quantified. The does grazed perennial pasture in southern Victoria (average annual rainfall 680 mm). Production data were collected for does and their Boer cross progeny ( $n = 985$ ) over 7 years. Mean ( $\pm$  s.d.) kidding percentage was  $167 \pm 21\%$ . For doe kids, single reared kids grew faster to weaning than twin reared kids (130 vs. 104 g/d,  $P < 0.01$ ). Twin reared kids from adult does grew faster than twins from maiden does (108 vs. 98 g/d,  $P < 0.01$ ). Doe weaning weight was  $19.3 \pm 3.7$  kg. For male kids slaughtered at a mean age of 72 days ( $n = 95$ ), mean live and carcass weight were  $17.0 \pm 2.8$  and  $7.9 \pm 1.5$  kg and average daily gain  $200 \pm 58$  g/d. A multiple regression ( $R^2 = 0.94$ ) indicated carcass weight increased by: 0.584 kg for each extra kg of live weight; increased by 0.244 kg for each extra kg of birth weight; 0.81 kg for each 100 mm of spring rainfall; and was reduced by 22 g/d for each day later birth was after mid-July; and reduced by 15 g/d for increasing age at slaughter. Faster growing kids had higher dressing yields. The cumulative effects on carcass weight of early birth of heavy kids in good seasons compared with late birth of light kids in poor seasons amounted to 2.7 kg. To meet defined carcass weight and delivery schedules in supply chains 'capretto' kid meat production systems will obtain benefits from managing: doe mating systems, to obtain early and high conception rates; the nutrition of does, to achieve rapid growth of kids; and regular weighing of kids to predict carcass weight.



**M-61**

**Predicting goat kids carcass fatness by an image analysis system**

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The amount and distribution of subcutaneous fat is an important factor affecting the carcass quality of goat kids. Fatness degree is determined by visual assessments according to five fatness scores (1 for 'very low' and 5 for 'very high'). New technologies like image analysis have been developed with the goal to accurate and give objectivity at a more important degree to this classification system. In this work, 58 Malagueña kids were suckled until slaughter day (1 month of age and 8–10 kg live weight, approximately). After slaughtering, the carcasses were weighed and a fatness score was assigned (1-15 scale, each class was divided into three subgroups; 1-very low; 15-very high). A digital picture was taken of the carcass dorsal side. According to the hypothesis that the high carcass fatness shows higher fat area (white color) than muscle area (red color) on the carcass, color measurements (grayscale: 0: black, 255: white; R (red) G (green) B (blue) color model: scale 0-255) were made in the pictures with an image analysis software. Stepwise regression analysis of color parameters measured with image analysis (x variables) and fatness score determined by visual assessments (y variable) was carried out. The correlation coefficient value was  $r = 0.55$  and the RMS residual was 0.9 ( $P < 0.001$ ). These results suggest that the application of image analysis at slaughter should be helpful as a means of supplementing and enhancing the system for grading kid carcasses.



## G-11

**Evaluation of different goat breeding plans**

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In Germany, goat breeding organisation is split into several individual associations, each carrying out its own breeding program. Breeding is decentrally organised because no AI station for small ruminants exists. Aim of the present study is to evaluate different strategies for implementation of a planned breeding program assuring genetic gain in selection traits. So far, three different strategies are compared: (1) The actual breeding program, (2) a breeding program based on a buck circle for progeny testing of young bucks, (3) an AI-based breeding program with progeny testing. Also, four different population sizes are evaluated: In a first step the population size of a single breeding organisation was evaluated ( $n = 2,000$  does). Then an increasing degree of cooperation between different breeding organisations was assumed ( $n = 7,500$  and  $12,000$  does). The last step with  $n = 30,000$  does reflects the total population size of German Fawn goats in Germany. For all cases, the population was split in a breeding (40%) and a commercial population (60%). The different breeding plans were modelled and evaluated with ZPLAN. For first evaluations, traits in the index were restricted to milk yield, fat- and protein-yield and protein percent. The breeding program in place does not entail genetic gain. Also, there is no increase in genetic gain if the population size increases while the breeding program remains. Genetic gain can be considerably increased with a system based on artificial insemination or with natural mating and progeny testing in a nucleus herd. The results show, that within a small population the nucleus breeding system is best whereas with growing population size the AI-based breeding plans outperform. Next steps of breeding planning have to investigate the breeding costs and breeding profit. Also, the organisational structures, which are important to implement the investigated breeding plans, have to be analysed.



G-38

**Enhancement of goat meat production in Guadeloupe through setting up of a breeding scheme for the indigenous breed: from theory to facts**

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The mismatch between supply and demand for goat meat in Guadeloupe led to the rising price thereof and a growing dependence on imports. Moreover, the heritage and identity of goat farming is very important on the island. Based on these observations, a breeding program was designed to preserve and enhance the population of Creole goats. Its image would be enhanced by the way, including tangible morphological changes. Farmers cooperative CABRICOOP initiated the project to improve the economic viability of farms. The program was then built thanks to a partnership between the CABRICOOP, the extension services and INRA. A 4-point approach was developed: 1) Characterization of farming systems and farmers' expectations in a field survey, 2) Identification of the basis for selection, 3) design of the selection scheme, 4) optimization of the scheme. The definition of the standard of the breed and the development of a scorecard enabled the selection of 500 Creole does in 10 farms. The breeding objective discussed with farmers integrates production traits (carcass weight and yield to 11 months), reproduction (fertility) and resistance and resilience to parasitism. The genetic parameters of the traits were estimated thanks to the database recorded in the Creole experimental flock of INRA. Weight and fertility are the two components which improvement generates the greatest profit. Simulations of responses to selection showed that it was possible to improve these production, functional and adaptation traits simultaneously. The annual genetic gain was simulated in a closed nucleus flock of 300 does and 15 bucks. The expected progress is 800 g/year for weight at 11 months and 3.7% for fertility, prolificacy being maintained and resistance slightly improved. Breeding objectives of production, reproduction and adaptation to the environment are compatible for Creole goats in Guadeloupe, which thus becomes a sustainable support for final crosses.



G-40

### **Milk quality breeding value prediction based on FTIR spectra**

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Fat, protein, and lactose content in milk may be found by infrared spectra (FTIR). Breeding values are found indirectly by predicting the phenotypic values for each milk sample, then estimating variance components, and then blup breeding values for individuals. We propose to use the heritable part of the FTIR spectra to predict breeding values of these traits, and possibly for other quality traits not available today. Heritable parts of spectra have been found, and variance explained by animal permanent environment, herd test day, and residual variance. 28000 FTIR spectra from 14869 goats in 271 herds were used of which 20000 for calibration. The > 500 specter frequencies were reduced to 8 factors by PCA, and their REML estimates of the four variance components. Portions explained by variance component effects are also shown on the FTIR specter scale. PLSR analysis established regression coefficients of spectra on the existing fat, protein, and lactose percent already recorded in the Dairy Goat Control. 8000 remaining spectra validated the usefulness of the method. Blup value scores were found for each factor for each animal. These carry info on the heritable part of spectra. Predicted breeding values for the spectra were transformed to breeding values for known chemical components of the milk (fat,...) by PLSR regression of milk spectra. Using the same 8000 spectra, predicted phenotypical chemical components were found using the same PLSR regressions for each trait, and univariate blup values calculated for fat, protein and lactose. Compared to the indirect method, prediction error variances for the direct method are 3.2% better for fat, 6.1% for protein and 4.1% for lactose percent. Multivariate blup values based on the 3 phenotypic traits had prediction errors between the two mentioned methods. We also hypothesize that the heritable part of the spectra may be transformed into predictions of other quality measures such as coagulation and taste, which are difficult to measure in sufficient numbers without use of the spectra. We recommend predicting breeding values for traits derived from the FTIR spectra from the heritable part of the spectra. Work was done in the project 'Quality Goat Milk for Cheese Production' financed by Norwegian Research Board and Tine Norwegian Dairies.



G-78

### **Response to a divergent selection based on somatic cell counts in Alpine dairy goats**

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Milk somatic cell count (SCC) is routinely collected in the French Alpine and Saanen dairy breeds and its heritability has been estimated to be around 0.20. Accordingly, it is possible to consider improving the mastitis resistance in goat by selection on SCC. However, efficiency of such a selection raises some concerns, especially because non-infectious factors of variation have a large effect on goat milk SCC. Our study therefore consisted in evaluating the consequences of SCC-based selection on intra-mammary infections. Using progeny-tested AI bucks selected for extreme breeding values for somatic cell scores (SCS = log transformed SCC), two groups of 61 High SCS and 44 Low SCS goats were produced and raised at the INRA experimental facility of Bourges. Milk bacteriological analyses and SCC of half-udders were performed at the kidding date and at 7 monthly points in first lactation. Milk production was similar in the 2 lines. The mean SCC was 1,440,000 cells/mL and 616,000 cells/mL for the High and Low SCS goats, respectively, with a significant ( $P \leq 0.05$ ) difference of 1.2 point in SCS. Regarding milk bacteriology results, 35% of samples were positive. Main bacterial types found were Coagulase Negative Staphylococci (58.4%) and especially *S. xylosus* (19.7%). The mean SCS was significantly higher for the positive than for negative milk samples ( $4.8 \pm 0.2$  vs.  $3.6 \pm 0.1$ ). Additionally, the milk SCS of positive samples was related to the bacterial type: *S. aureus* ( $5.5 \pm 0.5$ ), *S. caprae* ( $5.2 \pm 0.3$ ) vs. *Bacillus* ( $4.0 \pm 0.3$ ). Regarding the effect of the SCS line, frequency of positive samples was significantly higher in the High SCS ( $46 \pm 3\%$ ) than in the Low SCS ( $28 \pm 3\%$ ) goats. Within the High line, the difference between positive and negative samples (+0.9 point of SCS) was much higher than in the Low line (+ 0.4 point of SCS). This observation could be explained by a higher quantity of pathogens in the positive samples in the High line when compared to the Low line. In conclusion, results of the experiment gave good evidence that goat milk SCS is related to the infectious status of the udder and that SCS-based selection in goat will decrease the prevalence of intra-mammary infections and the amount of bacteria within infected samples.



E-5

**Causes and consequences of inefficient planning of goat grazing in natural protected areas. The Palmera breed case in Canary Islands**

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Through different research projects, carried out since 1997, the authors have dealt with the complexity of grazing and its sustainable development in natural protected areas (NPAs). The problem of goat grazing has been approached considering productive, ecological, economic, legal and social aspects. We studied 56 goat grazing farms of Palmera goat breed in the island of La Palma. On each farm, grazing areas and their average stocking rates (SR) were assessed using field surveys and Participatory Rural Appraisal (PRA) techniques. Carrying Capacity (CC) was estimated from shrub and herbaceous productivities and mean values assigned to different vegetation units. Due to the high variability in climatic conditions and vegetation types, data were treated separately for the northern and southern regions of the island. The Mann-Whitney test was used to determine production differences among vegetation units. To determine the effect of year and season was used the Friedman test for related measures. To determine the effect of environmental variables there were used linear and curvilinear regression and nonparametric Spearman correlation. All statistical analyzes were performed with SPSS 15.0 (SPSS, 1986). The perception of farmers on land use and the criteria considered by managers for decision making were obtained during workshops by means of PRA tools, and included in this analysis. Only 15% of the total surface of NPAs is subjected to grazing. Approximately half of this area (57%) is managed with continuous grazing. In the 14 vegetation units classified for this study, we find a negative correlation between their productivity and their coefficient of variation in relation to environmental variables ( $r = -0.55$ ;  $P < 0.01$ ). A significant negative correlation ( $r = -0.44$ ;  $P < 0.01$ ) was also detected between productivity and Use Factor (SR/CC). Considering how farmers use each vegetation unit and their respective productivity, we observed that the more productive units are barely occupied (8-16%) whereas most grazing areas (73%) are located in vegetation units with low carrying capacity. Unexpectedly, we can conclude that productivity is not a key factor when farmers choose grazing areas. Conversely they are using different criteria for the evaluation and selection of grazing areas in particular, based on local categories that are more related to social and economic aspects.





E-6

### **Goat ownership in the humid regions of Guinea-Bissau**

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Guinea-Bissau is one of the lower income countries in the African continent. It is chiefly an agricultural country with one commercial crop: cashew nut and the vast majority of the population is dedicated to small scale subsistence farming. Animal ownership plays a key role in both food security and the culture of local populations. Despite the preponderant importance of cattle, small ruminants, with special emphasis on goats play also a key role. In this work we will describe the main characteristics of animal ownership in two of least developed regions of Guinea-Bissau, the Northern Cacheu and Tombali, with a special emphasis on the goat species. Local goats are of the West African Dwarf breed and are tolerant to trypanosomiasis or sleeping sickness, as well as to other tropical diseases and parasitosis. Goats are owned by "enlarged families" and raised together in the ensemble of the village. Animals feed on spontaneous plants, crop residues and garbage. Mating is entirely at random and no selection is practised. Goats are not milked and animals are killed for consumption in one major occasion: the decease of a loved-one and/or a local personality/chieftain (choro ritual). Local populations rarely sell their goats except in case of an unexpected expense (hospital bill or similar). Commerce and trade of goat and goat products in the region is therefore extremely incipient.



E-16

### **Constraints to goat production in semi-arid south-western Zimbabwe**

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This manuscript seeks to highlight constraints to goat production in semi-arid south-western Zimbabwe. Although goats are highly adapted to semi-arid environments productivity is hindered by predation, water shortages and rangeland degradation. Predation by jackals is the major cause of stock losses. Farmers can reduce losses through herding their goats or using trained sheppard dogs. Water shortages especially during the dry season or drought years lower goat productivity. The government and non-governmental organizations could address this through installation of low cost sand abstraction equipment and bush pumps. The continued degradation of communal rangelands exacerbated by climate change also poses a great danger to sustained goat production. Rangeland management programs to improve woody plants diversity need to implemented. Proper goat marketing, extension and research programs can also help farmers improve revenue inflows from their flocks. Government and developmental agents need to be actively involved in goat production to alleviate poverty.



E-43

**Good Farming Practices (G.F.P.) for Colombian goats livestock systems: models, application and scope**

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The globalization of the economy and especially of food production has generated a clearly increasing demand of not only greater nutritional value products, but also safer and healthier ones. The implementation of GFP (Good Farming Practices) in Colombia represents a challenge to all conventional livestock producers and not exclusive to export-oriented livestock. More specifically, for livestock in the hands of small and medium producers which normally supply the market. The present research was developed in nine (9) Colombian geographical areas, each with 14 producers. The geographical areas and producers were selected for sampling based on strategy, availability of resources and conditions required by the productive environment. Rapid Rural Appraisal (RRA) methodology was used—as the theoretical work explains—to find the optimal level of ignorance facing the task of gathering information in the more simple and practical manner. The scientific and qualitative assessment of traditional farming practices in Colombian goat production systems and its relationship to GFP and animal welfare, allowed to clearly define three farming practices scenarios for the Colombian context: 1) The criteria 'relative to the animals' are used to evaluate the animals. Among these criteria, it is worth emphasizing the presence of injuries or wounds, the incidence of diseases, the BCS (Body Condition Score) and the presence or absence of certain behaviors. While many of the mentioned criteria were relevant to the assessment of GFP and animal welfare, and were applied to an extensive series of production methods, they provided nothing more than a snapshot of a particular moment in time; 2) The resource-based criteria are useful to assess housing, diet and other resources for animals. Although they are relatively easy to measure and their relation to GFP and animal welfare can be established through research, these criteria don't guarantee animal welfare in any given time. For instance, animals could suffer from diseases or experiment fear despite of having appropriate environment and resources. It is possible, that the described levels are not met using resource-based criteria when very different production systems are applied; 3) the management-based criteria are focused on human care as an important determinant of GFP and animal welfare. These criteria may include staff skills on operation, feeding practices, hygiene strategies and accounting.



E-1

### **Some fleece characteristics of native goats of Lorestan**

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Lorestan province of Iran has about 1.6 million the head of native goats which are meat-hair goats with low percentage of cashmara in their fleeces. Lorestan native goats are well adapted to harsh climate conditions that make it a valuable small ruminant in this area. In order to determine fleece characteristics of Lorestan native goat, hair samples were taken from 40 kids and 59 mature goats from both sexes. Fleece characteristics were: weight, fiber diameter, variability of fiber diameter, staple length, fiber length, cashmara percentage, hair percentage, breaking load, tenacity and yield. Data analyzed using tow-way ANOVA method. Fleece weight was different between ages and sexes, older goats produced heavier fleeces and however male goats had higher fleece weight. Both kids and goats also males and females had similar cashmara percentage, hair percentage and yield. Goats produced thicker fibers and higher variety of fiber diameter than kids, which is likely because of the age difference between them, but both age groups had similar breaking load and tenacity. Females produced longer staples than males. Results showed that 95 percent of fleece fibers were consist of dark fibers and it had low cashmara percentage and fiber length was high. It can be suggested that native goats of Lorestan are hair goats with valuable fibers in textile industry.



E-38

### **Developing organic supply chains for mohair and cashmere markets**

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While all animal fibres can claim to be natural, biodegradable and sustainable only those whose production system has been accredited as being organic can claim to be “organic fibre”. In the largest animal fibre market, Australian Merino wool, regulators and markets are placing pressure on producers to improve the ethical aspects (e.g. traceability, sustainability, safety, animal welfare) of their enterprises, and these pressures will increase with time for other animal fibres. Australia producers have exported organic wool but the premiums are low, only large scale producers are viable and the global financial crisis has undermined marketing efforts. The critical issue with organic production systems is the extent to which producers can make substantiated and true claims about the attributes of their products. An external auditor verifies that the farmer meets strict certification standards. Any food, cosmetics, fibre or any product that is described (labeled) as ‘organic’, ‘bio-dynamic’, ‘biological’, ‘ecological’ or by any other word of similar indication, must also meet government regulations relevant to this issue. World-wide, there are also available a variety of differing standards for certified organic textile products. Many Australian producers are not satisfied with current certifying requirements and seek more producer friendly and environmentally relevant standards, as occurred for Australian cotton. The following issues need to be considered by industry associations and supply chain partners if organically certified fibre is to be produced: 1) Development and adoption of low-cost “organic” or “eco-friendly” certification; 2) Investigation of critical production issues including: animal health; animal welfare; record keeping; 3) Alignment of research and development priorities; 4) Increasing the flow of information to producers; 5) Working with larger producers to develop successful case studies; 6) Clear identification of market opportunities and supply chains; 7) Development of direct marketing pathways to increase income to overcome the high costs for compliance.



M-43

### **Quality characteristics of hairy and Cashmere goat skin and Leather**

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One-hundred and sixty eight goat skins from male and female goats and two age groups (kids and adult) were randomly selected to evaluate the skin and leather characteristics. Sex and age had significant effect on weight and area of skin and leather. Sex and age had also significant effect on skin thickness. Overall, average weight of skin and leather were  $1023.4 \pm 25.9$  and  $432.6 \pm 13.0$  grams respectively, with a high coefficient of variation (35.2 and 41.3 %, respectively). The skin and leather areas were ranged between 18.5 and 74.3 and 27.9 and 102.2 Sq. dm, respectively. There was a high positive correlation ( $r = 0.8$ ) between weight and area of skin and leather. The hip region had high skin thickness, followed by the back, top shoulder, rib and belly, respectively. Shoulder, hip, ribs regions and parallel and perpendicular cuts had significant effect on breakage force, tensile strength and elongation of leather. The range of breakage force, tensile strength and elongation of the goat leather were 7.4 to 54.3 kgf/cm<sup>2</sup>, 75.4 to 569.7 kgf/cm<sup>2</sup> and 30.9 to 104.2%, respectively. Goat type had significant ( $P < 0.01$ ) effect on skin area, thickness and elongation% of leather. This study indicated quantitative and qualitative differences of hairy and Cashmere goat skin.



M-49

### **Indices for cashmere fleece competitions**

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Over the past 25 years the Australian Cashmere Growers Association has conducted National Fleece Competitions to identify the most valuable fleece in a range of mean fibre diameter (MFD), age and sex classes, and using the industry developed Patrick Index. The Patrick Index corrected cashmere weight for fibre diameter variation. It is likely, but unknown, that fleeces used to develop this index were biased towards more productive animals. We aimed to develop indices to enable the industry to identify biologically superior cashmere fleeces over the range of fleece quality types. We used a sample of 1,244 commercial cashmere fleeces from goats originating from 11 Australian farms based in different environmental zones. Least squares models, relating the logarithm of clean cashmere production (CCMwt, g) to MFD ( $\mu\text{m}$ ) and staple length (SL, cm), were fitted. These models were used to develop new indices for balancing the amount of fleece with the quality of fleece. Mean ( $\pm$  s.d.) production attributes were: CCMwt,  $134 \pm 62$  g, range 21-389 g; MFD,  $16.4 \pm 1.6$   $\mu\text{m}$ ; SL,  $8.7 \pm 2.1$  cm. There was little advantage of adjusting CCMwt of individual goats across farms for MFD because a model that contains MFD alone accounted for only 2% of the variance. A model that included both MFD and SL only accounted for 1% unit more of the variance compared with a model containing SL alone. Thus there was little advantage of adjusting CCMwt of individual goats across farms for MFD in addition to SL. That is, in fleece competition comparisons, where it is not practicable to make an adjustment for farm, there is little relationship between MFD and CCMwt. The increase in Clean Cashmere Staple Length Index with a decline in SL indicates that the index will provide an indirect indicator of desirable skin secondary follicle development.



# **POSTERS**



A-2

### **The birth weight expression is modulated by the breeding season in goats**

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Birth weight (BW) expression is a key phenotypic characteristic affected by placental, maternal, genetic and environmental cues. At the beginning of the embryonic life, although the embryo's nutritional requirements are low because of a low rate in the absolute growth, the rate of the relative growth is quite high. Therefore any dysfunction affecting organogenesis, may compromise fetal growth programming and reproductive outcomes in the adult life; a syndrome known as intrauterine growth retardation. This study evaluated the effect of breeding season (BS) across year [Spring (SP), Summer (SM), Fall (FL) and Winter (WT)] upon the expression of BW. This meta-analysis considered records ( $n = 1,084$ ) collected from a commercial herd kept under intensive conditions ( $22^{\circ}$  NL, 1,835 m). Does received across year a mixed diet composed by alfalfa hay [14% crude protein (CP), 4.7 net energy for maintenance (NEM MJ/kg)], corn silage [8.1% CP, 6.7 NEM MJ/kg] and corn grain [11.2% CP, 9.9 NEM MJ/kg], while mineral salts, fresh water and shades. Diets were balanced to cover 120% of their nutritional requirements according to physiological stage. The definitive statistical model for BW analysis considered the independent variables kidding year, (KY), genetic group (GT), litter size (LS), gender (GN), breeding season (BS), kidding season (KS) plus the interactions (KY\*GT) and (GN\*BS). The overall average for BW was 3.18 kg; both KY and GT affected ( $P < 0.001$ ) BW expression, observing the highest BW in 1995 (3.73 kg) while the lowest (2.72 kg) in 1998. The GT  $\frac{1}{2}$  Boer depicted the largest BW (3.65 kg), while the lowest was observed in the Boer genotype (2.63 kg); the greater the percentage of Boer genes, the lowest BW. Also, the KY\*GT interaction affected ( $P < 0.05$ ) BW. LS affected ( $P < 0.001$ ) BW; while singles had the largest BW (3.44 kg), the lowest occurred in triplets (2.85 kg), without differences ( $P > 0.05$ ) between triplets and quadruplets. Interestingly, while BW expression was not affected ( $P > 0.05$ ) by kidding season, it was affected ( $P < 0.05$ ) by breeding season. The highest and lowest BW values were observed at SP and WN (3.34 vs. 3.10 kg;  $P < 0.05$ ), respectively. Such embryonic-fetal adaptive responses suggest homeostatic adaptations to counteract physiological alterations generated by the doe nutritional status, available quantity and quality of food to both the embryo and the fetus as well as to a changing external environment throughout the year.



A-4

**Changes in blood and milk parameters in lactating Shami goats subjected to intermittent watering**

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Shami goats are an important economic resource in semi-arid regions around the Mediterranean area, largely grown for milk production. An experiment was conducted to assess the effects of an intermittent watering regime on physiological indicators of Shami goats in mid-lactation. Twelve does in mid lactation, were equally distributed to one of two treatments: daily watering and watered once every four days, respectively. The experiment lasted for 32 days under hot conditions (temperature between 14-35°C). Blood and milk samples were taken at the beginning of the experiment and on days 4, 8, 16, 24 and 32 thereafter, coinciding with the days of watering of the restricted group. The animals were weighed at the beginning and the end of the experiment and the daily milk production was also recorded. Several serum parameters were assessed as well as milk composition. The data were analyzed by ANOVA (repeated measures) using the IBM-SPSS Software. The serum concentrations of urea, protein and albumin, as well as osmolality, were increased in intermittently watered animals, denoting a state of mild dehydration. Other blood parameters including PCV, hemoglobin, creatinine, cholesterol, globulin, insulin and cortisol were not affected by the treatment. On the other hand, the does maintained similar weight and milk production in both groups. The differences in milk composition between the two groups were not significant. It was concluded that the Shami goats in mid lactation could tolerate the intermittent watering regime however, the consequences of the treatment under different physiological conditions warrants further research on a larger scale to account for high individual variability.



A-5

### **Evidence of tannin binding salivary protein in goat kids from tropical Mexico**

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The objective was to evaluate if goat kids fed with tannin rich (TR) fodders would express tannin-binding salivary proteins (TBSPs) and to measure the persistence of this response. Eighteen male and females Criollo kids ( $13 \pm 2$  kg live weight LW) without previous contact with TR fodders were allocated into three groups ( $n = 6$  each): control group (CG), treatment 1 (T1) and treatment 2 (T2). The experimental period was divided in three periods: in the first period all the groups were fed 300 g of *Pennisetum purpureum* grass fresh basis (FB) and 400 g FB of concentrate. During the second period T1 and T2 were offered 330 g FB of TR foliage *Lysiloma latisiliquum* with 55.5 g/kg DM of condensed tannins (CT), and CG was offered 500 g FB of *P. purpureum* without *L. latisiliquum*. All the groups received 430 g FB of concentrate. In the third period, foliage of *L. latisiliquum* was withdrawn from T1 while T2 continued receiving the *L. latisiliquum* foliage (plus concentrate) to assess persistence of any possible response. The CG and T1 groups received 500 g of *P. purpureum* with the concentrate. In each period two feed samples were collected for chemical analysis. Saliva samples were collected for turbidity (TT) and Lowry (LT) test, to measure the interaction tannins-protein and quantity of salivary protein, respectively. Tannic acid and *L. latisiliquum* extract were used as standards for the TT. During the first period the intake was 61.3 g DM/Kg LW 0.75 in the CG which was higher than T1 (55.7 g DM/Kg LW 0.75) and T2 (56.6 g DM/Kg LW 0.75) ( $P < 0.018$ ). During the second period intake in the CG was lower than that in T1 and T2 (60.9, 65.1 and 66.7 g DM/Kg LW0.75 respectively) ( $P < 0.040$ ). During the third period T1 intake was higher than CG and both were higher than T2 (75.8 vs. 65.3 vs. 58.7 g DM/Kg LW0.75) ( $P < 0.0001$ ). The quantity of protein was similar in all periods, first ( $P > 0.16$ ), second ( $P > 0.99$ ) and third ( $P > 0.10$ ). The salivary protein from all the groups reacted similarly with tannins as no difference was found between treatments for the TT. This suggests that goats from the Yucatan express TBSP without the need of previous experience of tannin consumption or any tannin intake stimulus. Possibly this effect is due to the long adaptation to the intake of tannins contained in the local browse vegetation. We conclude that Yucatan Criollo goats do not need oral stimulation with TR sources to produce TBSP. Hence, this may explain why these goats have acceptable shrub intake.



A-7

### **Study of social behaviour of young bucks reared together**

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Young bucks separate themselves from the flock after puberty forming small subgroups, this may be due to a decrease in gregariousness. In this work, changes in gregariousness and plasma cortisol levels of 20 males, about 18 months old, were assessed. Males were subjected to a standard test of social separation: each buck was put alone into a squared (4 m<sup>2</sup>) pen (1) surrounded by conspecifics during 5 min, (2) without conspecifics during 5 min and (3) with conspecifics during 5 min again. A series of typical distress behaviors such as vocalizations, displacements, jumps, smelling objects or partners were recorded by two observers; then indexes of agitation were made. To measure cortisol levels, blood samples were taken every 10 min one hour before and one hour after the test of separation. Indexes of agitation of treatments with conspecifics were different ( $P < 0.001$ ) from that without conspecifics ( $-0.9 \pm 4.7$  and  $-1.3 \pm 6.2$  vs.  $1.8 \pm 9.1$ , Medians  $\pm$  rank). Cortisol levels increased from the initial sampling until 40 min later ( $0.7 \pm 0.2$  vs.  $1.3 \pm 0.2$  pg,  $P < 0.002$ ), this was attributed to effect of sampling, but decreased 20 min later ( $0.9 \pm 0.2$ ,  $P < 0.008$ ) because males became probably accustomed. Cortisol levels increased after one hour of the test of separation reaching a peak 20 min later ( $1.4 \pm 0.2$  pg,  $P < 0.008$ ), then decreased significantly ( $1.1 \pm 0.2$  pg,  $P < 0.003$ ). Social separation in goat males caused an increase in both index of agitation and plasma cortisol levels.



A-8

**Maternal experience does not affect the change in gregariousness of parturient goats**

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A decreased in gregariousness is part of maternal behavior of goats; however, it is not clear whether maternal experience influences that change. The objective of this work was to measure changes in gregariousness around parturition by means of a standard test of social separation. Thirty six goats (12 pregnant multiparous, 12 pregnant primiparous and 12 non-pregnant) were tested as follows: each female was put alone into a squared (4 m<sup>2</sup>) pen (1) surrounded by conspecifics during 5 min and (2) without conspecifics during 5 min, at the end of these periods the pen door was open to allow the goat to get out. Typical distress behaviors such as vocalizations, displacements, jumps, eliminations and latency to left the pen were recorded by two observers; then, indexes of agitation were made and compared by Kruskal-Wallis ANOVA. The index of agitation without conspecifics of non-pregnant goats was different from those of parturient goats both multiparous and primiparous (3.2 vs. -2.1 and -2.1, respectively.  $P < 0.003$ ). In contrast, the index of agitation with conspecifics was no different between non-pregnant and parturient goats ( $P > 0.05$ ). On the other hand, latency to left the pen of non-pregnant females was different from those of parturient females both multiparous and primiparous ( $2.1 \pm 1.2$  vs.  $35.9 \pm 28.1$  and  $54.7 \pm 16.7$  sec, respectively.  $P < 0.001$ ). In conclusion, goats around parturition are less sensitive to social separation and maternal experience does not affect the decreased of gregariousness.



A-10

### **Geometric morphometric study in a goat pure breed**

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The aim of this study is to assess which bony skull parts are related to the shape variation in goat skull, since this species presents a high degree of variability in head morphology. A sample of 24 skulls belonging to adult “White Rasquera” goats (all teeth erupted) stored at a private collection of one of the authors (JS) was analysed using 2D geometric morphometric procedures. The dorsal view of each skull was photographed using a standard procedure through a digital camera Nikkor 28-80 mm® telephoto lens. Pieces were photographed once. Fifteen landmarks were collected. These landmarks represented the approximate topology of the skull. Three replicas were performed independently by each author. Error of measurements was also evaluated with an Intraclass Correlation Test showing an excellent replicability ( $c = 0.9992$  and  $0.9987$  for X and Y coordinates respectively,  $P < 0.0001$ ). Size was estimated after a Procrustes superimposition using the Thin Plate Spline method. Between-sample shape differences were visualized by superimposing landmarks of consensus specimens. The figure shows the landmark deviation from the type sample. Direction of landmarks deviations do not differ in the samples, e.g. intrasample variation does not involve different landmarks. Relative contribution of landmarks 6, 7, 13 and 14 are higher so the difference in shape is centred at the maxillary area. As all animals were adults, the variation of this morphogenetic unit must be also seen as not related to an ontogenic change. This general trend of shape changes indicates that animals differ for relative lengthening of the viscerocranium rather than for their relative width. The inclusion of this easily done type of study in a breed description might provide more information on morphological and functional characteristics of an animal population.





A-11

**Skull morphostructure of the Dwarf Gwembe goat**

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The aim of this study was to investigate the variance structure and provide an objective description of the skull shape (conformation) of this unknown breed. A multiple discriminating analysis (PCA) has been used because it decreases the risk that the lack of significant results might be due to the use of less sensitive methods and it reveals the multivariate structure of variation in a more detailed and more accurate manner. Skull measurements were made by the same researcher so no adjustments were necessary. Forty-three measurements common to the zooarchaeology database were taken on 30 new collected Dwarf Goat skulls within the Southern Zambia. Only those animals considered pure breed and of apparent good health were considered for this study. General variability within measurements was generally low ( $8.33 \pm 5.1\%$ ). Five Principal Components with eigenvalues greater than one were isolated. PC 1 with component loadings between -0.095 and 0.637 accounted for 70.6% of the total variation and gave emphasis to variables 1 (total length of the skull) and 2 (condyle-basal length), 40 (horn core basal circumference), 43 (latero-medial diameter of the horn core base) and 44 (distance between the horn tips without the horn sheath). The PC 2 accounted for a total of 20.9% of the total variation in the data and gave emphasis to same variables 1, 2 and 40. Little information is neglected if only the first two PC are considered. So broadly speaking, skull variation in Dwarf Goat is centred on total length (condyle-basal length is redundant with total length, bringing little additional information) and horn conformation and not of size variation. Skull measurements can describe more completely individuals or populations than do the conventional methods of "in vivo" head study. Moreover, alternative non-conventional indices can also provide extra information to indicate functional traits and relationships between breeds. With more samples, another research field would be to see if ecotypes occur across all breed distribution area.



A-12

### Effects of gender and nutritional restriction on weight of organs Saanen kid goats

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The objective of this study was to evaluate the effect of nutritional restriction (0, 25 and 50% of feed restriction) and gender (17 intact males, 14 females and 15 castrated males) on weight of organs of 46 Saanen goat kids ( $4.93 \pm 0.1$  of initial body weight, BW, mean + SD). The animals were individually fed goat milk until 50 days of age and total diet during the entire trial (from February 2008 to June 2009). Diet was balanced to satisfy nutritional requirements of growing animals for an approximate growth rate 150 g/day. Total diet consisted of corn hay (corn plant harvested at grain milk stage) and concentrate (corn, molasses, soybean meal and minerals) at a 50:50 ratio (DM basis). The daily amount of feed supplied to kids submitted to moderate (25%) and severe restriction (50%) was calculated as proportion of the amount consumed by unrestricted animals, which received feed ad libitum (0% restriction). When the unrestricted animals reached 15 kg of BW, all experimental animals, including those under moderate and severe restriction, were slaughtered. After slaughter and evisceration, the weights of thyroid, spleen, liver, pancreas, kidneys, lungs and diaphragm were recorded and expressed as g/kg of empty body weight (EBW). The experiment was performed in a completely randomized factorial design in  $3 \times 3$  (three genders and three levels of feed restriction). No interactions between feed restriction and gender were observed. Nutritional level and gender did not influence ( $P > 0.05$ ) diaphragm (5.57 g/kg EBW), lungs (18.64 g/kg EBW), kidneys (5.35 g/kg EBW) and spleen (2.25 g/kg EBW). The weights of pancreas, thyroid and liver were influenced ( $P < 0.05$ ) only by gender. Thyroid weight was higher in females (2.70 g/kg EBW) than in castrated (2.17 g/kg EBW) and intact (2.05 g/kg EBW) males. Pancreas weight was the highest in females (2.63 g/kg EBW), the lowest in intact males (2.11 g/kg EBW), and intermediate in castrated males (2.37 g/kg EBW), which did not differ from the other two treatments. Liver weight was the highest in females (28.77 g/kg EBW), the lowest in castrated males (24.65 g/kg EBW), and intermediate in intact males (26.14 g/kg EBW), which did not differ from the other two genders. In conclusion, differences in the weight of organs, especially thyroid, liver and pancreas, among genders suggests that the precocity of females, with all hormonal and metabolic changes involved, is already evident at this early stage of growth.



A-13

### **Lactation days effect on the somatic cell count variation in primiparous and multiparous goats**

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The official dairy tests (ODT) provide parameters to evaluate individual goats as well as the herd as a whole. This work analyzes the relationship between somatic cell count (SCC) and lactation days (defined as the period between the delivery day and the control day). It has been established a distinction between primiparous (PG) and multiparous goats (MG), in order to evaluate the effect of all these factors on the SCC. To this end, 39606 ODT of Florida breed goats (delivered in 2007), registered in ACRIFLOR (Association of Florida Breed Farmers), have been analyzed. It has been calculated a descriptive statistics for each delivery group (PG or MG) and the lactation period (P1: from delivery to 60 days, P2: 61 to 120, P3: 121 to 180, P4: 181 to 240, P5:  $\geq 241$  days); besides, data have been compared with the ANOVA and SNK test using the SPSS ® 15.0 software. The lowest SCC mean was found in primiparous compared to multiparous goats ( $1223.12 \times 10^3 \pm 15.46 \times 10^3$  vs.  $1612.39 \times 10^3 \pm 10.90 \times 10^3$  CS/ml,  $P < 0.001$ ). For the whole population (PG and MG), the lowest and highest SCC means were recorded, respectively, in P1 and P5 ( $990.32 \pm 15.78 \times 10^3$  and  $2162.27 \pm 28.51 \times 10^3$  SC/ml,  $P < 0.001$ ). In PG, the SCC increases as lactation advances (P1:  $815.58a \times 10^3$ , P2:  $1079.39b \times 10^3$ , P3:  $1136.13b \times 10^3$ , P4:  $1464.76c \times 10^3$  and P5:  $1955.62d \times 10^3$  SC/ml, where different superscripts indicate significant differences,  $P < 0.001$ ). Higher differences in SCC means between periods are recorded in MG (P1:  $1083.86a \times 10^3$ , P2:  $1508.78b \times 10^3$ , P3:  $1631.42c \times 10^3$ , P4:  $1764.21d \times 10^3$  and P5:  $2256.01d \times 10^3$  SC/ml, where different superscripts indicate significant differences,  $P < 0.001$ ). The analysis of Pearson bivariate correlations between lactation days and SCC shows a correlation of 0.199 for the whole population ( $P < 0.01$ ); the value being similar for PG and MG (0.209 vs. 0.192). In conclusion, as lactation days run, the SCC increase; this increase being even greater in multiparous than in primiparous goats. Both facts should be taken into account when assessing this ODT parameter at individual level.



A-17

### **Effect of Automatic Cluster Removers in the milking of Murciano-Granadina goats**

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The aim was to know the effect of an Automatic Cluster Remover (ACR) in Murciano-Granadina goat milking. Two experiments were developed to test the milking efficiency using Lactoflow® system (Gea Farm Technologies, Germany) equipped in a low-line milking parlour (Gea Farm Technologies, Germany), one at early lactation (P1) and other at late lactation (P2). Every experiment consisted on 4 sub-experiments (latine square) where 1 removing flow rate (RF: 250, 200, 150, and 100 g/min) at 3 delay times (DT: 10, 15 and 20 sec.) were tested on 3 similar groups of 28 goats (UMH farm). Goats were milked 2 days with every RF x DT (sampling the second day) and 40 kPa, 90 puls/min and 60% of pulsation ratio. The relation of machine milk yield (MMY, kg, recorded with Lactocorder®, Switzerland), post-milking striping yield (SY, g), residual yield (RY, g), with the experiment (RF) and DT was studied with a linear mixed model (Proc. Glimmix, SAS V 9.2., 2002) that included the fixed effects of RF, DT nested to RF, and day nested to RF. The random effect considered was the goat. Additionally, the frequency of cluster fall offs (CFO) and frequency of clusters double attachment (CDA: the milking operator reattaches the cluster after ACR activation because the udder is not stripped enough) at every ACR setting (RF x DT) was studied with a Chi-square analysis (Proc. Freq., SAS V 9.2., 2002). The milking duration (min, MT) among ACR settings and CDA was studied using a similar linear mixed model mentioned above, including the fixed effect of CDA (2 levels: yes or not) and the interaction of CDA with RF. MMY and RY did not showed significant differences among the studied settings. SY was statistically smaller when FC was 100 g/min. The frequency of CSO and CDA was not significant due to the low number of observations recorded, but registering a highest not significant CDA frequency at 250g/min of RF (n = 20) and lowest at 100 g/min (n = 12). MT was higher at both experiments if CDA occurred (differences of 1.12 min at P1 and 0.40 min at P2). MT differences between the RF with the highest level of CDA (250 g/min) and the RF with lowest CDA (100 g/min) were 0.43 min and 0.34 min at P1 and at P2, respectively. We concluded the study of the settings with smallest values of SY and CDA (RF = 100 g/min and RF = 150 g/min with a DT = 10 s) during a lactation is needed to know the best settings in a long term experiment and its effect on mammary gland sanitary status. Supported by project AGL 2009-10695.



A-19

**Mechanical milking efficiency under automatic stimulation previous to milking of Murciano-Granadina goats milked with low pipeline**

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The aim of the work was to study the effect of automatic stimulation previous to milking (T0: no stimulation vs. T1: 300 pulsations/min during 20 sec) on the mechanical milking efficiency of Murciano-Granadina goats. Two experiments were carried out (one at early lactation: 44 goats and other at late lactation: 42 goats) with a latine square design where animals were divided in 2 similar groups. The experiments were divided in two halves of 4 days and each group of goats was milked during every half using a different treatment (T0 and T1) in a low pipeline milking machine (Gea Farm Technologies, Germany). Variables were recorded at days 4 and 8 (the last day of every treatment). Milking parameters were 40 kPa, 90 pulsations/min and 60% of pulsation ratio. Variables regarding to milking efficiency recorded were performed using Lactocorder® (Switzerland) devices: milk machine (MM, kg); hand stripping (HS, g); residual milk (RS, g), machine milk time (MMT: time since cluster attachment to cluster removing, min), maximum milk flow (MMF, kg/min) and average milk flow (AMF, kg/min). Recorded variables and their relation to stimulation were performed with a linear mixed model (Proc. Mixed, SAS, V.9.2., 2002) considering the fixed effects of day (2 levels: 4, 8) and treatment (2 levels: T0, T1). Random factor was the animal. The interaction of treatment with day was not significant and was not considered in the final model. Stimulation was not significant ( $P < 0.05$ ) at any experiment neither variable. MM, MMF and AMF at early lactation were (T0 vs. T1): 2.25 vs. 2.20 kg; 1.036 vs. 0.99 kg/min; 0.75 vs. 0.70 kg/min, without significant differences ( $P < 0.05$ ) and slightly higher at T0 level. At late lactation, MM, MMF and AMF were (T0 vs. T1): 1.24 vs. 1.22 kg, 0.83 vs. 0.87 kg/min, 0.56 vs. 0.57 kg/min, respectively, without significant differences ( $P < 0.05$ ). LR at early lactation didn't showed significant differences (127 vs. 123g, T1 and T0 respectively;  $P = 0.7267$ ), but a higher LR was observed for T0 compared to T1 at late lactation (125 vs. 100 g,  $P=0.06$ ). It was concluded automatic stimulation of 300 pulsations/min during 20 sec not improves significantly the milking efficiency of Murciano-Granadina goats milked with low line milking machine, although a complete lactation experiment should be carried out in order to test if the higher LR resulted can affect the milk secretion of the mammary gland. The study was supported by project AGL- 2006-06909 (Spain).



A-20

**Differences in body core and shell temperature patterns between Black Bedouin, Damascus and crossbred goat kids in late winter**

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We have previously demonstrated the superiority of the Black Bedouin goats in terms of thermo-tolerance to both cold and heat stress, discretely, over the Damascus breed. The latter breed is generally favored over the former due to its better productive performance in terms of meat and milk yields. Local farmers often mistakenly assume - without following proper breeding programs - that cross-breeding would simply result in a hybrid possessing advantages of both sides. To date, there is no data available yet to postulate potential variability in the level of thermal adaptation (heat and cold) or body temperature patterns of the F1 hybrid from the two original breeds. We therefore carried out a winter experiment using male weanling goat kids ( $n = 7$ ) from the three breed lines, and implanted each animal with intra-peritoneal and subcutaneous thermal loggers, to study the body temperature patterns. Despite there were no differences in average daily core ( $T_{core}$ ) or peripheral ( $T_{sq}$ ) temperatures *per se*, or in their diurnal thermal rhythms, hybrid kids displayed stagnated and less labile daily variations (peak-nadir) in both body temperatures. Furthermore, a distinct demarcation in the average daily range of the core-to-peripheral thermal gradient ( $T_{core}-T_{sq}$ ) was detected among breeds, such that the hybrid line had significantly lower range ( $2.69^{\circ}\text{C} \pm 0.03$ ) than the Black Bedouin ( $4.22^{\circ}\text{C}$ ) or Damascus goats ( $3.89^{\circ}\text{C}$ ). These results may indicate hindrance in the thermal-lability of the hybrid line, potentially making it more prone to cold stress. More research is needed to elucidate the thermoregulatory abilities of the Black Bedouin x Damascus hybrid under more pronounced thermally-stressful conditions (i.e., heat stress), alongside the assessment of its meat and milk productivity, and to further investigate underlying predisposing genetic factors governing these responses to better establish successful breeding programs.





A-21

**Deformation and overgrowth of the hooves, is it a problem in intensive dairy goat farms?**

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One of the major consequences of intensive goat production is the lack of claw wear, often leading to claw deformation and overgrowth. Little is known about the prevalence of these two problems and the influence they have on lameness incidence. Our study was performed in an intensive dairy farm with 2000 goats (Alpine and Saanen) in milking. Lameness of thirty six randomly selected adult goats was scored (0 = not lame to 3 = severely lame) and the length, width of each claw along with the deformation of each hoof was measured. The anterior claws are wider than the posterior ones ( $P < 0.001$ ) and the medial claw (33.1 mm) is wider than the lateral one (23.4 mm) in the hind limb ( $P < 0.001$ ). The average length of the posterior claws is larger (80.1 mm) when compared with the anterior ones (77.1 mm) ( $P = 0.027$ ) and the medial claws are longer than the lateral ones (76.9 mm and 80.2 mm respectively) ( $P = 0.018$ ). A significant difference ( $P = 0.029$ ) in the prevalence of claw deformation was shown between anterior and posterior claws (32% and 50% of claws assessed, respectively). A relationship between lameness and deformation was also shown with all animals with three hooves deformed being considered lame. However, we found that 33% of animals with no claw changes had some degree of lameness. There were no significant differences between breeds. These results show that anterior claws probably suffer more wear possibly because of the climbing behaviour of the goats. This may indicate that the hind hooves could be a good indicator to evaluate claw overgrowth in a farm if the evaluation was done in the milking parlour. The length of the posterior claws also show some correlation with a higher prevalence of deformation. These preliminary results show a tendency for lameness in the animals with deformed hooves.





A-23

### **Identifying promising animal-based welfare indicators in intensively bred dairy goats**

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The AWIN project goal is to address the development, integration and dissemination of animal-based welfare indicators in different species, including goats. Considering the main productive systems around Europe, our first efforts focused on intensively bred adult dairy goats. We revised 40 scientific papers and drafted an initial list of relevant indicators, for each welfare criteria (good feeding, housing, health and behavior). From this list, the most promising animal-based indicators for on-farm welfare assessment were selected and the actions required to test their validity, feasibility, inter- and intra-observer reliability were identified. Some indicators can be collected in the home pen, but we hypothesised that some others may be collected during milking; a sampling strategy should be defined in order to gather the representation of the whole farm situation. Body condition score, panting score, kneeling, lesions/swellings, claw overgrowth, lameness, discharges, diarrhoea, abscesses, agonistic behaviour and abnormal oral behaviour have not been tested for their feasibility and reliability. Some of these indicators require to define/refine a scale and to develop a description and classification method with photographic illustrations as guideline. Lying behaviour, teats/udder abnormality, mastitis, isolated animals, snorting (sound alert) and qualitative behavioural assessment need to be better defined and fully tested. Preliminary results pointed out some doubts to include cleanliness as a reliable indicator, since goats are usually clean, but animals with wet hair need to be tested as an indicator of comfort around resting. Although shivering goats during cold season seem to be uncommon, we found some goats (probably weak animals) showing this behavior. This indicator needs further investigation. Many studies confirm the effectiveness of avoidance distance test to detect a good human-animal relationship, but we found many problems performing this test on goats. We are working to develop a valid test to show this relationship in every husbandry situation. During preliminary observations and sharing information with farmers, we found out new promising indicators that need to be completely investigated: animals with “bad hair”, probably weak animals with nutritional problems or parasitosis; waiting animals behind feeding goats, probably related to a lack of places at the feeding rack or fear of dominant animals.



A-24

**Comparison of body weight between males and females of Saanen breed, from birth to weaning**

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To evaluate the difference in weight gain between females and males from birth until weaning for two years, we used 54 Saanen goats (in 2010: 18 males and 14 females; in 2011: 9 males and 13 females). The experiment was conducted at the Goat and Sheep Sector of the Animal Science Department of Universidade Federal Rural de Pernambuco, UFRPE, in Recife, Brazil. After birth, the babies received the first aid care like the cutting the umbilical cord, birth weight and identification, moreover they stayed with their mothers until the third day of age. On the fourth day of age began the artificial suckling, where the goat milk was provided to babies twice day by bottle feeding, the amount offered was 20% of their live weight until 42 days of age. After reaching that age, they started to receive 1.5 L/animal/day until weaning at 60 day. In the second week of life were dehorned and have received a diet with increasing amounts until the consumption of 300g per day based on Tifton hay with 8% crude protein and a concentrate based on ground corn, soybean meal and wheat bran with 18% content of crude protein. The dehorning was done with a hot iron, but did not affect the performance of animals who were weighted weekly in the morning to evaluate the live weight and weight gain from birth to weaning. The data on weight and weight gain were calculated by analysis of variance in EXCEL. The birth weight average observed in 2010 was  $3.84 \pm 0.51$  kg, for males, and  $2.99 \pm 0.48$  kg, for females, respectively. The weaning weight average was  $13.89 \pm 1.71$  kg for males and  $12.81 \pm 0.84$  kg for females. The total weight gain from weaning to birth was  $10.54 \pm 0.93$  kg and  $9.82 \pm 0.89$  kg for males and females respectively. In 2011, the birth weight average was  $2.60 \pm 0.51$  kg for males and  $2.25 \pm 0.65$  kg for females. The weaning weight average was  $12.11 \pm 1.71$  kg and  $11.19 \pm 1.84$  kg for males and females, respectively. The total weight gain from birth to weaning was  $9.51 \pm 1.61$  kg and  $8.94 \pm 3.23$  kg for males and females. Significant differences in birth weight and weaning between males and females were observed. Males were heavier, proving that there is influence of gender on weight gain even in animals of the same breed.



A-29

### **Arterial blood pressure and heart rate in dairy goats**

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Heart rate and arterial blood pressure change in relation to reproductive state, time of day, movement, management routines, and other environmental factors. Heart rate is easy to measure and has been widely used to evaluate stress and wellbeing in animals. Blood pressure has been more difficult to measure, but it was made possible with implanted radio-telemetry devices some years ago. In short, under full anaesthesia, a transmitter body is placed subcutaneously on the neck. It is connected to a catheter, which is inserted into the carotid artery. Blood pressure and heart rate signals are transmitted to a receiver placed centrally above the goat's cage and data can be stored for later analysis. The animals can move freely in the cage. Using radio-telemetry, interaction between blood pressure and heart rate has been studied in Swedish domestic dairy goats in a series of experiments since late 1990ies. Reproductive state influences both parameters. Heart rate increases during the 4th month of pregnancy and reaches the highest levels at the end of pregnancy. Blood pressure does not change during pregnancy, lactation or anestrus, but increases by about 40 mmHg at parturition. Heart rate prevails at a high level during parturition, but then declines. Blood pressure and heart rate are higher when goats stand up than lie down. Movement increases heart rate and also blood pressure if something interesting or potentially dangerous appears. Thus, both heart rate and blood pressure increase if a hungry goat sees food or a thirsty goat sees water. The effects may partly be a sign of alertness, movement to reach the food or water, or an effect of food intake. Omitting food from goats results in decreasing heart rate. During hand milking both heart rate and blood pressure increase. When goats are accompanied by kids, they appear more restless and both blood pressure and heart rate fluctuate. Suckling is quick and there are no clear changes in blood pressure or heart rate. When goats were exposed to a dog during pregnancy, they moved around in the cages and climbed on the walls and both heart rate and blood pressure increased. During lactation the goats stood still and watched the dog intensively and then only blood pressure increased. In conclusion, registration of blood pressure simultaneously with heart rate is helpful in understanding reactions of the dairy goat. Reproductive period and behavior of the animal have to be taken into account when evaluating the data.



A-30

**Assessment of cortisol and thyroid hormones (T3 and T4) in mature and young dairy and meat goats**

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Management practices are generally not the same when it comes to the different types of goats (meat and dairy). Dairy breeds are usually handled more often than meat type animals. The stress associated with these management practices as well as age can influence the level of circulating hormones in these animals. This experiment was undertaken to assess the level of cortisol, thyroxine (T4) and triiodothyronine (T3) in mature (2 years old) lactating dairy (n = 10) meat (n = 10) goats and 2 weeks old dairy (n = 10) meat (n = 10) goats kids. Samples (5 ml each) were collected at 08:00 h on two different dates by jugular venipuncture into vacutainers containing K2EDTA. Plasma was harvested and assayed for cortisol, T3 and T4 using a Coat-A-Count (Diagnostic Product Corporation, Los Angeles, CA, USA) RIA commercial kits. Data were analyzed as a repeated measure analysis using SAS. Cortisol concentrations were lower in the dairy compared to the meat goats. Within breed, younger animals had lower ( $P \leq 0.05$ ) cortisol than older animals. Triiodothyronine levels were higher ( $P \leq 0.05$ ) in dairy animals than in meat type goats and within breed, mature goats had higher T3 compared ( $P \leq 0.05$ ) to kids. Mature meat goats had higher ( $P \leq 0.05$ ) T4 than meat goat kids and the dairy animals regardless of their age. These results suggest that level of circulating hormones may be due to breed differences or management type associated to breeds.



A-32

### **Histological mammary gland evaluation: comparison of three methods**

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9 goats, at mid in their third lactation, were used to histological mammary gland evaluation. The evaluation was done using three methods at different magnifications (20x, 5x and 40x, for method 1, 2 and 3, respectively) to determinate the histological components proportion (secretory, ductal, vascular and connective tissues). Two samples were randomly taken from each half udder, processed by hematoxylin-eosin staining and photographed for subsequent evaluation. All measurements were made by a digital image analysis program (Image-Pro Plus Version 4.5). The areas occupied by the secretory tissue, vascular tissue, ductal tissue and total tissue surface were determined for each image and for each method. The area occupied by connective tissue was calculated as the difference between the total area and other tissue surfaces. The results were expressed as total tissue percentages. An ANOVA procedure was performed using SAS, version 9.00. In method 1, the secretory tissue presented differences with the other two methods, probably because different percentage of connective tissues found for this method. Following this line of argument, differences between connective tissue percentages were detected in the three methods. However method 1 showed a higher connective tissue percentage, because at 20x magnifications it was possible to classify the interstitial tissue between the alveoli and the intra- and interlobular tissue. On the contrary, using method 2 it was only possible to detect the connective tissue placed in the intra- and interlobular space. In reference to the last method, the only connective tissue detected was the interstitial tissue between alveoli. Methods 2 and 3 take similar values of secretory and connective tissue percentages, although selection criteria were different. Vascular tissue percentage was similar in methods 1 and 2. Ductal tissue percentage was highly variable between samples, no detecting differences between methods 1 and 3 when this parameter was measured. In conclusion, method 1 take better values of connective tissue percentages because taking into account both intra-, interlobular and interstitial connective tissues; finding represented all four tissue types (secretory, connective, vascular and ductal tissues). And it is the recommendable method for the evaluation of the mammary gland development.



A-33

**Evolution of milk and blood immune parameters in goats and sheep during late pregnancy, partum and preweaning lactation period**

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It has been described that first hours of life is a critical period for goat kids and lambs in order to acquire passive immunity, nevertheless it also important to evaluate the evolution of blood immune parameters in pregnant and lactating goats and sheep, because prepartum, partum and preweaning lactation period can be considered as an important stressor that can not only negatively affect the dam, but also the litter. The aim of this study was to evaluate the evolution of blood parameters during late pregnancy, partum and preweaning lactation period (IgG and IgM concentration, Chitotriosidase activity and complement system activity) and the evolution of milk parameters during partum and preweaning lactation period (IgG and IgM concentration and Chitotriosidase activity) in goats and sheep. For this study, 12 goats and 12 sheep were used. Blood samples of each animal were taken at 7 and 15 days before partum, at partum and 5, 10, 20, 30 and 40 days after partum. Milk samples of each animal were taken at partum and 1, 2, 3, 4, 5, 10, 20, 30 and 40 days after partum. To determine IgG and IgM concentration a commercial ELISA kit was used. Chitotriosidase activity (ChT) was measured using a fluorescence assay and the complement system activity (total and alternative) was measured according to the hemolysis rate. Blood and milk IgG concentration showed no differences between goats and sheep during the studied period. However, both species presented a trend to decrease blood IgG concentration close to partum, increasing 5 days after it, probably because the highest milk IgG concentration was measured at partum in both species. IgM concentration was higher in sheep than in goats during the studied period in blood samples and from partum to day 3 after partum in milk samples. Chitotriosidase activity was higher in goats than in sheep, obtaining the highest activity at 40 days after partum in blood samples and at partum in case of milk samples. Blood complement system activity (total and alternative) was similar between species, increasing the alternative complement way 40 days after partum in goats. In conclusion, both species presented an important decrease of blood IgG concentration at partum, being more susceptible to infectious agents in this period. However, goats had a higher ChT than sheep not only in blood but also in milk, that confers a clear advantage against parasitic and fungi infections.



A-36

### **Adaptative and hematologic parameters of Canarian goats under winter conditions**

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Adaptation to their own environment is one of the principal advantages to develop genetic resources conservation programs. Adaptive responses can be measured by physiological parameters related to thermoregulation and other homeostatic traits. With this aim, a work was conducted to evaluate the behaviour of Canarian Goats blood parameters under winter conditions at Tenerife, Canary Islands, Spain. To investigate thermoregulatory responses effects under hematologic traits, were controlled, twice a day, rectal temperature, respiratory rate and skin surface temperature, for three days in 31 Majorera (M) and 21 Palmera (P) lactating goats. Blood samples were obtained in tubes contained EDTA and than were made analysis of white blood cells (total and differentiated leukocytes), hematias, hematocrit, hemoglobin and plaquets. In the same days were registered meteorology conditions, like air temperature and humidity, Black Globe Humidity Index (BGHI) and wind speed, in the place occupied by the animals. Multivariate analysis showed that body surface (BSt) and rectal (Rt) temperatures were related, confirming that even in winter conditions the animals can absorb thermal radiation and increase body heat load. However, the animals presented normal means of BSt, (M = 25.79; P = 28.08) and Rt (M = 39.33; P = 39.16), confirming their capacity to maintain homeothermic patterns. Majorera goats showed lower respiratory rate (RR) than Palmera goats, (M = 27.08; P = 32.13). No differences were found in white and red cells, as well as plaquet number between Majorera and Palmera goats, with normal values of Leukocytes, mil/mm<sup>3</sup> (M = 13382.6; P = 13070); Hematias mil/mm<sup>3</sup> (M = 13.343; P = 13.508); Hematocrit, % (M = 23.55; P = 23.12); VCM, fl (M = 16.94; P = 15.33); Hemoglobin, g/dL (M = 9.54; P = 8.00), Platelets/mm<sup>3</sup> (M = 483548; P = 624095). Numerous physiological and immune changes can occur in lactating animals as a result of strain under environmental stress conditions, however, with these findings we concluded that even Majorera and Palmera breeds presented no thermal stress reactions, as well as normal blood hematologic parameters, under Tenerife Island winter conditions.





A-37

**Effect of environment on the hormonal and biochemical responses of goats  
Canindé in the semiarid Brazilian**

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The semiarid region in northeastern Brazil has high temperature, high radiation and low relative humidity and this can cause physiological, biochemical and hormonal ruminants in response to these environmental conditions. The objective of this study was to analyze the variation of biochemical and hormonal parameters of goats Canindé depending on environmental conditions. Were analyzed 20 Canindé goats for a period of ten weeks of collection in the rainy season. We recorded environmental variables such as air temperature (Tar), relative humidity (RH), and globe temperature (Tg), recorded with the rectal temperature (RT) and respiratory rate (RR). In each animal was removed 10ml of blood for determination of biochemical parameters Glucose, Cholesterol, Urea, Total Protein, Albumin, globulin, triglycerides, creatinine, alanine aminotransferase (ALT), aspartate aminotransferase (AST) and the hormone triiodothyronine (T3) and thyroxine (T4). The atmosphere was measured using the average and regression analysis. It was observed values means of the Tar the 27.64°C and 40.93°C for Tg. Although exposed to the environment with the highest Tar goats Canindé managed to keep most of the studied parameters within the limits and when it increases the solar radiation measured by Tg, the animals did not significantly change the biochemical parameters, except for the ALT with an average of 195.23 U/L. T3 was significant only among the hormones, with a mean of 1.56 ng/dL. However it can be concluded that race Canindé is well adapted to semiarid Northeast, not to change any biochemical and hormonal parameters even when there is elevation of Tar and Tg.



A-38

**Effect of the environment on thermoregulatory and hematological responses in  
Canindé goats**

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Canindé breed is native from the Northeast of Brazil presenting some quite peculiar adaptive attributes which are considered as important productive components of the region, since the tropical environment may represent a limiting factor for the productive performance. The animals' ability to adapt to a particular environment depends on a number of adjustments in the body that under stressful environmental conditions may cause variations in the physiological and hematological parameters. The aim of this paper was to analyze the physiological and hematological responses of Canindé goats according to the environmental conditions. 20 Canindé goats were analyzed for over ten weeks of collection in the rainy season, in which environmental variables have been registered, such as air temperature (Tar), relative humidity (RH), and globe temperature (Tg), which were recorded with the rectal temperature (Tr) and respiratory rate (RR). Were extracted 5ml of blood from each animal to determine the hematocrit (Ht), leukocytes (Leu), erythrocytes (He) and, also later, the corpuscular volume (MCV) was estimated and dosed hemoglobin (Hb). We observed the effect of regression of air temperature on the physiological and hematological variables. The Tar mean was 29.23°C. Despite the differences in environmental conditions the animals did not significantly alter the Tr (38.37°C) or hematological parameters such as hematocrit (34.36%), erythrocytes ( $16.81 \times 10^6/\text{mm}^3$ ) leukocytes ( $12.83 \times 10^3/\text{mm}^3$ ) and hemoglobin (11.81 g/dL). It is possible to see that even being exposed to higher Tar environment Canindé goats can keep their Tr within the physiological limit, also did not alter any hematologic parameter as Ht, and Leu and red blood cell number and even Hb concentration, with variation only in respiratory rate, which represents an immediate animal response to adverse environmental conditions. However, it can be concluded that Canindé breed is well adapted to northeastern semi-arid, since it does not change any physiological and hematological parameter even when there is Tar elevation and the Fr is the mechanism used for these animals to maintain homeothermy.



A-41

**Effects of oxytocin administration using at different doses on milk partitioning**

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To investigate the effects of different doses of oxytocin on milk partitioning, 10 Canarian goats in second parity were divided into five groups of 2 animals each, according to milk yield. During a 6 week period, the goats were milked once daily (0800) except during one day a week when they were milked four times (0800, 1200, 1600, and 2000) and recording the milk obtained. On this day, after each milking, the animals were injected intravenously with a dose of oxytocin according to the experimental group, and the residual milk was measured. Group 1 was used as a control and was injected intravenously with 5 ml of saline solution, and the groups 2, 3, 4 and 5 were administered with 0.5, 1, 2 and 4 IU of oxytocin, diluted in 5 ml of saline solution, 1 min before machine attachment. Milk samples (total machine and residual fractions) were analyzed immediately after collection, to determine milk composition, using a DMA2001 Milk Analyzer (Miris Inc., Uppsala, Sweeden). An ANOVA (with repeated measures) procedure from SPSS was used for statistical analysis. Percentages of total machine and residual milk were unaffected in the 1200, 1600 and 2000 intervals, due to applied treatments ( $P > 0.05$ ). Total machine milk percentages were higher ( $P < 0.05$ ) in the control group ( $> 80\%$ ) than the oxytocin groups (ranging from 40.21% to 61.69%) at 1200, 1600 and 2000. Fat, protein and lactose percentages of total machine and residual milk did not differ between treatments at 1200, 1600 and 2000 ( $P > 0.05$ ). Fat percentages in residual milk did show a significant decrease between 1200 and 2000 for the studied groups. The apparent decrease in fat content could be due to cortisol released in response to stress caused by the experiment, preventing lipid formation from glucose and acetate. In conclusion, the results showed that differing injected doses of oxytocin did not affect the milk flow rate from alveoli to cistern. This could indicate that the contraction of the myoepithelial cells that surround the mammary alveoli is similar between low and high doses of oxytocin, and depends on accumulation of milk in the alveolar compartment.



A-42

### **Effects of oxytocin-treatment (endogenous and exogenous) on dairy production**

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To determine the effects of oxytocin (endogenous and exogenous) on dairy goat production, 39 Canarian goats were divided into three groups of 13 animals each according to milk yield. All goats were milked once daily (0700). During an 8 week period, group 1 was introduced to the milking parlor once a week, 10 h after morning milking, and all pre-milking routines were carried out, including stripping 2-3 squirts of milk from each teat, but the animals were not milked. During the same period, group 2 was injected intravenously with 2 IU of oxytocin outside the milking parlor once a week, and also 10 h after morning milking, but again the animals were not milked. Group 3 (control) remained in the pen without treatment. The day following applied treatments, milk recording was performed at the morning milking. A milk sample was collected to determine milk composition using a DMA2001 Milk Analyzer (Miris Inc., Uppsala, Sweden). An ANOVA (with repeated measures) procedure from SPSS was used for statistical analysis. Milk yield ranged from 1.92 to 2.15 L/d, from 1.83 to 2.06 L/d, and from 1.84 to 2.15 L/d throughout the experiment with goats of group 1, 2 and 3 respectively. However no differences were found due to endogenous or exogenous oxytocin treatments in any weeks during the experiment ( $P > 0.05$ ). Fat, protein and lactose percentages ranged from 4.34% to 4.86%, from 3.75 to 3.93%, and from 4.86 to 5.17% respectively, in the studied conditions and neither showed significant differences. In conclusion, the results indicate that the administration of synthetically manufactured oxytocin, or the oxytocin release by the stimulatory effect of milking procedures, have no galactopoietic effect in goats not milked immediately. Likewise, it did not produce apparent changes in the milk composition.



A-43

### **Effect of milking interval on concentrations of sodium and potassium in blood plasma and milk**

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The Na and K balance between alveolar and blood compartments is conditioned by tight junction (TJ) integrity. Knowledge about how milking interval affects the permeability of TJ in goats traditionally milked once a day is required. For this reason the objective of this study was to evaluate differences in concentrations of Na and K in blood and milk at different milking intervals. 32 goats (16 primiparous and 16 multiparous) belonging to two dairy breeds (Majorera and Palmera) were divided into two groups, according to breed and parity. Group 1 was milked after 10, 24 and 28 h of milk accumulation, whereas, the Group 2 was milked after 10, 24 and 32 h. Both groups were milked in a double 12-stall parallel milking parlor (Alfa-Laval, Madrid, Spain). Milk and blood samples were taken at each milking. Concentrations of Na and K in milk were determined using atomic absorption spectrometry (AAAnalyst 200 spectrometer, Perkin-Elmer, Norwalk, USA) in the Laboratory of Chemical Analysis of the Instituto Canario de Investigaciones Agrarias (Tenerife, Spain); and the concentrations of these ions in blood were measured by means of ion selective electrodes (Olympus AU2700 analyzer, Beckman Coulter, Tokyo, Japan) in the Laboratory LGS Análisis (Tenerife, Spain). An ANOVA (with repeated measures) procedure from SPSS was used for statistical analysis. Goat breed and parity affected ( $P < 0.05$ ) Na concentration in blood plasma. On average, Majorera showed greater levels (145.53 vs. 144.76 mmol/L) than Palmera goats; and primiparous showed lower values (144.62 vs. 145.66 mmol/L) than multiparous goats. However, K concentration was not affected ( $P > 0.05$ ) by these factors. Furthermore, Na and K were affected by milking interval; a decrease in Na concentration was observed between 10 and 24 h, whereas K concentration had increased at 24 h. In milk, breed and parity factors affected Na and K concentration. On average, Palmera showed greater levels of Na (20.49 vs. 17.39 mmol/L) but lower values of K (34.75 vs. 38.50 mmol/L) than Majorera goats. The primiparous goat had lower levels of both minerals (Na: 15.27 vs. 22.62 mmol/L; K: 35.45 vs 37.80 mmol/L) than multiparous goats. Milking interval did not have significantly effect on Na concentration, whereas, K concentration decreased at 24 h. In conclusion, the results described reflect an alteration in the transport of these ions across TJ due to milking interval, and depends on factors such as breed and parity.



A-45

**Effects of Micro-seaweed DHA supplementation on goat kids immune status**

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A high variety of food products with enhanced n-3 fatty acid content has been developed in recent years. Dietary modifications are based on the fact that the fatty acid composition of the diet is an important determinant of the fatty acid composition of the muscles and adipose tissue in preruminant animals. An experiment was performed using three different feeding groups of animals with different doses of a DHA source (DHA-gold©, Martek Biosciences): control (milk replacer-MR), low dose (MR-LD-DHA) and high dose (MR-HD-DHA). Blood samples were collected from the jugular vein daily from birth until day 10 of life, and after that, every five days until goat kids reached 8 kg of BW. Blood samples were collected in two different tubes: heparinized for plasma samples and a crystal tube to obtain serum. After collection, blood samples were centrifuged and plasma or serum were frozen in aliquots at -20°C until posterior analysis. The immune status of the kids was evaluated by the concentration of plasma IgG and IgM, and Chitotriosidase in plasma and complement system activity in serum. A PROC MIXED procedure factorial ANOVA (analysis of variance with repeated measures) was performed to evaluate the effects with the SAS program package. Values ranged between 0.141-15.540 mg/mL for IgG concentration, 0.080-0.965 mg/mL for IgM concentration, 404.99-3934.72 nM/mL/h for chitotriosidase activity, 50.58% and 24.31% for classical and alternative complement system activities, respectively. No significant differences were found among the different groups in any of the parameters measured on immune status. In conclusion, the extra cost of this DHA addition is not justified to improve the immune status of goat kids.



A-46

### **Self-suckling on goats: teat histological changes**

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One of the most frequent anomalous behaviors, in cows and goats, is called self-suckling whose causes, consequences, just as prevention or limitation have been deeply studied. However, its histological modifications have not been studied. For this reason, the main objective of this study was to evaluate morphological alterations in goat teats associate with self-suckling. Samples were obtained from 36 goat teats (18 animals), that were classified in control group (n = 7) and self-suckling group (n = 29). This study was divided into two basic experiments: the first was based on the measure of the study area (epidermis, connective and mucosa). For this purpose, it was used all the samples from the self-suckling group (29 samples). The second experiment was design in order to describe the Fürstenberg's rosette using the animals that presented a higher self-suckling frequency (6 samples), zero self-suckling frequency (7 samples) and the random control group (7 samples). Transverse and longitudinal sections were obtained from each teat and processed with hematoxylin and eosin staining and immunohistochemistry techniques, in order to study the different histological areas (epidermis, connective and mucosa). The results showed a positive correlation between the epidermis percentage and self-suckling frequency but it was not observed when the mucosa was correlated with this anomalous behavior. Metaplasia changes in the Fürstenberg's rosette were showed in subjects with a high suction rate; 66% of them had an increased cellular activity at the same tissue. In conclusion, the histological changes reinforce the theory that self-suckling behavior must be prevented in order to avoid milk losses by galactophagy and undesirable changes in teats.





A-47

### **Histological study of the goat teat**

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The tissues that form the teat directly affect the yield of the mammary gland. Its structure determines the dairy and milking method. In goat unlike cow and sheep, there are not studies that focus on this structure. Therefore, it is important to know the histological structure that comprises. This preliminary study aims to describe the goat teat and discuss the possible differences that exist with the bovine and ovine teats. 36 teats from dairy goats were collected and fixed in formalin. Samples were cut in transversal and longitudinal sections and stained with hematoxylin and eosin and immunohistochemistry techniques. Macroscopically, we observed a lot of teat sizes, not only in width, but also in height that showed a teat morphological variety. It could associate with the low breed selection pressure. Histological results showed a 75% of goats presented sebaceous glands, however this structure is not usually observed in cows. Sweat glands were observed in 89% of the samples. The blood vessels represented 2.4% of total tissue. The Fürstenberg's Rosette, a slightly projecting fold, is clearly noteworthy where a high percentage of the samples showed nodular subepithelial lymphoid proliferations. In conclusion, the histological structure of the goat teat presents great similarity to the cow although some differences have been found. The presence of lymphoid proliferations can help the immune response against pathogens.



A-48

**Morphological comparison between two south Italian goat breeds and two Canary Islands goat breeds**

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The aim of this study was to compare four goat breeds: two from Canary Islands (81 Majorera and 61 Tinerfeña goats) and two breeds from Calabrian region of Italy (98 Aspromonte and 98 Rustica goats). In this study eleven morphological measurements were recorded, zoometric indexes were calculated and the profile and coat colour were evaluated. The results showed that Aspromontana breed was significantly smaller than Canary breeds, showing differences in measures such as the height at the end of the neck, the circumference and length of the shank, the rump width and the length of the head. Majorera breed resulted the highest breed in this study due to they presented a body length, rump length and width bigger than the other studied breeds. With regard to the other parameters and using the calculated indexes, Tinerfeña breed showed a body index, transversal rump index, longitudinal rump index bigger than the other breeds used in this study. Rustica breed presented a rump index, relative thoracic deep index and relative shortness index bigger than Majorera, Tinerfeña and Aspromonte breeds.



A-49

**Morphological and biometrical investigation on Aspromonte goat**

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The Aspromonte dairy breed is a native goat from the grecanic area, in the province of Reggio Calabria (southern of Italy). In order to evaluate the morphology of the animals, 15 different morphological measures were recorded in 146 female and 69 male, from 13 farms. After that, 10 indexes were calculated. The measured animals were classified in three age groups: 12 to 24 months, from 36 to 48 months, 60 to 72 months of age. The data were subjected to statistical analysis using the SAS software. Aspromonte breed has a marked sexual dimorphism, that can be appreciated in; height at the end of the neck (68.3 vs. 74.3), body length (66.8 vs. 73.6, female and male, respectively), circumference of the chest (85.05 vs. 98.2, female and male, respectively), shin circumference (8.6 vs. 10.9, female and male, respectively), length of the shin (7.6 vs. 10.1, female and male, respectively), width of chest (16.8 vs. 19.9, female and male, respectively), thorax width (17.9 vs. 21.5, female and male, respectively), rump width of a sciatic (10.09 vs. 11.9, female and male, respectively), the length of the head (19.8 vs. 21.2, female and male, respectively). The body index, thoracic index, rump index, relative shortness index and cephalic index, did not show differences between sexes.



A-50

**Morphological and biometrical investigation on Rustica of Calabria goat breed**

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The Rustica of Calabria goat breed is reared in the province of Cosenza. This breed is highly heterogeneous due to the total lack of selection and research on it. The attitude of this breed is double (meat and milk). The aim of this study was to determine the morphofunctional characteristics of the Rustica of Calabria breed, using direct measurements carried out on 218 subjects (148 females and 70 males) from 7 farms in the Cosenza area. The measured animals during the study were classified in three age groups: group 1 (12- 24 months), group 2 (36 to 48 months) and group 3 (60 to 72 months). Data were analyzed using the SAS software. The results of this study showed that this breed had a low sexual dimorphism, probably justified by the breed attitude for meat production and the consequent need to produce a significant increase in muscle in both sexes. Sexual dimorphism appears more pronounced in group 3, for the body length values (69.6 vs. 76.6 female and male, respectively); shin circumference (9.2 vs. 11.2 female and male, respectively), length of rump (21.08 vs. 23.18 female and male, respectively). The dactyl-thoracic index showed the skeletal development rate, especially for long bones, compared to the development of the body. This calculation provides the centimeters of thoracic circumference which correspond to one centimeter of shank circumference, for which the greater this ratio, the more the higher the adhesion to the brachimorfism. Also analyzed the cephalic index, which expresses the proportions of the head, females have more dolichocephalous than male.



A-51

### **Immunological characteristics of colostrum and goat milk from partum to early lactation**

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Colostrum gradually changes further to become mature milk, which is called transitional milk. The European Regulation (1662/2006) states milking procedure must be carried out hygienically, ensuring in particular that colostrum must be obtained separately and not mixed with raw milk. The objective of this procedure is to avoid possible technological interferences in dairy industry. But, on the other hand, it is necessary to understand the evolution of immunological parameters for a suitable management of goat kid growing. The objective of this study was to analyze the evolution of immune status properties of goat mammary secretion samples from partum to a 90-days period. Goat colostrum and milk samples were collected from the farm of Universidad de Las Palmas de Gran Canaria (Las Palmas, Spain) at partum and 1, 2, 3, 4, 5, 15, 30, 60 and 90 days after partum from 10 Majorera dairy goats. Colostrum and milk samples were assayed for IgG, IgM, IgA, and Chitotriosidase (ChT) activity. Statistical analyses were performed using SAS package. Colostrum and milk ChT activity ranged from 2,775 at partum, to 178 nmol/mL/h at the end of the experiment. Colostrum ChT activity was significantly higher at partum than postpartum, and decreased continuously as time passed. IgG colostrum concentration was the highest at partum and then it dropped very fast. The IgM and IgA evolution was similar to that described previously for IgG, dropping considerably in the two days after delivery. These results showed milk secretion from goats at the next day postpartum is quite different from the colostrum, decreasing considerably the quality if used to bottle-fed colostrums. In conclusion, transitional milk is not mature milk, in immunological terms, after 4-5 days postpartum.



A-54

### Shading effects on respiratory rate and rectal temperature in Tunisian local goat kids during summer season

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This study aimed to survey the modulator effect of shading on respiratory rate and rectal temperature in Tunisian local goat kids during the hot season. Fourteen female kids were allotted to 2 groups. Group 1 ( $6.5 \pm 0.9$  mo;  $10.8 \pm 1.1$  kg) was exposed to daytime solar radiation and group 2 ( $6.6 \pm 0.8$  mo;  $10.8 \pm 2.0$  kg) was maintained under a shade regimen from June to August. Respiratory rate per minute (RR) and rectal temperature (RT) were assessed (1000, 1300, and 1600 h) three times a week. Data were statistically analyzed by PROC GLM of SAS. Model included the shading effect and day hour as main effects. Duncan test was used as multiple range test ( $\alpha = 5\%$ ). Pearson coefficients were calculated between ambient temperature (AT), RR and RT. Results are presented in means  $\pm$  SE. The RR was affected ( $53 \pm 1.1$  and  $44 \pm 0.6$  in group 1 and group 2, respectively;  $P < 0.001$ ) by shade, especially at 1000 h and 1300 h. Goat kits under shade succeeded to maintain RR around 44 during day, but those exposed to solar radiation had RR between  $47 \pm 1.8$  at 1600 h and  $64 \pm 2.1$  at 1300 h. The RT did not differ between the two groups at 1000 and 1600 h, but was greater ( $P < 0.001$ ) in group 1 at 1300 h. In both groups, RT was greater at 1000 than at 1300 and 1600 h. Shading allowed a reduction in RT at 1300 h. The RR and RT were more correlated to AT in group 1 ( $r = 0.29$  and  $r = 0.20$ , respectively;  $P < 0.0001$ ) compared to group 2 ( $r = 0.13$  and  $r = 0.13$ , respectively;  $P < 0.01$ ). Correlation reached maximum at 1300 h in group 1 ( $r = 0.55$ ;  $P < 0.0001$ ) and at 1600 h in group 2 ( $r = 0.41$ ;  $P < 0.0001$ ). The RR and RT were highly ( $P < 0.0001$ ) correlated in group 2 ( $r = 0.54$ ,  $0.29$ , and  $0.47$  at 1000, 1300 and 1600 h, respectively). In group 1, RR and RT were correlated ( $r = 0.30$ ;  $P < 0.001$ ) only at 1300 h. In conclusion, Tunisian local goats adapt to hot season by increasing respiratory rate and modulating rectal temperature. Shading allowed a reduction in RT at maximum solar radiation time.



A-55

**Effect of fish oil and additional starch on in vivo deposition of  $^{13}\text{C}$ -vaccenic acid and the product of its  $\Delta 9$ -desaturation,  $^{13}\text{C}$ -rumenic acid, in the body tissues of lactating goats fed sunflower oil**

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A study was conducted in lactating goats with the aim of measuring the deposition of trans-11 18:1 (vaccenic acid, VA) and the product of its  $\Delta 9$ -desaturation, cis-9 trans-11 18:2 (rumenic acid, RA), in the major tissues that are involved in lipid metabolism in the lactating ruminant (i.e., mammary secretory tissue, liver, and omental and perirenal adipose tissues) and examining its potential link with variations in the expression of genes encoding  $\Delta 9$ -desaturase (SCD1 and SCD5). Eight lactating Alpine goats were fed a diet based on grassland hay and a concentrate (forage:concentrate ratio 67:33) supplemented with either 90 g of sunflower oil/d (SO diet; n = 4) or a combination of 60 g sunflower oil and 30 g fish oil/d plus additional starch (+65%; i.e., +102 g/d) from rolled barley (SFO diet; n = 4). After 18 d on treatment, a single bolus of 1.5 g of VA- $^{13}\text{C}$  as nonesterified fatty acid was delivered by jugular injection. Four d later, the goats were slaughtered, and samples of body tissues were collected for the measurement of VA- $^{13}\text{C}$  and RA- $^{13}\text{C}$  enrichment by gas chromatography-mass spectrometry and SCD1 and SCD5 expression by reverse transcription qPCR. Data were analyzed by 1-way ANOVA using the MIXED procedure of SAS. The statistical model included fixed effects for sampling site, diet, and their interaction. The desaturase index of VA- $^{13}\text{C}$  [calculated as RA- $^{13}\text{C}/(\text{RA-}^{13}\text{C} + \text{VA-}^{13}\text{C})$ ] varied according to the tissue and was particularly high (38%) in the mammary secretory tissue. SCD1 and SCD5 mRNA levels were also higher ( $P < 0.05$ ) in mammary tissue than in liver or adipose tissues. In omental adipose tissue, the desaturase index of VA- $^{13}\text{C}$  (27%) was higher than that of the perirenal fat (3%), although SCD1 and SCD5 were expressed at similar levels in these 2 tissues. Feeding SFO diet was associated with increases ( $P < 0.05$ ) in VA- $^{13}\text{C}$  and RA- $^{13}\text{C}$  enrichment in liver and mammary tissue, respectively, and a reduction (-58%;  $P < 0.05$ ) in the  $\Delta 9$ -desaturation index of VA- $^{13}\text{C}$  in the perirenal adipose tissue. Nevertheless, no significant effect of dietary treatment was observed for SCD1 or SCD5 mRNA abundances in the tissues studied. Taken together, these results are consistent with the role of mammary secretory tissue as the primary site of  $\Delta 9$ -desaturation of VA in lactating goats. Furthermore, the effects of diet on  $^{13}\text{C}$ -fatty acid enrichment were not related with changes in the mRNA abundance of genes encoding  $\Delta 9$ -desaturase in any of the body tissues.





E-2

### **Some skin characteristics of native goats of Lorestan**

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Lorestan province of Iran, with about 1.6 million the head of native goats is of a great importance in producing skin of goat. Skin and leather of goat are used in different industrial and hand craft products of Iran. In order to determine the quality and quantity of skin from Lorestan native goats, 99 goats from different sexes in 2 different age groups randomly were selected. Skin and leather traits were: weight, size, thickness, length, width, breaking load and tenacity. Data analyzed using tow-way ANOVA. Age of goats significantly affected weight of skin and mature goats had heaver skin. Male goats also had higher weight of skin. Size of skin significantly differed between different age groups and sexes, mature female goats produced bigger skins. Thickness of skin was not similar in different parts of skin and it was the highest at rump of goats. Age and sex had effect on the length and width of skin but they did not have effect on the breaking load and tenacity of skins. Results showed that the skin of male goats is scored from very big to medium size of standard degrees and the skin of male and female kids gets standard degree of big.



E-3

**Effect of environmental factors on the performance of Khorasan native goats**

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Native goats of Khorasan are kind of hairy goats which have good performance in producing meat and fleece. Hair samples collected from 26 kids and 35 mature goats from two sexes and fleece characteristics determined. Traits were: weight, fiber lenght, variability of fiber lenght, staple lenght, variability of staple lenght, fiber diameter, variability of fiber diameter, breaking load, tenacity, hair and cashmara percentage and fiber diameter of cashmara. Data analyzed by two-way ANOVA procedure. Age had significant effect on fiber diameter, fleece weight and breaking load of hair, kids had finner fiber diameter with heavier fleeces and lower breaking load. Fiber diameter, variability of fiber diameter and fleece weight were higher in male goats. 26 percent of fleeces had  $11.1 \pm 2.2$  percent cashmara which females had higher cashmara percentage than males. Results showed that native goats of Khorasan have hairy fleeces with medium fiber length. They had lower fleece weight in comparison to the other native goats. Considering effect of age and sex on fiber diameter, sorting fleeces of kids and mature goats should be done separately.



E-4

### **Evaluation of fleece of native goats of East Azerbaijan from different ages and sexes**

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East Azerbaijan province of Iran is a mountainous location which has cold climate. Native goats of this province are well adapted to the cold weather and poor pastures which is growing under extensive system. Fleece of these native goats has both hair and cashmara fibers and most of fleece characteristics are influenced by environment. In order to determine these characteristics, samples were collected from 24 kids and 36 mature goats from both sexes. Fleece traits were: weight, fiber length, variability of fiber length, staple length, variability of staple length, fiber diameter, variability of fiber diameter, breaking load and tenacity of fibers. Average fleece weight was 281 gr which was very low in comparison to the other hairy native goats. Fleece weights were similar between different ages and sexes. Fiber length and diameter are two important factors that determine the price of fleece. East Azerbaijan goats produced long fibers but sex and age had no effect on fiber length. Fiber diameter was higher in mature goats; however sex had no effect on fiber diameter. Variety of fiber diameter was low. Samples had 32 percent cashmara which means Azerbaijan native goats are kind of hairy goats. According to the effect of age on fiber diameter, it is recommended to separate fleece of kid and mature goats, however according to the cold climate of East Azerbaijan it is suggested to shear goats every two years in order to avoid cold stress.



E-7

### **Goat production by small-scale farmers in Egypt**

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In the Nile valley region in Egypt, goats are found in smallholdings as mixed flocks with sheep and other farm animals like cattle and buffaloes. Several technological interventions and development projects were implemented in this area in order to resolving goat production constraints. A survey was conducted with 210 goat owners in three representative areas aimed to analyze the potential impact of such alternative technologies among small-scale farmers, highlighting aspects determining their success or failure. The survey was carried out using structured questionnaires contained a total of 90 items grouped into goat owners production resources, management practices, goat production performance and their production constraints. Bio-economic data were collected and submitted to cost - benefit analysis. The analysis showed that higher rate kids mortality (11.4%), lower body weight at 4 months (14.3kg) and longer kidding interval (307 days) are the major factors limiting productivity. Adoption of the technology is significantly affected by farmers education level, lack of capital, contact with extension agents and total area of owned land .Goat breeding programme are constrained by small flock sizes, low levels of literacy and lack of proper recording practices. In conclusion, it is important to examine the production system holistically, and involve the producer at every stage in the planning and operation of any development projects.



E-9

**Fifteen years monitoring goat grazing impact in Natural Protected Areas. Essential points and main conclusions**

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Environmental conservation of natural protected areas is frequently a difficult task when it coexists with grazing goats, even more in limited insular territories. The challenge for managers and farmers is to fit animal production and environment protection under sustainability criteria. This paper gives an overview of fifteen years of monitoring in four of the Canary Islands. The work was carried out in 23 protected areas, where 129 farmers occupy a total of 22,700 ha. To estimate productivity 3,000 cuts of forage were done in different seasons. To delimit grazing areas we worked together to farmers with surveys and Participatory Rural Appraisal techniques. To evaluate grazing impact on environment 695 point-quadrat transects were done, in and out of grazed areas. In addition, to estimate the effect of grazing abandonment, 38 exclusion cages, inside grazed areas, were located and monitored yearly. All data were processed using data basis and geographical information systems software. Results indicate that there is a great diversity of production systems depending on how farmers adapt to environment and to legal restrictions. In general, environmental protection drives to changes in the production systems such as abandonment of rotations and increase of feeding supplies, which reduces their efficiency and profitability. Except in specific cases, no significant impact has been detected on ecosystems, at least during the monitored period; therefore a long-term monitoring process must be implemented. The main achievements of this research are related to the characterization and enhancement of traditional production systems and to the development of a methodological benchmark which allows incorporate farmers knowledge to scientific criteria, in order to elaborate feasible management proposals.



E-10

**Nature and use of labour in goat farms: An analysis of the herds in mountainous areas of the Spanish Betic Massif**

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The nature and use of labour is a key element for livestock farms, whose activities require constant and continuous applications of manpower. Moreover, the cost of labour significantly affects the economic performance of the herds. The paper examines the nature and use of labour in goat farms in mountainous areas of south-eastern Spain. From the information gathered by a survey conducted to 186 livestock farmers in municipalities of the Spanish Betic Massif, the structure of the herds in the area has been first described. The nature (from farmers themselves, familiar, permanent and temporary employees) and use of labour in the goat farms has been analysed, estimating also the importance of the cost of labour in the context of the whole herd operating cost. A herds typology, based on the type of labour used, has been performed, and using it as a dependent variable, a multinomial probit model has been specified and estimated, trying to identify variables linked to the use of the work force. The model specification includes, as independent variables, structural figures of the herds (number of heads, farm territorial dimension, management system) and personal characteristics of the farmers (time commitment to livestock activities, age, educational and training level, membership in cooperatives, etc.). Among results obtained, the existence of a scale effect on labour use has been deeply analysed. Some conclusions have finally been drawn.



E-11

**Marketing products by the goat breeders: An analysis of factors related to sales strategies in herds of mountain areas of south-eastern Spain**

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The way of marketing products often becomes a crucial factor for the economic viability of livestock farms. The paper analyses the marketing practices, used for both meat and milk, among goat breeders in the mountainous areas of south-eastern Spain. From a survey performed to 186 goat breeders in counties located in the Spanish Betic Massif (Penibética and Subetica mountain ranges) the various product sales channels used by farmers have been first identified and described, and its importance in the area has been valued. On a second step, some factors likely to be related to the choice by goat breeders of different trade channels have been considered, among them the following: herd size, territorial dimension of the farm, type of production system, farmer's level of dedication to his livestock activity, membership of cooperatives, farmer's education and training level, continuity in farming, etc. To determine the relationship between those factors and the marketing practices performed by breeders, a bivariate dependence analysis, complemented with multivariate Probit models, have been carried out. Based on the obtained results some findings have, finally, been drawn that might to help in designing strategies to improve marketing goat productions at the local level.





E-12

**Livelihood security and economy of Changthangi goat based transhumance production system in Western Himalaya**

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The Jammu and Kashmir State is famous for pashmina which is produced from Changthangi breed of goats reared under transhumance production system. A study was carried out to assess production performance, economic viability, livelihood security and value addition of fiber in Changthangi goats. The breeding tract spans 1,600 km from the Chinese province of Qinghai in the East, across Central and North Tibet to Ladakh (India) in the West. The altitude of tract varies from 3,700 to 4,500 m masl with wide seasonal and diurnal variations and fluctuating temperature (ranging between 35°C to -40°C). The sampling of pashmina goats was carried out using multi-stage stratified random and probability proportional to size sampling techniques. Project evaluation techniques and growth models were used for economic analysis. The final sample comprised of 250 nomadic households rearing 18,328 Changthangi goats from three zones of Changthang with variable altitude. The primary data on altitude, population, demographic trend, flock structure and size, sex, age and grade of pashmina revealed high correlation between altitude and flock size *visa-a-vis* fiber quality (pashmina). Pashmina production and breed population showed positive growth momentum with CAGR of 3.70% and 4.94%, respectively. Cold aridity, altitude of  $\geq 4,000$  m masl and availability of quality pasture significantly contribute to lower fiber diameter ( $\leq 14 \mu$ ). Diseases inflicted high economic losses (20% to 30%). Overall, animals were highly inbred which influenced the production and economic parameters negatively. Pashmina yield was highest in castrated bucks (585g) and lowest in does (385g). Body weight turned higher in castrated (30kg) and lower in breeding bucks (27kg). The project evaluation analysis revealed a high BCR (1.72 at 12% discount rate), IRR (Rs.1843.17), NPV (72.14) and PBP (0.58 yrs.) indicating the enterprise as profitable and financially viable. The fiber had average diameter 8-14 $\mu$  with unique quality and spinning, weaving and embroidery annually realises around INR.100 million revenue to the State besides generating 3.56 million mandays. The study flags agenda for research and planning that could take into account constraints with essential measures in breeding, feeding, animal health, pastures, marketing and socio-economic problems.



E-13

**Role of Income-Generating Activities (AGR) in the Development of Rural Families, Ouarzazate Region, Morocco**

Hassania Kanoubi; Presidente of Rosa Association

*Bd Med V; Imble 12; Appt 2; Hay Tassoumaâte Ouarzazate; BP 55; CP 45002; Poste Tassoumaâte-Ouarzazate.*

At the heart of a dry mountainous region, victim of drought and rural exodus, food shortages are resulting in child health problems. Since 2005, fifty-two groups of women, joined together by the ROSA Association, have organized and set in motion small collective activities.

**ROSA ASSOCIATION FOR THE DEVELOPMENT OF THE RURAL WOMAN**

Founded in January 2005, the ROSA Association unites about fifty groups of women who live in a rural environment. Its aim is to involve rural women in development, through the creation of income-generating activities (AGR). To this end, ROSA establishes family farming projects, literacy training, and hygiene awareness in the home and in cottage industry. ROSA projects are intended to spread as widely as possible, basing that growth, like Heifer International and Livestock Without Borders, on the process of "Whoever receives... gives," or Heifer's motto of "Passing on the Gift."

**GLOBAL OBJECTIVES:** To improve nutrition for rural families using the products of small farms: livestock, dairy Goats products Sheep products, eggs, and honey. To create a source of income for women through the sale of these products To limit rural-urban migration by developing a food business, by helping other families through the principle of "Whoever receives...gives." To allow groups of women to find dignity by managing the development of their community. ROSA's projects are based on the principle of "Whoever receives...gives" (or animal microcredit). Each time a family receives an animal, it agrees to donate an offspring to another family. ROSA's Accomplishments women benefit from this program. are chosen by their groups according to several criteria: For families who do not have enough land to feed ruminants, rabbits and beekeeping are proposed. Training families in techniques for raising and farming dairy goats, cows, poultry, and bees. See the Appendix for a presentation of the themes raised in these technical training sessions. Establishment of a Cheese-Making Cooperative. The continuing growth in the number of goats and of recipients led ROSA to group the goat farmers together in a cooperative called COROSA, created on March 14, 2008. Objectives of the COROSA cooperative: To improve the financial situation and the social recognition of village women; To strengthen women's skills in the areas of processing and marketing cheese-



E-15

**Design and development of an expert system for knowledge management in systems of goat-sheep production in Colombia. Sesigetec**

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Was designed and developed an Internet Software for sheep and goat farmers which corresponds to an Expert System than applies concepts of knowledge creation matrix. Part of the principle that producers have Tacit knowledge acquired by oral tradition, myths, legends and personal experience, and that there Explicit knowledge that is scientific, systematic, statistically, documented. The creation of new knowledge applicable combine Explicit with Tacitus, by the Matrix Knowledge Creation. The software goes through the steps of the matrix of knowledge creation. First step is for the Socialization, the producer expounds his Tacitus knowledge from which the software does a general characterization of the farm. Second step in the system becomes the Externalization, the producer develops an array of strategic analysis of the farm from the point of view of tacit knowledge, ending with a matrix with the ordinal ranking of the critical points of the farm's, most important to less relevant. Third step, the software begins the process of Combination that is based on the classic elements of an expert system, there is an interface that communicates with the user. Heuristic model was developed based on trees (Synergies and hierarchies) that present indicators of the farm with the cause-effect expressed mathematically. In the tree analyzes data entered in the characterization and iterative system assesses the impact of all variables in the tree outside identifying the total production outside the normal ordering them from largest to smallest effect. Identified critical indicators generated Explanation System is a document produced by the Software which explains the logical relationship between the variables. The critical variables are related to the Knowledge Base, the system will offer content in documents, videos, photos and Internet addresses where producer can learn about the critical points of the farm. The software then allows the producer to change the variables in the tree to evaluate the effect of any changes or improvements he wants to do and makes a second Ranking of problems that the farmer determined by their new understanding from Explicit knowledge learned. From this second ranking Software Internalization process starts where you build a plan of improvements in a worksheet in which documents the strategy, tactics and logistics for carrying on the farm. All this analysis is stored in the base of experiences that other producers can be found later.



E-19

**Agroforestry for sustainable goat farming: shade, shelter, fodder, and environmental benefits of trees**

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The establishments of trees on farms provide shade and shelter for grazing livestock, protecting them from extreme heat and cold conditions. Many trees and shrubs are also important feed sources, especially during periods of pasture scarcity. In addition, agroforestry provides benefits to farm ecosystems by assisting in the control of soil erosion and salinity, nutrient cycling or trapping, enhancing biodiversity through provision of refuges and corridors for wildlife, and by absorbing carbon dioxide from the atmosphere thereby reducing affects on global warming. All these factors suggest a vital role for trees in enhancing the sustainability of farming systems, especially in the context of climate change where more severe weather extremes are expected. This research focusses on the benefits of agroforestry to meat goat farming, a particularly important and growing domestic industry given the increasing global demand and Australia's lead role in world goat meat export. Currently most supply comes from harvesting feral goats, but there is also an emerging interest in the farming of domestic breeds in high rainfall areas to ensure a more reliable supply of both live animals and carcasses for export markets. There is a significant potential for goats in silvopastoral systems, given their unique characteristics, particularly their hardiness, adaptability, and their tendency to browse on plant material that is not consumed by other stock. Two major experiments are included in the project: one investigating the effect of shelter provision on the growth and performance of newborn nursing kids (0-3 months old), and the second investigating the effect of shade and supplementation with fodder from acacias and willows on the productivity and performance of weaned kids (3-6 months old). Acacias are usually planted together with eucalypts in direct seeded shelterbelts in the Southern Tablelands of NSW (the area of study), which makes them suitable for the provision of both shelter and fodder. Willows are also frequently available on farms, and supplementing grazing animals with them may assist in control of internal parasites. While there have been studies in the literature investigating the nutritional benefits of willows and acacias to goats and other domestic herbivores, the aim of this study is to test the effect of willow and acacia supplementation on goats with and without the provision of shade from trees, and in the particular context of the Southern Table of NSW. The possible correlation between shade and fodder supplementation will be investigated. Productivity parameters, such as live weight changes, body condition scores, control of internal parasites, and feed intake, will be used in the analysis. This research will result in a greater understanding of the roles of trees and shrubs in sustainable goat farming, and will also result in well tested recommendations to the goat industry, to optimally establish and design goat farms by incorporating trees and shrubs in the landscape.



E-20

**Application of knowledge theory in characterization and modelling dynamics  
systems of goat production in Colombia**

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The application of Knowledge Theory in the Characterization and Modelling System Dynamics of Goat Production Systems in Colombia, introduced as the new variable, expression level of knowledge producers for determine their technological development level. A survey was designed through systems approach, where questions raised by components. Components included in the methodology were general aspects, knowledge, nutrition-food, population, reproduction, production, genetics, health, economy and administration. The survey was developed in Access, to facilitate data entry field, interaction analysis between components and data processing. Representative variables that explain in great proportion the behavior systems are altitude (m), production indicators (milk production), reproduction indicators (fertility and prolificacy) innovation level in processes and products (knowledge expression), technical and technology services sale (knowledge expression) and investment. 77 surveys were developed, defining 40 variables used for characterization descriptive statistics. The typification was performed using principal component analysis and clusters, in 27 monitoring farms and 12 variables throwing two main components: Principal Component 1: Knowledge Expression Level, explaining a variation of 72% , yielding positive correlations with process innovation (management) and products and investment by producers. The main component 2 Technology Development Level explains 28% of variation, yielding positive correlations with income levels of producers, product positioning and opening new marketing channels. Were obtained and modeled three types: Cluster 1: Farms with high knowledge expression level, accounting 13% of sample, characterized for technical and technological services goat sale, Cluster 2: Farms with medium knowledge expression level, representing 16% of farms tested, which are implemented collecting and analyzing information to enhance marketing process, Cluster 3: Farms with low knowledge expression level, accounting 71% of sample where data collection, knowledge expression and opening marketing channels are limited. In this analysis we concludes, technological development level of goat production systems in Colombia, is high influenced by the knowledge expression level of the producers.



E-23

### Causes of losses of breeding goats in dairy herds

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Data of 14352 goats ( $n = 14352$ ) from 61 farms registered in ACRIFLOR (Association of Florida Breed Farmers) were analyzed in order to assess the causes of reproductive goats losses in commercial herds. To determine these causes and its association with the sources of variation, a Chi-square analysis was performed, considering the following factors: year of loss (2006 to 2010), season of loss (spring, summer, autumn, winter), number of delivery (1 to  $\geq 5$  deliveries) and age at delivery (considering three categories, based on the standard deviation above and below the mean:  $\leq 36.63$ ,  $36.64$  to  $86.47$ ,  $\geq 86.48$ ). Three reasons of losses were recorded: death (38.3%), sale as breeding stock (16%) and culling (sale to slaughter) (47.3%). The frequency of these losses was not homogeneous, with highly significant differences ( $P < 0.001$ ). In this sense, the highest proportion of culling losses (62.3%) was during 2006, the highest sales as breeding stock (27.6%) was in 2008, while the largest proportion of deaths (48.8%) was observed in 2007, and the lowest value (34.2%) was in 2006. The highest proportion of losses for sale as breeding stock (27.1%) was observed during spring and the lowest one (5.3%) was during summer. The high animals demand in spring could be related to the farmer's need to comply with the requirements imposed in relation to the herd size by the Common Agricultural Policy; so, in August, after the inspections, the less productive goats were culled. A substantial proportion of losses occurring after the first and second births was found (24.8% and 23.9%, respectively); this could be associated with the elimination of females due to: low milk production, failures in the rearing and growing stages, health problems (mainly mastitis), reproductive failure due to sub- and supra-feeding, and a misuse of genetic evaluation to choose the farm replacement. Also, females' losses at three, four and  $\geq$  five deliveries were 19.1%, 13.0% and 19.1% respectively. The average age of breeding loss was  $61.56 \pm 24.92$  months. A significant value ( $P < 0.01$ ) of losses by sale to slaughter and death was found in goats younger than 36.63 months (47.5% and 43.4% respectively). These results suggest that there are a high proportion of young females leaving the herd prematurely; besides, age and season have influence in loss causes. Hence, it is necessary to take management corrective actions, especially in replacement animals, in order to ensure an efficient productive life of the females.





E-24

### Nonlinear model for analysis of growth curve of goats in Colombia

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During SIGETEC project development, alliance UNAL-Unisalle -Corpoica-ANCO-MinAgricultura during the years 2010-2011 monthly monitoring has been done the weight of males and females of about 2,000 animals on 42 goat farms located in the departments of Antioquia (n = 6), Valle (n=10), Cundinamarca (n = 18) and Santander (n = 8) in Colombia. Data collected were analyzed using Gompertz nonlinear model. Outliers were validated and convergence. Was generated a Gompertz nonlinear model ( $P < 0.01$ ) for every 4 months for each department and sex, for a total of 24 models. Analysis of variance was applied to the parameters a, b and c, to determine differences. As a result it was found that the growth curve of goats department is different ( $P < 0.01$ ). The Department of Antioquia has the best curve with weight =  $40.57 * e^{(-e^{(0.6253 \text{ to } 0.225 * \text{Age in months})})}$  and 35.78 kg at 12 months, followed by Valle with Weight =  $36.46 * e^{(-e^{(0.7334 \text{ to } 0.2131 * \text{Age in months})})}$  and 31 kg at 12 months, followed by Gauteng with weight =  $26,679 * e^{(-e^{(0.9512 \text{ to } 0.6511 * \text{Age in months})})}$  and 26.6 kg at 12 months finally the lighter curve is the de Santander Weight =  $21,789 * e^{(-e^{(0.598 \text{ to } 0,359 * \text{Age in months})})}$  and 21.26 kg at 12 months. The general curve for the four departments is Weight =  $28.85 * e^{(-e^{(0,746 \text{ to } 0,409 * \text{Age in months})})}$  and 28.4 kg at 12 months. There were no significant differences between sexes or between departments and sexes. The farms in Antioquia and Valle did not show differences between them ( $P > 0.05$ ), which coincides with his dedication primarily to milk production that allows a higher level of organization and feeding, the same as genetic crosses to milk potentially could lead to greater heterosis. Furthermore no significant differences between Cundinamarca and Santander ( $P > 0.05$ ), where most farms are sampled meat production target with prevalence of indigenous breeds are either dairy breeds which are not parenting. There were no significant differences in the growth curve of males versus females ( $P > 0.05$ ), showing signs of poor parenting, possibly associated with that on dairy farms is not an adequate breeding males for the disinterest in their flesh.





E-25

**Patuchev: an experimental device to assess low input goat breeding systems, using local resources and complying with agro-environmental sustainability goals**

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The experimental platform Patuchev is aimed at assessing and proposing strategies in order to lead to low input and sustainable goat farms. Main issue is self-sufficiency based on local resources, in order to link production and territory. The project is to explore dairy goat rearing systems allowing: A positive impact on the environment by (1) limiting high energetic cost inputs (pellets, mineral fertilization, mechanization), (2) limiting pesticides, veterinary drugs and exogenous hormones use, (3) providing environmental services (landscape, biodiversity, carbon storage). A productive and attractive business taking into account the consequences of technical adjustments related to environmental issues on productivity and economic output. The attractiveness of breeder's profession should be improved regarding workload, technicality and image. An activity offering products of high organoleptic and sanitary and quality, fitting into the landscape and social surrounding. Multi-specific cultivated grassland and solar-heated air dried hay are the key points of the forage system, combined with cereals and protein plants. Crop will be fertilized with composted manure from the herd. The device is composed of 3 x 10 hectares and a 180 French alpine goats-herd equally divided into three groups: one group in seasonal reproduction and grazing, two groups out of sexual season, one of them grazing and the other one bred inside and fed on hay. The inputs and outputs flows, including energy, will be handled separately for each group. Evaluation and comparison of breeding systems will be assessed by 1) zootechnical performances: production and health, especially regarding parasitism. Results will be collected through lactation and throughout dairy goats' careers. 2) Environmental criteria, such as energy consumptions, greenhouse gases emissions, biodiversity and soil biological activity; 3) Economic criteria (gross margin). For a better dissemination of knowledge, Patuchev is strongly linked to a 28 goat farms research and development network involved in self-sufficiency and grassland-based systems (REDCap). This network will enable the research carried on Patuchev to be extended in farm conditions. This organization gives a wide place to exchange and thereby facilitates the emergence of innovative research issues. All the buildings have been built on purpose for the project (goat shed and solar dryer) and the operational launching will occur on September 2012.



E-29

### **Development of goat kid rearing systems using alternative milk sources and post weaning feeds**

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The aim of this study was to develop a feeding system for the rearing of goat kids ready for breeding at seven months at a target female body weight of 25kg. The trial consisted of a milk feeding period and a post-weaning feeding period. During the milk feeding period, two alternative milk sources was compared to conventional goat milk and for the post-weaning feeding period two different feeds was compared. Goat kids were removed from their mothers and placed in kid nursery pens at three days of age. A total of 16 twin goat kids, both males and females, were allocated per treatment. The three milk treatments were goat milk, cow milk and cow milk replacer. Each goat kid received two daily feeds of 500 ml each of the designated milk by bucket. As from day ten, calf pellets and milled lucerne hay was freely available to goat kids of all treatments. Goat kids were initially weighed every two weeks and closer to weaning, weekly, in order to wean them at 12kg. After weaning the goat kids were kept on the calf pellets for another two weeks. Subsequently, goat kids from each milk treatment were allocated to one of the two post-weaning feeding groups. One group continued to be fed calf pellets while the other group was switched to a grower diet for goat kids and lambs. These pellets and lucerne hay were available *ad libitum* for the remainder of the trial. It was found that the days to weaning for the groups reared on goat and cow milk was slightly shorter than for the group receiving the cow milk replacer. Weights obtained at the end of the trial at breeding age did not show any residual effect of the milk treatment received, indicating that compensatory growth took place; while both post weaning feeding systems resulted in breeding weights above 25kg with no major differences between the two feeds.



E-30

### Dairy goat farming in Greece

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The objective of the study was to assess farm conditions and to describe the characteristics of dairy goat herds in Greece. For this reason, 60 randomly selected goat herds (23.426 goats) from 16 prefectures were surveyed from September 2011 to March 2012. Data were collected during pre-scheduled on-farm visits, using a case-specific questionnaire which comprised questions about livestock, nutrition and management practices. Descriptive statistics and Pearson correlations were calculated using SPSS 18©. Average farm size was  $40.0 \pm 84.57$  ha, varying considerably from 0.0 to 431.0 ha; 20% (12/60) of the farms did not cultivate any crops, whereas 10% (6/60) cultivated more than 100 ha including cultivated pasture land. The average herd comprised  $390.0 \pm 325.4$  adult does (50 to 1600),  $29.0 \pm 25.6$  bucks (2 to 100) and  $83.0 \pm 73.4$  yearlings (5 to 300); bucks to does ratio was about 1:13. Furthermore, replacement rates for does and bucks were  $0.14 \pm 0.043$  and  $0.28 \pm 0.091$ , respectively. Mean body weight (BW) of adult does and bucks were  $46.3 \pm 6.16$  and  $66.2 \pm 9.77$  kg, respectively. Kids were slaughtered at a mean age of  $80 \pm 26.5$  days, producing carcasses of  $9.6 \pm 2.21$  kg. Moreover, mean age and BW at first mating were  $8.7 \pm 3.25$  months and  $29.7 \pm 5.80$  kg, respectively. Average milk yield was  $212.3 \pm 124.79$  kg per doe per year, with almost 18.3% (11/60) of the herds producing more than 300 kg per doe annually and 10% of the herds (6/60) less than 100 kg annually (3 of them did not milk their goats during the previous year). Average litter size was  $1.6 \pm 0.25$  kids per goat. Mean duration of grazing and distance covered were  $7.6 \pm 2.79$ ,  $10.6 \pm 3.22$ ,  $8.8 \pm 4.08$ ,  $4.1 \pm 3.10$  hours and  $7.6 \pm 6.10$ ,  $9.5 \pm 6.20$ ,  $7.9 \pm 5.96$ ,  $3.7 \pm 3.53$  km at spring, summer, autumn and winter time, respectively. About 12% of goat herds (7/60, only in islands) were raised extensively. Significant and positive correlations were found between annual milk yield per goat and replacement rate of bucks ( $r = 0.345$ ) and does ( $r = 0.418$ ), litter size ( $r = 0.578$ ), doe BW ( $r = 0.596$ ) and first parity does BW at mating ( $r = 0.385$ ). Annual milk yield per doe was significantly and negatively correlated with distance covered during grazing at spring and summer ( $r = -0.314$  and  $r = -0.285$ , respectively) and kid weaning age ( $r = -0.438$ ). In conclusion, a significant variation regarding farm characteristics, productivity and management schemes was revealed for goat production systems in Greece. The work was funded by FP7 project SOLID No 266367.



E-31

**Evaluating goat grazing effects on vegetation in Rural Parks of the Canary Islands: what changes with grazing exclusion on the long-term?**

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Extensive goat grazing is one of the traditional activities to be maintained in Rural Parks of the Canary Islands. These Natural Protected Areas aim to ensure sustainability of traditional activities so that they can coexist with biodiversity conservation; however little efforts have been made to measure the effect of grazing on vegetation on the long-term. We evaluated the consequences for vegetation, analyzing different indicators (plant cover, species richness, productivity and composition), during 8 years of goat grazing exclusion. Monitoring was done in traditionally grazed areas in Canarian Rural Parks: Anaga and Teno in Tenerife, and Valle Gran Rey in La Gomera. A total of 18 permanent exclusion cages were established for long-term monitoring, and all the variables were measured in plots inside and outside the exclosures. Plant cover was the most affected variable due to grazing exclusion whereas other indicators analysed are more conditioned by environmental factors such as interannual climatic fluctuations or the predominant plant community type. Changes after long-term exclusion were not as evident as expected, and most variables showed no trend with time elapsed after exclusion. Goat grazing management in Canarian Rural Parks is characterized by practices that contribute to sustainability such as low to medium stocking rates, rotation and food supplementation in dryer seasons, thus explaining its low impact. These results contradict the common idea that grazing is a harmful activity *per se*, and point out the importance of considering that the relationship between grazing and vegetation is complex and that other factors are also intervening.



E-33

### **New Utilization of Goats in Japan**

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The number of goats in Japan has declined rapidly from around 669,000 head in 1957 to only less than 20,000 in 2010's. As the reasons behind it, the followings can be pointed out; first, as the Japanese economy developed, farmers found non-agricultural incomes and simply did not need to keep goats for their daily foods. Second, due to the low profitability of goat farming, little commercial goat farms could survive under the severe economic situation. However the number seems to recover slightly since around the year of 2000. More and more people are now interested in keeping goats because of two main reasons, which are as companion animals and animals for cleaning wasted lands. Animal assisted activity including animal assisted education is now getting popular in Japan. Some primary schools and kindergartens keep goats or non-governmental organizations take their goats to schools for educating children. Also nearly ten percent of total Farm lands, especially in the mountainous areas, have been abandoned due to economic and social reasons. Grazing goats is comprehensive way to clean up noxious weed at low cost. Some farmers' groups keep goats for the purpose mentioned above. The author investigated these cases of new utilization of goats in Japan using survey method, and analyzed the prospect and problems of these ways of utilization. The author concluded that either in both cases, professional assistances and advice including medical and technical ones are vital for further development.



E-34

**Evaluation of vegetation responses to different goat grazing regimes in semi-natural ecosystems: a case study in Tenerife (Canary Islands)**

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The European Common Agricultural Policy (CAP) highlights the importance of maintaining and promoting traditional activities, and of conserving managed ecosystems. In the Canary Islands, extensive management of native goat breeds has to coexist with environmental protection of about 40% of the territory, and with the controversial effects of goat grazing on sensitive island ecosystems. Therefore, to ensure the sustainability of this traditional activity and the conservation of managed ecosystems, it is necessary to analyse how production systems affect plant communities. In this study we analyzed the effects of grazing (heavy grazing, light grazing and long-term abandonment) on plant species composition, diversity and structure (frequencies of functional groups based on growth form and bare ground) of semi-natural ecosystems to determine if these characteristics were being negatively affected by grazing pressure or if virtually no differences exist between managed and abandoned ecosystems. We analyzed data from 63 permanent point-quadrat transects located in the Rural Park of Anaga (Tenerife), which were sampled annually from 2001 to 2005. The structure of semi-natural ecosystems was clearly affected by grazing, but we did not observe a complete turnover in species composition. Abandonment led to more advanced stages of the succession dominated by late successional and endemic shrub species. Grazing resulted in more diverse open ecosystems dominated by herbaceous species typical of pastures, and seemed to adversely affect grazing-sensitive endemic shrub species. Some differences were detected between grazing intensities. In heavily grazed areas, the frequency of annual grasses was higher, the decrease of shrubs was more pronounced and some introduced species were favoured. In lightly grazed areas, the shrub legumes were less abundant and some annual legume species were favoured. We concluded that the maintenance of heterogeneous landscapes characterised by different grazing regimes is key to conserving traditional ecosystems. Goat grazing is indispensable for maintaining traditional open agroecosystems, but grazing intensity should be controlled over time to avoid negative effects on the vegetation, e.g., the drastic reduction of sensitive shrub and palatable species or the expansion of exotic species. Additionally, maintaining some abandoned areas is necessary to preserve grazing-sensitive endemic species.



E-35

### **Adoption of goat management practices through Farmers Field School**

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Heifer International, an organization dedicated to end hunger and poverty while saving the earth, inherits the tradition of passing on the gift. Goat along with training is a widely practiced gift. The gift of goat to be productive needs adoption of learned skill and knowledge from training by family receiving the gift. In an effort to increase the adaptation of learned knowledge and skill, women farmers of Shaktikhor in Chitwan of Nepal were facilitated to run a yearlong Farmers Field School (FFS) with little technical assistance from a community level animal health worker to discover overall goat management practices suitable and profitable for them. They used a participatory evaluation tool named Goat Eco-System Analysis (GESA) to test usefulness and profitability of newly acquired knowledge and skills in field of goat management. Existing practices, when challenged with new practices, were tested by conducting small trials. Monthly participatory discussion using GESA and small trials helped them to decide suitable and profitable management practices for their goat. The forum of FFS availed the women farmers, mostly illiterate, a platform to interact, test, conclude and adopt discovered practices to their goat farms. They challenged their existing knowledge, skill and practice of goat management with newly acquired knowledge and skill in field of goat housing, feeding, breeding, health and other management. They developed and adopted a set of practices simultaneously in their farm that resulted into, besides others, remarkably reduced age at first service and first parturition; increased twinning; and increased monthly weight gain. Number of months required to attain marketable sized goat reduced by 10 months. The developed goat management practices were found to be adopted by most of the families who participated and many of the families around the FFS site not participated directly. Similar FFS running currently at other locations in Nepal are also yielding similar results signifying its importance for adoption of locally suitable goat management practice to increase production, productivity and profit from goat enterprise.





E-39

### **Importance of body weight in goat production, husbandry and welfare**

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Recent developments in our knowledge of variation in goat body weight on goat production, profitability, management requirements and animal survival are reviewed. The mature body weight of goats is positively associated with their potential to grow rapidly. Body weight is directly related to the nutrient requirements of goats, irrespective of their productive state. For goats, body weight is associated with age at puberty, eruption of incisor teeth, reproductive performance and ovulation rate, carcass production, carcass attributes, body condition score, mohair and cashmere production, fibre attributes and, skin quality. Some of these attributes are allometrically related to body weight which means the change in attributes is directly proportional to changes in body weight when assessed on the log scale. The body weight at weaning is regarded as a critical benchmark for animal welfare, production and profitability. Illthrift, lack of growth and high mortality in recently weaned kids are related directly to body weight at weaning, and the risks increase rapidly as body weight declines. Mortality risk to adverse weather is highly related to low body weight but better assessed via body condition score. The reported mature size in goat breeds range from about 10 kg (East Bengal Dwarf goat) to about 120 kg (dairy breeds, Improved Boer). There is little evidence of the systematic study of the body weight of goat breeds at different ages or when farmed in different environments. In Australian farmed goats, mature size of does is not reached until 4 to 5 years of age. The impacts of slow rates of body weight maturity have not been quantified for goat breeds or production systems and has implications for predictions of nutrient requirements. Knowledge of body weights is critical for many animal health interventions. Direct and indirect methods of body weight determination are summarised.



E-40

### **Factors affecting behavior of goats in pens with electric strand additions to cattle barb wire fence**

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A constraint to grazing of goats in cattle pastures is the different types of fence required for containment of both species. Thus, the objective this experiment was to investigate effects of meat goat breed, gender, experimental period, and preliminary and washout treatments on behavior in pens with electric strand modifications to cattle barb wire fence. Eighty of four types of growing meat goats (Boer wethers and doelings,  $24.0 \pm 1.27$  and  $22.3 \pm 0.97$  kg; Spanish wethers and doelings,  $16.9 \pm 0.43$  and  $15.6 \pm 0.28$  kg, respectively) were assigned to four sets of 20 animals used in  $5 \times 5$  Latin squares. Test pens of  $2.4 \times 3.7$  m had three metal panel sides and one of barb wire strands at 30, 56, 81, 107, and 132 cm from the ground adjacent to a pasture with abundant vegetation. Fence treatments were electric strands at 15 and 43 (LH), 15 and 23 (LM), 15 (L), 23 (M), and 43 cm (H) at 6 kV. During a 4-wk adaptation period, animals were sequentially exposed each week to test pens with different fence conditions: no electric strands, one strand at 0 kV, LH, and LH. Two preliminary treatments (barb wire with no electric strands and LH) were applied the week before the first measurement period. During the Latin square periods, after fasting overnight each set of animals was placed in test pens and observed for 1 h with a video surveillance system. In the 1-wk interval between observation periods, two washout treatments were imposed: with or without electric strands at  $\geq 6$  kV situated next to concentrate feed troughs. Data were analyzed by a MIXED model with the repeated measure of period. There were no effects of gender or preliminary or washout treatment, and interactions between fence treatment and breed were non-significant. Fence treatment affected the percentage of animals exiting test pens (31, 23, 16, 35, and 30%; SE = 5.3 for LH, LM, L, H, and M, respectively). Breed influenced ( $P < 0.05$ ) exit (12 and 43%; SE = 3.8), exit time ( $15 \pm 4.0$  and  $5 \pm 2.1$  min), and animals receiving a shock (10 and 4% for Boer and Spanish, respectively; SE = 1.8). Exit decreased as period advanced (60, 35, 23, 10, and 8 % for 1, 2, 3, 4, and 5, respectively; SE = 5.3). In conclusion, meat goat breed needs to be considered in development of a method to evaluate electric fence additions to cattle barb wire fence, and differences in exit among periods indicates that either a Latin square approach is not suitable or would require different preliminary and/or washout treatments.



E-41

### Spatial-temporal movements of grazing goats

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Grazing behaviour can be an important input in animal management practices. However, human presence can alter grazing behavior. The objective of this study was to monitor grazing behaviors in goats via use of GPS collars. Fourteen Spanish wether goats were fitted with GPS collars and released into a 14-ha paddock. Collars that recorded a fix every 5 min were deployed for 2 wk during the early summer (max = 32°C, min = 22°C). Fixes from 1 h after sunrise (07:00 h) until 1 h before sunset (19:30 h), resulting in 2,730 fixes, were analyzed for grazing behaviors, which included distance traveled and turning angles, using a repeated measures analysis. Distance traveled was calculated from two consecutive fixes and turning angle involved three consecutive fixes. Turning angle was then categorized into four quadrants. If turning angle was between -45° and 45°, then direction was forward; between -135° and 135°, backward; between 45° and 135°, right; between -45° and -135°, left. Hour of the day greatly affected ( $P < 0.01$ ) distance traveled, peaking at 1,440 m traveled at 13:00 h with two minima at 10:00 and 17:00 h (266 and 430 m, respectively). The time of 13:00 h also accounted for proportionally the greatest percentage ( $\chi^2 = 1997$ ,  $P < 0.01$ ) of forward movements (79, 5, 6, and 10% for forward, backward, left, and right, respectively, for that hour) and the 10:00 and 17:00 h accounted for the least (46, 13, 21, and 20% for forward, backward, left, and right, respectively, for those hours). Generally, forward movements accounted for 61% of the fixes, right and left movements were equal at 15%, and backward movements were 9%. These results indicate that goats had directed movement at mid-day, as evidenced by the greatest distance traveled and primarily forward movement, and more tortuous movement at mid-morning and mid-afternoon, as evidenced by the least distance traveled and the higher degree of turning angles.



E-42

**Questioning the resilience of goat production in the Tropics at different levels from the animal to the whole farming system**

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In the Tropics, the biotic and abiotic constraints induce feed fluctuations and a great variety of diseases damaging the goat production. What could be its resilience under such stressful environment? The capacities of the Creole genotypes to living and producing under these constraints are frequently assigned to their adaptation (faculty to fit their behavior at different levels of organization to maintain their well-being and guarantee their survival and that of their progeny). The many crossbreeding that occurred within the Creole populations, the natural selection to which they were submitted and their use for multiple bio-economic purposes, have assigned them very original traits. They have stored up many combing alleles that allow the species survival. Qualified as hardy breeds they present different capacities of resistance and flexibility. It goes too for the systems of production (SP) known as very diverse and multi-purpose. The hazards and dysfunctions of the markets (distancing between local vs. imported, informal vs. formal) the official frames of governance (legal constraints, models of development) and more than any, the natural disasters (climatic, geological, and sanitary) have traced the history of the animal production in the French Antilles. The traditional system, an inheritance of a past colonial, continues in different forms that offer a panel of variable solutions. At the opposite, the modern system of production based on productivism, passed through many crises and is “perennial” only owing to regular public subsidies. The latter is inconsistently considered as the predominant model of development. The fitness capacities of the Creole animal (mixing adaptive and productive traits) have been highlighted as necessary for sustaining the diverse husbandry activities. More specifically the Creole goat resilience towards parasitism stresses has been included in the breeding program of selection. The diverse goat SP contain hidden sources of functioning that could be valorized: building adaptive trajectories and suggesting intermediary models of development to reach sustainability in a limiting hard environment. The multifunctionality (animal and system) allow to pass through the obstacles and failures of the maximization of the productivity under limiting tropical conditions: allocation of nutrients between adaptive and productive functions or repartition of risks between the diverse bio-economic purposes.



E-44

**Responses of plant functional groups to goat grazing. Does goat grazing really affect ecosystem?**

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This work seeks to address several questions: Do plant functional groups respond differently to grazing? Can we use plant functional groups as tools for management, to support production and conservation efforts? We studied the effect of goat grazing on the relative frequency of several plant functional groups on island ecosystems. To measure the relative frequency of seven functional groups between 2001 and 2005, a total of 36 permanent point quadrat transects were selected randomly in grazed and abandoned areas at the study sites. There were three types of responses: groups that did not respond to grazing (grasses and, with regard to origin native, alien and endemic groups), groups that showed on average a significantly higher relative frequency in grazed areas (herbaceous legumes and non-legume forbs) and groups that decreased in these areas (shrubs). Goat grazing has a significant effect on vegetation structure in the study area, increasing the frequency of the functional groups necessary for the maintenance of grazing. How some functional groups respond to grazing depends on inter-annual climatic variability. Therefore, assessing the effects of goat grazing on ecosystems requires a long-term approach.



E-45

### **Using local resources to improve food self-sufficiency in livestock**

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Livestock producers in the Canaries depend on imports for animal feed. Only 9 % of agricultural is produced locally; well below the 25 % recommended for a balanced economy. Annual production from the 490,000 ruminants in the Canaries is 153 mill L of milk, 13 mill kg of meat, plus manure. Animals consume about 300,000 tm of concentrates at year and practically all the ingredients are imported. Moreover, a large part of the 67 % of the imported forage is poor quality and expensive. According to official figures, only 26,000 tm of forage is produced and much of this is not used effectively. Feeding regimes based on local forage and grazing would considerably improve the supply chain for Canarian livestock feedstuffs. Use could also be made of agro-industrial by-products from harvest residues and food processing waste, supplemented by imported primary products. To achieve these aims, there are a number of actions that could be undertaken. Short term actions (1-3 yr): collect and compare existing technical information and results, and engage with producers; plan activities according to the local climate; establish a series of trials (for research farms and producing farms); re-integrate previously cultivated land that has now been abandoned; establish nurseries for seed and native forage plants and grasses; construct simple infrastructures to store forage and the agro-industrial by-products effectively and establish low-interest credit and fair prices for local meat and dairy products. Medium term actions (3-5 yr): evaluate the success of the short-term plan and continue to develop it; create a scheme for low-cost hire of agricultural machinery and equipment; found a laboratory to assess nutritive value of feedstuffs, thereby assisting producers to improve marketable yield and establish conditions that permit the cultivation of some of the primary products that make up the concentrates. Long term actions (+ 5 yr): undertake research to improve the quality of local grasses and forage; examine the potential use of fire-breaks in the forests for controlled grazing and assisting in the prevention of forest fires and establish technical training courses and workshops. Agriculture has a vital role in stewardship of the countryside and environmental protection. To ensure the survival of the region as a tourist attraction, business development must be enabled in the agricultural sector to secure the supply chain in addition to reducing leakage from the local economy.



E-47

### **Overview of the Chinese Goat Industry**

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China is located in the southeast of Asia and it has the most complex geographic environment in the world. Thus, there are many different breeds of goat formed in China. In recent ten years, the goat inventory of China kept around 150 million head and the inventory of 2010 was 142 million head. With the improvement of people's living standard, more and more Chinese pursue healthy diet. And because of high protein, low fat and low cholesterol included in chevon, the consumption of chevon increased rapidly. At the same time, policies for protecting the environment such as returning grazing land to grassland, forbidding grazing, rotation grazing had been implemented in the north of China, which made the augment of goat's number has been limited. As a result, the supply of chevon can't meet the demand. The price of chevon went up quickly and the market had to depend on import. As the traditional use of goat, the yield of its fur and milk had kept rising every year. In China, a large proportion of goats were raised by thousands of general peasant households, but the large scale farms increased rapidly in the meanwhile. The level of raising meat sheep and goat on a scale had reached 21.01 percent. This paper takes a graphical look at the goat industry of Chinese agriculture over the past quarter century (1986-2010) drawing on statistical data from China Statistical Yearbook, China Animal Husbandry Yearbook and the Food and Agriculture Organization.





E-48

**Validation of participatory methods to identify sustainable indicators subjected to an improvement program in the goat production systems in Lara State, Venezuela**

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A methodology of the Assessment Framework Management Systems Incorporating Natural Resources Sustainability Indicators (MESMIS) was validated with the aim of identifying indicators subjected to improvement programs in the goat production systems in two communities in semi-arid state of Lara, Venezuela; in which the productive potential of the system is considered a priority because of the economic and the social and environmental impact to occur. The activity was held in collective workshops where farmers selected, measured and assessed according to indicators of environmental, social and economic, depending on how they perceive and understand their environment, with the help of facilitators who will provide for a participatory research approach. The application of the method in the two communities led to five indicators of sustainability subject to a breeding program for both Cauderales (sustainable agro-biodiversity, food security, use of records, level of employment and marketing) to San Jose de los Ranchos (coverage grass, farm type, utilities, education and marketing programs). The use of this method is recommended, for being efficient and a reliable alternative to design and implement plans and rural development programs that promote sustainability in the region.



E-49

**Technical and economical records in the *Capra hircus*-*Aloe vera* production systems in the community of Cauderales, Urdaneta Municipality, Lara State, Venezuela**

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This research was developed in the semiarid region of Cauderales in Lara state, Venezuela, located at 290 m.o.s.l and within 10° 34' 9" North Latitude and 69° 42' 20" west longitude, with an average temperature of 28.3°C and an average precipitation of 500 mm. Records of 15 farms belonging to the Production Innovation Socialistic Red (PISR) of goat-Aloe were evaluated. Surveys with open and closed questions and interviews were conducted. The data collected was analyzed through the frequency analysis and correlation. The results indicated that 64% of the farmers are older than 40 years, 44% had elementary school level and 52 had more than 20 years of work experience in the field, 20% are dedicated to goat rearing and 27% to aloe cropping and 53% to both activities. On the other hand, 80% had used production records and only 12% had received instructions in those matters. With regard to the kind of record used, 75% of the farms took information of the kid births, 50% took information about health problems, 34% recorded the incomes and outcomes, 20% kept records of the machinery and equipments, 13% had records of the surroundings such as kind of soils, trees and water supplies and 100% had documents of land properties. Same wise, 26% of the farmers considered that the main reason to keep records is for decision taking. It can be concluded that the majority of the farmers had used some kind of record in their farms, with a high tendency of using technical records, there was no evident correlation within variables such as age of the farmers, instruction level, kind of economic activities, participation in formal organizations and previous courses about record with regard to the production records.



E-50

### **Introducing Canarian goats in Senegal to improve goat milk production**

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Senegal is a country where livestock accounts for 7.4% of the national GDP and 30% of the primary sector. The livestock population includes 3.2 million cattle and 8.5 million sheep and goats. Local milk production is low and 60% of domestic demand is met by imports. The local milk production system relies on climatic conditions with higher production during the rainy season and a slowdown and even stoppage during the 9 month long dry season. The goat is present in all Senegal cultural realities. Traditional goat farmers raise with local breeds, Sahelian and Dyallonké goat, hardy but with a very low milk production, often mixed with sheep and cows under extensive conditions. The hardiness of Canarian goats especially in their Majorero breed goes along with high yields and excellent adaptation to aridity. These goats could contribute to self-sufficiency in milk and milk products due to their adaptation to the harsh environment of Senegal, their short production cycle and their ease of husbandry. The significance of goat constitutes an interesting nexus between Canaries and Senegal, moreover the differences of the breeds exploited and the production systems can be the basis for sharing knowledge in different areas and enrich both countries. In order to turn Senegal's goat production into a sustainable source of income, introduction of new productive genotypes like Majorera and applying modern feeding management practices by introducing forage crop and by-products to economize the diet are necessary. The main objectives of these projects of Canarian Government (GANAFRICA Project and AECID-Canarian Cooperation Project) is to deal with several issues, such as the dissemination of milk goat farming increasing and providing dairy production among the rural population and the sustainability of production systems with the possible coexistence between local and high production breeds. Nowadays 128 Majorera goats have been already introduced in Senegal. 54 of them have gone to Research Centres and experienced farmers where different feeding and productive experiments will be carried out. The rest will be exploited in the north of the country by a cooperative in a new installation in order to a profitable production allowing a genotype distribution among local farmers. At the same time Senegal farmers and technicians have been trained in Canary Islands in forage crops and by-products, milking practices, feeding and reproductive management and cheese production.



E-51

**Tolerance to abiotic stresses in Egyptian desert sheep and goats raised under hot-dry conditions: Response to natural and acute heat stresses**

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The study aimed to assess the physiological response of desert Barki goat and sheep to both natural and acute heat stresses, under the hot-dry conditions of the North-Coastal Zone, of Egypt. Sixty ewes and twenty-six does were exposed to natural heat stress (NHS) under direct solar radiation between 1200 and 1500 h in July and August, 2009. Exposure to natural heat stress significantly increased ( $P < 0.001$ ) most of the studied biological parameters while decreasing heat production in both sheep and goats. Tidal volume, decreased also with NHS but more in sheep than in goats. It seems that the main thermoregulatory mechanisms of tolerance to NHS in the desert Barki sheep were heat dissipation through respiration while decreasing their heat production. Desert goats relied mainly on reducing their heat production when exposed to NHS. A heat stress tolerance index was developed to assess individual animal response to natural heat stress based on the changes in respiration rate, rectal temperature, tidal volume and heat production. The distribution of heat stress index in goats was more towards the two tail-groups than in sheep (35 and 23% vs. 27 and 12%, respectively). To assess the response of the two species to acute heat stress (AHS), 68 desert Barki ewes and 31 Barki does were confined in a climatic chamber of  $> 41^{\circ}\text{C}$  for 120 min., in April 2010. Their rectal temperature was measured in 3-minutes intervals. Thermal profile of both species best fit mathematically to the "Fourier Series Polynomial" function ( $R^2 > 0.87$ ). The initial rectal temperature of goats in response to AHS was mild, 90% of them has less rectal temperature than  $40^{\circ}\text{C}$ . Fifty percent of the sheep have initial rectal temperature  $> 40^{\circ}\text{C}$ . Goats attained the peak of their rectal temperature within 20-30 minutes, after which, they showed a descending slope in their thermal response towards  $39.0\text{-}39.5^{\circ}\text{C}$ , till the end of the trial Barki sheep showed a rather plateau-shaped in their thermal profile, around  $40^{\circ}\text{C}$ , during the whole exposure period, which may reflect more efficient biological homeostasis mechanisms of desert goats than sheep. Response to both natural and acute heat stresses indicate better tolerance of the indigenous desert Barki goats to heat stress than the Barki sheep under the hot dry conditions of Egypt.



E-52

**Working with goat producers with participative methodologies: Experiences at  
Lara state, Venezuela**

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This paper has been aimed at determining the evolution of methodologies and approaches to research and development (R & D) of goat breeding at (National Institute of agricultural Research) INIA of Lara state Venezuela from 1966 to 2011. The research is the product of systematic analysis of information generated by INIA Lara. The outcome was the identification of the characteristics of the actions (R & D) and the guiding principles of them in the 6 analyzed periods, for defining these were used processes generated by: organizational changes and response to environmental demands. We conclude that the approach of the processes (R & D) in goat breeding in INIA Lara has undergone a major change from the first projects in the mid-60's, to designing action strategies, projects and programs directly with producers today, and that the appropriation of power by communities is a fundamental aspect for the consolidation and development of goat farming, therefore the effective participation and coordination between stakeholders in decision-making is the most important guidance action.



E-53

**Goat (*Capra hircus*) cheese price fluctuations at San José de los Ranchos zone,  
Torres municipality, Lara state, Venezuela**

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This article shows the analysis of goat cheese price fluctuations at farm level in the community of San Jose de Los Ranchos, Lara state, Venezuela, during 2000-2008. The raw data were obtained through interviews carried out to goat small farmers and cheese gatherers of the zone. The secondary information was taken from official statistics. To analyse price fluctuations it was used Price Level Adjustment (LPA) and national price index for the consumer (NPIC), taking into account year 2007. The results show an increment of goat cheese nominal prices at farm level and a decrease of constant prices (reexpressed), with a price variation average of 33% and 3,4%, respectively. It can be concluded that the price increment to nominal values was lower to the inflation growth in three of the studied years.



E-57

### **Dairy goat grazing management: analysis of its profitability**

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Goat grazing systems offer important environmental, sociological and nutritional advantages. Nevertheless, the number of grazing goat holdings has decreased slightly in the majority of EU countries. But in the three last years, there has been a change. Feed prices have gone up and there has been a decrease in milk prices, which have made that some farmers to go back to grazing their goats. The aim of this communication is to analyze different grazing management and its relationship with profitability of farms. Data from 16 farms located in Sierra de Cádiz (south of Spain) was collected by monthly monitoring during 2011. A total of 42 indicators were calculated, which were related to feeding management, milk productivity and feed and milk prices. A first, factorial, data-reduction analysis was carried out using the method of principal components. Thus the explanation of 86% variance and 2 factors were obtained. These factors were: use of pastures and forages and size of farm. After, three groups of farms were found using a cluster analysis type k-average: low (LG), medium (MG) and high grazing (HG), with 2, 9 and 5 farms, respectively. In general, grazing farms showed high milk production seasonality: 29% of milk was sold in the first trimester of year, 41% in the second, 20% in the third and 10% in the fourth. The productive and reproductive management allows a better use of grazing resources; as the highest goat feed demand coincides with the highest pasture offer (spring and autumn in the Mediterranean basin). Such, Net energy obtained from grazing is rather similar among trimesters: 34% for the first one, 47% for the second, 39 for the third and 32 for the fourth. The different feeding strategies used by farmers are reflected in the Net energy obtained from grazing (50% for HG versus 37 and 16% in MG and LG farms, respectively). Taking into account all farms, feed purchased represent the highest feeding cost (mean of 71%). The mean cost of rented land and crops are 23% and 5%, respectively, although only half of farms have such costs. The highest difference between milk income and feed cost per year worker unit corresponds to HG farms (20830 €), whilst lowest values are found in MG and LG (9200 and 6800 €, respectively). A high size of flock (665 goats), a big surface (423 ha), a good productivity (328 L sold per goat and year) and an optimum use of grazing area, are the key to obtain the best profitability for HP farms.





E-58

### **Weed control, soil nutrient change and goat metabolic condition with goat grazing**

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The uncultivated area has been increasing all over Japan. The area is overspread by wild grass, causing worse scenery and damaging with blight, insects and wild animals. Thus, the weed control in the area is required in recent years. As a countermeasure against the weed control, livestock grazing has been introduced. Among some animal species were applied for clearing grass, goats were reported to have positive effects on the weed control. However, little information was available on the practical management of goats for weed control. Besides, the effects of goat grazing on soil nutrient change and metabolic condition of goats were still ambiguous. Therefore, this study was conducted to evaluate the effects of goat grazing in uncultivated land on weed control, soil nutrients and goat metabolic condition. The study was conducted at an uncultivated land in the Experimental Farm, Faculty of Agriculture, Meijo University. The grazing field (4 a) and control field (outside of the grazing field) were prepared. The grazing area was fenced with an electric net, had a water trough at one end. Five quadrates (0.5 m × 0.5 m) were set in each field. Two Japanese Saanen goats were intermittently released into the grazing field from May to August in 2011. The goats were fed 800 g fresh weight (FW)/head/day of rice straw, 90 g FW/head/day of barley and 70 g FW/head/day of wheat bran during the experiment. Weed species, height and density of each weed species in the quadrates were recorded. Soil samples were collected from 5 cm depth in the quadrates at the beginning and end of experiment, and analyzed the contents of nitrogen, phosphorus and potassium. Blood samples of goats were taken fortnightly except in the late of June, then metabolic contents of blood plasma were analyzed. The remained grass in the quadrate at the end of experiment was collected for measuring dry matter (DM) amount. The goat grazing decreased the height and density of major weed species, *Bromus catharticus* and *Duchesnea chrysantha* (the reduction rate: 18.4% to 31.2%). Thus, the weed species were sufficiently controlled by the grazing. The goats removed 18.0 kg DM of grass using 145 hours in the grazing area. Thus, the amount of cleared weeds with goat grazing could be shown as 62.1 g DM/head/hour. The phosphorus content of soil in the grazing field was significantly increased (from 0.20% to 0.28%), though the concentration of nitrogen and potassium tended to be decreased and maintained during the experiment (from 0.31% to 0.27% in nitrogen, from 0.49% to 0.49% in potassium). Although the content of non-esterified fatty acid in blood plasma was increased at the end part of the experiment (above 300 µEq/l), the triglyceride concentration tended to decrease at the same times (below 20 mg/dl). These changes indicated the energy deficiency of goats during hot season. The application of goats for weed control and phosphorus supply to the soil in the uncultivated area was effective. However, the provision for energy deficiency of grazing goats during hot season was required.



E-59

**Six years of targeted selective treatment against gastrointestinal nematodes in a mixed sheep and goat herd in the tropics**

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The aim of the study was to design and test a targeted selective treatment (TST) scheme that would reduce the number of adult female goats and hair-sheep treated with an anthelmintic (AH) in a herd kept under sub-humid tropical conditions. The study was performed from January 2006 to December 2011. The animals used the tropical forest as the main source of food (20°52'07'' N; 89°37'24'' W). Rainfall in the area is concentrated from May to December (mean of 960 mm per year). The flock consisted of a commercial mix of Pelibuey hair sheep (average 48 females per year), and the local Criollo Goats (average 127 females per year). Once a month, all the females were monitored using the TST scheme which includes the FAMACHA© and a body condition score (BCS) scheme (where 1 was emaciated and 5 was fat). Animals showing FAMACHA© scores 3, 4 or 5, and/or a low BCS (1, 2) were fecal sampled to determine their fecal egg counts (EPG) using a McMaster technique. Animals with more than 750 EPG were treated with an effective dose of levamisol (dose according to the ruminant species). The same procedure was followed every month. Goats had 3 times more chances to score a low BCS (1, 2) than sheep (OR = 3.07; 95% CI = 2.8-3.4;  $P < 0.0001$ ). Also, goats had 16 times more chances to show a FAMACHA© 4-5 than sheep (OR = 16.16; 95% CI = 10.6-24.7;  $P < 0.0001$ ). As a result, goats had 1.6 times more chances of being sampled to determine their EPG than sheep (OR = 1.66; 95% CI = 1.5-1.8;  $P < 0.0001$ ). Nevertheless, the use of FEC helped to keep a similar proportion of goats needing an AH treatment compared to sheep (OR = 1.40; 95% CI = 1.21-1.63;  $P < 0.0001$ ). On average, the proportion of animals needing no AH treatment in a year was similar between sheep and goats (54.6% and 45.4%, respectively). Sheep and goats needing one treatment per year were 31.9% and 30.9% respectively, two AH treatments were 11% and 14.5% and three or more treatments per year 2.6% and 8.9%. In conclusion, the TST programme implemented allowed to reduce the use of AH drugs and nearly half of the animals needed no treatment.



E-60

**Participatory rural appraisal (PRA) with goat farmers at North Natural Park in Boavista Island (Cape Verde)**

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In the last years, the tourist development in Cape Verde is pushing to a part of active population from primary sector to service sector, resulting that farmers' activity is reduced and as consequence, depopulation and landscape damage of many rural areas occurs. A Rural appraisal was done with goat farmers in the North Natural Park of Boavista Island, using a participatory methodology. The main objective was to know the actual situation of agrarian sector and to facilitate to rural population perceptions of their reality and improve their capacity to make decisions in the resolution of their problems. The PRA process (Chambers, 1992, Tillmann and Salas, 1994) took place at the beginning of April 2006 and during ten days 15 goat farms were visited and different tools were used, including Venn diagrams, maps, seasonal calendars and time lines to answer questions including use of natural resources, traditional goat cheese production and distribution, agrarian sector organization, etc. Open meetings were organized the last two days where farmer analyzed their problems and gave the possible solutions. The most important problems detected were: 1) lack of water for irrigation due to a bad state of dams and lack of maintenance of them; 2) expensive cost of imported rations from other cavoverdian islands and lack of local production of raw materials to feed goats make that goats farmers don't feel the necessity of keeping goats inside corrals; 3) hygienic-sanitary deficiencies in goat management and in goat cheese elaboration have repercussions on low rentability and a low income level at the farm; 4) low or null professional associations due to lack of leadership and low participation of farmers in the agrarian associations existed. In general, the agrarian sector of Boavista Island is characterize for small dimension farms (agricultural and goats herds), individually production, traditional formation and limited technical assistance. Agrarian activity at Boavista is very important at the North Natural Park due to that many people work in this sector that has a great influence in domestic economy. In addition generational change was assured due to 73% of farmers are less than 45 years old. It is necessary a major consciences of regional government to promote local agrarian products link to a sustainable use of local natural resources trough associations.



E-61

**Monitoring controlled goat grazing effects on landscape structural properties**

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Introduction of goats into a Mediterranean nature park leads to changes in cover of woody vegetation as well as changes in landscape properties. The aim of this study is to develop a procedure for planning and monitoring goat grazing in an agro-pastoral farming system. Goats used for this research were of Damascus and Mamber breeds, which are commonly raised in the Eastern Mediterranean region. This research took place at the "Ramat-Hanadiv Nature Park," (450 Ha) located at the south of Carmel mountain ridge, an area dominated by dense Mediterranean shrubland. The goat herd (150 head) grazes all year round, at certain GIS-defined polygons (sites) of various sizes (2-20 hectares). The yearly grazing plan was designed for management of areas in which a dense woody thicket is not the desired landscape, or to reduce the cover of an undesired species. Grazing can take place in several polygons in parallel according to food availability, shrub phenological stage and management objectives. Each polygon was chosen by specific requirements of park ecologists. A yearly plan was formulated where during each season goats had to graze at specific polygons. A compatible monitoring protocol was developed and spatial and temporal changes in vegetation composition and structure were recorded. Monitoring included ground surveys and aerial photo classification and analysis. Measuring woody cover by both methods has led to similar results, although data analyzed from aerial photo classification were more accurate, when applied at the whole site level. Changes in landscape structure indices, such as patch size, patch density, or edge density can be more easily measured by aerial photo classification, but they reflect a two-dimensional picture and overlook the fact that goat browsing influences vegetation mainly beneath the canopy. More relevant parameters, such as vegetation height distribution, cover of the understorey layer, dimension of gaps, or shifts in community composition can be detected exclusively by detailed ground surveys. In order to evaluate the extent to which the landscape was visually altered by goat browsing, an index (BLD) was developed and applied to data obtained from ground and aerial photography. Changes in woody cover and landscape structure were measured on both spatial and temporal basis. A combination of parameters and methods is proposed in order to obtain maximum efficiency of the monitoring program.



E-63

### **El Hierro Island, sustainable management**

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In semiarid regions, the reduced availability of good quality green fodder has limited the livestock development and ruminant feeding is largely dependent on concentrated feeds. In Canary Islands about 2/3 of total forage consumed by livestock feed are imported. El Hierro Island, as a Biosphere reserve, has to develop innovative approaches towards a balanced relationship between mankind and nature. In order to minimize the unsustainable ruminant feed management, a geographical information system is design to improve natural resources management. Soil-plant relationship determines the nutrient cycles in the rhizosphere. Analyzing climate, soil and plant data, different zones are determined assigning variable grazing capacity in pasture zones and determining optimal ones to cultivate forage crops both rain fed and under irrigation. The climate of the islands varies greatly depending on altitude, the orientation of the mountain systems, the influence of the trade winds, the cold Canarian marine stream, and orography. The north and northeast, which are influenced by the trade winds, have a humid and cool climate, whereas the south is more arid and hot. The study area comprised the major natural pastures and fodder crops areas of the island at altitudes ranging from 300 to 1200m. Soil reaction ranged from slightly acid to slightly alkaline. Average bulk density was 0.95 t m<sup>-3</sup>. Total Organic Carbon (TC) increased with altitude, the amorphous aluminosilicates components of the soils have probably contributed to the relatively large levels of soil TC. Previous studies have determined that three factors can be described in soils: the first, including soil carbon and N associated with soil management; the second, a lithogenic one loading on Mn, Fe and Cu and, the third grouping P and Cd associated by both. The nutrient concentrations in plants, related to soil properties, are similar to those obtained in mixed pastures composed mainly by grass species for P, slightly higher for Cu and lower for K and Mn. Nitrogen values corresponding to a crude protein of 12%, are not enough to supply an equilibrated diet for ruminants so more legumes must be introduced. Also, as low N mineralization rates in Andosols could contribute to explain these values, micorrization could be implemented. Forage C4 crops under irrigation can be cultivate in the warmer part of the island. In the west part of the island, better grazing practices must be implemented in order to avoid erosion.



E-64

**Balance of five years of a plan of development of production and marketing in short-circuits of fresh and processed meat goat in region Poitou-Charentes (France)**

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The annual production of goat kids in region Poitou-Charentes (France) represents more than 260.000 animals for a turnover of around six millions €. From the cultural point of view, kid goat meat participates of the traditional gastronomy in the region. Nevertheless, this goat meat sector is neglected for several decades by the actors of the programs of research and development. In 2007, the goat professional leaders of the, Regional Federation of the Goat Farmer Associations of Charentes-Poitou (or FRESYCA) decided to recruit a person to develop the production and the marketing of goat meat in short circuits, whether it is fresh or processed. The major stakes are the raising of the production of kids and the reforms by optimization of breeding practices and the commercial development. As an example, the valuation of a kid sold in 3 days is 3 € against 26 € if he (it) is manured for a month (for a 12-€ gross margin). Also, the price of one goat of reform is from 10 € to 15 € in lively while the product of one goat transformed into pâtés can reach 380 € (for 150-€ of margin). This development plan includes four lines of work: setting up a quotation of kids, realization of a study of techno-economic references on fattening workshops of kids, training in the processing of products with goat meat and actions of promotion and marketing. In 2012, several breeders, farmers or milkmen are committed in the production and the marketing of goat meat (of kids or goats of reforms), whether fresh or processed (sausage, pâtés, rillettes, dried meat, recipes in jars, etc.). A weekly quotation of kids became institutionalized, technical documents were drafted, a website is developed ( [www.terredeschèvres.fr](http://www.terredeschèvres.fr)), methodological tools are given to all. This article proposes a summary of results for five years thanks to this regional development plan of the meat short-circuits from the goat sector. Now, the ambition is to expand actions in favor of goat meat sectors nationally and internationally.





E-66

### **Adaptability of Saanen goats raised in semi-arid northeast of Brazil**

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The aim was to evaluate through of the Iberia test the adaptability of Saanen goats raised in the semi-arid region of Northeastern Brazil. The experiment was conducted at the Experimental Farm of Universidade Estadual Vale do Acaraú, in Sobral, state of Ceará, Brazil. Twenty Saanen goats, raised in semi-intensive system were used. The animals had with access to grazing on native caatinga and supplemented with a diet of crude protein, minerals and water ad libitum. The climate is of type BSH'w, megathermal. Rainfall and temperature have annual averages of 888.9 mm and 30°C, respectively. The meteorological data recorded were: dry bulb temperature, wet bulb temperature and wind speed, with the data been collected at the same time of the physiological variables. From these data the Index Globe Temperature and Humidity (BGT) were calculated, showing values of 92.12 and 95.05 for dry and rainy seasons, respectively. The physiological characteristics studied were rectal temperature (RT), respiratory rate (RR) and cardiac frequency rate (CF), which were collected in both periods, in the morning and in the afternoon. The RT was measured by digital thermometers inserted in the rectum of the animal for one minute. RR was measured by the movement of the flanks/minute with the aid of a timer and HT was obtained with a stethoscope placed directly into the left thoracic region, by counting the number of breaths for 30 seconds and the value being multiplied by two, thus determining the beats per minute. The coefficient of heat tolerance (CTC) was determined to the according the Iberia test using the formula  $CTC = 100 - [18(TR - 39.1)]$ . The results were subjected to analysis of variance and compared by Tukey test at 5% by SAS®. It was observed difference between periods for RT (39.1°C) and CF (92.45mov/min) during the rainy season, in the afternoon. There was no difference between the dry (58.03) and rainy (58.69) seasons in afternoon for RR. The dry season had higher CTC (107.59) compared to the rainy season (99.49) in the Iberia test. Thus, using test Iberia the animals were outside the zone of thermal comfort with the exception of the rainy season. Although the animals can maintain homeothermy during the rainy season, the combination of climatic elements, particularly at high relative humidity, imposes a degree of thermal discomfort, causing the animals to trigger the mechanisms of dissipation of body heat.





E-67

**Constraints to production, transformation and marketing of goat production systems and products in Lara and Falcon states - Venezuela**

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The International Center for Agricultural Research in the Dry Areas (ICARDA) in collaboration with the Project for the Sustainable Development of the Dry Areas of Lara and Falcon States (PROSALAFa II) and the National Institute for Agricultural Research (INIA) in Venezuela conducted (July-August 2006) an assessment of key factors that gravitate on dairy goat production in six communities of Lara and Falcon states, Venezuela. The objective was to assess production constraints in production, transformation and marketing of goat products. Producers, intermediaries y consumers were targeted. Participatory workshops involved 165 and 335 producers in Lara and Falcón states, respectively, and 49 and 403 intermediaries and consumers, respectively, around main markets. Most important production constraint is water scarcity associated with poor water harvesting. The unrestricted use of communal land for grazing, leading to range degradation is another constraint. Facilities are poorly equipped with few having feeders, water reservoirs, milking and a processing facilities. The average herd size of 120 goats, low proportion of productive does (58%) out of which only 20% produce milk at 0.66 kg/animal/day, 36% kid mortality. Kidding occurs year-round with no market targeting schedules. Goat production systems operate on a rigid distribution of family labor. Migration, mainly involved the youth. Processing of milk is scarce because of low productivity, marketing problems and low prices, though no information on market prices is generalized for most farmers. Training on animal health, critically requested in a site specific fashion, should consider this specificity for effectiveness. Farmers are eager to be engaged in barn and feeding system improvement, goat breeding and cheese processing. Consumers' preferences for the goat cheese of this region open possibility for diversified cheese production and for other goat-milk derivatives, as some of these products can be obtained only by importing. Consumers are interested in product origin and quality an issue for appropriate interventions with impact chance. Technical cheese elaboration problems reflect on cheese quality, particularly the salting of cheese. Adequate policies to facilitate the marketing of a product, enforcing quality standards and underlining its denomination of origin will be critically needed in this context.



G-8

### Milk yield and lactation length in goats in tropical conditions

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Total (TP) and 210d (P210) milk yields, and days in lactation (DL) were evaluated in a confined multibreed goat herd, in a tropical environment, and milked 1x. A total of 171 records was analyzed using a linear mixed model that included as fixed effects: age at calving ( $AC_i$  for  $i = 2, \dots, 8$  or more years), year ( $Y_j$  for  $j = 1, \dots, 8$ ) and season ( $CS_k$  for  $k = 1, \dots, 4$ ) of calving, prolificity ( $PR_m$  for  $m = 1, \dots, 3$ ), breed group ( $BG_l$  for  $l = 1, \dots, 6$ ); and as random: buck, and the (co)variables previous dry period (DP) and days in lactation (DL). All sources of variation, but PR ( $P > 0.05$ ), affected ( $P < 0.05$ ) TP, all but CS and PR ( $P > 0.05$ ), affected ( $P < 0.05$ ) P210, and DL was affected ( $P < 0.05$ ) by AC, Y, and CS, but not affected by PR, DP and BG. The averages for TP, P210d and DL were  $195.23 \pm 6.03$  kg,  $156.76 \pm 4.60$  kg and  $239.24 \pm 4.33$  days, respectively. BG 1/2Canary1/2Alpine had a higher production over all other genotypes, with maximum difference between breed was 53.74, 51.55 kg and 34.47 days, over 5/8 Canary, for TP, P210d and DL, respectively. Goats 5/8 Canary had a trend for higher frequency of shorter lactations. The TP, P210 and DL increased with each level of AC up to the age of 6 years, with maximum differences of 75.15, 86.38 kg and 67 days, for TP, P210d and DL, respectively. The biggest differences among Y for TP, P210d and DL were 134.34, 144.27 kg and 72.6 days, respectively. The trend of Y was to diminishing as the years went by, probably related with the fact that it is a farm in growth and with budget problems. The maximum differences among CS were 72.6, 33.4 kg and 100.43 days, for TP, P210d and DL, respectively. Goats calving in September had longer DL and higher TP. The DP had an average of 131.15 days. For every additional day over the average, the TP and the P210d had a reduction of 0.18 kg and 0.14 kg, respectively. The DP did not affected DL ( $P = 0.36$ ). The DL had an average of 239.24 days, and for every additional DL there was an increase of 0.72 kg on TP. It can be expected differences among breeds in TP and P210 on tropical condition, as well as for some non-genetics effects on the variation in TP, P210d and DL, as well as a higher production and longer DL of BG 1/2Canary1/2Alpine over all other genotypes.



## G-16

**Growth Modeling of Teddy goat thriving under desert conditions**Abdul Waheed<sup>1</sup>, Muhammad Tariq<sup>2</sup>, Muhammad Masood Tariq<sup>1</sup>*(1) Faculty of Veterinary Sciences, Bahauddin Zakariya University, Multan; (2) Animal Husbandry in the Tropics and Sub-Tropics, University of Kassel, Germany.*

The objective of this study was to define suitable model for the growth studies of Teddy goat of Pakistan. Growth data on 74 Teddy goats was analyzed to estimate growth curve parameters using different non-linear models. These goat were maintained at Livestock Experiment Station, Rakh Ghulaman, district Bhakkar (Pakistan). Different non-linear regression models including Gompertz, Brody, Bertalanffy, Monomolecular, logistic, Richards, and Weibull were fitted. The values of parameter 'a', the asymptotic weights from these models were 28.2, 33.1, 28.9, 33.1, 27.1, 28.2 and 27.9, respectively. The values of the turning point, 'b' were 1.30, 1.12, 0.82, 0.17, 2.54, -3.63 and 27.02, respectively. The corresponding values for parameter 'c', the growth rate were 0.39, 0.17, 0.33, 0.70, 0.61, 0.40 and 0.06, respectively. The R<sup>2</sup> values for these models ranged from 96.8 to 97.9%. Brody and Monomolecular models showed higher estimates than other models and showed the best fit to the growth pattern of Teddy goat. Asymptotic weight was affected significantly ( $P < 0.05$ ) by season and type of kidding while sex of kid(s) born had no effect on these parameters. It was concluded that Brody's model would be used for modeling growth in Teddy goat.



G-17

**Phenotypic characterization of Mohammad Puri goat breed in Pakistan**

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The objective of this study was the phenotypic characterization of Mohammad Puri goat breed in Pakistan. Qualitative and quantitative data on 65 female 16 male Mohammad Puri goats were recorded for phenotypic characterization. Animals were white coat colour, leggy and sturdy. Males having longer horns than females with pointed ends. Horn length averaged  $12.4 \pm 0.76$  cm and  $16.5 \pm 1.16$  cm in female and males, respectively. Head length, neck length, ear length, ear width and mouth width showed sexual dimorphism and averaged  $16.8 \pm 2.20$  cm vs.  $21.0 \pm 1.26$  cm,  $19.4 \pm 0.36$  cm vs.  $22.5 \pm 0.85$  cm,  $25.5 \pm 2.05$  cm vs.  $33.2 \pm 1.10$  cm,  $11.4 \pm 0.26$  cm vs.  $13.0 \pm 0.30$  cm and  $2.54 \pm 0.10$  cm vs.  $3.1 \pm 0.16$  cm in female and males, respectively. It is a newly evolved breed previously remained unnoticed for many years and though to be outcome of crosses between Beetal and Teddy goat breeds. This information would be helpful in exploring the potential and future research on different aspect of this particular breed.



G-18

**Molecular cloning and tissue-specific expression of the heart-type fatty acid-binding protein (H-FABP) in goats**

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Heart-type fatty acid binding protein (H-FABP) is an intracellular molecule engaged in the transport of fatty acids through myocardial cytoplasm. The H-FABP supplies long-chain fatty acids (LCFAs) as an important energy source for muscle growth and maintenance, and also directs LCFAs towards fat storage within muscle fibers. In order to understand the structure and function of heart-type fatty acid-binding protein (H-FABP) in goats, the cDNA of H-FABP gene was cloned and sequenced from the heart of Tianfu goat using T-A clone technique. In China, Tianfu is an emerging goat breed with promising productive performance. The structure and function of H-FABP were analyzed by bioinformatics, and the gene expression profile in various tissues was examined by real-time PCR. A predicted 3D model was constructed by homology modeling. The results indicated that the full sequence of H-FABP cDNA is 650 base pair (bp), containing 402 bp coding region and encoding 133 amino acids. The isoelectric point of the protein is 6.11, and the molecular weight is 14.7 kDa. There were eight phosphorylation sites in this protein. The secondary structure of the protein was mainly  $\alpha$ -helix, random coil and extended strand. The deduced amino acid sequence of H-FABP shared significant identity with H-FABP from other mammals. The phylogenetic tree based on H-FABP protein sequence was closely related to that of cattle. The H-FABP mRNA is a broad-spectrum expression gene that was detected in heart, liver, spleen, lung, kidney, *longissimus dorsi* and crureus. In particular, high expression levels of H-FABP mRNA were detected in heart, *longissimus dorsi* and crureus; but low expressions level was observed in liver tissue. The reported study defined the structure and function of heart-type fatty acid-binding protein (H-FABP) in goats.



G-19

**Molecular cloning and tissue-specific expression of the liver-type fatty acid binding protein (L-FABP) gene in goats**

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It has been suggested that L-FABP may play a longer-acting role in regulating hepatic fatty acid oxidation/metabolism by participating in an intricate interplay between both cytoplasmic and nuclear receptor proteins that bind and are activated by dietary long chain fatty acids. The objectives of the study were: (1) to understand the structure and function of liver-type fatty acid binding protein (L-FABP) gene; (2) to determine the effect on the fatty acid binding in goats; and (3) to locate the molecule marker correlated with meat traits. The cDNA of L-FABP gene was cloned and sequenced from the liver of goats using T-A clone techniques. The structure and function of L-FABP were analyzed by bioinformatics, and the gene expression profile in various tissues was examined by real-time PCR. A predicted 3D model was constructed by homology modeling. The results indicated that the full sequence of L-FABP cDNA is 405 base pair (bp), containing 384 bp coding region and encoding 127 amino acids. The secondary structure of the protein was mainly  $\alpha$ -helixes, extended strands and  $\beta$ -turns structure. The deduced amino acid sequence of L-FABP shared significant identity with the L-FABP from other mammals. The phylogenetic tree based on L-FABP protein sequence in goats was closely related to that of cattle and pig. An L-FABP specific product was generated by RT-PCR in various tissues, the amount of L-FABP mRNA in liver and kidney was higher than those in heart and skeletal muscle, and it was not detectable in lungs. The study suggested that L-FABP gene could be regarded as an important candidate gene linked to fatness traits that could improve meat quality in goats.



G-20

### **Molecular cloning and tissue expression of caprine calpain 1 gene**

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The objectives of the study were to molecularly clone and determine tissue expression of calpain 1 gene in goats. Calpain1 gene is closely related to meat quality in livestock and poultry, but has not been cloned in goats. Calpain 1 is known to be responsible for meat tenderness and is involved in the breakdown of the muscle fibers at slaughter process of converting muscle into meat, and its subsequent aging. Based on the bovine mRNA sequences (GenBank accession number: AF22119), the cDNA of calpain1 was amplified successfully for the first time in Tianfu goats using T-A clone technique. Results showed that the full-length cDNA of calpain 1 was 2151 base pair (bp) encoding a protein with 716 amino acid residues and contained three conserved domains, a catalytic activity region, and a catalytic activity center. Bioinformatics analysis indicated that the secondary structure was mainly  $\alpha$ -helix and random coil, and contained rich hydrophilic regions, certain phosphorylation loci, and protein kinase A/C loci. Caprine calpain 1 was identical to calpain1 in other mammals. Tissue expression of the gene was detected in heart, liver, spleen, lung, kidney, *longissimus dorsi*, and crureus. The expression was the highest in crureus from goats 6 month of age. Gene expression of calpain1 in internal organ tissues was significantly different from that of *longissimus dorsi* and crureus. The studies demonstrated that calpain1 could be an important candidate gene for meat tenderness in selective breeding in goats.





G-21

### **Cloning, structural analysis and expression of cardiac troponin C1 (TNNC1) gene in goats**

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Cardiac troponin C1 (TNNC1) is the calcium-binding subunit of the myofibril thin filament that regulates excitation-contraction coupling in cardiac muscle. Genes involved in myoblast differentiation and muscle contraction are potentially related to meat quality. In the study, we cloned TNNC1 gene in goats for the first time (GenBank accession number: HQ640744) and analyzed its tissue expression. Results indicated that TNNC1 was a 161-amino acid polypeptide that had been highly conserved during evolution. Its nucleotide sequence was similar to various animals ranged from 97.94% (cow) to 83.33% (African clawed frog), and the identity of encoded amino acids was resembled to cows (100%) and smelt (92.55%). Fluorescence quantitative PCR analyses revealed that the TNNC1 gene selectively expressed in muscular tissues of goats. It expressed in cardiac tissue and slow skeletal muscle (soleus), but not in fast skeletal muscle (*longissimus dorsi*, *gluteus maximus*), brain, kidney, lung or liver. The amino acid residue of Ca<sup>++</sup> binding site II was identical in mammals, avian and fish. This study provided insight into the molecular structure, expression patterns and evolution of TNNC1 gene in animals, and a theoretical basis for the application of gene manipulation in goat production.



G-22

### **Environmental and genetic variation sources of dairy traits of Polish goats**

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In the Polish market circumstances goat raw milk production comes first to cheese production though an increasing trend for goat cheese demand is apparent. Hence, improvement of both milk volume and fat/protein contents seems a justified breeding goal. The purpose of this study was to analyze the structure of the Polish dairy goat data and to indicate non-genetic and genetic variation sources for milk, fat, protein yields, and fat and protein contents. The data set comprised 18,563 lactations of 8,938 goats, while 6 generation pedigree included information on 13,159 animals. To evaluate the impact of environmental effects an ANOVA model included herd-sire interaction as a random and herd-year-season of kidding, breed, litter size, parity, year of birth and regression on day-in-milk as fixed effects. To estimate co(variance) components the REML method with the VCE package was applied. Observations were treated as repeated within animal. Average number of lactations per goat was 2.1. About 30% of the goats lacked data on their sires and dams. Most of the daughters were mated with bucks which were used in two or three herds in which six to ten sires were used in total. Average inbreeding coefficient was 0.61%. The yield traits were affected by all investigated factors except the breed. Goats which bore more than two kids had highest milk, fat and protein yields of lowest content of milk components ( $P < 0.01$ ). The first parity goats had lowest milk, fat and protein yield ( $P < 0.01$ ), but highest fat content ( $P < 0.01$ ). Milk yield kept increasing till 4th lactation. Heritabilities for dairy traits were moderate (0.21, 0.18 and 0.19 for milk, fat and protein yield and 0.23 and 0.27 for fat and protein content, respectively). Repeatabilities ranged from 0.30 for milk, through 0.28 for fat, to 0.27 for protein yields, and 0.25 and 0.28 for fat and protein contents. Genetic correlations between milk yield and fat and protein contents were negative and moderate (0.27 and -0.30), correlation between fat and protein contents amounted to 0.58 and those between milk, fat and protein yields ranged from 0.71 to 0.86. Correlations between fat yield and its content and for protein yield and its content were positive and moderate (0.35 and 0.23). The ratios of dairy traits' variance components for the Polish dairy goats do not differ from such ratios in other goat populations.



G-26

### **Identification of differentially expressed genes in anagen and telogen of Inner Mongolian Cashmere Goat**

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The objective of this study was to characterize the mode of gene expression in skin in anagen and telogen. Gene expression profile of Cashmere goat skin in anagen and telogen were studied via Functional Classification Microarray and in situ hybridization in this study. The results revealed that, compared with the newborn goats on March, 33 genes were differentially two-fold or greater. Among these 33 genes differentially expressed, 8 genes were up-regulated, the percentage was 3%, whereas 25 genes were down-regulated with the percentage 9.5%; Compared with the adult goats on September, 35 genes were differentially two-fold or greater. Among these 35 genes, 4 genes were up-regulated; the percentage was 1.5%, whereas 31 genes were down-regulated with the percentage 11.8%. Compared with the adult goats on September, 49 genes were differentially two-fold or greater. Among these 49 genes, 5 genes were up-regulated; the percentage was 1.9%, whereas 44 genes were down-regulated with the percentage 16.8%. Bioinformatics analysis revealed that for all genes differently expressed two-fold or more above, 6 genes (POU3F3, POU5F1, UTF1, KGF, Integrin  $\alpha$ 6, Trk C and BMP2) were associated with hair follicle development, which could be recognized as candidate gene in future studies. Also, the bioinformatics analysis results reveal that most differently expressed genes were monitored to be relative with cell signal transduction and cell development, which were mainly belong to nucleotide binding, protein binding, DNA binding and ion binding molecule. And these genes were usually located at cell envelope. Real-time quantitative PCR was employed to quantify the BMP2 expression in adult Inner Mongolia Cashmere goat skin. The expression of BMP2 in telogen was 27.8 times greater than expression during anagen phase. No significant change in the level of the expression of  $\beta$ -actin (house-keeping gene) was observed at anagen phases. Results of in situ hybridization indicated that BMP2 expressed at hair shaft in secondary hair follicle in telogen. However, it was found to be absent in anagen. It suggested that BMP2 gene could be recognized as the reference gene in hair follicle development in future study.



G-27

**Characterization of Hoxc9 gene expression in hair follicle of embryonic Inner Mongolia Cashmere goat (*Capra hircus*)**

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The objective of this work is to study the expression of Hoxc9 gene in both primary and secondary hair follicle by the method of RT-PCR and in situ hybridization in the embryonic period of Inner Mongolia Cashmere goat. Skin samples, which were collected from the middle of fetal bodies every 10 days at the age of 75d to 135d, were made into skin paraffin section, and RNA were isolated from them. The fragments of Hoxc9 gene of Inner Mongolian Cashmere goat were amplified by PCR and cloned into pGEM-T vector, and probes and primers were designed according to the sequences. The results of RT-PCR analysis showed that Hoxc9 gene expressed during different fetal stage. The positive signal of Hoxc9 gene was detected in hair follicle of Cashmere goat by situ hybridization. The results revealed that Hoxc9 gene began to express firstly in epithelial cell at 75d, then expressed in hair matrix, dermal papilla, inner root sheath, outer root sheath and hair shaft along with development of hair follicle. Meanwhile, lots of keratinocytes proliferated during this process. It suggested that Hoxc9 gene could be an important determinant for hair follicle proliferation.



G-28

**The influence of inbreeding depression on economic traits in Inner Mongolia  
Cashmere goats**

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The objectives of the present study were to calculate the individual inbreeding coefficient and to analyze the possible inbreeding depression on economic traits of Inner Mongolia Cashmere goats or individual increases in inbreeding coefficient  $F(i)$  for the quantification of inbreeding depression. The pedigree file of the Inner Mongolia Cashmere goats included 34,339 animals born from 1990 to 2011. Only animals with at least 2 equivalent generations of known pedigree were included in the analysis of inbreeding effect on birth weight, weaning weight measured at approximately 120 d, and body weight, cashmere weight, cashmere thickness, staple length, fiber diameter, fiber length at yearling. The maximum value of inbreeding coefficient was 31.64% for animals. The average generation interval was 4.57 for the breed. The average inbreeding coefficient was 2.93% for Inner Mongolia Cashmere goats. Inbreeding depression was observed for most of traits in this study. The inbreeding coefficient were divided into eight groups according to the  $(1/2)^n$ . The results obtained by GLM procedure indicated that inbreeding coefficient had significantly effect on birth weight, weaning weight, body weight, cashmere weight, body weight, staple length and fiber diameter of Inner Mongolian Cashmere goats. By regression analysis, there were -0.0045 kg, -0.0391 kg, -0.0495 kg and -2.81 g per 1% increase in inbreeding coefficient for birth weight, weaning weight, weight and cashmere yield at yearling, respectively.



G-32

### **Preliminary report on the Ibicenca or Pitiüsa goats breed growth**

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The Ibicenca or Pitiüsa goat is one of the most endangered goat breeds in the world. In order to rescue the breed, a program has recently been initiated during these years, starting with the characterization of morphological variables and its genetic characterization. This paper describes the study of the functional characterization of the breed, to reintroduce their products back into its traditional framework, in terms of both, a zootechnical and commercial context. The preliminary analysis reflects the behavior of the growth of Ibicenca or Pitiüsa kids, as well as the incidence that their gender and type of calving are going to have over it. Weights (kg) at birth (BW), at 15 (W15), 30 (W30) and 70 (W70) days of life, of 99 (52 males, 47 females) animals born in 67 calvings (41 simple: SB, 61%; 26 double: DB, 39%) were registered. Daily average weight gain facts (DWG15, DWG30, DWG70) were also obtained from the measured weights. GLM procedure of SAS Statistical Software was used to test the effects of gender and type of calving. The gender factor showed no significant difference in any of the variables, while birth rate showed significant difference ( $P < 0.01$ ) in all variables apart from DWG30 and DWG70. Averages and standard deviations depending on the type of calving, SB and DB respectively, were BW:  $3.68 \pm 0.58$ ,  $3.11 \pm 0.45$ ; W15:  $6.32 \pm 1.2$ ,  $4.87 \pm 1.01$ ; W30:  $8.44 \pm 1.63$ ,  $6.93 \pm 1.65$ ; W70:  $12.61 \pm 1.45$ ,  $11.18 \pm 0.89$ ; DWG15:  $2.67 \pm 0.98$ ,  $1.7 \pm 0.61$ ; DWG30:  $2.12 \pm 0.69$ ,  $2.14 \pm 0.81$ ; DWG70:  $3.96 \pm 1.35$ ,  $3.54 \pm 1.07$ . Finally, the most propitious equation to describe this stage of growth from the commonly used models found in literature was analyzed through NLIN SAS procedure. The most suitable adjustment of the growth equation was different according to the type of calving: While Von Bertalanffy equation,  $y=a*(1-b*exp(-k*t))$ , resulted to be the best for SB, Verhulst model,  $y=a/(1+b*exp(-k*t))$ , turned out to be the best for DB. The adjustments, according to R<sup>2</sup>, were 97.78 and 97.51 respectively. The result for each type of calving equations were: SB,  $y=15.62*(1-0.38*e^{-0.02*t})$ ; DB,  $y=12.87/(1+3.14*exp(-0.04*t))$  ( $y$ =weight in kg,  $t$ =time in days). It could be concluded that the type of calving has an important effect on the growth of the Ibicenca or Pitiüsa kids until they have reached their 70 days of life, as commercial age.



G-33

### **Characterization of the Grey Goat of Lanzo Valleys (Fiurinà), a new Italian dairy population**

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Genetic diversity, geographical distribution, breeding systems, morphological characteristics, milk production performance, and milk quality of the Grey Goat of Lanzo Valleys, a new Italian dairy goat population, were revealed in a 3-year study. Only about 150 heads of this breed exist, including it among the animal genetic resources at risk of extinction. This goat, locally named Fiurinà, is only reared in few alpine valleys (from 400 to 1,400 m a.s.l.) of the Piedmont region (NW Italy). Data were collected in about 20 farms, breeding approximately the 50% of the whole Fiurinà population. The genetic uniqueness of the breed was pointed out by means of microsatellite and mitochondrial DNA analyses, the latter highlighting for the first time the presence of sequences belonging to the haplogroup C in an Italian goat breed. Extensive or semi-extensive farming systems are practiced in all the flocks. When fresh grass is available, the goats graze on pasture, while in winter the diet is exclusively based on conserved forages. The breed is of medium size, with a quite high frequency of well-developed and turned backward horns. The distinctive morphological trait of the breed is the color of its fleece: a mixture of white, grey, and black coarse outer hairs with brown under-down, from which the local name “Fiurinà” (= speckled) derives. Mammary apparatus evaluation shows that udder is usually pyriform and well supported with symmetric, directed downward and cylindrical-shaped teats. An appreciable, although quite variable, milk yield (from 1 to 3.5 L/head/day) was recorded. Milk fat, protein, casein, and lactose contents average 3.58%, 2.99%, 2.45%, and 4.41%, respectively; such values are similar to those reported in the literature. Despite hand milking is practiced in all farms, milk has a low number of somatic cells, indicating correct milking practices. Among fatty acids,  $\alpha$ -linolenic acid shows a notable concentration (0.82 g/100 g fat), representing a promising nutritional aspect due to the beneficial effects of this fatty acid on human health. The genetic uniqueness of the breed is also confirmed by casein polymorphism analysis: the casein cluster is characterized by an interesting and wide variability, which includes the presence of rare and unique haplotypes (i.e., A-C-F-C’, E-A-C-B, F-C1-F-C’). A comprehensive knowledge on Fiurinà breed characteristics constitutes the basis for effectively supporting and safeguarding this livestock genetic resource.





G-34

### **Effect of Short-chain Fatty Acids on GPR41 and GPR43 expression in Goat Mammary Epithelial Cells**

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The objective of this study was to investigate the effect of Short chain fatty acids (SCFAs) on activation of G Protein-coupled Receptor 41 and 43 (GPR41, GPR43) in goat mammary epithelial cells (GMEC) and to evaluate their effects on lipid metabolism regulation through their receptors. In this study, GPR41 and GPR43 genes were cloned from dairy goat mammary gland by RT-PCR. Sequencing analysis indicated that the coding region length of GPR41 and GPR43 was 978bp and 987bp respectively. The GPR41 and GPR43 sequences were deposited in GenBank (HM013824 and HM623658). Both GPR41 and GPR43 proteins have seven transmembrane helices predicted by TMpred software. Relative expression levels of GPR41 and GPR43 in GMEC were detected by Semi-quantitative Real Time PCR. The results showed that GPR41 has obviously a higher expression than GPR43 in GMEC. In order to determine whether SCFAs could enhance the expression of GPR41 and GPR43, GMEC were pre-treated with different concentrations (0, 0.1, 0.3, 0.5, 1, 5, 7, 10 mM) of propionate for 24h. Real Time PCR analysis indicated that there were no significant changes in the expression of GPR41 comparing with that of control. By contrast, there was a trend toward increased GPR43 mRNA expression in GMEC. To confirm the effects of butyrate and propionate on adipogenesis of GMEC, GMEC were incubated in DMEM/F-12 containing 3 mmol/L propionate and butyrate respectively for 24h. Oil red O staining of neutral lipids indicated that SCFAs stimulated lipid accumulation significantly, and butyrate stimulated lipid accumulation more than propionate. Furthermore, we also detected the mRNA expression of genes including GPR41, GPR43, LEPR, FASN, TIP47, HFABP and SREBP1 by Real Time PCR. The results showed that propionate could significantly increase the levels of GPR43 and LEPR mRNA, and the levels of TIP47 and HFABP mRNA were also slightly increased, but there were no remarkable changes in the expression of GPR41, FASN and SREBP1. It is concluded that SCFAs have obvious effects on activation GPR43 but not GPR41 in GMEC, and SCFAs signals may regulate the lipid metabolism in mammary epithelial cells by stimulating GPR43 expression.



G-37

**Y-chromosome haplotype diversity in domestic goats**

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In goats, domestication process has been mainly studied by using mitochondrial DNA markers. As much as six different lineages and a very weak phylogeographic structure have been revealed, suggesting very old migration processes and at least two independent domestication events in Asia. However, neither the geographic locations of the original stocks nor the routes of migration have been established. Interestingly, the information provided by Y-chromosome polymorphisms may be complementary to that of mitochondrial DNA and thus it may clarify the origin of domestic goats. In this work, we have sequenced seven regions of the Y-chromosome from 24 different goat breeds distributed worldwide. Our preliminary results agree with two independent domestication processes and suggest at least two migration routes from East to West: a Northern one linking Asia and Europe, and a Southern one that may have reached the Iberian Peninsula through Africa.



G-39

### **Rosiglitazone regulating the activation of PPAR $\gamma$ in Goat Mammary Epithelial cells**

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As a factor of nuclear transcription and adipogenesis, PPAR $\gamma$  closely connects with the maturity, proliferation and differentiation of fat cell and it has become the research focus of fatty acid metabolism. However, few articles in respect to the function of PPAR $\gamma$  during milk lactation are published. The objective of the experiment is to investigate the function of the gene during the process of lactation. We constructed Luciferase vector containing 3 consensus PPREs (PPAR response element). Goat mammary epithelial cells were cultured in the DF-12, at 37°C in 5% CO<sub>2</sub>, to assess the PPAR $\gamma$  activation, cells at 80% confluence were transiently transfected with luciferase reporter along with RL-TK as a control, its ratio is 25:1. After a 24-h recovery period in serum-free medium, cells are treated with rosiglitazone. After the transfections, cells are treated with 0, 10, 25, 50, 100, 200  $\mu\text{mol/L}$  rosiglitazone. The result suggests that the treatments with different concentrations of PPAR $\gamma$  agonist cause different effective activation of promoter plasmid. It shows that the activation of the PPAR $\gamma$  is promoted gradually under the 100  $\mu\text{mol/L}$  rosiglitazone, but decreased at 200  $\mu\text{mol/L}$ . Maybe the cells are harmed by the high concentration of DMSO. It also revealed that the activation of PPAR $\gamma$  in cells treated at 50  $\mu\text{mol/L}$  rosiglitazone is much higher than that of cells without luciferase reporter. The result is verified by the repetition of the same experiments in MCF-7 cell. Treated with 50  $\mu\text{mol/L}$  rosiglitazone about 24h, the total RNA of goat Mammary epithelial cells was extracted. We detected the genes relative to fatty acid metabolism through qRT-PCR. It showed that the expression levels of many genes containing LPL, FASN, ACACA, GPR41, HSL, TIP47, BTN1, ADRP, ATGL, SCD, SREBP, LXR $\alpha$  increased significantly. Cloning the PPAR $\gamma$  gene of dairy goat, we constructed recombinant adenovirus vectors, and then Packaged and amplified of recombinant adenovirus to over-express it in cultured goat mammary epithelial cells. The change of genes relative to fatty acid metabolism were detected by real-time fluorescence quantitative PCR after treatment with adenovirus for 48h. Its results indicated that only few genes expression changed compared with the control. However, the expression levels of many genes included AGPAT6, DGAT2, CD36, SCD, ACACA increased greatly after treatment with rosiglitazone and recombinant adenovirus together compared the group of treatment with rosiglitazone and r



G-42

### **Further evaluation of the interest of resilience traits in the genetic improvement of Creole goat**

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The high economic loss of small ruminants' production due to gastrointestinal nematodes (GIN) infection coupled with an increasing number of nematode resistant to anthelmintic drugs, stimulated alternative approaches that sustainably reduce nematode effects. Breeding for animals that have better resistance/resilience to nematode infection is one of the promising alternative approaches and advocated as the strategy that creates possible sustainable change in worm control. Fecal egg count (FEC), as an indicator of host resistance and packed cell value (PCV), as an indicator of resilience to GIN, have been widely studied in Creole goats in particular and in goats in general. The aim of this ongoing study is to estimate genetic variability of resilience criteria using PCV, kid's growth rate depression due to GIN and number of treatments (Ntrt) and their genetic relationship with resistance trait, FEC, in Creole goats. A total of 8521 records on 4722 animals, collected for 15 years at INRA-Gardel experimental farm Guadeloupe (French West Indies Caribbean Island), were analyzed. Growth rate depression of two groups of half-sib fattening kids (3-11 months of age) raised at nematode infected (GRi) and non-infected (GRni) pasture, and number of treatment (drenching requirement) of suckling does based on FAMACHA© score, were recorded. A sire model was fitted to kid's growth rate depression and an animal model was fitted to the other traits. Only fixed effects that had significant effect on the variables were included in the analysis. The heritability and repeatability for PCV and Ntrt was  $0.14 \pm 0.02$ ;  $0.27 \pm 0.01$  and  $0.12 \pm 0.09$ ;  $0.26 \pm 0.04$  respectively. From our knowledge, this is the first estimation for genetic parameter of Ntrt. The heritability estimate of log transformed FEC was  $0.19 \pm 0.04$  and for growth rate traits estimates were situated in intermediate range ( $0.16 \pm 0.02$  for GRni and  $0.23 \pm 0.03$  for GRi). The genetic parameters estimated for PCV and log transformed FEC in this study are consistent with previous studies in Creole goats. The genetic correlation between GRni and GRi were  $0.42 \pm 0.32$ . Although the precision of estimation is low, it seems that the growth with and without GIN infection are different traits. The work will continue on improving statistical models, estimating correlations with resistance traits as well as assessing the impact of resistant breeding on these resilience criteria.



G-43

**Gene expression profile of a Moxoto male prostate gland**

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Moxoto is a remaining goat native breed from northeast region of Brazil. The certified pure Moxoto breed now exists only a few brazilian northeastern farm flocks and at the livestock for breed conservation maintained by Empresa Brasileira de Pesquisa Agropecuaria Caprinos e Ovinos (EMBRAPA-CNPC, Sobral-CE). Our work aimed to characterize the transcriptome of several tissues from Moxoto due to its strong rusticity which gives the breed the hability to survive and reproduce in adverse conditions of climate and very dry grazing ground. The present study reports the first transcriptome of a Moxoto male prostate gland defined using Applied Biosystems SOLiD sequence data and CLC Bio® bioinformatic analysis. 35 million raw sequence reads were assembled into 532 single contiguous sequences using as reference the NCBI Bovine genome sequence, the duplication tax into this cDNA library was 29.39%. The minimum length of the contigs was 200bp and maximum length 906 bp. The average contigs length was 286 bp. 532 Moxoto prostate putative proteins were characterized based on homology. We found expressed several classes of proteins such as cytochromes, ATPases, heat shock proteins, Na<sup>+</sup>/K<sup>+</sup> transporters, kinases, dehydrogenases, mutases and others. Overall, the present dataset provide information for future genomic, proteomic, and metabolomic explorations that will ultimately contribute for genetic knowledge and conservation of this brazilian native goat pure breed threatened of extinction. We also expect that our data could give useful information for programs of goat genetic improvement for reproductive efficiency worldwide.



G-44

**Genetic diversity and differentiation in Iberian goat breeds**

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This work was carried out in the framework of the CONBIAND network, which is a scientific society aimed at studying and promoting the genetic diversity of different livestock species in Iberoamerica. A set of 22 microsatellite genetic markers recommended by FAO/ISAG for genetic diversity studies with goats were used to analyze a comprehensive sample of the goat breeds currently recognized in Portugal and Spain. Overall, 27 Iberian goat breeds were analyzed, including 8 breeds from the Balearic and Canary islands. The mean number of alleles/locus was lowest in the Formentera breed and highest in Mallorquina and Florida. The expected heterozygosity/locus/breed ranged from about 0.6 to 0.71, except for the Palmera breed, where it was 0.51. The proportion of genetic variability accounted by breed differences was 0.077, while the within-breed deficit in heterozygosity was above 0.1 in the Blanca Celtibérica, Pitiüsa, Mallorquina, Serrana and Preta de Montesinho. The diversity among breeds, assessed by Nei's DA genetic distances, indicates the existence of an isolated cluster of Canarian breeds, while the other breeds tend to cluster with those with a close geographical distribution. Our comprehensive study of Iberian breeds indicates that the existing levels of genetic diversity are high in the majority of the breeds, but several breeds show levels of inbreeding which suggest that there is the need for programs aimed at management of their genetic diversity, to avoid further genetic erosion.



G-45

### **Demographic study and population structure of the Moxotó goat breed of Brazil**

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The Moxotó is considered a native goat breed, adapted to the semiarid condition of Brazil, having as its main characteristics the rusticity, prolificacy and leather quality. Its origin is the State of Pernambuco, Brazil, and it was recognized by the Ministry of Agriculture in 1974. This breed has lost genetic variability, and due to this, several studies have been undertaken to characterize it and to know its status or degree of extinction dangerous. In this study, population parameters of 572 animals of the Moxotó breed, born from 1984 to 2005, were studied to define the risk situation of the Moxotó breed in Northeast of Brazil. Data were collected using the archives of the Brazilian Goat Breeder's Association (ABCC). The pedigree analyses were done using the program ENDOG v. 4.8. (Gutiérrez & Goyache, 2005), based on the following population parameters estimates: The mean relationship (AR) and inbreeding ( $\square F$ ) population coefficients were not estimated. The effective population size ( $N_e$ ) per generation was 364.35 animals, and the effective number of founder ( $f_e$ ) animals was 88 and of ancestors ( $f_a$ ) was 89. Within the 89 ancestors, only 14 animals were responsible for 50% of the genetic variability of the population. The Wright statistics estimated by means of  $F_{is}$ ,  $F_{it}$  and  $F_{st}$ , by herd, were, respectively, -0.005954, 0.004485, and -0.001443. The negative  $F_{is}$  shows the absence of subdivision of the population due to the preponderance of matings among subpopulations, contributing to minimize inbreeding. The low number of individuals analyzed by state indicates the threat situation of the breed. When closed small populations are under concern, as the native animals, inbreeding increases each generation, since breeding animals have common ancestors. This was not observed due to the low number of animals, however the breed is in dangerous and the genetic parameters show it. The low number of animals refers only to registered animals, which represent about 1% of the existing population.





G-46

### **Demographic study and population structure of the Canindé goat breed of Brazil**

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The Canindé is one of the native goat breeds that present a defined breed pattern, besides a great productive potential to be explored for meat and skin. This breed suffered an indiscriminate crossbreeding process with several commercial breeds, risking its effective population size, and, consequently, its genetic potential. Additionally, this breed presents few studies aiming to get knowledge of its origin, productive potential and genetic diversity. During the last decades, the expressive introduction of exotic breeds in the country has caused impacts in goat biodiversity in Northeast Brazil. In this study, population parameters of 399 animals of the Canindé breed, born from 1996 to 2003 and 2007, in Northeast Brazil were studied. The base population, where one parent is known, is the effective founder number with 391 animals. The main objective was to define the risk situation of the Canindé breed in Northeast of Brazil. Data were collected using the archives of the Brazilian Goat Breeder's Association (ABCC). The pedigree analyses were done using the program ENDOG v. 4.8. (Gutiérrez & Goyache, 2005), based on the following population parameters estimates. The mean relationship (AR) and inbreeding ( $\square F$ ) population coefficients were not estimated: The effective population size ( $N_e$ ) per generation was 374.15 animals, and the effective number of founder ( $f_e$ ) animals was 8 and of ancestors ( $f_a$ ) was 3. Within the 8 ancestors, only 1 animal was responsible for 50% of the genetic variability of the population. The Wright statistics, estimated by means of  $F_{is}$ ,  $F_{it}$  and  $F_{st}$ , by herd, were, respectively, -0.005310, 0.003928 and -0.001361. The negative  $F_{is}$  shows the absence of subdivision of the population due to the preponderance of matings among subpopulations, contributing to minimize inbreeding. The low number of individuals analyzed by state indicates the threat situation of the breed. When closed small populations are under concern, as the native animals, inbreeding increases each generation, since breeding animals have common ancestors. This was not observed due to the low number of animals, however the breed is in dangerous situation and the genetic parameters show it. The low number of animals refers only to registered animals, which represent about 1% of the existing population.



G-47

### **Genetic polymorphisms and diversity analysis in Indian goat breeds with respect to CAPN1 gene**

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India has rich livestock diversity adapted to different agro-climatic zones and geographical regions. Livestock sector plays a critical role in the welfare of India's rural population. It contributes nine percent to Gross Domestic Product. This sector is emerging as an important growth leverage of the Indian economy. Calpains have been considered as candidate genes for carcass performance and meat quality traits in the farm animals. The micromolar calcium-activated neutral protease (CAPN1) gene encodes  $\mu$ -calpain that degrades myofibril proteins under the post-mortem conditions which appears to be the primary enzyme in the postmortem tenderization process. In this study, genetic polymorphisms of the CAPN1 gene among seven Indian goat breeds. Direct DNA sequencing has been done to identify the genetic polymorphisms in 42 unrelated samples from seven different goat breeds, ten single nucleotide polymorphisms (SNPs) were detected in CAPN1, one existed SNPs in exon 9 (5707 C/T), resulted in the change of amino acid arginine to tryptophan and the other polymorphisms were at intron 8 (5543T/C), intron 14 (4638T/C, 4689C/T) and intron 17 (6417T/G, 6499T/C, 6529T/C, 6533C/G, 6539A/G and 6542T/G). The observed heterozygosity ( $H_o$ ) was highest (0.50) in Sirohi and Osmanabadi breeds followed by Barbari (0.23) and Malabari (0.20). The least heterozygosity was found in Black Bengal (0.06) breed and the expected heterozygosity ( $H_e$ ) was highest (0.45) in Sirohi and Osmanabadi (0.37) followed by Barbari (0.34) and Malabari (0.19). The allele frequencies, the least allele frequencies ranged from 0.083 to 0.405 and the major allele frequencies ranged from 0.595 (locus 6499T/C) to 0.917 (locus 6529T/C). Black Bengal was found to be fixed in all the alleles except two locus 6417 T/G and 6533 C/G. The identity values oscillated from 0.7866 to 0.9593. The Nei's genetic distances were below 0.0294. The breeds Ganjam and Black Bengal had the lowest identity value (0.7866) which agreed with large distance 0.2400. Black Bengal and Osmanabadi had the highest genetic identity (0.9593) which agreed with the lowest genetic distance (0.0294). These polymorphisms will be used in further research for associations between gene polymorphisms and enzyme activity as well as caprine meat quality traits.



G-49

**Estimates of non-genetic effects of linear traits in Murciano-Granadina goats**

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This study presents the first phase of a research dedicated to the integration of morphological linear assessment methodology in the breeding program of the Murciano-Granadina dairy goat. Presently an experimental recording has been developed in order to test the suitability of the methodology and the human resources involved. In the present communication the results of the research on non-genetic factors on morphological linear traits are described. Seventeen linear conformation traits records were used in the present study: Stature, chest width, body depth, rump width, rump angle, angularity, bone quality, anterior and posterior attachment height, half superior ligament, udder width, udder depth, nipples placement, teat diameter, rear legs view, lateral legs view and mobility. The linear scoring evaluation was carried out in a random sample of 655 females belonging to 6 farms integrated in the breeding program of the breed. Using a fixed-effects factorial model were determined the effects of herd, kidding type, days of lactation and age of the goat. The determination coefficient ( $R^2$ ) of univariate models was used as an approximation to the estimation of the source of variation explained for the individual factors. The results of multifactorial analysis  $R^2$  showed that the model explains the greatest part of the variability. Herd, kidding type and age shown a significative effect in 15, 7 and 6 of the studied variables, respectively ( $P > 0.01$ ). According to the univariate analysis results, herd and age effects have an influence on the whole variability to justify its incorporation to the models applied in the genetic analysis, while the kidding type had not a clear influence to be taken into account in these models. Our results has been useful to optimize the structure of the genetic models, improvement the non-genetics sources of variation which are really affecting the morphological linear traits used in the animal qualification. This is a very important step to finally add these selection criteria to the Murciano-Granadina breeding program.



G-50

**Characterization of the Creole goat population of Guadeloupe (FWI) by pedigree data analysis, morphological measures and microsatellite markers**

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Goat breeding in the French West Indies is oriented toward meat production, and others features such as cultural traditions, gastronomy or leisure. In Guadeloupe, the goats belong to an admixed population, called Creole goat, inherited from the colonial history of the region, from various origins. This breed has very good adaptation traits and maternal characters, and achieve good level of productivity in semi-intensive grazing systems locally managed. Creole goat exhibit also a useful genetic variability for susceptibility to internal parasites, and is a model for studies on genetic resistance against these illness. Recently, a breeder association, particularly aware of the interest of this breed, decided to implement a selection program based upon this breed. The first step of this program consisted in a characterisation study of this population, mainly based on the flock maintained by INRA research station. This flock has been maintained isolated from years, with little introductions. The pedigree of the flock has been traced until the base population, around 1975. Coancestry coefficient and inbreeding of the animals were estimated using the PEDIG software. Based on the pedigree, a sample of 92 adults representative of the flock, from both sex (66 females and 26 males), and aged between 2 and 10 years, has been selected for a morphological description. 12 linear measures and 4 classifiers have been used to describe each individual. Blood samples were collected upon 25 individuals, and treated in LABOGENA facility; after DNA extraction, 12 microsatellites markers used for parentage testing in goat in France were analysed. These results were analysed with GENETIX software to describe the genetic diversity of the flock. The main results obtained on each type of information are presented and compared to published references. The mean inbreeding coefficient within the flock was around 3 % in the last generation. The Creole goat population is of medium size, compared to West African and Iberican breeds from which it is supposed to be derived. Genetic markers show a good diversity, with a mean number of allele of 5.8, smaller than indigenous breed from Africa but comparable to European breeds. The mean observed heterozygosity was 0.75 (upon the 12 markers), higher than the expected one (0.70), resulting in a Fis coefficient of -0.07. Despite the observed inbreeding, the genetic diversity appears to be maintained within the flock.



G-51

**The phylogenetic relationship and ecological regionalization of Chinese domestic goats by large-scale mitochondrial DNA analysis**

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Goat production is considered to be very important for its contribution to the development of rural area. China owns a great variety of domestic goat genetic resources. Some of the popular goats in China with potential genetic merit are the indigenous breeds for meat and cashmere. We present herein the phylogenetic relationships of 33 Chinese domestic goat breeds reared throughout China by systematical investigation into their mtDNA variability, then discussed the Chinese goat ecological regionalization with genetic information. The results showed that all goat breeds in this study proved to be extremely diverse, average haplotype diversity and nucleotide diversity being  $0.990 \pm 0.001$  and  $0.03234 \pm 0.00082$ , respectively. The 666 sequences gave 326 different haplotypes. Phylogenetic analyses revealed that there were 4 mtDNA haplogroups identified in Chinese domestic goats, in which haplogroup A was predominant and widely distributed. Our finding was consistent with archaeological data and other genetic diversity studies. Anova analysis showed there was significant geographical structuring. Almost 84.31% of genetic variation was included in the within-breed variance component and only 4.69% was observed among the 6 geographic distributions. China can be divided into six regions according to the climate, goat breeds and their performances and our research results of large-scale mitochondrial DNA analysis: northern pasture region, agri-animal husbandry integrated region, Qinghai-Tibetan high land pasture region; Southwest mountain region; north agricultural region and south agriculture region. Southwest China contains about 40% Chinese indigenous goat breeds representing special economic and ecological characteristics. This genetic diversity results further supported the previous view of multiple maternal origins of Chinese domestic goats, and the results on the phylogenetic relationship and ecological regionalization contributed to a better understanding of the history of goat domestication and modern production of domestic goats.



G-52

### **Morphological characterization and goat production system of Canindé Breed in northeastern Brazil**

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Characterization is an important strategy within a conservation program of genetic resources. Thus, this study aimed to characterize morphologically the production system Canindé breed goat in northeastern Brazil. Data were collected from 08 herds, distributed in the states of Paraíba, Rio Grande do Norte, Pernambuco and Bahia. Morphological characterization was based on information from 206 females. To characterize the production system, some aspects were considered related to feeding management, sanity and reproduction, through semi-structured interviews. For the morphological characterization, presence and absence of earrings, horns, beard, politetia and fur length were observed. The morphological variables were subjected to frequency analysis by state and by the FREQ procedure and principal component analysis with the help of the PRINCOMP procedure of SAS (1999). It was observed that most farmers interviewed raise their animals in extensive system, being the native pasture the basis of their feeding. All interviewed farmers receive technical guidance and all animals are vaccinated and dewormed. Only 12% of these farmers use bucks from other breeds, and in Pernambuco state it is clear the process of genetic dilution of the flock, with strong influence of the Anglo Nubian and British Alpine breeds. There was significant difference in the presence of beard ( $P < 0.001$ ) and politetia ( $P > 0.05$ ) among the four states studied, in which herds of Bahia had a higher frequency of beard (0.79 p. 100), less frequency in flocks of Rio Grande do Norte (0.21 p. 100). Most animals showed no politetia, which is a common feature in inbred herds. There was a higher frequency of short fur animals, horns and no earrings in herds on this study. Four principal components were necessary to explain a minimum percentage of 80% of the total variation on assessed data. In general, the animals of Canindé breed in Brazil are raised on extensive system; mostly having horns, short fur, no earrings with low politetia, and animals with beards can only be observed only in some locations. This study is a strong contribution for the preservation of the studied breed; a local resource of great historical, social and economic importance for the Northeast Region of Brazil.



G-53

### **Local knowledge applied to characterization of Moxotó Brazilian goat breed**

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Studies focusing on participation bring us close to the reality, being key elements for phenotypic characterization and description of the breed standard as a basis for conservation and breeding programs. The aim of this study was to characterize the native goat breed Moxotó in its center of origin, based on local knowledge. The research was conducted with 17 breeders of Moxotó goats from its origin centre, the Moxotó Valley, Ibimirim, State of Pernambuco, Northeastern Brazil. It was measured 302 animals (86 males and 216 females), for which it were taken Longitude of Head (LH), Face Longitude (FL), Head Width (HW), Ear Size (ES), Body Length (BL), Thoracic perimeter (TP), Withers height (WH), height of sacral region (HSR), rump width (RW), rump length (HL) and Perimeter of Cinnamon (CP) for those animals which breeders indicated as being more representative of the breed. The data were subjected to principal component analysis with the help of the SAS software (1999). It was observed that the selection criteria adopted by farmers are based on qualitative traits, with emphasis on type traits. They practice selection for other traits indirectly, especially for those associated with adaptability. In classical breeding programs, this method is usual and it is called indirect selection or correlated response. The ear size, important feature pointed out by farmers, is a result of visual choices, as seen in the statement: "If it has not small ear, a legitimate Moxotó it is not." This statement was unanimity among farmers involved in this research; also being a way to identify mixing with exotic breeds. The most used selection criteria in selecting the animals by farmers were the white coat with black stripe on the back, small ears, belly and black limbs, black triangle in the nape, presence of tears, no politetia in males. All these features are included in the official standard of the breed. In the principal component analysis for Moxotó females and males, it was necessary 4 and 3 components to explain 82.61% of the total variation on the data, respectively. The most important features for the characterization of females were TP, BL, HH, EL and HW; as for the characterization of males TP, WH, HL, EL and FL were the most important. The participation of farmers throughout the characterization process proved to be crucial for closer to reality, since it was clear that they have their own criteria for choice and selection of breeding stock.





G-54

### **Demography and population structure of the Murciano Granadina goat breed based on pedigree analysis**

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Murciano-Granadina is one of the most important goat breeds in Spain according to their census and it is the most censused milk production goat breed in that country. Studies assessing genetic diversity of this breed were made using microsatellite markers but pedigree analysis could give additional information to animal breeding plans and to management of the genetic diversity of this important breed. Population studies in farm or wild animals include, among other practices, studies of census and indexes that define the structure of these populations. Demography involves knowledge of the age pyramid, generation interval, migration and other processes. The study of population structure by pedigree analysis is useful to identify important circumstances that affect the genetic history of a population and to understand how the intensive use of a small number of superior individuals may reduce the genetic diversity of populations. The aim of this study was to analyze the demographics and population structure of the Murciano-Granadina goat breed with 24,444 pedigree data (12,120 males, 13,453 females) and at least one parent known provided by CAPRIGRAN (Asociación Nacional de Criadores de Caprino de Raza Murciano Granadina). The population structure was analyzed using the ENDOG software version 4.0. The average generation interval was  $2.77 \pm 0.016$  years; the average relatedness coefficient (AR) was 0.03%, the average inbreeding was 0.18% and the effective number of ancestors explaining 50% of the population was 366. The distribution of founder animals revealed that from 49 studied herds four were responsible for 42.5% of the genetic variability of the breed, indicative of a strong genetic bottleneck. The best distribution of offspring per father was obtained between 1992 and 1994 (9.84) and the best offspring per mother was obtained between 1995 and 1996 (1.31). The F index considering the 49 herds was calculated and it was obtaining values of 0.0030 (FIS), 0.0046 (FST) and 0.0016 (FIT). The results reveal a low level of genetic differentiation, according to the values found for FST. It is concluded that demographic and population structure using genealogical information is useful for assessing levels of diversity and population structure, important tools for the appropriate genetic management of these populations.



G-55

### **Genetic diversity and relationships among the new world Creole goats assessed by microsatellites markers**

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The present work aimed to study the diversity and genetic relationships among Creole goat populations. Microsatellite information was provided by BioGoat, a scientific consortium established within CONBIAND society which main objective is investigating the genetic signatures of Iberian breeds taken to the Americas. In the present study, nineteen breeds from ten American countries were sampled, including Creoles from Colombia (COL, 28), Bolivia (BOLIV,40), Argentina (ARGENT, 40), Paraguay (PARA, 84), Cuba (CUBA, 40), Galapagos Islands (GAG, 30), Ecuador (CEC, 12), Peru (PERU, 65), Venezuela (VEN, 50), San Clemente Island (SC, 104), Spanish (SPA, 25) and Myotonic (MY, 65). Furthermore, seven native breeds from Brazil were included: Moxotó, MOX (40); Serrana Azul, SAZUL (40); Canindé, CANIN (40); Repartida, REPAR (40); Graúna, GRAU (40); Marota, MARO (40) and SRD (40). Twenty two microsatellites proposed by FAO and ISAG (BM1329, BM1818, BM6506, BM6526, BM8125, CRSM60, CSRD247, ETH010, ETH225, HAUT27, HSC, ILSTS011, INRA63, MAF065, MAF209, McM527, MM12, OarFCB048, OarFCB304, SPS115, SRCRSP8 and TGLA122) were analyzed. Observed heterozygosity ranged from  $0.4713 \pm 0.0435$  in SC to  $0.7825 \pm 0.0209$  in PARA followed by SPA goats ( $0.7138 \pm 0.0355$ ) and SRD ( $0.7065 \pm 0.0379$ ). The lowest mean number of alleles was obtained in the GAG group (4.00), probably due to the geographical isolation of this breed and its reduced herd size. The highest value, however, was observed in PARA population (9.14). Estimated  $F_{ST}$ , obtained according to Weir & Cockerham, was 0.18. This value is very high compared with the values obtained in similar studies involving goat breeds from other continents. The neighbor-net constructed with the DA genetic distances showed that Creole populations from Brazil grouped together in the same cluster. SPA, ARGENT, PARA, BOLIV, COL and MY breeds clustered together while the breeds from islands (SC, GAG and CUBA) were the most distant populations. This is the most comprehensive study of the genetic biodiversity of goat populations from Creole breeds. The results obtained indicate that a high genetic diversity and genetic differentiation exists in the American continent, although most of the breeds included in the study are highly endangered and some populations show genetic diversity values which raise some concerns.



G-56

### **Breeding targets for dairy goats suitable for poverty alleviation in Uganda**

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The aim of this study is to determine the best strategy for developing a breed of goat suitable for household milk production under Ugandan conditions. The milk yields of indigenous Small East African Goats, European Dairy Goats and various grades of crosses, were measured under a zero-grazing management system similar to that used by goat improvement programmes in southern Uganda. These records were compared with the theoretical limits to milk production when using the feeds available to smallholders. In formulating a breeding strategy, consideration was given to field experience from various organisations relating to the health and survival of the various types of goat. No indigenous strain was found which was suitable as initial stock for a community-based selective breeding programme; the low milk production meant that too few would be milked, making selection impossible. European Dairy Goats were also unsuitable because the survival was very poor, and the numbers available were limited. Cross-breeds of around 50% dairy goat genetics provided the best option as starting stock, having reasonable disease resistance, good climate tolerance, and sufficient milk production potential to make them milkable in practice. The milk production of such cross-breeds was approximately 1.5 litres per day at 1 month after kidding, dropping to 0.5 litres at 6 months after kidding. This was much less than the 2 litres per day which theoretically could be supported on the feeds available. Based on these results, the most important productivity-related selection criterion is the late-lactation milk production.



G-57

**Italian Goat Consortium: 50K BeadChip analyses in autochthonous goat breeds**

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An Italian Goat Consortium has been established to analyse the genomic diversity of Italian goat breeds reared in different conditions from the Alps to the main islands. To date, blood samples have been collected from 12 breeds and a total of 288 unrelated animals. Genomic DNA has been extracted using commercial kits and genotyped with the 53.347 SNPs Illumina Infinium iSelectHD Custom Bead Chip. Here we show preliminary results on Orobica, Bionda dell'Adamello and Valpassiria breeds, reared in Central and Eastern Alps, in Northern Italy, and on Grigia Ciociara, reared in Central Italy ( $n = 90$ ). SNP call rate was on average  $0.99 \pm 0.016$  (average  $\pm$  SD). A total of 98.25% SNPs were polymorphic, 1.1% monomorphic and 0.5% gave no results. Observed average heterozygosity across breeds was  $0.38 \pm 0.11$ , while average expected heterozygosity  $0.41 \pm 0.11$ . The four breeds analysed had average MAF of  $0.32 \pm 0.12$ . Only 0.9% of SNPs were rare, and 97.6% had a MAF  $> 1\%$ . Moreover 12.5% of SNPs were out of HW equilibrium. The analysis of other 8 local breeds from the Alps, and from Sicily and Sardinian islands is in progress. Large scale genomic information produced by new technologies has potential application in the genetic improvement of economic traits, in the traceability of typical goat products linked to local breeds and permits to select SNP subsets informative for parentage analysis. In addition, a detailed assessment of within and between and breed goat diversity is useful to reconstruct goat population history and demography and in the management and conservation of genetic resources. Genetic and genomic innovation, coupled to research, can enhance the sustainable productivity and the competitiveness of goat farms that play a strategic role in the economy of marginal rural areas. The research was also supported by the project "INNOVAGEN" (Italian MIPAAF Ministry).



G-58

### **Aardi goat performance and adaptation in Saudi Arabia**

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In Saudi Arabia, goat husbandry is one source of income of farmers, represent 17% of livestock. Aardi goat is one of the indigenous Saudi goats, well-adapted to desert condition (El-Nouty et al., 1990; Alamer, 2006) they utilize water more efficiently at higher ambient temperature than Awassi sheep (Alamer, 2009, 2011). Transportation of Aardi goat is a stress challenge. High stocking rates and mismanagement and Climate change are the main problem in this matter. Leading to frequent and extended drought periods, is complicating the situation. The use of shrubs and trees as goats feed, while, Concentrate feeds used to tackle this objective. Alamer, (2009) Study the effect of water restriction on lactation performance of Aardi goats under heat stress conditions. Results show that live weight loss during water restriction was similar in both groups (8 and 6%) Milk production reduced by 20 and 18% with 50 and 25% water restriction. Al-Shaikh and Mogawer (2001) Study Factors affecting body weight of Aardi goat kids in Saudi Arabia including dam weight, litter size and kid sex on birth weight and weight gain from birth to weaning, Weight gains at 3, 6 and 10 weeks of age were higher in kids born to heavy than to medium or light weight dams. Male kids consistently had higher body weights and daily weight gain than female ones. Salah, et al. (1989) study body weight of Aradi goat kids in Saudi Arabia at different ages and affecting factors. Birth weight averaged 2.6-3.6 kg. Heavy dam produced heavy kid; Males were always superior for their body weights over females. El-Nouty, et al. (1990) study physiological responses, feed intake, urine volume and serum osmolality of Aardi goats deprived of water during spring and summer in order to evaluate the adaptability of Aardi goats to arid environment, and Alamer (2011) study water requirements and body water distribution in Awassi sheep and Aardi goats during winter and summer seasons. They notice that Feed intake was not affected by either season or species. During the winter season, Aardi goats had lower water intake in comparison with Awassi sheep. Aljumaah and Hussein (2012) study serological prevalence, while Al-Mufarrej, et al. (2011) study toxoplasmosis in goats in Riyadh, while Sawaya, et al. (2003) study physical and chemical characteristics of ghee and butter from goat's and sheep's milk. While Sawaya, et al. (2010) study on chemical composition and nutritive value of goat milk.



G-59

### Lactation Curve Parameters in Teddy Goats Using Wood's Model

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The present study was conducted to estimate the parameters of lactation curve of Teddy, one of the smallest goat breed in Pakistan. Teddy goat breed is famous for its prolificacy and animals of this breed thrive well in irrigated as well as rain-fed areas of the country. This breed has the largest population among other 25 goat breeds in the country. Teddy is found in different colours but white coat is the most prevailing one. Animals of this breed have short stature and compact body. Both sexes are horned but males have longer twisted horns. The does of this breed produce very small quantities of milk for about 70 to 90 days but reproduce more number of kids. Therefore, milk production throughout the lactation was studied in order to explore various facts about it. Milk yield data on does ( $n = 70$ ) kept at three different government farms (Rakh Kheirewala, Layyah, Rakh Ghulaman, Bhakkar and Chak Katora, Khanewal) were weekly recorded. Lactation curve parameters were computed using Wood's model (Incomplete Gamma Function of Wood). The initial yield ( $a$ ), rate of increase ( $b$ ) and rate of decline ( $c$ ) parameters in Wood's model for Teddy goats were 382.34, 0.4899, and 0.1571, respectively with  $R^2$  value of 93.5%. Peak yield (PY), time to reach peak yield (TPY) were 0.430 litres and 3.1 weeks, respectively. Percent squared bias (PSB), persistency and mean square error values were 0.37, 70.5 and 19.19%, respectively. After computation, the parameters were fitted in fixed effects model to test effects flock, parity, type of birth, sex of kid ( $s$ ) born and age of doe on them. Flock effects were significant for all the parameters, including PSB and persistency. Parity significantly affected only parameter ' $a$ ' and LMY. Type of birth was significant for TPY only. Sex of kid significantly ( $P < 0.05$ ) affected parameter ' $c$ ', TPY and persistency. Linear effect of age of doe was significant for ' $a$ ' and PY in Teddy goats. Quadratic effect of age was non-significant for all parameters. Lactation length significantly affected parameter ' $a$ ', ' $b$ ' and LMY. It is suggested that Wood's model may be used for explaining the lactation of Teddy goats. Information may be helpful in predicting lactation yield in Teddy breed especially in brood does when twins and higher kidding rates are observed in the breed.



G-60

### **The effect of age and body condition score on milk production and reproduction of Saanen goats**

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Body condition score, milk yield, number of kids born/doe, date of birth, and age of does were examined on 5 Saanen goat farms ( $n_1 = 37$ ,  $n_2 = 17$ ,  $n_3 = 45$ ,  $n_4 = 17$ ,  $n_5 = 80-90$ ). Body condition score and daily milk yields were registered monthly, five times from May to September on the first four farms, while on fifth one it was carried out during 3 years. New, 9-grade scale from 0.5-4.5 increasing by 0.5 point system was developed by the authors to measure body condition score. Relationship among body condition score (BCS), prolificacy, lactation number, milk production and age; repeatability and heritability of BCS, and heritability of milk yield were analysed. The repeatability of BCS was stronger than intermediate ( $r = 0.65$ ;  $P < 0.05$ ). The highest amount of milk was produced on the farms where BCS was 2.5 at the beginning of lactation (0-60 days), 2.7 in the middle of lactation (60-120 days) and 3.0 or more in the last third of lactation. These data were associated with 2.57, 2.51, and 2.25 kg/day/doe average milk production. On the other farms while the difference from these BCS increased, the level of milk production decreased. If the average BCS of a stock was lower than 2.0, the animals were not able to perform the expected milk yield and litter size. In this case they reached the lactation peak very early, on around the 20th – 30th days; followed by a significant decrease of milk production, while in a stock with good BCS, the peak production was observed around 60th day followed by a slight decline. The highest litter size was found in 4th-5th lactation at 4 or 5 years of age (2.18 by lactation number, and 2.19 by age); this litter size was reached beside a significant BCS decline (2.19). Four-year-old does performing their fourth lactation produced the highest amount of milk (2.46 and 2.49 milk kg/day/doe), and the peak production was reached by significant decline of BCS (2.20 and 2.19). The two-year-old does having second lactation had the best BCS (2.52 and 2.53), and their milk production significantly exceeded the one-year-old does. The heritability of BCS and milk yield were lower than the average, and their value could be significantly affected by environmental factors (feeding according to needs).





G-61

### **Racial characteristics and morphometric measurements of the Pampeana red goat (Cabra colorada pampeana)**

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Pampeana red goat is an important genetic resource in the region, with high rusticity and adaptation to the harsh environmental condition in which they lives. In order to establish the breed features as a local race and differentiate it from other regional goats, the phenotypic characteristics and morphological measures were performed. For the study, 533 non pregnant goats more than 3 years old from 50 flocks were analyzed. Qualitative variables included were: udder type, fronto-nasal profile, presence of beard and tassels, length and direction of ears, type of horns, coat characteristics, skin, mucous and hooves pigmentation, hair length and fineness. The animals were weighted and measured for: Head length (HL), Head width (HW), Face length (FL), Breast height (BH), Breast width (WB), Body length (BL), Rump length (RL), Rump width (RW), Height at withers (WH), Height at the croup (HC), Height at the tail base (HT), Thoracic width (TW), Shank circumference (SC), Thoracic circumference (TC) and Body weight (BW). According to the results, the Pampeana red goat has a straight fronto-nasal profile (76%) or subconvex (24%), arc (15%) or spiral-arc (79%) horns, clear face with short hair (100%), partially (38%) or totally (62%) pigmented skin, partially (46%) or totally (35%) pigmented mucous, short beard (90%), medium (56%) or long (39%) size ears with horizontal (52%) or down (47%) direction, long and wide croups, medium size neck with short hair in the front and ventral region, width and deep breast, strong legs with totally (46%) or partially (51%) pigmented hooves, secluded udder (87,5%), uniform fleece, with long (71%) to medium (29%), fine (96%) and silky hair, generally curly. Partial or complete seasonal shedding reveals a moderately thick and short hair. The color of the coat ranged from red to dark tan, with a more dark and thick line of hair in the dorsal body region. The quantitative variables, its average and variation coefficient, between brackets, were: HL:21,9 (5,02); HW:13,2 (4,74); FL:18,8 (6,10); BH:32,2 (5,99); BL:72,2 (5,71); WB:19,5 (8,95); RL:23,2 (5,38); RW:16,9 (8,88); WH:68,0 (4,89); HC:70,5 (4,67); HT:60,3 (6,16); TW:21,9 (14,07); SC:9,1 (6,25); TC:88,5 (5,71) and BW:51,1 (15,19). The morphological structure point out to a rustic and environmentally adapted animal, with strong osseous framework indicative of a meat type goat. Zoometrical measures have lower coefficient variation suggesting that the evaluated sample presents a medium to height homogeneity.



G-62

### **Genetic variability of the casein gene cluster in Sarda goat**

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In order to analyse genetic variability of the casein gene cluster, a survey was conducted on 935 Sarda breed goats (814 females and 121 males) belonging to 33 different farms. Genotyping was carried out with different specific PCR-based methods (RFLP, AS-PCR, SSCP). Allele frequencies, Hardy-Weinberg equilibrium and observed and expected heterozygosity were calculated using GenePop. Haplotypes were inferred using the PHASE program. Six alleles were evidenced at the CSN1S1 locus: A (0.202), B (0.520), E (0.030), F (0.242), N (0.001) and O1 (0.005). The major genotypes were BB > BF > AB > AF > FF. The CSN2 gene showed the A (0.375), C (0.597) and O1 (0.028) alleles and the most frequent genotypes were AC > CC > AA. Six alleles have been identified at the CSN1S2 locus: A (0.313), B (0.006), C (0.271), E (0.018), F (0.383) and O (0.009), with the following major genotypes CF > AF > AC. Eight alleles were found at the CSN3 locus (A, B, B', C, C', D, E and M), in addition to two haplotypes not yet identified, X and Y. The most frequent alleles were CSN3 A and B and the most frequent genotypes were BB > AB > AA. All the loci analysed, except for CSN3, were in H-W equilibrium for the population analysed. The highest values of observed heterozygosity were found in the CSN1S1 and CSN1S2 genes, with 0.621 and 0.689, respectively; the CSN2 locus showed 0.519 and CSN3 had 0.463. Interestingly, in males, for the CSN1S1, CSN2 and CSN3 genes, heterozygosity was higher than in females. The Sarda goat population showed 28 haplotype combinations with frequency > 1% at the casein gene cluster CSN1S1-CSN2-CSN1S2-CSN3. In females, seven of the inferred haplotypes showed frequencies > 5%, that is FCFB (0.134), BACA (0.091), BCFB (0.079), BCAB (0.068), BAAB (0.061), BACB (0.055) and ACAB (0.050). Only one haplotype (A01FB) included a null variant, and had frequency 0.016. Out of the 7 haplotypes with frequency > 5%. In males, the haplotype combinations with frequency > 5% were the same as in females, except ACAB, showing a frequency of 0.036, while the A01FB haplotype had a higher frequency (0.054). In conclusion, although strong alleles prevail in Sarda goats, there is a marked genetic variability which allows to diversify production, since strong alleles produce milk with high fat and protein content and good processing properties, while defective alleles can produce milk for direct consumption.



G-63

**Non-genetic factors of variation of litter size and weights at birth, one month of age and weaning in a multi-breed goat population in northern Mexico**

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Litter size and preweaning growth of kids define a very important part of the income obtained by goat farmers in Mexico. Knowing the influence of some environmental factors, especially those susceptible of being categorized, upon these traits, should contribute to propose better management strategies for herds, while it is essential for the genetic evaluation and selection of breeding animals. The aim of this study was to estimate the effect of these factors on litter size (LS) and on three measures of weight taken at birth (BW), one month of age (MW) and weaning (WW) in a multi-breed (Granadina, Nubian, Toggenburg, Alpine and Saanen) and crossbred population of goats from the National Goat Center, Tlahualilo, Durango, Mexico. Data on these traits, together with pedigree information, were registered from 1979 to 2000 (21 years); LS from 12,506 kiddings and WB and MW from 17,755 kids issued from 570 sires and 5,249 dams. A multitrait animal model, including fixed effects (kid's sex, litter size, dam's breed and dam's age at kidding, the combined effect month-year of kidding and a quadratic covariable for the age at weaning), direct and maternal genetic effects, permanent maternal environment and residual random effects, was used for the analysis of weight traits and two different two-traits animal models (BW and LS in the first one while MW and LS in the second), including fixed effects (kid's sex, dam's breed and dam's age at kidding and the combined moth-year of kidding), direct and maternal genetic effects, permanent maternal environment and residual random effects were used for the analyses of LS. Average values and their standar errors for weights (Kg) were  $3.2 \pm 0.64$  (BW),  $7.45 \pm 1.50$  (MW) and  $13.88 \pm 2.95$  (WW). Average LS was  $1.68 \pm 0.58$ . All fixed effects included in these models were significant for all traits studied. Males showed higher weights than females (+2.5; +3.5 and +11.5 for BW, MW and WW, respectively). LS, taken as a fixed factor, had a negative influence on weights. Dam's age at kidding significantly affected LS. It has a large effect on young dams, growing from 1.25 to 1.46 kids/parturition between the 2nd and the 3rd year of age, smoothly increasing up to 1.75 for 10 years old dams. I also had a large effect on BW, with 4-5 years old goats having kids weighting 20% more that those issued from younger goats, although it had a lesser effect on MW and WW, with only 4 to 6% difference. This indicates that a growth compensatory effect was exerted.



G-64

**Genetic relations between litter size and weights at birth and at one month of age in a multi-breed goat population in northern México**

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Early weaned kid ("cabrito") is one of the most important source of income for goat farmers in Mexico. Litter size is, therefore, an important selection objective, while this trait has been proved to be genetically related to birth weight and the early growth of kids. The objective of this study was to determine the genetic relationships between litter size (LS) and weights at birth (BW) and at one moth of age (MW) using data collected during 21 years in a multi-breed (Granadina, Nubian, Toggenburg, Alpine and Saanen) and crossbred population at the national Goat Center, Tlahualilo, Durango, Mexico. LS from 12506 kiddings of 5249 dams mated to 570 sires and the BW and MW of the 17755 issued kids were analyzed. Two different two-traits animal models (BW and LS in the first one and MW and LS in the second), including fixed effects (kid's sex, dam's breed and dam's age at kidding and the combined moth-year of kidding), direct and maternal genetic effects, permanent maternal environment and residual random effects, were used for the estimation of the variance and covariance components. Total heritabilities estimated for BW and MW were  $0.203 \pm 0.02$  and  $0.099 \pm 0.02$ , respectively, while the same genetic parameter for LS was  $0.041 \pm 0.02$ , when estimated with BW (1st model), and  $0.053 \pm 0.02$ , when estimated with MW (2nd model). Direct heritabilities were  $0.218 \pm 0.03$  (BW),  $0.132 \pm 0.02$  (MW) and  $0.053 \pm 0.02$  (1st model) and  $0.080 \pm 0.02$  (2nd model) for LS. Maternal heritabilities were  $0.150 \pm 0.03$  and  $0.026 \pm 0.01$  for BW and MW, respectively, while  $0.108 \pm 0.02$  (1st model) and  $0.084 \pm 0.02$  (2nd model) for LS. Genetic correlations between direct and maternal genetic effects were  $-0.331 \pm 0.107$  (BW),  $-0.526 \pm 0.15$  (MW) and  $-0.583 \pm 0.11$  (1st model) and  $-0.558 \pm 0.13$  (2nd model) for LS. Direct genetic correlations between LS and BW was  $-0.314 \pm 0.13$  and between LS and MW was  $0.010 \pm 0.16$  (non significant). Maternal genetic correlation between LS and BW was  $-0.628 \pm 0.08$  and between LS and MW was  $-0.672 \pm 0.21$ . Correlation of direct genetic effect of BW and MW with maternal genetic effect of LS were  $0.308 \pm 0.09$  and  $0.042 \pm 0.25$  (non significant), respectively. Therefore, it is concluded that selection pressure should be focused on weights favouring simultaneously maternal ability of goats.



G-65

**Direct and maternal components of genetic variation for weights at birth, one month of age and weaning in a multi-breed goat population in northern Mexico**

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Goat farming in México is mainly oriented to meat production, mostly early weaned kids ("cabrito"), particularly in the north, where many dairy goat farms have an important component of their income based on kid selling. Knowing the genetics of weight traits is, therefore, a prerequisite to design selection strategies. The aim of this work was to estimate the components of variance and covariances for three measures of weight taken at birth (BW), one month of age (MW) and weaning (WW). Data on kidding performances and weights at these three moments of kids growth, together with pedigree information, were gathered from 1979 to 2000 (21 years) in a multi-breed (Granadina, Nubian, Toggenburg, Alpine and Saanen) and crossbred population from the National Goat Center, Tlahualilo, Durango, Mexico. Data considered in this study came from 17,755 kids issued from 570 sires and 5,249 dams, of which 42% and 73%, respectively, had information in the data vector. A multi-trait animal model, including fixed effects (kid's sex, litter size, dam's breed and dam's age at kidding, the combined effect moth-year of kidding and a quadratic covariable for the age at weaning), direct and maternal genetic effects, permanent maternal environment and residual random effects, was used to estimate variance components. Total heritabilities estimated for BW, MW and WW were  $0.250 \pm 0.02$ ,  $0.108 \pm 0.02$  and  $0.026 \pm 0.004$ , respectively. Corresponding direct heritabilities were  $0.214 \pm 0.03$ ,  $0.130 \pm 0.023$  and  $0.139 \pm 0.05$  and the respective maternal heritabilities were  $0.154 \pm 0.02$ ,  $0.035 \pm 0.01$  and  $0.090 \pm 0.04$ . Genetic correlations between direct and maternal genetic effects were  $-0.175 \pm 0.18$  (BW),  $-0.383 \pm 0.15$  (MW) and  $-0.405 \pm 0.25$  (WW). Direct genetic correlations of BW with MW and WW were  $0.242 \pm 0.12$  and  $0.429 \pm 0.18$ , respectively and that of MW with WW was  $0.461 \pm 0.19$ . The respective maternal correlations were  $0.721 \pm 0.13$ ,  $0.768 \pm 0.17$  and  $0.594 \pm 0.27$ . We concluded that direct genetic effects on these traits were always superior to maternal effects and the antagonism between direct and maternal genetic effect is not significant for BW, but very important for MW and WW. This antagonism may cause an important restriction on the growth of kids after one month of age if selection is not carried out for maternal abilities.



G-67

### **Phenotypic characteristics of indigenous goats in two biogeographic regions of the north of Morocco**

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To characterize the indigenous goats in 2 biogeographic regions in the north of Morocco, age and biometrics traits were collected from 168 animals in 53 flocks located in the Mediterranean plain region with oceanic influences (OC; 102 goats) and mountainous Mediterranean region (MED; 66 goats). An ANOVA analysis, using GLM procedure of SAS (with repeated measures), was applied to test the effect of biogeographic region on phenotypic characteristics. Age of animals was similar for OC (3.3 years) and MED (4.1 years) regions. Concerning quantitative biometric measurements, no significant differences were observed between OC and Med regions for height at withers (63.1 cm vs. 60.8 cm), length of ear (14.7 cm vs. 14.2 cm), hair (4.71 cm vs. 5.45 cm) and horns (18.1 cm vs. 19.21 cm). However, canon circumference recorded in OC region (8.04 cm) was higher than that in MED region (7.64 cm). For qualitative biometric observations, significant differences between OC and MED were recorded for hair type and colour, chamfer form and presence of tassels. Black colour was dominant (36.3%) in the OC region, whereas brown colour was dominant (28.8%) in the MED region. Medium hair and concave chamfer are dominated in the two regions, but in different proportion 56.9 vs. 87.9% in the OC region and 83.3 vs. 100% in the MED region, respectively. The absence of tassels was a dominant character in OC region (75% of animals), while the presence of tassels was mainly observed in 51% in the MED region. No significant differences between OC and MED regions were observed for ear and horn form and presence or absence of barb. However, dressed ear, ibex horn and the presence of horn were dominant with 67.9, 53.8 and 58.4% of animals, respectively. In conclusion phenotypic diversity of goats is weakly structured by the biogeographic region in the north of Morocco.



G-68

### **Bayesian inference of geographic expansion of domestic goats**

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The past population dynamics of goats from 13 countries of Eurasia and Africa were estimated using Bayesian skyline plots, a coalescent Markov chain Monte Carlo method that does not require an assumed parametric model of demographic history. We analyzed 1204 sequences from the HVI segment of mitochondrial DNA of domestic goats to generate a posterior geographic distribution of effective population size through time. The results show that goats breeding has expanded greatly there are about 4300 years in Morocco before the European countries and Asian countries outside the center of domestication of this species. In fact, in Iran, Greece, Sicily and Turkey, this event took place prior to Morocco, while the other studied countries have this event more recently; Studies on archaeozoological data could help to confirm these results. Also work on other species of domestic ruminants (sheep and cattle) could contribute to the understanding of the migration of farming practices of these species throughout the world.





G-69

**Investigation of pituitary factor 1 (Pit1), growth hormone (GH) and prolactin (PRL) genes polymorphism in Carpathian goat breed**

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The objective of current study was to investigate the polymorphism of pituitary factor 1 (Pit1), growth hormone (GH) and prolactin (PRL) genes in Carpathian goat breed, a rustic breed exhibiting a high heterogeneity concerning mammary gland development and its lactation capacity. In an effort to better understand this complex trait two experimental lots of goats were set up. The first lot was composed of 10 goats characterized by a well developed mammary gland and high milk yield. The second lot was composed of 10 goats with less developed mammary gland and low milk yield. To identify polymorphisms, possible linked with these extreme phenotypes, a complete sequencing of these genes was targeted. A panel of 28 pair of primers were designed to amplify target regions, spanning from the promoter region through the 3' end of each gene. Amplification was performed on DNA extracted from blood samples collected from the 20 goats by using Fast to Tissue PCR kit (Fermentas, Vilnius, Lithuania). Amplicons from all genes were analysed in 1.5 % agarose gel containing 1X Sybr Safe (Invitrogen, Eugene, OR, USA). The PCR reactions containing single amplicons were sequenced using the BigDye Terminator v1.1 Cycle Sequencing Kit (Applied Biosystems, Foster City, CA, USA). Sequencing products were analysed by capillary electrophoresis on an Applied Biosystem 3730 device (Applied Biosystems, Foster City, CA, USA). In Pit1 gene two mutations located in exon 2 (T/C and A/G, respectively) and one in exon 6 (A/G) were identified. Allelic frequencies were in the first group: T = 1, C = 0; A = 0.95, G = 0.05 (exon 2); A = 0.17, G = 0.83 (exon 6), while in the second group were: T = 0.28, C = 0.72; A = 0.35 G = 0.65 (exon 2); A = 1, G = 0 (exon 6). In PRL gene three mutations were identified one in exon 1 (T/C) and two in exon 4 (A/G and T/C, respectively). Allelic frequencies were in the first group: T = 0.32, C = 0.68 (exon 1); A = 0.78, G = 0.22; T = 0, C = 1 (exon 4), while in the second group were: T = 1, C = 0 (exon 1); A = 0, G = 1; T = 0.79 C = 0.21 (exon 4). In GH no differences were observed between the two groups. We concluded that differences in allelic frequencies between the two groups, could explain at least partially the high variability of milk yield observed in Carpathian goat breed. The current study is a part of a complex study targeting several other key genes involved in mammary gland development and its lactation capacity (Project PN-II-RU-TE No. 113/2010-2013, code 224).



G-70

### **How to estimate additive and non-additive genetic effects in crossbreed herds by (CO) variance**

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Crossbred herds are common in tropical environment due to the constant introduction of external genetic resources, commonly without any defined management objectives, other than crossbreeds them. Performance is then due to Additive and Non-additive genetic effects, and this last depends on how well alleles coming from different breeds nick. Block is a common statistical technic to adjust for and to estimate differences among groups; pure and F1 groups are required to that purpose, and it is very unlikely in commercial herds to find all groups properly balanced. Direct fraction of alleles coming from the different breeds ( $FD_i$ ) and of heterozygous loci ( $FD_{ij}$ ) as (co)variables have also been used; where  $FD_i$  is a function of paternal ( $FP_i$ ) and maternal ( $FM_j$ ) genetic structure and  $FD_{ij}$  is estimated from the individual genetic structure. In this case, there might be misled estimates of heterozygosity because the parents' genetic structure is not taken into account; in addition, there is a scale effect that may drive to erroneous inferences. Fractions of alleles could be converted to fraction of loci or genotype assuming equilibrium; where  $FD_{11} = FD_{12}$ ,  $FD_{22} = FD_{21}$ , and  $FD_{12} = 1 - FD_{11} - FD_{22}$ . In this case, pure genotypes are proportional to fractions of alleles, but heterozygosity doesn't; in addition, it is very unlikely to reach equilibrium, in particular when parents don't have the same genetic structure. The use of fractions of loci with a particular genotype ( $g_{ij}$ ), estimated from parents' genetic structure, is suggested; where  $g_{11} = FP_1 \times FM_1$ ,  $g_{22} = FP_2 \times FM_2$ , and  $g_{12} = FP_1 \times FM_2 + FP_2 \times FM_1$ . If  $i = 1, \dots, n$  and  $j = 1, \dots, m$  stand for the paternal and maternal breed structure; for  $n \leq m$ , there will be  $n(n+1)/2 + (m-n)n$  different genotypes. Each genotype,  $g_{11}, \dots, g_{1m}, \dots, g_{n1}, \dots, g_{nm}$ , stands for the fraction of loci with a particular combination of alleles. If parents are of the same breed there will be not chance for a locus to be heterozygous; if parents are pure from different breeds, the fraction of heterozygous loci will be equal to unity. Thus, the regression of the phenotype on  $g_{ij}$  estimates the phenotypic difference among genotypes. The solution for the regression will be the genetic value or deviation of each genotype from the base; so it will allow to estimate both the general and specific combining ability, and therefore the predicted difference associated to the use of a particular breed in a given situation, which is the breed breeding value.



G-71

**Western Maryland pasture-based meat goat performance test: a five year  
summary**

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The Western Maryland Pasture-Based Meat Goat Performance Test was initiated in 2006 at the University of Maryland's Western Maryland Research & Education Center (39° 30' N/77° 44' W) in Keedysville, Maryland USA. The purpose of the annual test was to determine genetic differences in meat goat bucklings consuming a pasture only diet, with natural exposure to gastro-intestinal parasites. While on test, the goats were handled bi-weekly to determine body weights (BW), FAMACHA© eye anemia scores (FAM), body condition scores (BCS), coat condition scores, and dag scores. Fecal samples were collected bi-weekly to determine individual fecal egg counts (FEC). Pooled samples were collected every 14 to 28 days for larvae identification (Larvae ID). Since 2006, data have been collected on 374 bucks, of various breeds and breed types, representing 46 herds in 17 states. There were significant year effects ( $P < 0.001$ ) for FAM, FEC, BCS, and ADG. Fecal egg counts were highest in 2007 and 2008 and lowest in 2009 and 2010. FAMACHA© scores have been trending lower (getting better) and were lowest in 2010. ADG was highest in 2007, but did not differ in years 2008-2011. There were significant ( $P < 0.0001$ ) correlations between FEC, FAM, and ADG: a weak positive correlation (0.26) between FEC and FAM and a weak, negative correlation between FEC and ADG (-0.11). Within years, the correlations between FEC and FAM were significant and ranged from 0.14 and 0.42. Year had no effect on Larvae ID and pooled fecal egg counts. From 2009-2011, the worm load carried by the goats was composed of 92.5% *Haemonchus contortus*.



G-73

### **Effect of $\alpha$ S1-casein (CSN1S1) genotypes on milk composition and cheese yield in Carpathian goat breed**

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The objective of current study was to investigate the association of CSN1S1 polymorphism with milk composition and cheese yield in Carpathian goat breed. To establish the experimental lots, milk and blood samples were collected from 507 goats. The genotypes of goats for the six major milk protein genes were determined by isoelectric focusing (IEF). The CSN1S1 genotypes were confirmed by PCR-AS and PCR-RFLP, performed on DNA samples extracted from blood. Experimental groups were composed of 82 goats exhibiting different genotypes at CSN1S1 locus (AA, EE, FF, OO, AE and AF) and similar genotypes (in terms of protein synthesis rates) in the remaining five major milk protein loci. During the experimental period the goats were kept under the same managing conditions. Four milk recordings and sampling were performed on these goats in 2010 (3rd lactation) and two in 2011 (4th lactation). Total protein, total casein, fat, non-fat solids and lactose contents, pH and SCC were determined at a professional laboratory (FCCL Floresti, Romania) using a MilkoScan and a Fossomatic devices (Foss Electric, Hillerod, Denmark). The remaining milk collected from each goat was mixed according to CSN1S1 genotypes and cheeses were obtained by rennet coagulation. After two days of drying in a controlled environment the cheeses were weight. A mixed repeatability model including genotype for CSN1S1, number of lactation (confounded with year of kidding), month of kidding, number of kids born and month of sampling, as fixed effects, goat as random effect and logSCC as covariable, was used for the analyses of milk components. In the case of pH and logSCC, the covariable was deleted from the model. For the analysis of cheese yield, a model including CSN1S1 genotype, number of lactation and month of cheese processing was used. Bonferroni correction was done to set the significant level for lsmeans comparisons between the different genotypes. Main results show a significant effect of the CSN1S1 polymorphism on all studied variables, with the exception of pH. Particularly relevant are the differences of strong (AA) genotypes and medium (EE) and weak (FF) genotypes for total casein and total protein. No differences were found between medium and weak genotypes for these composition variables. Cheese yield differences were also observed between strong, medium and weak genotypes. Results are in accordance to those found for other breeds.



G-74

### **Using the Lactocorder for milk recording in Murciano-Granadina Goats. First results**

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Lactocorder ® milk meter (LC) was approved by the International Committee for Animal Recording (ICAR) for goats, but the tests were made with goats of Alpine and Saanen breeds. The aim of this study was to examine whether or not LC meets the criteria of ICAR in Murciano-Granadina breed (MG), an example of local breed whose milk has a different composition comparing with the two mentioned breeds. In the first experiment, 6 LC were tested in 3 commercial herds where MG goats were milked once a day. Two hundred and four goats were recorded (32-35 records per LC). A reference milk recording jar was installed in series with each LC. Milk productions ranged from 300 to 2,800 mL/day. Three of the LC showed an average bias higher to the limit of 3% set by ICAR (3.5, 4.0 and 11.5%; mean difference between the reference and the LC measurement, as a percentage of reference yield). Furthermore, standard deviation of the differences in all the LC was above the 5% ICAR cut-off (values between 10.7 and 16.1%). Given these results, the company made an intensive maintenance (cleaning of the electrical conductivity sensors) and a first adaptation of the software. Then, we conducted a second trial in the experimental farm of the Universitat Politècnica de València with the 6 fitted LC, using 31 MG goats and 5 recording days (total 157 records, about 25 per LC). Reference milk production was obtained by weighing on a balance (values between 650 and 3,300 mL). Although the results improved, LC did not meet the ICAR requirements. The average bias was lower than 3% in 5 LC (values between -2.9% and 1.7%) but 4.8% in the sixth one. However, the standard deviation of the differences with the reference values was still higher than 5% (between 7.0 and 10.4%). We conclude that, in order to use these devices in the official milk recording of MG or other local breeds with high level contents (protein, fat), at least further improvements in the software are necessary to meet the criteria of ICAR.



G-75

**Future prospects of goats as a source of milk and meat, to decrease the milk and meat gap in Egypt**

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To improve goat breed in the poor areas of low input conditions of Egypt, this review article discuss the potential advantages of dairy goats, goat breeds in Egypt, characteristic of Zaraibi goats, breeding programs to improve goat productivity in some developed countries and finally a plan for improving goat milk and meat production in Egypt through propagation of local goats to increase total milk and meat yield and decrease the milk and meat gap in Egypt. Although goat population in Egypt is about 3.60 million heads, goat milk production represents less than 0.05 % of annual total milk production. According to this fact, it is of great interest to improve goat milk yield to satisfy milk requirements, raising the living standards of inhabitants and to decrease the milk gap in Egypt. The same situation exists for meat goats which require intensive efforts to improve the goat breeds to decrease the meat gap. Four goat breeds are raised in Egypt mainly in the Egyptian deserts following the extensive production system, among these breeds Zaraibi which is generally recognized for its distinguished milk production and prolificacy in comparison with other prevailing breeds. Recent researches proved that goats are more efficient than buffaloes in utilizing feeds to produce 1 kg of milk and also to produce 1 kg of meat. Ministry of Agriculture has established a nucleus flock of Zaraibi Goats since 1983 at El-Serw Experimental Station from animals brought from locations where the breed is distributed for improvement and propagation. Genetic and phynotypic profile of reproductive and milk production traits, variance and covariance components of some economical traits were determined as well as the construction of an index to help in planning for a sound selection program. Successful crossbreeding programs were carried out in some developed countries, crossbreeding of local breeds with western breeds for the production of Guanzhng and Lashon types in China, the Boer goats which was introduced to India for upgrading local goats for meat production and the Turkish studies directed to improvement of dairy breeds. Since Zaraibi breed is a superior breed among goat breeds in Egypt, its propagation either as a pure breed or through crossing programs with other breeds (French Alpine as a Dairy breed or Boer as a meat breed) must take more interest and efforts as a mean for increasing milk and meat yield and subsequently decreasing the milk and meat gap in Egypt.



G-76

### **Development of breeding schemes in overseas regions: the case of goats for meat production in the Reunion Island**

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In the French island of Reunion, (Indian Ocean, 800,000 inhabitants), 37,600 goats are reared mainly for meat production. Farming systems are very diverse but they still constitute a secondary activity generating an income supplement. The herds are genetically very heterogeneous and derive from crossbreeding between land race goat (Cabri Péri), endangered species, and exotic races (Saanen, Boer, Alpine). Goat meat is highly appreciated in Reunion. 700 to 800 tons of goat meat are imported each year. To increase local production, breeders are primarily oriented to the Boer goat. This specialized breed meat is present for several decades. Any importation of ruminants is however suspended for health reasons. So, Farmers decide to develop a breeding scheme based on artificial insemination. Research, development and selection institutions work with breeders to define Boer dom's standard, so that the race is officially recognized in France. The selection scheme aims to improve meat production. Evaluation of the animals is based on a grid developed by the people involved in goat production sector. The evaluation grid is currently tested on 450 crossbred females. These females are inseminated artificially with boer goat semen produced by Capgènes, the single French National Centre of production of buck seeds. The assessment skills are suitable both for males and females and give a judgment on the characters of race (9 positions) and functional (11 positions). Race characters therefore account for 75% of the final score. At the same time 8 morpho-biometric measurements are performed to characterize the goats that will form part of the basis for selection. Insemination protocols are tested and validated over a period of three years. In France, there is not a certified performance testing for goat meat production; so we adapt the method and the tool developed for mutton sheep. The objective is to characterize 1,400 goats to select 1,000 for the basis of selection. We have developed tools to enable the implementation of the schema of the Boer Dom selection. However we must still specify measurable and quantifiable objectives of selection.





G-79

**QTL detection for milk production traits, fatty acids, udder morphology and milking speed in Alpine and Saanen goats**

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In France, an important research and development programme for mapping traits of interest in dairy goat has been carried out in the last three years. The project is based on a large daughter design of 20 Artificial Insemination Alpine and Saanen families. The traits considered relate to milk production, udder morphology, milking speed and resistance to mastitis (milk somatic cell counts). The project also includes a large scale on-farm phenotyping scheme for fatty acids (“PhénoFinlait” project) allowed by the use of mid infrared spectra. The population has been genotyped with the 50K SNP goat chip which was recently released by Illumina in the frame of the International Goat Genome Consortium. This tool was produced thanks to a few collaborative SNP discovery research programmes (INRA, France; Malaysian Agricultural Research and Development Institute; University of Utrecht, Netherlands). A total of 2,254 goats and 20 IA sires were genotyped with the illumina goat chip including a total of 53,347 synthesized SNPs. Quality control of genotype included essentially SNP call rate (> 99%), animal call rate (> 98%), minimum allele frequency (> 1%), Hardy Weinberg equilibrium and pedigree consistency. After editing, a total of 49,647 SNP were validated for further analyses. Almost all 2,254 goats had information for milk production traits (milk, fat and protein content and yield), SCC and for eleven udder type traits. Daughter yield deviations for ten fatty acids (plus 8 groups of fatty acids) were also available for 2,096 goats. Finally milking speed was recorded in a subset of goats, with an average of 40 daughters of the 20 Alpine and Saanen sires. QTL detection based on linkage analyses (using the QTLmap software) are in progress for milk production and SCC traits. The project was funded by the French Phenofinlait programme (ANR, Apis-Gène, CASDAR, CNIEL, FranceAgriMer, France Génétique Elevage and Ministry of Agriculture) and the European 3SR project.



M-4

### **Effects of time road transport, carcass weight and ageing time on instrumental and sensory meat parameters in Negra Serrana suckling kids**

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The aim of this study was to determine if the ageing time, the carcass weight and the time of the pre-slaughter transport can influence both instrumental and sensorial parameters in Negra Serrana suckling kids. Sixty male kids were used and divided into two groups according to the transport conditions to the slaughterhouse: short transport (two hours) and long transport (six hours). Within each group the carcasses were classified as heavy (> 7 Kg) or light (< 7 Kg). Also, both instrumental and sensory meat parameters were analyzed at two different ageing times: 3 and 8 days. The instrumental parameters analyzed were: the pH using a pHmeter CRISON pH25; the Water Holding Capacity according to Graw and Hamm (1953); the toughness using a Texture analyzer INSTRON provided of a Warner Bratzler Blade Set and the color using a spectrophotometer CM-700 d/600 d according to the CIE (1986) with a D65 illuminant and a 10 degree observer. The sensorial analyses were carried out with 15 families, with a minimum of three members per household, during 15 weeks and cooking the meat always in the same way. The sensory parameters to evaluate were visual aspect, tenderness, juiciness, taste and global valuation. The pH values were normal for all the parameters studied. Using an ANOVA test we found that for the ageing time were not significant differences at the parameters studied but we observed a tendency of the tenderness and the sensory evaluation to improve when the ageing time increased from 3 to 8 days. With respect to the effect of the carcass weight significant differences ( $P < 0.001$ ) were found for the W.H.C as the % of juice expelled increased in the heavy animals. The differences appeared also for the color parameters ( $P < 0.001$ ) where the meat from heavy kids was darker and redder. And, at last, for the tenderness ( $P < 0.05$ ) which improved when the animals were heavy. Finally, significant differences were not observed ( $P > 0.05$ ) for the road transport in any of the parameters studied. Based on these results and according to the conditions of the present study, it could be said that probably an ageing time up to 8 days was not enough to observe significant differences with the parameters studied. Furthermore, a tendency was observed in the sensory evaluation to improve for the light kids. Moreover, a road transport up to 6 hours for the Negra Serrana suckling kids would be optimum.



## M-5

### Effect of diets with different carotenoid profiles on the Vitamin A content of goat's milk

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Recently, the role of carotenoids and liposoluble vitamins has been established in the nutritional and sensory properties of dairy products. In this way, the variation in the nature of the forage used to feed ruminants has been identified as an efficient way to modulate the concentration of these compounds in the milk of different species. However, there are few studies on goats. Considering all these points, the aim of this report was to assess the influence of the type of feeding on the retinol content of goat's milk. Three groups of ten female goats were used in this study. Each group had a different diet: pasture (group 1), Unifeed + citrus pulp (group 2) and Unifeed (group 3). The analysis of carotenoids in the diet was done as follows: an extraction with hexane and ethanol followed by saponification with sodium hydroxide. Finally the samples were washed, dried and dissolved in ethyl acetate prior to their injection in a HPLC system. The extraction of retinol from the milk samples was carried out according to previous studies in other species (Jewell *et al.*, 2004; Hulshof *et al.*, 2006, Nozière *et al.*, 2006). The HPLC-system was an Agilent 1100 equipped with an YMC C30 column. The mobile phase was methanol, methyl ether terbutyl and water. The chromatograms were monitored at 325 nm for the retinol and at 450 nm for the carotenoids. In all the feed samples lutein,  $\beta$  and  $\zeta$ -carotene were detected and also violaxanthin was detected in group 1, while zeinoxanthin and zeaxanthin appeared in the samples from the group 2 and zeaxanthin was present in the group 3. In relation to the milk samples, retinol was detected in the milk of the three groups of animals in different amounts:  $61.33 \pm 6.66$ ,  $56.14 \pm 12.04$  and  $44.81 \pm 9.70$   $\mu\text{g/ml}$  for the groups 1, 2 and 3, respectively. Although these differences were not significant ( $P > 0.05$ ) we observed a relationship between the type of diet and the retinol content. Therefore, we can suggest that further studies are necessary to confirm the variations of retinol concentration in the milk of goats according to the diets.



## M-6

**Effect of green maize supplementation on conjugated linoleic acid and n-3 fatty acids composition of Alpine goat milk: preliminary results**

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Hungary has continental climate with hot summer and low humidity, during warm season, the pastures are running dry, animals are need to provide some supplementary feed, which basically means a hay-based feeding. In this way, the milk c9t11CLA and n-3 fatty acids content decreases can be observed. One of the possible ways is fed cropped green forages as supplementary feeding. In this study focused on the influence of green maize supplementation on the fatty acid profile of milk. Twenty lactating Alpine goats were randomly allocated to two treatment groups to investigate the effect of green maize supplementation. The goats involved in the first group fed with alfalfa hay; however, the other goats fed green maize supplementation. The investigated period lasted 5 weeks, which involved the period of the first 3 weeks for adaptation to the diet and the last 2 weeks for experimental period. The individual milk samples were collected from animals once a week during the first 2 weeks of the investigated period for the analysis of chemical composition. The milk fat was dissolved in sodium hydroxide methanol solution and re-esterified to methyl esters. Methyl esters of fatty acids were determined by gas chromatography. Data were analyzed by SPSS 15.0 statistical program package. The milk from green maize supplemented goats had significantly higher fat, protein, lactose and total solids without fat contents ( $P < 0.05$ ) than goats fed only alfalfa hay. The green maize supplementation considerably increased the total conjugated linoleic acid content in milk (0.53 % vs. 0.70 %;  $P < 0.01$ ). The n-3 fatty acids were higher in the milk (0.43 % vs. 1.05 %;  $P < 0.001$ ). In addition the n-6/n-3 ratio was also more favourable in the green maize supplemented group (7.78 vs. 1.88;  $P < 0.01$ ). Diet with green maize supplementation significantly increased the concentration of n-3 polyunsaturated fatty acids such as  $\alpha$ -linolenic, eicosapentaenoic acid (EPA) (C20:5 n-3) and docosahexaenoic acid (DHA) (C22:6 n-3), which are efficiently prevent cardiovascular diseases. In conclusion, these results indicate that green maize supplementation is positive benefits for goat milk producers, e.g. improve goat milk nutraceutical value. Research was supported/subsidized by the TÁMOP 4.2.2/B-10/1-2010-011 Development of a complex educational assistance/support system for talented students and prospective researchers at the Szent István University” project.



M-7

### **Bioactive compounds and antioxidant activity in goats' whey in two feeding systems**

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This study determined the presence of antioxidant agents activity in goats' whey of two feeding systems. Some bioactive compounds have been associated with important health benefits to the consumer. The production and processing of goat milk have been increasing finding different types of cheeses, with a consequent increase in the amount of whey. Milking goats ( $50 \pm 5$  kg) were used. One group was fed grazed/browsing in semiarid rangeland, the other was fed with Lucerna forage and grain concentrate, in indoor conditions. Goats were milked for five consecutive days; the milk was processed raw or pasteurized. Goats' milk cheese was made and four types of whey were obtained: GR = grazing/browsing raw whey, GP = grazing/browsing pasteurized whey, IR = indoor raw whey, IP = indoor pasteurized whey. All samples were kept frozen at  $-80^{\circ}\text{C}$ , lyophilized and stored at  $4^{\circ}\text{C}$ . 10 g of whey were put on a flask with 50 ml of MeOH:water (80:20 v/v) for 2 h at room temperature, then was added 50 ml of a solution of acetone:water (70:30 v/v) after to 2 h; the sample was filtered and concentrated at  $30^{\circ}\text{C}$  in a rotary evaporator. Each whey was analyzed three times. Different concentrations (10, 100, 1000 y 10,000 ppm) of whey extracts were employed, resuspending in MeOH:water or MeOH. Total polyphenol content (TPC) was determined by the Folin-Ciocalteu colorimetric method. 20  $\mu\text{l}$  of extracts per sample was assessed by HPLC to determinate the presence of flavonoid and hydroxycinnamic acids. ABTS + and  $\beta$ -carotene bleaching assays were made to determine the antioxidant activity in the samples. Alpha-tocophenol and BHA were used as standards. The results were analyzed with a variance analysis in a 2 x 2 factorial arrangement. Comparison of the means was established by Tukey's test ( $P < 0.05$ ). All data were analyzed with GLM for SAS statistical Program. TPC was of 19.0 to 24.5 mg equivalents of gallic acid/100 g of dry whey, without differences ( $P > 0.05$ ) among whey samples. Catequin (GRW= 1.34 mg/100 g) and quercetin (GPW= 52.3 mg/100 g) were detected in all samples. Caffeic acid was better ( $P < 0.05$ ) in IPW (0.62 mg/100g) in relation to the rest of the other samples. In regard to ABTS free radical and  $\beta$ -carotene bleaching, GRW (10,000 ppm) in MeOH:water and MeOH reported a free radical scavenging activity of 66.4:59.3%. In conclusion, the goats' whey contains bioactive compounds, which has a protective effect avoiding free radical damages, particularly in animals fed in grazing/browsing conditions.



M-9

### **Comparison of 20 macro and trace mineral concentrations between commercial goat milk yogurt and cow milk counterpart**

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Yogurt has been increasingly popular in many parts of the world. Although yogurt is known for high nutritional and therapeutic values, few reports are available for mineral compositions of yogurts from different dairy species. The objective of this study was to compare concentrations of 20 different minerals between commercial goat milk yogurt (CGY) and commercial cow milk yogurt (CCY) with reference to goat milk yogurt manufactured from Fort Valley State University (FVGY), Fort Valley, GA, USA. Three different lots of CGY and CCY each were purchased from local retail stores located Warner Robins, GA, and 3 batches of FVGY were made at the University dairy plant using goat milk collected from the University milking herd. All experimental yogurt samples were stored at 4°C, and duplicate samples were taken from each lot for mineral assays. Minerals were analyzed by an Inductively Coupled Plasma Optical Emissions Spectrometer (Thermo Jarrel Ash Enviro 36, Worcester, MA), using argon as the carrier gas and the EPA method 6010. Total solids (TS) content (%) of FVGY, CGY and CCY products were 11.03, 13.1 and 11.3, respectively, indicating the commercial products of both species had higher TS than the university made yogurt. Respective mean mineral concentrations (ppm, wet basis) of FVGY, CGY and CCY were: Ca 1057, 1162, 1160; P 838, 974, 929; K 1327, 1717, 1208; Mg 102, 133, 113; Na 545, 449, 475; Fe 4.28, 3.33, 2.11; Mn 0.24, 0.19, 0.13; Cu 10.5, 9.85, 7.22; Zn 17.5, 11.7, 11.8. The levels of all macro minerals except potassium were higher in commercial products in both goat and cow yogurts than the FVGY. Within the same species products (FVGY and CGY), FVGY contained lower macro minerals than CGY, which may account for the breed and diet differences, where Nubians usually contain higher total solids than other goat breeds. FVGY had higher Fe, Mn, Cu and Zn contents than both CGY and CCY products. The heavy metal concentrations (ppm) of Pb, Cd and Ni appeared to be normal range, while respective Al contents of FVGY, CGY and CCY were 11.9, 8.66 and 7.65, which were higher than the levels of Pb, Cd and Ni. It was concluded that the commercial yogurts of both species contained higher major mineral contents than the university yogurt, which may be attributed to differences in breed, diet and lactation stage of milking animals. In addition, the commercial products contained additives such as tapioca which could increase total solids and firmness of the products.





## M-10

**Effects of castration, fattening method and period on meat fatty acid profile of Fars native he-goat kids**

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A completely randomized design in a factorial experiment (3 factors) was used to study the effects of castration (Burdizzo method), fattening methods (individual- and group-fed) and fattening periods (90, 120 and 150 days) on meat fatty acid profile of Fars native male kids at three months of age. Fifty two kids at three months age were divided into two sex groups (castrated vs. intact). Each group was divided into two subgroups, one of which was housed in individual pens and the housed in group boxes. The kids were fed ad libitum with a pelleted total mixed ration. At the end of each fattening period, twelve kids were slaughtered (three kids per subgroup). The cold carcass was weighted and split along the midline. The left side was weighed and cuts according to the tradition in Iran. Cuts (leg, shoulder, loin, flap, breast and neck) were dissected into lean, bone and fat. Dissected lean and fat of cuts were minced and well mixed. Fatty acid compositions of ground meat samples (muscle and fat) from half-carcasses were determined. Average body weight at the beginning of experiment were not significantly different between the intact and castrated groups (16.7 and 16.8 kg respectively), and also between fattening methods and fattening periods. Slaughter live weights were not significantly different between the intact and castrated groups (31.1 and 30.5 kg respectively), and also between individual and group fattening (30.4 and 31.2 kg respectively), but were different between fattening periods (27.6, 30.5 and 34.3 kg respectively). Oleic (42%), palmitic (27%) and stearic (18%) acids were the most abundant fatty acids in the meat. Castration significantly increased the myristic, palmitic, palmitoleic, oleic and arachidic acid contents, but decreased the stearic and linoleic acid contents. Group feeding resulted in a significant increase in linoleic acid and PUFA contents. Duration of the fattening did not significantly affect the fatty acid contents. Significant interactions were found between sex type, fattening method and period of fattening for PUFA content, and the ratios of PUFA:SFA, MUFA:UFA and PUFA:UFA. According to the data, castration and individual feeding could not be recommended under the conditions of the present experiment, and a fattening period of 120 days resulted in the highest ratio of PUFA:SFA in meat.





## M-11

**Effect of lupin on carcass characteristics and meat quality of growing and fattening goats**

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To determine the effect of lupin incorporation in the diet of kids on growth performance, carcass characteristics and meat and fat quality. We used 4 groups of 7 kids each from 90 days until 180 days of age. We distributed to these groups four rations of concentrate (Rm, R2, R3 and R4) iso-energetics and iso-nitrogenous respectively with 0%, 12%, 21% and 35% DM of lupin physically treated and supplemented with barley and fava beans. During this study, the goat kids were weighed to estimate ADG. After 3 months, the animals were slaughtered and many measurements were made on carcass weight, gastric pouch, adipose and bone tissue, length of carcass and thigh and carcass color. To make the analysis of meat quality, the samples were taken on the *Longissimus dorsi* and *Semimembranosus* muscle, and conserved in the freezer at -20°C. The fatty acid profile was determined by gas phase chromatography, after extraction by the method of Folch *et al.* (1957) and esterification by the method of Christie (1993). An analysis of variance of a single criterion of variation was made by Excel (2007) and SAS software (SAS, 2001). Results showed no effect of lupin on final weight, ADG, carcass yield, gastric pouch weight, adipose tissue and bone tissue importance, length of carcass and thigh and compactness index, while its incorporation improved significantly muscle and conformation index ( $P < 0.01$ ). For carcass color, rates higher than 20% increased significantly redness of tail and saddle ( $P < 0.01$ ), and decreased significantly saddle lightness ( $P < 0.05$ ). The organoleptic and technological quality of meat were not affected because color, tenderness, pH and water retention were similar for all groups. For the nutritional quality of meat, lupin induced significant reduction of humidity ( $P < 0.01$ ), while minerals, protein and fat were not affected. For fatty acid groups, there were a highly significant difference between the 4 rations for all groups of fatty acid except Desirable Fatty Acids ( $P < 0.001$ ). This difference was similar for *Longissimus dorsi*, because rates of lupin affected UFA, MUFA, PUFA and SFA but DFA were not ( $P < 0.01$ ). However and contrarily of *Longissimus dorsi*, only DFA were significantly affected and improved them by lupin incorporation. In conclusion, lupin incorporation can reach 35% DM of the concentrate of kids without negatively affecting carcass characteristics and meat quality.



## M-13

**Bulk milk antibiotic residue occurrence, somatic cell count and total bacterial count in dairy goat flocks**

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To study the yearly variation of bulk tank milk variables in dairy goat flocks and to identify the main target practices and flocks groups to improve milk quality and safety, a total of 10,045 records of antibiotic residue (ARO), total bacterial count (TBC) and somatic cell count (SCC) were obtained over 5 years (2007 to 2011) from a mean of 26 goat flocks belonging to the Consortium for Ovine Promotion (CPO), Villalpando, Zamora (Spain). All CPO flocks were enrolled in the analysis service of the Dairy Interprofessional Laboratory of Castilla y León, Spain. Bulk tank milk samples were collected from the flocks after homogenization, preserved with acidol (3 microliters/ml), and kept at 4°C until analysis in the interprofessional laboratory. Total bacterial count was determined with a Bactoscan 8000 instrument (A/S N, Foss Electric, Hillerod, Denmark), and SCC was analyzed in a Fossomatic 5000 (A/S N Foss Electric). Antibiotic residues in milk were analyzed by the screening test Eclipse 100 (ZEU-Inmunotec, Zaragoza, Spain) which is a microbial growth inhibition assay containing spores of *Bacillus stearothermophilus var. calidolactis* and an acid-base indicator. Incubation was done at 65°C for 3h. Positive or negative results were obtained by difference of photometric readings at 590 and 650 nm in comparison with negative control samples. A categorical model using the CATMOD procedure of SAS was used to analyze the ARO yearly variation over 5 years studied. Based on this model, ARO significantly decreased from 0.31% (year 2007) to 0.00 (year 2011). For continuous variables, ANOVA evidenced a significant decrease for least squares means of log TBC from 2008 (5.20) to 2011 (4.94); similarly, log SCC decreased from 6.28 (year 2007) to 6.21 (year 2011). The correlation coefficient between TBC and SCC was significant ( $r = 0.24$ ). Measurable improvements in ARO and TBC found over time would be associated with incentive, education, and training programs implemented to increase milk safety in CPO goat flocks. Nevertheless, mastitis control programs should be intensified within flocks due to high SCC found. As a whole, ARO, TBC and SCC bulk tank milk variables can be used to monitoring mammary health and milk hygiene and safety throughout time within a Milk Quality and Safety Assurance Program to reduce on-farm risk in goat flocks.



M-14

**Effects of intra-mammary bacterial infection and stage of lactation on goats milk quality for cheese making**

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The effects of mammary gland bacterial infection and stage of lactation on leukocytes infiltration into the mammary gland and on milk quality were studied. Goats were at two stages of lactation: mid- or late-lactation. In mid-lactation goats, bacteria-free glands and CNS-infected glands were compared. In late-lactation goats only uninfected glands were studied. Bacterial infection significantly increased the number of SSC, leukocytes percentage and in particular PMN. Among the infected glands, the leukocyte percentage in those infected with *S. aureus* (99%) was significantly higher ( $P < 0.05$ ) than those in glands infected with *S. simulans*, *S. epidermidis* (each 86%) or *S. caprae* (74%). In bacterial-free glands at late-lactation, SCC increased to higher level than that of mid-lactation-infected glands with the three CNS species, however, leukocyte percentages were lower. Milk quality was most affected by stage of lactation (particularly end-lactation) and bacterial infection. Curd firmness 60 min after enzyme addition was significantly lower in bacteria-infected glands and at late-lactation, and of those, significantly lower at late-lactation and in agreement with rennet clotting time, which was significantly longer. The study also highlighted the effectiveness of lactose level as a predictor of milk quality. Lactose concentrations  $< 4\%$  was associated with non-coagulating milk. The present results signify the importance of identifying infected glands and animals at late-lactation in order to prevent milking them into the bulk milk tank, especially to that intended for cheese making. Such milk might still meet the criteria for drinking milk, therefore, farmers will be able to exploit the milk they produce more economically.

**M-16****Meat production and carcass characteristics of the Cyprus Damascus goat**

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The aim of the present study was to review the available scientific information on the meat production potential and the carcass characteristics of the Cyprus Damascus (CD) goat, the predominant goat breed kept on the island for meat and milk production. The results of many years of research carried out at the Cyprus Agricultural Research Institute (ARI) on this breed were the main source of information utilized. Goats of the experimental ARI herd are kept under a high input system based on concentrate feed and minimal grazing. Kids are weaned abruptly at 7 weeks and then fattened until 120 days of age on pelleted concentrate mixture of 18% crude protein content, offered ad libitum. Feed to gain ratio of intact male kids (castration is not practiced) from 50 to 120 days of age, is between 3.5 and 4.0, while the average daily gain over the same period is 248 g/day. Based on fertility figures, number and live weight of kids weaned and alive at 120 days of age, it was estimated that per adult goat joined, 45.8 kg of kid live weight are produced at 120 days post-partum. Of this production, 12.7 kg goes for replacement of males and females in the herd, while the rest 33.1 kg (24.6 from male and 8.5 from female kids) is destined for meat, giving about 16.0 kg of carcass split into 10.5 kg of meat plus 1.8 kg of fat and 3.7 kg of bones. Slaughtered at a younger (80 days) or older (140 days) age, the dressing percent of male kids was 47.4 and 49.7 respectively, expressed as cold carcass (international standard) on fasted slaughter weight. The corresponding carcass weight at 80 and 140 days was 10.2 and 19.6 kg, while the respective fat and bone content at the two ages was 7.8 and 12.8%, and 27.1 and 21.6%. The meat percent of carcass was fairly constant at all ages examined with a value of about 65. The good growth and carcass characteristics of the CD goat seem to be transmitted to its crosses, at least with a native goat breed. In conclusion, the high reproductive performance, combined with very good growth and carcass characteristics of the Cyprus Damascus goat, imply that this breed is suitable for meat production and could be further exploited for this purpose.



## M-18

### Quality characteristics of restructured chevon jerky as influenced by addition of sodium nitrite

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Goat meat (chevon) is an excellent raw material for preparation of low fat value-added products because of its healthier fatty acid profile. Homemade jerky products have gained popularity recently in the US. Compared to beef jerky, there is limited information available about quality of chevon jerky. The aim of this study was to evaluate the quality characteristics of restructured chevon jerky, prepared with or without sodium nitrite ( $\text{NaNO}_2$ ). Eight batches of restructured chevon jerky were prepared in the meat processing facility at Fort Valley State University. Ground chevon (9.00 kg/batch, leg cuts) from Spanish goats (6 mo old,  $n = 58$ ) was mixed with a jerky seasoning either with or without  $\text{NaNO}_2$  (22.7 g/batch), and then extruded through a stuffing horn. Restructured jerky strips were placed in a smokehouse at  $93.3^\circ\text{C}$  for 3.5 h. The jerky strips were *vacuum* packaged and stored at ambient temperature under fluorescent light for quality analysis at 0, 14, and 28 d. Inclusion of  $\text{NaNO}_2$  resulted in jerky with higher ( $P < 0.01$ )  $a^*$  values (redness, 14.24 vs.  $8.17 \pm 0.218$ ). The  $a^*$  and  $b^*$  (yellowness) values of jerky decreased ( $P < 0.01$ ) with storage time. Texture properties of jerky were not influenced by  $\text{NaNO}_2$ . Hardness values significantly decreased from 6.36 to 5.44 kg (SEM = 0.391) with storage time. Addition of  $\text{NaNO}_2$  did not significantly affect the microbial counts of jerky; however, the aerobic plate counts progressively increased ( $P < 0.01$ ) from  $1.8 \pm 0.47$  to  $6.0 \pm 0.47 \log_{10}$  CFU/g during the 28-d storage time. Water activity ( $a_w$ ) and pH values of jerky were not affected by the inclusion of  $\text{NaNO}_2$ . However,  $a_w$  (0.84 to  $0.87 \pm 0.013$ ) and pH values (6.46 to  $6.61 \pm 0.028$ ) increased ( $P < 0.01$ ) with storage time. Inclusion of  $\text{NaNO}_2$  decreased ( $P < 0.05$ ) thiobarbituric acid reactive substances (6.26 vs.  $6.81 \pm 0.189$  mg malonaldehyde/kg), but the values did not significantly change during 28 d of storage. Sensory analysis by an eight-member panel showed that jerky with  $\text{NaNO}_2$  added had higher ( $P < 0.01$ ) color and flavor scores compared with jerky prepared without  $\text{NaNO}_2$ . Jerky with  $\text{NaNO}_2$  added tended ( $P < 0.1$ ) to have higher overall acceptability compared with jerky made without  $\text{NaNO}_2$ . The results indicated that inclusion of  $\text{NaNO}_2$  in chevon jerky significantly improved the quality characteristics of chevon jerky and that alternative packaging/storage conditions are required to prolong the shelf life of the product.



## M-19

### Goat yogurt decreases blood pressure in hypertensive men and women

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The purpose of this study was to evaluate the functional hypotensive effect of a yogurt supplemented with peptides derived from goat whey hydrolysates. In addition, we evaluated the overall effect of goat yogurt consumption on blood pressure. Following CONSORT 2010 guidelines, a six-week stage 1 human intervention double-blind trial was conducted to determine the influence of daily consumption of goat yogurt supplemented with a goat whey protein hydrolysate on systolic and diastolic blood pressure (SBP and DBP, respectively). A total of 39 enrolled hypertensive subjects were selected from a group of 246 patients that participated in the annual health evaluation program of the Universidad Central de Venezuela, Campus Maracay. Subjects were randomized to consume either 150 g per day goat yogurt ("placebo" group) or 150 g per day goat yogurt supplemented with goat whey heat-denatured protein hydrolyzed by a *Aspergillus oryzae* proteases-assisted lactic acid fermentation ("treatment" group). This supplemented yogurt had an average content of added peptides of 224 mg, that showed an in vitro angiotensin converting enzyme (ACE) inhibitory activity (expressed as IC<sub>50</sub>) of the  $13.7 \pm 1.3$  ug/g. Resting blood pressure was calculated as the average of three measurements taken using the right arm, with 1 minute rest cycle between measurements. SBP and DBP were measured on day 1 and during the last day of weeks 3 and 6. All subjects, in each group, enjoyed the taste and convenience of the goat yogurt daily portions. Results from day 1 and end of week 6 were compared by a t-student test. Both, SBP and DBP, significantly decreased ( $P < 0.05$ ), by the end of the study, in both treatment and placebo groups. In the treatment group, SBP and DBP decreased 6 mmHg and 5 mmHg, respectively; while in the placebo group, the decrease was 9 mmHg and 6 mmHg, respectively. However, there were no statistically significant differences ( $P > 0.05$ ) between both groups. Therefore, it can be considered that the hydrolysate supplementation, at the dose level used, had no effect on blood pressure. Pooling all results together from both groups showed a significant ( $P < 0.05$ ) decrease of 7 mmHg and 5 mmHg for SBP and DBP, respectively. In conclusion, daily consumption of goat yogurt may be a valuable dietary intervention in the treatment of hypertension.



**M-20**

**Characterization of goat cheese in the north of Morocco**

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The main objectives of this work is to identify the different processes used to elaborate goat cheese in the North of Morocco and to assess its physical, chemical and microbiological qualities. A survey was carried out in the North of Morocco with 53 farmers producing mainly traditional fresh cheese using either pure goat milk or mixture. Data concerning the valorisation techniques was collected and 3 samples of cheese by farm were obtained to assess the hygienic, physical-chemical and nutritional qualities. In general, we have identified 5 categories of processes depending on modalities of coagulation. Several preservation methods were identified during this survey. The study on local cheeses has shown that fresh goat cheese has average composition as fellows: pH 4, acidity 167°D, dried matter 30.5%. Fat 49%, proteins 39%, lactose 0,52 % and ash 5% of dried matter. The results of microbiological analysis showed the dominance of halotolerant flora followed by psychrophilic and mesophilic aerobic bacteria and mold and yeast. To determine the best fabrication process, a comparative study was carried out among different process based on physical and chemical composition and hygienic quality. According to the variance analysis, the physical-chemical and hygienic analysis parameters were significantly dependant on the used process. The best values were observed with the process using mixed coagulation with a lactic predominance.





## M-21

**Effect of pre-partum nutritional supplementation strategies on milk production and offspring body weight in goats managed under grazing conditions**

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The aim of this study was to evaluate the effect of nutritional supplementation on days 15 or 35 pre-partum upon milk yield and offspring body weights in goats grazing a semiarid range. Ranging goats (n = 31; 1200 - 1800 h) were divided in three experimental during the last third of gestation: i). Control Group (CG; n = 7) without nutritional supplementation, ii). 15-Group (15G; n = 10) which received a 15d pre- to 7d post-partum supplementation of 500 g per animal per day of a mixed ration (20% chicken manure, 37% rolled corn, 37% bran, 4% treacle, 2% salt) during the morning at 0800 h., and iii). 35-Group (35G; n = 10) which received the same mixed ration on 35d pre- to 7d post-partum. Before the onset of the supplementation period and immediately after parturition, blood samples were taken to quantify blood glucose concentration in all animals. At parturition, all goats were weighted; besides, the offspring of the three experimental groups were weighted at parturition, and at 7d and 15d after birth. In addition, milk yield was measured on 7d and 15d post-partum; all goats were milked at 2000 h, separated from their off-spring, and milk yield was recorded the next day at 0800 h. Serum glucose concentrations (mg/dl) and milk yield (kg) and both doe and offspring body weights of the experimental groups were compared by ANOVA (SYSTAT 12, 2007, USA). The results are as shown in Table 1. Present results demonstrate that a 15 or 35 day supplementation period increases serum glucose levels at parturition, milk production and both doe and offspring body weight of goats under range-grazing conditions in northern Mexico. Such supplementation regime could be of particular importance because of the well established kid-meat market for milk-fed kids in this region of Mexico while the potential increases in the survival rates of replacement kids, it also represents an important strategy to increase not only the goat's energy balance but also milk production.

Table 1. Pre-partum serum glucose concentrations (mg/dL) and milk production (kg/day) in goats receiving different nutritional supplementation strategies and it's effect over the mother and kid body weight at parturition under grazing conditions in northern Mexico

Group	Mother weith (kg)			Kid Weight (kg)			Glucose (mg/dl)		Milk production (kg)	
	-35	Birth	7	Birth	7 d	15 d	-35 d	0 d	7 d	15 d
Control	54 ± 3.1a	44 ± 2.2a	44 ± 2.2a	3.5 ± 0.2a	4.4 ± 0.2a	5.4 ± 0.3a	47 ± 4.1a	181 ± 25a	1.1 ± 0.2a	1.0 ± 0.2a
G 15	54 ± 2.3b	46 ± 2.0a,b	44 ± 1.6 a	3.4 ± 0.2a	5.0 ± 0.2a	6.3 ± 0.1b	48 ± 3.1a	275 ± 20b	1.6 ± 0.1b	1.5 ± 0.2b



M-22

**Physicochemical properties and texture of Coalho cheese prepared with cow's milk and goat's milk during storage**

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This study was carried out with the purpose of assessing the physicochemical and texture parameters of Coalho cheeses made from a mixture of goat's and cow's milk and of comparing the evaluated characteristics with those obtained for the Coalho cheeses made from goat's milk and cow's milk alone during storage at 10°C for 1, 7, 14, 21 and 28 days. The Coalho cheese is a typical Brazilian semi-hard dairy product, manufactured with mass semi-cooked and traditionally consumed fresh or matured, and the descriptive terminology commonly used to characterize samples of Coalho cheeses marketed in Brazil is rubbery texture. The physicochemical (including moisture, protein, fat, pH and salt using LactoScope Filter C4 apparatus) and texture parameters (hardness, chewiness and cohesiveness using TA-XT2 Texture Analyzer™) were evaluated. The analyses were carried out in triplicate and the means of the results were evaluated by the Analysis of Variance and Tukey's test to compare significant differences ( $P < 0.05$ ) using the SPSS software (v. 17, Chicago IL, USA). In general, among the assessed physiochemical parameters, the kind of milk used during production only influenced ( $P < 0.05$ ) the moisture, fat and salt contents of the cheeses. Cheeses with larger proportions of goat milk showed higher values for the hardness profile ( $P < 0.05$ ) and the storage period did not influence this parameter. The parameters of chewiness and cohesiveness did not differ significantly ( $P > 0.05$ ) between the types of milk during in the manufacture of cheese and the assessed storage times. This kind of cheese may be an alternative for the producers of goat dairy products and consequently may strengthen the dairy products supply chain.



## M-26

**Why has goat milk been left behind? A preliminary study of consumption habits and acceptance of goat milk products by Portuguese consumers**

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Considering the potential benefits of goat milk and goat milk products in health and economy, this study intended to estimate goat milk consumption among Portuguese consumers as well as to evaluate acceptance of goat milk and goat milk products. It was also an objective to evaluate consumer's perceptions and to understand which factors would contribute to increase goat milk and its products consumption. An e-questionnaire with 23 questions was developed. The first part of the questionnaire intended to characterize the sample of the population inquired considering gender, age, education, income, place of birth and residence, number of people in household, job, marital status and type of diet (Q1 to Q11). The second part intended to understand consumer consumption habits of goat milk and goat milk products and also the main reasons leading to the actual level of consumption of these food items (Q12 to Q16). The last part meant to understand which factors could increase goat milk and goat milk products intake, the type of products consumers would like to find available in the market and how much they would be willing to pay for them (Q17 a 23). The e-questionnaire was completed by 445 responders, 121 male and 324 female. Out of the 445 responders, 86% affirmed to drink cow's milk, 15% soy milk and only 3% to drink goat's milk. The main reasons pointed out to the low level of goat milk or goat cheese consumption were taste and flavor, while for yogurt were price and market availability. Although it was seen that goat milk consumption is residual, 70% of the inquiries affirmed consuming goat milk products, 27% of which on a weekly base. According to data obtained, the main factors that may be worked in order to increase goat milk products acceptance are: the improvement of organoleptic characteristics (38%), variety offered (26%), price (25%) and market availability (19%). Apart from cheese, yogurt (39%), desserts (25%) and sauces (24%) are the 3 main choices for goat milk products that individuals would like to find available. Data obtained suggests that in Portugal there is a market potential for developing new goat milk products which nonetheless, must be adapted to consumer's preferences in terms of flavor. Additionally, results indicated that educational and promotional campaigns should be developed in order to attract more consumers to the consumption of goat milk and its products taking advantage of the nutritional and health benefits of these products.



M-27

**Ultimate pH, and color of meat and adipose tissue in goat kids as influenced by breed and feeding system**

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This study was conducted in goat kids to evaluate the effects of breed and feeding system on ultimate pH, and color of meat and adipose tissue. Pasture or a concentrate-based diet was offered to 40 weaned male goat kids ( $25.9 \pm 1.4$  kg) of meat (Boer) and dairy (mostly Alpine and Saanen) breeds following a 2 x 2 factorial arrangement. Kids from each breed ( $n = 20$ ) were blocked by body weight and randomly assigned to a feeding system. Kids housed indoor in individual pen received concentrates (corn, soybean meal, and vitamin and mineral premix) and grass hay. Intensive pasture-fed kids were reared in group (by breed) and allowed to graze ad libitum with access to a vitamin and mineral supplement. Kids were slaughtered when they reached  $44.5 \pm 0.6$  kg live weight. At 96 hours post-mortem, left side of each carcass was cut between the 12th and 13th ribs. Ultimate pH and meat color coordinates (lightness ( $L^*$ ), redness ( $a^*$ ) and yellowness ( $b^*$ )) were measured on the *Longissimus dorsi* muscle. Caudal subcutaneous and kidney adipose tissue color values were also recorded. No interaction was observed between feeding systems and breeds for reported parameters. Meat kids had greater average daily gain compared to dairy kids (156 vs. 116 g/d;  $P < 0.01$ ). Fattening period was shorter for kids fed the concentrate-based diet compared to those fed intensive pasture (131 vs. 149 g/d;  $P < 0.05$ ). Dressing percentage was neither affected by breed nor by feeding system ( $48 \pm 3\%$ ). Concentrate-fed kids had higher ultimate pH than pasture-fed kids (5.99 vs. 5.65;  $P < 0.01$ ). Compared with dairy kids, meat kids had lighter meat (41.9 vs. 40.5;  $P < 0.02$ ) and caudal adipose tissue (74.5 vs. 70.8;  $P < 0.01$ ). Breed did not affect meat or adipose tissue yellowness. However, dairy kids showed higher redness values for meat (15.3 vs. 13.7;  $P < 0.04$ ) and kidney adipose tissue (-0.09 vs. -1.06;  $P = 0.01$ ) than meat kids. Feeding system did not influence meat color. Higher redness values in caudal and kidney adipose tissues ( $P = 0.01$ ) were observed for pasture-fed kids. Feeding pasture also increased yellowness in kidney adipose tissue (8.11 vs. 6.35;  $P < 0.01$ ). In conclusion, pasture feeding increased redness and yellowness in adipose tissue but decreased meat ultimate pH; meat color was only influenced by breed with meat kids having lighter meat and lower redness value than dairy kids.



## M-32

### **Carcass characteristics of Creole goats genetically indexed for faecal egg count**

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The Creole goat is reared for meat production. The main mode of feeding is based on grazing system. In those conditions the animal suffers from gastro-intestinal strongyles (GIS). Studies are going on the effect of GIS upon feeding and growing performances as well as upon physiological responses of the animals. Each animal was genetically indexed for faecal egg counts (FEC) at 11 months of age. The estimation of the breeding value (BV) for FEC of each kid of the flock takes into account their own individual performances, the performances of its ascendants, and their pedigree. Within each experiment the animals were allocated according to their BV, their weaning performances. At the end of each experiment animals were slaughtered according to a standard procedure and data on carcass characteristics were collected. A data base was then built with 72 Creole kids, defined with the different BV (susceptible S, n = 34; resistant R, n = 38). The slaughter weights ( $17.3 \pm 4.4$  vs.  $16.3 \pm 4.3$  kg), the carcass weight ( $6.6 \pm 2.1$  vs.  $6.1 \pm 2.9$  kg) and yield ( $51.5 \pm 5.4$  vs.  $51.0 \pm 3.9$  %) were not significantly different ( $P > 0.05$ ). The scores (conformation, internal and external fat) and linear measurements (height, length and width) assessed upon the carcass did not differ and were in line with previous results obtained on Creole goats reared under the same feeding conditions and within the same range of carcass weight. The chemical (ultimate pH and temperature) and physical properties (the L, a, b color parameters) of the carcass assessed upon the *longissimus* muscle did not differ according to BV. Significant differences ( $P < 0.05$ ) were observed in weights of liver and internal fat deposits. The susceptible goats exhibited higher weights (and proportions) than the resistant ones: 10% and 25% more, respectively for the liver and fat deposits (relatively to empty body weight). The cooking loss tended to be lower ( $P < 0.06$ ) in S goat meat than in the R one: 25 vs. 30 %. Further researches are required for a better understanding of these results as it related to the lipid metabolism (variation in liver and fat deposits). Since Creole goat is reared mainly for meat production it appears important to assess the meat potential of the kids according to their BV. In that case gastrointestinal parasitism must be addressed also and experiments are required to assess its effect on meat parameters.



M-33

**Meat quality of goat and sheep sausages**

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The main objective of this work was to contribute to the characterization of a new product, based on goat and sheep meat with a strategy, which gives value-added to meat from culled goats and sheep, which have a very low commercial price. Carcasses from animals weighing more than the body weight allowed by PDO label specifications were used to produce fresh sausages. Sheep and goats sausages were produced in a traditional industry, in Northeast Portugal. The following characteristics were evaluated in the final product: pH, water activity (aw), hemic pigments, moisture, ashes, protein, total fat, hidroxiprolin, oxidation index and fatty acids profile. The analyses were performed in the Laboratory of Technology of Carcass and Meat Quality of Bragança Agrarian Scholl according to established protocols. Results showed significant differences between sheep and goats sausages in moisture, ashes, total fat content and fatty acids profile. Sheep's sausages presented lower protein content, more ashes and higher fat content than goats' sausages. The major fatty acids found were oleic (C18:1), palmitic (C16:0), stearic (C18:0) and linoleic (C18:2), mainly affecting the different portions of saturated fatty acids (SFA) with 3.51 and 2.52 g/100 g dry matter, monounsaturated (AGM) with 3.89 and 6.04 g/100 g dry matter, and poly-unsaturated fatty acids (PUFA) with 1.37 and 2.11 g/100 dry matter, in sheep and goat sausages respectively. Goat's sausages presented significantly lower values for the main fatty acids than sheep' sausages, which can be an important information to characterize the products and distinguish them. Results suggests that fatty acids profile can be an essential tool to detect alterations and would be useful to verify the authenticity of these kind of meat products.



M-34

**Production and milk composition of dairy goats fed with cane sugar in replacement of corn silage**

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The intake of dry matter and other nutrients was evaluated in lactating goats fed with cane sugar instead of corn silage. In three 4 x 4 Latin squares were distributed 12 Saanen goats with average weight of  $45.22 \pm 5.3$  kg and  $42.23 \pm 2.66$  days of lactation at the beginning of the experiment. The diets were 0, 33.3, 66.6 and 100% levels of replacement of corn silage by cane sugar and roughage:concentrate ratio of 50:50. The experiment consisted of four periods of 21 days, 14 (animal adaptation) and 7 (data collection). Immediately after the milking and weighing of milk, homogenization was performed in approximately 40 ml then collected milk of both the morning and afternoon for determination of fat, protein, lactose and total solids, and measured pH, temperature and density. There was no influence of substitution of corn silage by sugar cane consumption of dry matter (DM) in kg/day, % LW eg/kgPV0, 75, organic matter (OM), crude protein (CP), non-fiber carbohydrates (NFC), total carbohydrates (TCHO), neutral detergent fiber (NDF) and total digestible nutrients (TDN), but the consumption of ether extract (EE) and acid detergent fiber (ADF) decreased linearly. The total milk production in kg/day was not influenced by the inclusion of cane sugar in the diet, but milk yield corrected for 3.5% fat decreased linearly. The production of protein, lactose and total solids of milk was not affected by the substitution of corn silage, but fat decreased linearly. There was no influence on the content of protein and lactose, but the fat and total solids were negatively influenced by the inclusion of cane sugar in the diet. Feed efficiency was not affected when using the cane sugar instead of corn silage. The sugar cane can substitute corn silage in medium production goat diets as exclusive roughage, with no altering milk production and feed efficiency, but reduces the fat content of milk.





## M-35

**Effect of genotype at CSN1S1 per diet interaction on milk fatty acid profile in  
Derivata di Siria lactating goats**

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A study was carried out to evaluate how the dietary levels of energy and protein requirements and its interaction with polymorphism at the CSN1S1 genotype locus can affect fatty acid (FA) profile in Derivata di Siria lactating goats. Twenty-seven goats, homogeneous for days of lactation ( $50 \pm 5$ d), milk production ( $1.3 \pm 0.3$  kg/d), and body weight ( $42.1 \pm 1.2$ kg), were selected on the basis of their CSN1S1 genotype, as follows: nine homozygous for strong (AA) allele, nine heterozygous (AF) and nine homozygous for weak allele (FF). The goats were used in a 3x3 factorial arrangement of treatments, with three genotypes (AA, AF, FF) and three feeding treatments. In the course of the trial, the goats received the same pelleted diet (5.8 MJ NE 1/kg DM; 15.2% CP) but in variable amounts according to the treatment. The three experimental treatments supplied 70 and 75 % (L), 100 and 110% (M) and ad libitum (H) of the goat's energy and protein requirements, respectively. The experiment consisted of three simultaneous 3 x 3 Latin squares for the three genotypes, with one square for each level of energy and protein requirements. Each experimental period lasted 23d of which 15d for adaptation and 8d for milk samples collection. The genotype×diet interaction was significant ( $P < 0.05$ ) for SFA, omega-3, SCFA, Medium Chain Fatty Acids (MCFA) and Thrombogenic Index (TI). A slight ( $P < 0.06$ ) effect of genotype×diet interaction was detected for PUFA and C18:1/C18:0 ratio. In the H group a larger number of parameters were affected by genotypes than in L and M groups. SFA and SCFA were lower in AA and FF than AF when H diet was consumed. In M and L, PUFA decreased from AA (6.73, 6.22), AF (6.80, 6.02) to FF (6.25, 5.39) genotype, respectively. For the AA goats, higher value was obtained for PUFA when H diet was consumed. AF goats showed a higher value for omega-3 when M and L diets were ingested. In M group, MCFA increased ( $P < 0.05$ ) from AA, AF genotypes to FF one. Also, TI worsened in FF genotype than AA and AF when M was consumed. Shifting from L to H diet, C18:1/C18:0 ratio significantly increased in AA and AF slightly in FF. MCFA increased ( $P < 0.05$ ) in AA, AF and FF when the diet shifted from L to H. TI decreased ( $P < 0.05$ ) in AA and AF, slightly in FF when the diet changed from H, M to L. FA profile of CSN1S1 genotypes seems to depend on the diet consumed. Similarly, the advantage of changing diet in order to optimize FA profile depends on the genotype of goats.



## M-36

**Physicochemical and sensorial characteristics of milk from goats supplemented with different vegetable oils**

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The purpose of this study was to evaluate the influence of diet supplementation with different oils to milking goats on the physical, chemical, and sensory characteristics of milk. Eight multiparous crossbred Saanen x French-Alpine goats, at d 50 of lactation and weighing 54 kg on average, were penned individually; drinking water and feed were provided *ad libitum*. A simultaneous double Latin square ( $4 \times 4$ ) experimental design was used, with 8 animals randomly distributed into 4 treatments and 4 periods. The experimental groups consisted of complete diets on a DM basis, three types of vegetable oil (or sesame oil or castor oil or faveleira oil) at the same level (4.0%) and a control group (0% oil). The tests with the experimental diets lasted 76 days, consisting of four periods of nineteen days. Analyses were performed on the physicochemical, sensory and fatty acids composition in milk. Physicochemical analyses were performed in accordance with the procedures recommended by AOAC International (2000). In determining the profile of fatty acids in milk fat, the lipids were extracted by a mixture of organic solvents (chloroform: methanol) as described by Folch *et al.* (1957). The lipid fraction was esterified and methylated according to method described by Hartman and Lago (1973). Quantitative descriptive analysis (QDA) was performed in triplicate using 12 trained panelists. The statistical model of sensory analysis data contained only the fixed effect of the treatment. Treatment means were compared by Tukey test at 5% error probability (SAS, 1999). The inclusion of castor oil in the diet of dairy goats origin a decrease ( $P < 0.05$ ) in dry matter intake, milk yield and protein content of milk, as well as promotes changes in the fatty acid profile of increasing concentrations of saturated fatty acids, obtaining negative consequences in sensory attributes. The manipulation of the diets of goats with the inclusion of sesame oil or faveleira oil promotes desirable variation ( $P < 0.05$ ) in fatty acid profile of adding levels of unsaturated fatty acids reducing the fatty acids with atherogenic potential, and further positive effect on sensory characteristics making it milk is more attractive to consumers. Further studies on the characterization of volatile compounds in milk from goats supplemented with vegetable oils could contribute to understanding the sensory changes in milk and, consequently, to developing animal feeding strategies aimed at improving goat milk quality.



M-38

**Relative growth of carcass cuts and tissues of goats from five racial groups finished on pasture or feedlot**

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This work was conducted with the objective of evaluate the relative growth of carcass cuts and tissues of goats. Seventy-eight male and female kids from five racial groups were used: Alpine;  $\frac{1}{2}$  Boer +  $\frac{1}{2}$  Alpine ( $\frac{1}{2}$  BA);  $\frac{1}{2}$  Nubian +  $\frac{1}{2}$  Alpine ( $\frac{1}{2}$  ANA);  $\frac{3}{4}$  Boer +  $\frac{1}{4}$  Alpine ( $\frac{3}{4}$  BA); and  $\frac{1}{2}$  Nubian +  $\frac{1}{4}$  Boer +  $\frac{1}{4}$  Alpine (TC); distributed in two finishing systems, pasture (FS1) and feedlot (FS2). The kids were slaughtered at an average of 22.07 kg of live weight and  $128.4 \pm 7.9$  days. The average weight of half carcasses was 5.09 kg. To determine the allometric growth the exponential equation was used  $Y = aX^b$ . The crossing with the Anglo Nubian provided the early growth of the leg in relation to the half carcass weight. The loin grew late in the Alpine animals and  $\frac{1}{2}$  the ANA. In animals from group TC ribs grew late. The crossings did not influence the development of the neck. The palette was considered earlier in kids  $\frac{1}{2}$  BA and TC. Muscle tissue in relation to the half carcass, grew early in the group  $\frac{1}{2}$  BA. In FS1, the palette grew early, while this growth was intermediate in FS2. The fat tissue of animals in FS1 had a late growth. The females showed early growth of leg and muscle tissue, while in males was considered intermediate. The growth of goats is influenced by the crossings, sex and finishing system.



## M-39

### Racial group, sex and slaughter weight in muscle fiber area, collagen and fatty acid profile of kid meat

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The aim of this research was to evaluate the muscle fiber area and the collagen content of Semitendinosus muscle and the fatty acid profile of *Longissimus dorsi* muscle of male and female kids from different racial group and slaughter weight. There were used 74 kids from five racial groups (RG): Alpine (A),  $\frac{1}{2}$  Boer +  $\frac{1}{2}$  Alpine ( $\frac{1}{2}$  BA),  $\frac{1}{2}$  Anglo Nubian +  $\frac{1}{2}$  Alpine ( $\frac{1}{2}$  ANA),  $\frac{3}{4}$  Boer +  $\frac{1}{4}$  Alpine ( $\frac{3}{4}$  BA),  $\frac{1}{4}$  Boer +  $\frac{1}{4}$  Alpine +  $\frac{1}{2}$  Anglo Nubian (Tricross – TC), and one third of each RG was slaughtered when reached 25, 30 and 35 kg, after 24 hours of fasting. Samples of Semitendinosus muscle were collected to prepare slides with histologic cuts (10  $\mu\text{m}$ ) stained with hematoxylin-eosin for muscle fiber area analysis and with picrossirius-hematoxylin and reticulin technique for collagen analysis. For each animal there was measured the area of the cross-section of about 200 muscle fibers and the collagen content in 10 fields of the slide randomly chosen. For fatty acid profile, samples of *Longissimus dorsi* were homogenized in a processor. Lipids were extracted and the analysis of fatty acid profile was performed in a gas chromatograph. The experimental design was totally randomized and the Tukey test ( $P < 0.05$ ) was used to compare the means. The analysis were processed by SAEG (Genetic and Statistical Analysis System), version 8.0. The characteristics of muscle fiber area and collagen percentage of Semitendinosus were not different among racial groups, slaughter weights, sex and interactions, showing general means of 2,487.96  $\mu\text{m}^2$  and 6.60% respectively. The value of correlation among muscle fiber area and collagen content was  $-0.3121$ , which although significant ( $P < 0.01$ ) is considered low, demonstrating that the characteristics are independent. The gender influenced the fatty acids C14:0, C16:0, C16:1, C20:3n3, C20:5n3 and  $\omega$ -3; the RG influenced the levels of C18:2n6c, C20:0, C24:1 and CLA cis. The SW did not affect the fatty acid profile, but the interaction G x SW influenced the levels of C18:0, UFA and the PUFA/SFA ratio. Kids slaughtered at up to 35 kg, regardless of racial group and sex did not show differences in muscle fiber area and collagen percentage. Male and heavier animals produced the best meat in terms of nutrition.



M-47

**Milk production and composition of Toggenburg and Toggenburg-Anglo Nubiana crossbred goats in Southeastern Brazil**

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To investigate milk production and composition of Toggenburg and crossbred Toggenburg Anglo Nubiana goats in an intensive dairy production system, nine Toggenburg and seven crossbred goats were used in a commercial farm at the same nutritional management. Milk production was obtained daily for 11 months in a two daily hand milking system. The individual composite milk samples for analysis of fat, protein, lactose, total solids and somatic cell count (SCC) were collected in the morning milkings and stored in plastic bottles containing two tablets of bronopol. After collection, the samples were homogenized by inversion until complete dissolution of the tablets. Analyzes were performed by using electronic device Somacount 2300 (Bentley Instruments ®) in the Milk Quality Laboratory at Embrapa Dairy Cattle. For statistical analyze, the data was submitted to SAEG procedures. The average milk production was 2.5 L/d for Toggenburg-Anglo Nubiana and 2.1 L/d for Toggenburg goats, but there was no difference ( $P > 0.05$ ) between the two groups for milk production, protein, lactose and SCC. There was difference ( $P < 0.05$ ) for fat content and total solids and they were higher for the crossbred group (3.9 and 3.3% for fat content, and 12.3 and 11.6, for total solids, for crossbred and purebred, respectively). These results indicate that even in more intensive production systems it is possible to take advantage of heterosis through crossbreeding. Financial Support: FAPEMIG.



M-48

**Goat milk composition and rennet coagulation properties - Effect of grazing season, diet and genotype**

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The present study aims to investigate the effect of grazing season, diet, and genotype (CSN1S1) on goat's milk composition and rennet coagulation properties. Eighty Norwegian dairy goats were randomly assigned in two groups (Early and Late) balanced for genotype (CSN1S1, exon 12) and number of lactations. The difference in mating and kidding dates for the two groups were approximately eight weeks. At day ~ 130 in milk, the goats in each group were allocated in four dietary groups (cultivated pasture (C), forest rangeland pasture (R), high quality hay (HH) and low quality hay (HL)). Pooled samples from 4 milkings (2 days, morning and evening) were obtained from each individual goat. Rennet coagulation properties (rennet clotting time (RCT), firming rate (K20) and gel strength (A30)) were analyzed by the Formagraph method. Total casein (pH 4.2) was measured by Kjeldahl analysis, and individual caseins were quantified by capillary electrophoresis. Casein micellar size was measured by photon correlation spectroscopy (PCS). Somatic cell count and lactose content were measured by FTIR analysis (Milkoscan). The coagulation properties (RCT, K20 and A30) were clearly influenced by season. Shorter RCT and K20 and higher A30 was obtained in milk from goats in Early season compared to Late season. It was not possible to detect major differences based on the four different diets. However, by comparing goats fed hay versus pasture, the more favorably properties such as higher casein content,  $\alpha$ s2-casein content and higher A30 were found in milk from goats grazing on pasture (cultivated and forest pasture). The coagulation properties were also affected by the goat's genotype (CSN1S1). Goats homozygous for the deletion in exon 12 displayed poor coagulation properties having the largest casein micelles and less content of total casein and  $\alpha$ s1-casein. The lower content of  $\alpha$ s1-casein in the goats homozygous for the deletion in exon 12 may be compensated by a higher content of  $\alpha$ s2-casein. This protein was found to be of great importance for the rennet coagulation properties. Lactose and gel strength (A30) was positively correlated however; lactose does not improve gel strength (A30) directly. We will investigate further if lactose can be used as a rapid marker for better cheese milk.



M-51

**Contribution of objective and subjective attributes in predicting carcass weight and eye muscle area of grazing Angora goats**

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Meat production is an important component of the financial returns from mohair production but there are few objective reports of carcass production or quality. This work aimed to develop equations for farmers and meat processors to predict the weight and attributes of Angora goat carcasses of different genotypes. The sires were from South African, Texan and combinations of these genotypes. At 6 years of age, and prior to slaughter, eye muscle depth (EMD) and subcutaneous fat depth (SFD) of the castrated male goats were determined by ultrasonic scanning. The mean ( $\pm$  S.D.) live weight at slaughter was  $62.8 \pm 7.66$  kg; body condition score (BCS)  $2.7 \pm 0.6$ ; carcass weight  $24.4 \pm 3.87$  kg; EMD  $28 \pm 3.4$  mm; SFD  $3.1 \pm 0.98$  mm. Live weight accounted for 84% of the variation in carcass weight. The best prediction equation for carcass weight, accounting for 91.5% of the variation, included terms for live weight, SFD, EMD and sire, with SFD and EMD accounting for 5.3% and sire 2.4% of the variation in carcass weight. At 6 years of age there are differences of up to 2.8 kg between Angora sires in the carcass weight of their progeny. The best prediction for EMD included only BCS and carcass weight accounting for 66% of the variation. The on-farm measurements of live weight and BCS used together accounted for nearly 58% of the variation in EMD. BCS alone accounted for 51% of the variation. In this study farmers could have obtained almost as good a prediction of carcass weight without the cost of external contractors needed to measure SFD and EMA by using live weight and BCS which together accounted for 87% of the variation. On-farm measurements of live weight and BCS of Angora goats are valuable predictors of both carcass yield and EMA, and can be used to optimise financial returns.





M-52

### **Total protease activity in goat milk and relationship with casein expression**

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Milk protein system plays a crucial role in milk nutritional and technological properties. Milk proteins undergo the action of both native milk proteases as well as by psychrotrophic bacteria's proteases with important effects on milk composition. The aim of the present study was to optimize a technique for quantifying goat milk total protease activity (TPA) based on azocasein degradation. Azocasein is a nonspecific protease substrate which, under appropriate pH and temperature conditions, is degraded by milk proteolytic enzymes and releases the azo dye into the media changing from red to colorless. The colorimetric determination was performed using a spectrophotometer UV-VIS at the wave length of 345 nm. The linearity of the method was evaluated by adding known quantity of N protease from *Bacillus subtilis* to a commercial bulk pasteurized milk sample and repeated ten times to validate the method. Milk samples from 24 Camosciata primiparous goats were used to set up the method. Milk protein profiles of the individual milk samples were also analyzed by isoelectrofocusing (IEF) to get an overall picture of the main milk protein and their expression level. The IEF gels were acquired and quantified by imaging analysis. Moreover,  $\alpha$ S1-CN was analyzed at the DNA level to assign the correct genotype to each goat. The calibration regression showed the high linearity of the method (determination coefficient  $> 0.99$ ) and the repeatability was 0.98. The TPA mean of the analyzed samples was 6.17 mU/mL. Only intermediate (0.375) and high expression levels (0.625) of  $\alpha$ S1-CN were found by IEF. This result was also confirmed at the DNA level: 15 individuals carried only strong level alleles, 3 both strong and intermediate level alleles, 3 both strong and weak level alleles, and 3 only intermediate level alleles (EE). Relations between individual TPA, daily milk traits, days in milk,  $\alpha$ S1-CN expression level, and distribution of the different protein fractions were preliminarily estimated by PROC CORR analysis (SAS, 2008). TPA was positively correlated ( $r = 0.40$ ;  $P < 0.08$ ) with milk protein percent, with  $\alpha$ S1-CN ( $r = 0.45$ ;  $P < 0.03$ ) and  $\gamma$ -CN ( $r = 0.44$ ;  $P < 0.05$ ) content. The variation found could be influenced by milk protein genetic polymorphism which in goat's species strongly affects the four casein fractions. The method applied is an easily applicable technique for routine milk tests on bulk and individual samples. Work is in progress to confirm the results in other 150 milk samples.



M-53

### Effect of fresh and dry forage of two grasses and two legumes species on fatty acid profile and nutritional index of milk and cheese

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The aim of this study was to evaluate the fatty acid profile and Health Promoting Index (HPI) of milk and cheese obtained from goats fed with fresh and dry forage of grasses and legumes. Forty Derivata di Siria goats homogeneous for milk production, days of lactation and BCS were allotted to four groups and they were fed with two grasses: *Lolium perenne* fresh (LF) and dry (LD), *Hordeum vulgare* fresh (HF) and dry (HD), and two legumes: *Medicago sativa* fresh (MF) and dry (MD) and *Vicia sativa* fresh (VF) and dry (VD). The milk was processed as Caciotta cheese and ripened for 20 days. Each trial lasted 15d, 10d for adaptation and 5d for experimental period. The lipid fraction of milk was extracted and fatty acids (FAs) were converted in methyl esters then separated and quantified by gas chromatography. The FAs peaks were identified using single and mixture of standard FAs. The nutritional index HPI was calculated according to Chen *et al.*, (2004). The statistical analysis of data was carried out by GLM procedure of ANOVA. Mean values, expressed in g/100 g FA, were compared by Tukey-test. In cheese and milk from legumes groups were observed minor significant difference of FA profile compared to grasses groups. In cheese from legumes MF and VF groups, ALA (0.979 vs. 0.763; 1.549 vs. 1.418), omega-3 (1.824 vs. 1.079; 1.97 vs. 1.78) and Long Chain Fatty Acids (LCFA) (42.97 vs. 35.37; 37.53 vs. 37.21) were significantly lower ( $P < 0.05$ ) than MD and VD, respectively. The higher HPI was observed in cheese (0.531) of MF than in cheese of VF group. Legumes species did not affected milk FA profile and nutritional index. The HF group was characterized by differences ( $P < 0.05$ ) between milk and cheese for SFA, INFA, MUFA, PUFA, omega-3 and LCFA. Cheese from HF and HD exhibited a decrease ( $P < 0.05$ ) for ALA (0.725 vs. 0.598), SFA (64.85 vs. 60.62), omega-3 (1.35 vs. 0.96) and an increase ( $P < 0.05$ ) for MUFA (28.94 vs. 33.37) omega-6 (3.3 vs. 3.7), LCFA (47.33 vs. 50.35) and HPI (0.66 vs. 0.78). On the contrary, in cheese from LF to LD an increase ( $P < 0.05$ ) of ALA (0.511 vs. 0.652), MCFA (38.23 vs. 41.17) and LCFA (35.35 vs. 40.44) was detected. The grasses species especially *Hordeum vulgare* seems to provide a footprint clearer than legumes species and *Lolium perenne*. Also the differences between products were emphasized in the fresh form of the herbage.



## M-54

### Effects of level and length of supplementation on leather characteristics of yearling Boer and Spanish wethers

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Spanish (S; 28 - 40 wk of age) and Boer (B; 33 - 46 wk) wethers were used to determine effects of level and length of supplementation on leather characteristics. The experiment started in January and had 110 and 108 day periods (PR). Wethers resided on pastures with free-choice access to alfalfa hay and supplementation (SL) with 0.5 or 1.5% BW (DM basis; L and H, respectively) of a pelleted diet (16% CP and 60% TDN). Five S and 6 B were harvested initially, and 12 per breed (BR) and SL were harvested after PR 1 and 2. Skins were salted for 10 to 14 days and then chrome tanned. There were BR differences in initial BW (33.3 and 23.7 kg,  $P \leq 0.06$ ), initial thickness of leather (1.83 and 1.48 mm,  $P < 0.05$ ), and % elongation (66.6 and 55.1%,  $P < 0.01$ ) for B and S, respectively. The ADG was greatest ( $P < 0.05$ ) among PR-BR treatments for PR1-B (139, 74, 63, and 56 g for PR1-B, PR1-S, PR2-B, and PR2-S, respectively; SEM = 5.23). The BW was affected ( $P < 0.05$ ) by SL (48.2 and 43.1 kg for H and L), BR (53.1 and 38.2 kg for B and S), and PR (41.8 and 49.3 kg in 1 and 2, respectively). Leather thickness and tensile strength were unaffected by PR or SL but B skins were thicker (1.91 vs. 1.71 mm,  $P < 0.01$ ) and had greater tensile strength (31.0 vs. 28.1 MPa,  $P \leq 0.06$ ) than S skins. Percent elongation was greater ( $P < 0.05$ ) in PR1 than PR2 (51.9, 58.6, 45.1, and 40.5%, for PR1-H, PR1-L, PR2-H, and PR2-L, respectively; SEM = 1.323) and greater for B than for S skins (50.6 vs. 47.4%,  $P < 0.05$ ). Young's modulus was unaffected ( $P > 0.05$ ) by BR (15.9 and 14.7 MPa for B and S, respectively) but was greatest ( $P < 0.05$ ) for L goats in PR2 (9.47, 6.93, 19.38, and 25.61 MPa for PR1-H, PR1-L, PR2-H, and PR2-L, respectively; SEM = 1.159). Fracture energy was higher ( $P < 0.01$ ) for B than S skins (5.39 vs. 4.61 J/cm<sup>3</sup>) and was greatest ( $P < 0.05$ ) for L goats in PR1 (5.00, 5.96, 4.73, and 4.32 J/cm<sup>3</sup> for PR1-H, PR1-L, PR2-H, and PR2-L, respectively; SEM = 0.277). As goats aged, leather stiffness increased as seen by lower % elongation and higher Young's modulus in PR2. Supplementation level affected body weight with lesser effects upon leather characteristics. Boer goats were larger, grew faster and had greater skin thickness, the latter which contributed to the greater values of B leather for tensile strength and % elongation. Goat skins were not shaved to an equal thickness and results are based upon tests of full skins. Further research is needed to evaluate the above characteristics on shaved goat leather.



M-56

**Determination of the volatile free fatty acids content in canary goat cheeses by headspace solid-phase microextraction and gas-chromatography**

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Free fatty acids (FFAs), which are formed during cheese lipolysis, are very important components due to their contribution, together with other analytes, to cheese aroma. It has been argued that the content and distribution profile of volatile FFAs is a useful strategy to determine the optimum ripening time for a goat cheese. Volatile compounds responsible of aroma have been determined, in recent years, with the headspace solid-phase microextraction (HS-SPME) technique. The procedure is simple, and utilizes commercial micro-fibers which are easily automated in a gas-chromatograph (GC). The procedure has also been applied to the determination of volatile FFAs in cheeses. This work reports the utilization of HS-SPME-GC to determine the content of nine volatile FFAs in Canary goat cheeses elaborated with raw milk, and using different ripening times as well as different rennet samples. Moreover, several statistical tools, such as principal component analysis (PCA) and discriminate analysis (DA) have been employed with the purpose of finding correlations between the ripening time and/or the rennet nature on the content and distribution of volatile FFAs in Canary goat cheeses. The results of this study would help in improving the knowledge about the ripening of Canary goat cheeses, and/or the influence of the type of the rennet, in the obtained aroma of the resulting cheese.



M-57

**Utilization of a novel multiple headspace solid-phase microextraction approach to determine volatile free fatty acids in canary goat cheeses**

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Canary Cheeses are mainly elaborated with raw goat milk. They are characterized for unique flavor and texture properties, which can be linked to the adaptability of the goat to the Canary Islands and their feed, as well as to the specific cheese's elaboration and ripening conditions. The majority of volatiles in cheeses are formed during ripening. Free fatty acids (FFAs) are formed during lipolysis. FFAs are present in higher contents in cheese elaborated from raw milk than those from pasteurized milks. FFAs contribute, altogether with other volatiles, to cheese aroma. Indeed, the content and distribution profile of FFAs is a useful tool to evaluate the optimum ripening time for a cheese. Headspace solid-phase microextraction (HS-SPME) is an analytical tool that has been used to determine volatile in cheeses, including volatile FFAs. Up to date, there are only seven commercial SPME coatings available. The commercial carboxen-polydimethylsiloxane (CAR-PDMS) coating is very convenient for the analysis of polar compounds. More recently, polymeric ionic liquids (PILs), which are available in our laboratories, also constitute interesting alternatives to commercial coatings. The main limitation of the HS-SPME technique takes place during quantification if a complex matrix, such as cheese, is being analyzed. Therefore, a novel procedure, multiple headspace solid-phase microextraction (MHS-SPME), has been developed to overcome the quantification problems in complex samples of conventional HS-SPME. MHS-SPME requires the consecutive measure of a sample to almost ensure quantitative and reproducible extraction. The technique is also easily compatible and able to automation with gas-chromatography (GC). This work reports the influence of several experimental variables on the novel MHS-SPME technique when determining a number of volatile FFAs, namely: acetic acid, propionic acid, iso-butyric acid, n-butyric acid, iso-valeric acid, n-valeric acid, n-hexanoic acid, iso-hexanoic acid, and n-heptanoic acid. The method has been carried out using the CAR-PDMS and the PILs coatings in a high number of goat Canary cheeses made with raw milk.



M-58

**Performance, carcass characteristics and meat quality of intact and castrated  
Ardhi goat kids fed high energy diet**

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An experiment was conducted to evaluate the effects of castration on growth performance, carcass characteristics and meat quality of Ardhi goat kids. Twenty-four weaner male kids with an average age of 3 months and 14.191 kg body weight were assigned randomly to one of two equal groups and the kids in one group were castrated using elastrator rings while the other group was left intact. All kids were fed ad libitum on high energy commercial pellets for 82 days and slaughtered. Castration had no significant effect on slaughter weight, feed intake, gain, feed: gain ratio, carcass weight and dressing percentage. Castrated goat kids had significantly ( $P < 0.05$ ) heavier liver weight, more body fat thickness and lighter head weight than comparable intact. There were no differences ( $P < 0.05$ ) between estimated and intact kids on all studied internal fat depot weights, chemical composition of the 9-11th rib joint and meat quality of the longissimus muscle except for the separable fat percentage from 9-11th rib joint which was higher ( $P < 0.05$ ) for castrated as compared to intact kids.



## M-60

**Instrumental texture and colour of raw goat's milk cheeses made with artisan kid rennet paste, vegetable rennet (*Cynara cardunculus*) and a mix of both**

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The instrumental texture and colour of cheeses made with different types of rennet were analysed. Four different thistle flowers, artisan kid rennet paste (AKR), a mix of plant rennet and artisan kid rennet (KPR), and genetically engineered chymosin (GEC) were used in cheesemaking. Plant rennets were prepared from blossom heads of the cardoon thistle (*Cynara cardunculus*). These plants were collected wild (PW) or harvested (PH). The flowers were either cultivated in the same year as cheese was made (N) or had been harvested the previous year (O). All these coagulants, including the mixture of animal rennet and thistle flower, are used in traditional Canarian farmhouse cheeses. The cheeses were made in an experimental plant, in triplicate, using raw goat's milk, the only variable being the type of rennet used (AKR, KPR, GEC, PWO, PWN, PHO and PHN) and the amount of rennet was adjusted to give the same coagulation time in all batches. KPR rennet was a mixture of AKR and PWN rennet. Cheeses were ripened for 7 or 20 days. TPA (texture analysis profile) texture was determined with a TA-HD-Plus texturometer. Five texture parameters (hardness, fracturability, cohesiveness, elasticity and gumminess) were analysed. Colour was measured with a Minolta CR-200 colorimeter and the CIELCH colour space analysed. With the exception of cohesiveness, all texture parameters were affected by rennet type. Seven day-cheeses made with GEC were more fracturable ( $P < 0.05$ ), harder ( $P < 0.05$ ) and less gummy ( $P < 0.05$ ) than the other cheeses. Cheeses made with AKR or KPR rennets formed a homogeneous intermediate group, whereas cheeses made with any of the plant rennets were grouped by texture parameters and were less hard, fracturable and needed less energy to chew. AKR and KPR cheeses were more elastic than those made with the other rennets. Texture was affected by the type of coagulant used in the 20-day-old cheeses. With the exception of PHN cheeses, 20-day-old cheeses made with vegetable rennet, including KPR, had lower scores for fracturability, hardness and gumminess than 7-day-old cheeses. In addition, 7-day-old cheeses made with GEC and AKR rennets were lighter in colour and showed a higher Hue angle ( $P < 0.05$ ) than the rest. Ripening time also affected colour parameters, increasing C values and decreasing L values (except in cheeses made with KPR rennet). Instrumental texture appears to be an appropriate method to differentiate cheeses made with very different coagulants.





M-62

**Prediction of carcass tissue composition of goat kids from different racial groups from meat cuts**

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Were used 78 carcasses of goat kids, slaughtered with average of 120 days old, of five racial groups: Alpine (A),  $\frac{1}{2}$  Boer +  $\frac{1}{2}$  Alpine ( $\frac{1}{2}$  BA),  $\frac{1}{2}$  Alpine +  $\frac{1}{2}$  Anglo Nubian ( $\frac{1}{2}$  ANA),  $\frac{3}{4}$  Boer +  $\frac{1}{4}$  Alpine ( $\frac{3}{4}$  BA),  $\frac{1}{4}$  Boer +  $\frac{1}{4}$  Alpine +  $\frac{1}{2}$  Anglo Nubian (Tricross - TC), not castrated males and females, and two finishing systems (ST1 – kid with mother goat in pasture and ST2 - kid weaned and confined, from 60 days old). The carcasses were split down the dorsal midline. The left side was divided into five primal cuts: shoulder, leg, rib, loin and neck. After, each cut was separated into dissectible muscle, bone, fat and other tissues. The racial group, gender and finishing system affected the yield of fat and bone in the carcass. The yield of muscle was influenced only by termination system, and the yield of other tissues influenced by gender. The first generation of the crossing of breed Alpine with Boer increased fat deposition and decreased the bone, helping to improve the finish of the carcass. Females had a higher proportion of fat and less bone than males. There was significant correlation between muscle, fat and bone carcass with these same tissues in cuts. Due to the high relationship between the constituent components of the carcass with the rib and leg cuts, and provide prediction equations with the highest coefficients of determination; these are the cuts that should be used for this purpose.

**M-63****Goat milk and dairy products of Hungarian producers**

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Comparing to dairy cattle, the importance of goat milk production is limited in Hungary. In 2011 the total population was 81 000 heads, of which 44 thousands were does, but only 16 thousands were officially registered. The dominant part of the population is belonging to the domestic breeds, while the main exotic breeds (Saanen, Alpine, Nubian, Boer) are also bred, and most of them are kept in small farms, however, big sized farms with up-to-date technology are also functioning. The estimated annual goat milk production is 6-8 million litres, of which 0.8 million litres was officially controlled (hygienic quality and quantity) in last year. The average milk yield is between 200-500 litres (but on some farms 800 litres are exceeded), dominant part (75-85%) of income originated from milk in the sector. While the number of official goat milk processing firms was 24 in 2003 (the first class hygienic milk quality was supported), it was only 12 in 2011. The number of goat milk products also decreased during this period (from 150 to 100 kinds), and the export of milk products almost disappeared. The milk production data of goat breeds kept and milked in Hungary, and possibilities of increasing milk quantity were evaluated in this study. The composition (fat, protein, lactose and fat-free dry matter), and the quality (total number of bacteria, somatic cell count, acidity, pH, and freezing point) of milk as well as their changes during lactation were analyzed based on the period between 2001 and 2011. Special health and hygienic regulation could be followed by smallholder's (including goat farming) in basic food production, processing and marketing in order to help farmer to sell their products under less serious conditions. Following the requirements of the regulations the milk was also evaluated. Based on the production data, buying up prices and number of milking animals, the profitability and the sustainability of goat farming was also analysed. As conclusion, besides increasing of individual milk production and/or increasing of number of milked animals per farms are also necessary, but the effect of breed is not neglectable. Over a certain cost level production cannot be profitable, while the sale of own produced and processed products could increase incomes, but the available market has basic effect on sustainability.



**M-64**

**Fatty acid profile of milk and “coalho” type cheese from dairy goats fed vegetable oils in the Brazilian semiarid**

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Fatty acids of milk and “Coalho type” cheese were analyzed in samples from Saanen and French Alpine goats fed diets enriched with 4% of vegetable oils (castor, sesame and “faveleira”). Animals were arranged in a double 4 x 4 Latin square design and each pair of goats received diets containing one of the oils for 19 days. Supplementation with “faveleira” and sesame oils in the diets of goat did not promote an increase in total fat in milk and cheese, but decreases concentrations of SFA acids and increased levels of MUFA, PUFA, AGD and IA, of both products. The oil supplementation of dairy goats has potential for improvement, up to 30%, the index of atherogenicity of goat milk and cheese, indicating that manipulation of goat diets with these vegetable oils presents as an option for control the nutritional parameters of goat milk and cheese.



## M-65

**Evaluation of milk composition of crossbred goats in different times of year in the municipality of Mossoró-RN/Brazil**

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The Northeast region is characterized by a tropical climate with two very different periods, the dry season (August to January) and rainy (February to July). Some factors such as nutrition and seasons can change the composition of goat milk, mainly by changing the chemical characteristics (fat, protein, lactose and total solids). The objective of this study was to evaluate the influence of dry and rainy season on variations in the composition of goat milk. The experiment was conducted at the Polo Settlement Hippolytus, in the municipality of Mossoró-RN/Brazil in the month of June (summer) and December (dry) 2011. During the shortage, the animals feed only on native vegetation (caatinga). In rainy season the animals are based on food, native vegetation and concentrate supplementation the basis of corn bran and soybean meal. We collected 49 samples of milk obtained from individual arrays crossbred at different stages of lactation during the morning milking and sent to the Laboratory of Dairy Management Program of the Northeast Dairy Herds (Progene) UFRPE to determine the chemical composition. We obtained the following average values for the chemical composition of goat milk in the dry and rainy seasons, respectively: fat ( $3.96 \pm 0.98$ ,  $2.65 \pm 0.51$ ), protein ( $2.95 \pm 0.42$ ,  $3.38 \pm 0.43$ ), lactose ( $3.82 \pm 0.244$ ,  $4.11 \pm 0.32$ ) and total solids ( $11.65 \pm 1.31$ ,  $11.02 \pm 0.86$ ). In the rainy season, the chemical composition of goat milk kept in accordance with the requirements of current legislation (IN 37) in Brazil. These results can be explained by the quantity and quality of pasture available during this period. In the dry period, a decrease in lactose content and an increase in fat content. The literature shows that the lactose content is influenced by the different levels of concentrate, with differences over the lactation period, while the fat constituent is suffers more variations and can be connected to the milking turn and the degree of blood of animals or race. The goat milk produced in the rainy season showed chemical composition according to the standards. The differences in the constituents of milk in this study are probably due to the ecological conditions of the region, the degree of blood of animals and feed management.

**M-66**

**Production and quality of milk of crossbred goats in small production units in the Mossoró-RN/Brazil**

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In order to evaluate the production and milk quality were used 26 crossbred goats of Saanen and Anglo-Nubian, small production units in the Mossoró-RN. The experiment was conducted during the period August to November (dry season) 2011. The production system was the semi-intensive. Milk samples were collected monthly during the morning milking, shipped in containers by the by the laboratory of Programa de Gerenciamento de Rebanhos do Nordeste (PROGENE) da Universidade Federal Rural de Pernambuco (UFRPE), Recife/PE. We determined the chemical composition of milk, the total bacterial count (TBC) and somatic cell count (SCC). We performed ANOVA and Tukey test at 5% probability. There was no statistical difference for milk production at the assessment ( $P < 0.05$ ). The average yield was 0.488 kg/day/goat. According to the literature, there has been greater than 0.50 kg/goat/day for races natives. However, the goats were in the dry season, when the native pasture cannot meet the requirements set by the animals. Goat milk had the following chemical composition, fat (2.77%), protein (3.22%), lactose (4.21%), total solids (11.11%) and solid non-fat (8.34%). As few as lactose content presented below which calls for legislation in Brazil (4.3%) for goat milk. This result is probably due to low production presented by lactating females. Total bacteria count (CBT) is associated hygiene during milking. The CBT found in the experiment was 144.86 ufc/mL. This result is in accordance with current legislation in Brazil, which recommends a maximum of 500,000 cfu /mL. Although there is legislation to SCC of goat milk, the value found was 394.62 cells/mL. The literature has shown that the values for this species should be included between 24,000 and 2,549,000. In the conditions of this experiment was conducted, we conclude that despite the low production presented by the goats, the milk produced in small production units is adequate for consumption.



M-67

**Somatic cell count of goat milk produced in production units in the municipality of Mossoró-RN/Brasil**

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The somatic cell count (SCC) is a parameter of fundamental importance in a production system, as well as inferences about the quality of milk, also assesses the health of the mammary gland and prevalence of mastitis in the herd. The objective of this study was to evaluate the somatic cell count (SCC) in four production centers of goat milk. The experiment was conducted in the first half of 2011 in four dairy units (1, 2, 3, and 4) in the Mossoró city-RN/Brasil. We collected 130 milk individually samples obtained during morning milking. The animals were crossbred at different stages of lactation, created on feeding with native vegetation (caatinga). The samples were sent to the Milk Laboratory of Programa de Gerenciamento de Rebanhos Leiteiros do Nordeste (PROGENE), UFRPE, and analysis were performed by flow cytometry technology. After laboratory analysis, we obtained the following average values for somatic cell count:  $\text{CCS/mL} \times 10^3$  (1033.14) (405.20) (2341.21) and (1349), in the pole 1, 2, 3 and 4, respectively. The results showed that only the three centers were above the average found in the literature. It is known that the CCS goat milk has high physiologically, and these values are influenced by factors such as genetics, nutrition, environment and management. The normative instruction No. 37 does not establish values for somatic cell count of goat milk. However, they are frequently reported that animals in different stages of lactation have values between 844,000 and 1,440,000 cells/ml considered free of mastitis. Although not regulated by legislation it is necessary to periodically somatic cell count as a measure of prevention and control of udder health, which affects the yield and product quality.



M-68

**Production and composition of goat milk produced in the municipality of  
crossbred Mossoró-RN/Brazil**

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The use of crossbred goats has contributed to increased milk production in the semi-arid region in the northeast of Brazil, being important on the socio-economic rural community. The objective of this study was to evaluate the production and chemical composition of milk of crossbred goats created on native pasture. The study was conducted in the first half of 2011 in four agricultural centers (1, 2, 3 and 4), goat milk producers in the municipality of Mossoró-RN/Brazil. Were used 130 crossbred goats at different stages of lactation, reared in extensive system. Monthly milk control was performed to obtain the production of livestock for agricultural pole. We collected 130 samples of milk obtained during milking in the morning to perform the chemical analyzes. Then the samples were sent to the Laboratory of Dairy Management Program of the Northeast Dairy Herds (Progene), Federal Rural University of Pernambuco (UFRPE). The analysis was performed by means of mid infrared spectroscopy, performed in an automated electronic device (Bentley Combi 2300). Were obtained the following average values for milk production by agricultural pole: 0.82 kg/head/day, 0.48 kg/head/day, 0.74 kg/head/day and 0.85 kg/head/day. The average values for the chemical composition of goat milk were, fat (3.46%), lactose (4.69%), protein (3.45%) and total solids (8.05%). The results of the chemical composition showed that only the fat that did not meet the recommended legislation in Brazil (37 IN: 0.6 to 2.9). It is known that fat is the constituent of milk that most affected by various factors such as variations milking shift, race, climate and food. The milk production was the second pole below the mean found in literature for this type of herd that is 0.70 kg/head/day. Given the above, we conclude that the use of crossbred females is a good alternative for obtaining goat milk quality.





M-69

### **Milk composition and individual cheese yield from milked and/or suckled Swedish dairy goats**

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Dairy goats are mainly held for cheese production, and milk with higher contents of fat, total protein and casein is required to achieve maximum cheese yields. Swedish dairy goats are known to produce milk with low contents of fat, total protein and casein, which results in a relatively lower cheese production. The objective was to investigate how different milking and suckling regimens affects milk yield, milk composition and individual cheese yield in Swedish dairy goats. In study 1, individual milk samples from 8 goats (Swedish landrace) in early lactation were collected continuously during milking combined with suckling (MS; day 1) and during milking only (M; day 2). In study 2, milk samples were collected from 12 goats, kept in 4 different MIX systems (milking combined with suckling). The dams were separated from kids during 8 h during day time (system 1 and 2), milked twice daily and suckled before milking (1) or milked before suckling (2). In system 3 and 4, the dams were separated from kids for 14h overnight and milked once daily, they were suckled before milking (3) or milked before suckling (4). The milk samples were analyzed for fat, total protein and lactose contents by a mid-infrared spectroscopy method. Casein content and individual cheese yield was measured by a rennet-coagulation method, where 35 µl of rennet was added to 10 ml of fresh milk (40°C). The samples were set to coagulate for 30 minutes before the curd was vertically cut into four similar rods and centrifuged at 1650 x g (15 min 28°C) to remove the whey. In study 1, the fat content in milk was higher during MS ( $P < 0.05$ ) than during M only. In study 2, both fat content and individual cheese yield was higher when suckling occurred before milking, compared to milking before suckling ( $P < 0.05$ ). Furthermore, the individual cheese yield was highly correlated with both fat and casein content in milk. These preliminary results show that individual cheese yield is highly correlated to fat and casein content in milk. Thus, indicating that suckling before or in combination with milking gives a better udder emptying probably due to an increased oxytocin release. In conclusion, suckling increases both fat content and cheese yield in Swedish dairy goats.



## M-70

### Carcass characteristics of pasture vs. pen-fed goats: a preliminary study

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Eighteen buck kids were used in a preliminary study to compare the carcass characteristics of pasture vs. pen-fed goats. Consigners to the 2011 Western Maryland Pasture-Based Meat Goat Performance Test provided goats of similar genetics for comparison. The [TEST] goats (n = 9) consumed a pasture-only diet and were rotationally-grazed among six 2-acre paddocks, composed of various cool and warm season grasses. The [PEN] goats (n = 9) were housed in zero-grazing pen (4.9 m<sup>2</sup>), given unlimited access to grass hay, and hand-fed grain (ADM Goat Power™) once daily, the amount they could eat in 20 minutes. After 112 days of consuming their respective diets, the goats were weighed and transported (60 km) to a custom-exempt slaughterhouse (Country Foods, Waynesboro, PA) for same day slaughter. The carcasses were deboned and measured six days later. Live weights did not differ between the two groups, but the PEN goats had heavier ( $P < 0.045$ ) cold carcass weights ( $12.3 \pm 1.3$  vs.  $9.4 \pm 0.5$  kg) and tended ( $P < 0.065$ ) to have heavier hot carcass weights. Dressing percentage was higher ( $P < 0.02$ ) for the PEN goats than the TEST goats ( $44.4 \pm 1.6$  vs.  $39.4 \pm 1.2$  %). The carcasses of the PEN goats were fatter, as evidenced by thicker ( $P < 0.04$ ) body wall ( $0.62 \pm 0.09$  vs.  $0.41 \pm 0.04$  cm), a higher ( $P < 0.0005$ ) percentage of kidney and heart fat ( $2.64 \pm 0.03$  vs.  $1.45 \pm 0.01$  %), and a higher ( $P < 0.008$ ) percentage of overall carcass fat ( $4.34 \pm 0.26$  vs.  $2.14 \pm 0.08$  %). The differences in percent lean and rib eye area were not significant, but the PEN goats yielded a higher ( $P < 0.017$ ) percentage of boneless meat than the TEST goats ( $24.49 \pm 1.5$  vs.  $19.78 \pm 0.01$  %). Percent protein and intramuscular fat in the *longissimus dorsi* did not differ between the two groups of groups, whereas the fatty acid analysis showed statistical differences in 9 of 27 fatty acids: 16:1 ( $P < 0.005$ ), 18:1 trans-10 ( $P < 0.045$ ), 18:1 trans-11 ( $P < 0.001$ ), 18:1 cis-9 ( $P < 0.016$ ), 18:3 and 20:1 ( $P < 0.0001$ ), 20:5 ( $P < 0.0001$ ), 22:6 ( $P < 0.0003$ ), and 24:1 ( $P < 0.016$ ). It is not known if these differences are relevant to human health. Overall, while pen-feeding improved carcass yield and value, the economics of pen feeding will vary by farm.



M-71

**Comparative study between two systems of milk partitioning in three dairy goat breeds at two milking frequencies**

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Thirty-six dairy goats belonging to three Canarian breeds (Majorera, Tinerfeña and Palmera) in the middle lactation were subjected unilaterally to once daily milking (X1) or twice daily milking (X2) during 6 weeks. The aim was to compare two systems of milk partitioning in relation with milking frequency and breed factors. During wk 1, 3 and 5, each goat was injected intravenously with 0.8 mg of an oxytocin receptor blocking agent to measure cisternal milk (CM). Later, the goats were injected intravenously with 2 IU of oxytocin to reestablish milk ejection to allow the measurement of alveolar milk (AM). During wk 2, 4 and 6, the machine milk was recorder (MM, milk collected between attaching the line and the final cessation of the milk flow without manipulating the udder), machine stripping milk (MSM, milk remaining in the udder after manual manipulation) and residual milk (RM, milk collected after injecting goats with 2 IU of oxytocin). Pearson correlation coefficients among fractions were calculated using the SAS statistics package. High negative correlations between MM and MSM were observed in all breeds studied for X1 (Majorera,  $r = -0.87$ ; Tinerfeña,  $r = -0.92$ ; Palmera,  $r = -0.92$ ) and X2 (Majorera,  $r = -0.82$ ; Tinerfeña,  $r = -0.89$ ; Palmera,  $r = -0.78$ ). On the other hand, MM and RM were significantly correlated in all breeds for X1 (Majorera,  $r = -0.87$ ; Tinerfeña,  $r = -0.69$ ; Palmera,  $r = -0.78$ ), while only the Majorera breed presented significance for X2 ( $r = -0.78$ ). However, no significant correlations were detected when comparing CM and AM with MM, MSM and RM ( $P > 0.05$ ); which impedes the establishment of a relationship between both systems, and could be explained as a consequence of teats placement of the Canarian goat breeds whose teats are not located in the ventral portion of the udder. In conclusion, the results reflect the importance of udder morphology on milk partitioning parameters and indicate that both milk partitioning systems do not seem to be comparable among them.



M-72

**The effect of diet and DHA addition on the sensory quality of goat kid meat**

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To enhance the nutritional quality of meat, dietary strategies have been developed to manipulate the fatty acid profiles of muscle tissues. Fatty acids affect meat attributes, including hardness, colour and lipid stability, and flavour. Little research has been done, however, on the effects of dietary omega-3 polyunsaturated fatty acid (PUFA) supplementation on the sensory characteristics of meat. Docosahexaenoic acid (DHA) is one of the critical omega-3 PUFA for the optimal performance of multiple body systems and therefore one of the most used to improve the meat quality. To address this issue, six diets were fed to goat kids: goat's milk (GM), powdered whole cow's milk (CM), powdered whole cow's milk plus DHA (low dose; CM-LD-DHA), milk replacer (MR), milk replacer plus DHA (low dose; MR-LD-DHA), and milk replacer plus DHA (high dose; MR-HD-DHA). A descriptive, semi-trained sensory evaluation and a consumer triangular test were performed to analyze the resulting meat. Generalized Procrustes Analyses (GPA) were used to analyze the descriptive sensory data, while triangular tests were analyzed by consulting tables within the Norma UNE-EN ISO 4120. High doses of omega-3 PUFA produced meat with unusual odours, unpleasant flavours, and low overall appreciation scores. Low doses of DHA maintained a positive sensory perception. However, consumers could not detect a difference between meat derived from animals fed GM, CM, or MR (with or without supplemental n-3 PUFA). In conclusion, the used concentration of DHA is a critical factor in the sensorial quality of the meat products.



## M-73

### Meat quality of goat kids fed whole cow's milk and an exogenous source of DHA

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As the main role of dairy goat farming is to yield marketable milk, artificial rearing is closely linked to the intensification of these farms. Therefore, the use of milk replacers is paying attention. There are many milk replacers on the market, but their high price is doing farmers to leave the kids with their dams or dispose of them. Classic works did not recommend the use of cow's milk to feed goat kids, due to mainly problems with diarrheas. On the other hand, since some years ago a hot topic is the use of omega-3 fatty acids in the nutrition such as the docosahexaenoic acid (DHA) to enhance the nutritional quality of the meat. 30 Majorera males and females newborn goat kids were randomly assigned to three groups according to sex and diets: goat milk (GM), whole cow's milk (WCM) and whole cow's milk plus Docohexanoic Acid (DHA-gold©, DHA) (WCM9). All animals were fed ad libitum during the experiment. Goat milk was taken from the bulk tank every day during the experiment and the dehydrated WCM was rehydrated and used to feed WCM and WCM9 groups. For WCM diets, the dry matter was 16% w/w, being 9g the concentration used of DHA-gold©. When goat kids reached 8 kg of body weight, they were slaughtered following EU regulation. In order to study the meat quality physicochemical parameters (moisture, fat, protein, ash, total and soluble collagen, water holding capacity, cooking losses and tenderness) were measured as well as fatty acid profiles, which were performed on subcutaneous and intermuscular depots from the shoulder, pelvic fat from the leg cut, peri-renal fat from the rib cut, and intramuscular fat from the semimembranous muscle. Results indicated that the diet containing DHA did not affect meat quality characteristics, or proximate composition of the meat. However, C22:6n3 fatty acid levels, mainly in intramuscular fat, were enriched in CM-DHA animals, and the n-6/n-3 PUFA ratio was improved, although no differences were found with respect to WCM. In conclusion, powdered WCM is an effective option for feeding goat kids, and the inclusion of DHA to WCM increases the quantity of this fatty acid in the meat.



M-74

**Effects of micro-seaweed DHA supplementation on growth, carcass and meat qualities of Goat Kids**

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A large number of products enriched with polyunsaturated fatty acids omega-3 are being developing because the recommendations launched from the major health agencies worldwide. Thus, meat products have been one of the main foods that have been tested this fortification, based on the fact that the composition of dietary fatty acids will be a factor in the fatty acid composition of muscle and fatty tissues of pre-ruminant animals. There is also evidence that consumption of polyunsaturated fatty acids by the kids, improves growth and carcass quality and meat. Thus, the following experiment was conducted in which 30 kids were divided into three groups based on their diets: one group was fed with a commercial milk replacer, and the two other groups were fed with milk replacer with the addition of a product rich in DHA (DHA-gold), in two different concentrations: low concentration (9 g/l) and high concentration (18 g/l). Growth, conformation and carcass and meat qualities, with special interest on the fatty acid profiles measured on intramuscular, perirenal, pelvic, subcutaneous and intermuscular fat depots. A one-way ANOVA was performed to evaluate carcass and meat measurements; a PROC MIXED procedure factorial ANOVA was performed to evaluate the effects of the treatments on growth using the SAS program package. Although a difference in tissue distribution related to the amount of subcutaneous fat was detected, finding a greater quantity for the supplemented diets, no other significant differences were found for any of the measured parameters, except the fatty acid profiles, in which the addition of the exogenous source of DHA clearly affected the amount of this fatty acid in the different analyzed fat depots. Additionally, the quantity of the DHA supplied with the diet also had an important influence on the final amount, with a higher quantity found in the tissue when DHA was supplied in the diet at a higher concentration. These results lead us to conclude that the addition of polyunsaturated fatty acids omega-3 is justified as a way to improve fatty acid profiles, but not for the other parameters.



M-75

### **Milk quality in Aspromonte and Rustica goat breeds**

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In Calabria, goats are the most important species used in breeding livestock, probably because goats are well adapted to the topography of the region. Calabria has three goat breeds: Aspromonte breed, Rustica of Calabria breed and Nicastrese breed. In the southern mainland of Italy, animals have been selected for milk production, which is used for cheese-making, although recently consumers have shown interest for goat meat and other milk products. In Calabria, the most important dairy products are the Aspromonte goat cheese and Musulupu, obtained from Aspromonte goat milk. The milk of Rustica goats has been used to feed kids and cheese-making that is locally commercialized. The aim of this study was to analyze the quality of Aspromonte and Rustica goat milk. Samples were taken Calabria region farms, between February and April 2011, about 45 days after-partum. In reference to the fat value, it remained significantly higher during all the study period for the two breeds (4.6% vs. 3.9% in the February for Aspromonte and Rustica breed, respectively). The protein percentage decreased between the first and the third month of study in both breeds (from 3.7 and 3.8 to 3.6 and 3.5 in Aspromonte and Rustica breed, respectively). The lactose percentage appeared to be almost constant in the two studied breeds. In conclusion, during all the studied period Aspromonte breed has revealed a higher fat quality than Rustica of Calabria breed, but both goats presented a good milk quality to make cheese.





M-76

**Region effects on Camosciata Alpina and Saanen milk quality reared in Sicily,  
Italy**

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The aim of this preliminary study was to find an effect of different goats breeding areas and the number of lactation on milk quality from Saanen and Camosciata Alpine goats. The milk quality data (fat, protein and somatic cell count), were obtained since 2004 to 2010 in 4 Sicily provinces. Saanen goats from Caltanissetta province showed the highest fat percentage for all lactation number (4.3 - 5.3%). In the first and second lactation for protein percentage in Saanen did not find difference between provinces (2.6 - 3.6%), however since third lactation the Caltanissetta goats presented the higher values (3.8 - 3.9%). Camosciata Alpine goats from Enna province evidenced a big difference in the fat percentage from first until third lactation period (2.7 - 4.6%), showing no differences in the rest of the studied lactations. In reference to the protein percentage of Camosciata Alpina goats breeding in Sicily, no differences were found (3.3 - 3.8). With regard to the somatic cell count of Camosciata Alpina in all lactations studied there was not differences between provinces (2,877,620 cell/mL), however, Saanen goats showed differences during lactation periods. Agrigento's province showed the lower somatic cell count from first at fourth lactation (843,710 cell/mL). In conclusion, the Sicily province has a low effect on the milk quality from Camosciata delle Alpi breed however has effect in Saanen goat milk quality.



M-78

**Musulupu, cheese-relic of the graecanic area of Calabria. Manufacturing and chemical composition**

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Musulupu cheese is a traditional dairy product from the southern part of Italy, it is still produced with ancient techniques. The aim of this study was to analyze the chemical composition of Musulupu cheese and to evaluate the cheese-making technology of this product that for many years was in danger of disappearing. This cheese, which binds to the traditional Easter festivities, is made with raw milk of Aspromonte goat breed (one of the three native goat breeds in Calabria) sometimes supplemented by 10-20% of sheep milk. One of the most remarkable aspects in the production of this dairy product is the use of goat rennet to curd. The obtained curd is cooked and after that is pressed into molds, hand-carved of wood, called "Musulupare". Finally the cooked curd creates a delicate crust that highlights the inlaid engraved molds, usually associated with religious symbols. Musulupu cheese is used without mature period, it is consumed at the same day of preparation. Musulupu chemical-physical properties shows a pH value equal on average to 5.5, an average content of 42.6% DM. Chlorides concentration were negligible, as it was expected because salt is not added for preparation and the cheese is consumed within 48 hours. The butyric stodd mean was 20.2%, and the protein mean content was 18.54%.



M-79

### **Physical characteristics and chemical composition of Murciano-Granadina goat's colostrum**

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The aim of this work was to study the physical characteristics and chemical composition of Murciano-Granadina goat's colostrum. 43 animals were used divided into two groups according to the lactation number: 24 multiparous (10 single birth and 14 multiple birth) and 19 primiparous (15 single birth and 4 multiple birth). Samples (300 ml) were collected every 12 hours during the first seven days post-partum. The physico-chemical parameters and somatic cell count were determined. The results were analyzed using analysis of variance with repeated measures (Proc Mixed, SAS, 2008), including the factors: time post-partum, litter size, lactation number, their interactions and the production level as a covariate. Time post-partum had a significant effect ( $P < 0.01$ ) on all parameters studied, decreased over the lactation days, with the exception of lactose. From the results, it can be considered that the secretion of colostrum takes place between partum and the 36 or 48 hours post-partum, according to the component analyzed. The mean values of the first 48 hours were: pH = 6.54, density = 1040 (g/l), electric conductivity = 4.97 (ms/cm), freezing point = 0.537 (-°C), titratable acidity = 24.02 (°D), fat = 8.13%, protein = 7.72%, lactose = 3.91%, dry matter = 21.54%, total IgG = 9.71 (g/l) and somatic cell count = 1,871,672 (cells/ml). In relation to other factors of variation studied, the number of lactation influenced ( $P < 0.05$ ) on most components, a greater amount of first lactation goats for protein, lactose, SCC, titratable acidity and freezing point, whereas the dry matter and electric conductivity was higher in multiparous animals. Litter size affected ( $P < 0.05$ ) pH, protein, and lactose, being higher in primiparous goats. The animal's production level influenced only the protein and dry matter contents, with an inverse relationship between volume and the percentage of these parameters.

**M-80****Ethanol stability of Murciano-Granadina goats' milk**

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In order to study the ethanol stability of fresh goats' milk, twenty-five Murciano-Granadina goats from the experimental flock of the Universitat Politècnica de València were used. Animals were in good health conditions. Individual milk samples were obtained every two weeks since the second week post-partum until the end of the lactation period (7 months). Milk samples were analysed to determine its chemical composition: fat, protein, lactose and total solids; hygienic quality: somatic cell count (SCC) and total bacterial count (TBC) and physico-chemical properties: electric conductivity, milk acidity by titration and pH value. The alcohol test was performed by mixing equal volumes (2 ml) of a milk sample and an ethanol solution (ethanol/water, v/v) ranging from 26 to 60% (difference of 2% between them) in a petri dish. Alcohol stability was defined as the percentage of ethanol solution which induces milk coagulation. The alcohol test results showed values ranging from 32 to 56% presenting an average of 45%. To identify the factors affecting milk alcohol stability an ANOVA was performed using SAS software. The statistical model used included the effects of the individual goat, the lactation stage and milk quality parameters (electric conductivity, milk acidity, pH, fat, protein, lactose, total solids, logSCC and logTBC) as covariates. Statistical analysis results showed a significant effect of the individual animal ( $P < 0.001$ ) and the lactation stage ( $P < 0.001$ ) on the milk alcohol stability presenting lower values in the early post-partum weeks. Quality parameters of fresh goat's milk hardly affected the alcohol stability of milk samples. Spanish regulation (Real Decreto 752/2011) establishes a minimum concentration of 45% for the performance of the alcohol test in goats' milk. The results obtained in this study showed a high percentage (56%) of fresh milk samples coagulates with 45% ethanol solution. Thus, a study with bulk milk to minimize the individual effect and a wider range of variation of milk quality parameters should be carried out to establish the optimal concentration for the realization of the alcohol test in goats' milk.



## M-81

**Antibiotics detection capability (CC $\beta$ ) of microbial screening tests in goat milk**

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The aim of this study was to calculate the detection capability (CC $\beta$ ) of some microbial screening tests to detect antibiotic residues in goat milk. Antibiotic-free milk samples were obtained in the mid-lactation period from 40 Murciano-Granadina goats of the experimental flock at Universitat Politècnica de València. Microbial screening tests assessed were BRT MRL (Analytik in Milch Produktions-und Vertriebs-GmbH. Munich, Germany), Delvotest MCS (DSM Food Specialties. Delft, Netherlands), Delvotest MCS Accelerator (DSM Food Specialties. Delft, Netherlands) and Eclipse 100 (Zeu-Inmunotec. Barcelona, Spain). Antibiotics selected for this study were amoxicillin, ampicillin, cloxacillin, penicillin, oxytetracycline, tetracycline, gentamicin, streptomycin, tylosin, erythromycin, enrofloxacin and colistin, being the most commonly used in Spain for the treatment of diseases in goats. CC $\beta$  of microbial screening tests was calculated according to the Guidelines for the validation of screening methods for residues of veterinary medicines (Community Reference Laboratories Residues, 2010), as the lowest antibiotic concentration evaluated producing 95% of positive results in the test. Antibiotic concentrations used for the calculation of the CC $\beta$  of microbial screening tests were 0.5 x EU-MRL in twenty replicates, 0.75 x EU-MRL in forty replicates and EU-MRL equivalent concentration in sixty replicates. Initially, the lowest antibiotic concentration (0.5 x EU-MRL) was tested in all the microbial screening tests. When the percentage of positive results was below 95% (error  $\beta > 5\%$ ) a higher antibiotic concentration was tested (0.75 x EU-MRL first and 1 x EU-MRL, if necessary). The results were interpreted visually by three trained technicians except for the Delvotest MCS Accelerator that were interpreted instrumentally by Delvotest Accelerator system. BRT MRL, Delvotest MCS, Delvotest MCS Accelerator and Eclipse 100 tests were able to detect amoxicillin, ampicillin cloxacillin and penicillin at or below EU-MRL in goat's milk samples. However, the CC $\beta$  of these screening tests for all non-betalactam antibiotics was greater than the EU-MRLs except for tylosin that was detected at or below EU-MRL in all cases. In conclusion, commercial microbial screening tests currently available are unable to detect most antibiotics used for prophylactic and therapeutic treatments of infectious diseases in dairy goats.



M-82

### **Determination of IgG in goat bulk milk from different regions of Greece**

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European laws require cheese manufacturers to state the species of origin of the milk used for cheese production or other dairy products. For example, according to the relevant EU legislation (Commission 1994), PDO feta cheese cannot be labeled and be sold as such unless it has been produced from 100% sheep milk or from a mixture of sheep and goats' milk (up to 30%). A number of commercial ELISA used to detect and quantify defined amounts of goat's milk involved in the production of feta cheese. Immunoglobulin G (IgG) has been successfully used as a target antigen in most immunological methods. A standard curve based on the concentration of pure goat's milk was currently used. Due to the fact that this concentration can vary according to the breed, age, health status and the lactation is useful to know the real concentration of IgG for goat milk being collected by the industry. Thus, the aim of this current study was the determination of the mean levels of IgG in goat milk from different region of Greece. 1530 authenticated bulk goat milk was obtained from 18 regions throughout the lactation period (march- July 2010). Fresh row milk was immediate frozen and stored at -200°C until needed. A non-competitive ELISA was performed for the IgG quantitative determination. The results shows that the mean value of IgG concentration obtained from all the samples was  $0.486 \pm 0.256$  mg/ml, whereas the levels of concentration ranged between 0.100-1.719 mg/ml. Statistical analysis (analysis of variance - ANOVA) was used to assess the results. Significant differences ( $P < 0.05$ ) were observed for the studied goat milk's IgG concentration, between regions as well as between the lactation period. Significantly higher mean value of IgG  $0.847 \pm 0.206$ , found on 1st 15 days of April ( $P < 0.05$ ). The high variation that was found in IgG concentration can be considered as normal, taking into account that there are many factors of variation without know if we working with bulk milk samples. The results obtained in this study are of practical relevance for milk analysis laboratories and dairy industries in Greece. Data used until now had been obtained by measuring IgG concentration in milks from a limited number of goats usually chosed by one farm, while in this work data are obtained from a high number of samples, representative of the whole goat milk production of Greece.



M-83

**Light backscatter evaluation of milk coagulation properties in dairy goats supplemented with soybean oil under heat stress conditions**

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It has been observed that dairy goats under heat stress conditions produce milk with less fat concentration and some other negative effects. In an attempt to compensate for the reduction of milk fat concentration, goats under heat stress conditions were supplemented with soybean oil. The aim of this study was to evaluate the potential effect that both factors, heat stress and soybean oil supplementation might exert on the aptitude of milk for coagulation. Eight multiparous Murciano-Granadina dairy goats maintained in metabolic cages were used in a replicated 4 x 4 Latin square design with 19-d periods (14-d for adaptation to the treatment and 5 d for measurements). Goats were allocated randomly to one of 4 treatments in a 2 x 2 factorial arrangement. Factors were no (C) or 3% of soybean oil (S) on DM basis, and thermal neutral (TN) or heat stress (HS) conditions. This resulted in 4 treatment combinations: TN-C, TN-S, HS-C, and HS-S. Milk was collected on the first day of each one of the four five-day measurement periods. Immediately after collection, milk was pasteurized, stirred and distributed in small containers that were maintained at 4°C until used, for evaluation of the effect of refrigerated storage on milk coagulation. Milk samples were coagulated at 32°C using animal rennet (250 mg•L<sup>-1</sup>). Milk coagulation was monitored using a NIR fiber optic light backscatter sensor and small amplitude oscillatory rheometry. Simultaneously, clotting and cutting time were visually evaluated by an experienced cheesemaker. Optical parameters  $t_{max}$  and  $t_{2min}$  were highly correlated ( $0.86 < r < 0.98$ ,  $P < 0.0001$ ) to the visual clotting and cutting times and the rheological gelation time. However, the correlation between the optical parameters,  $t_{max}$  and  $t_{2min}$ , and the rheological cutting time was significantly smaller ( $r = 0.66$  and  $0.67$ , respectively;  $P < 0.0001$ ) than for previous parameters. Nevertheless, when milk from animals under HS were not included in the statistical analysis, the correlation between  $t_{max}$  and  $t_{2min}$ , and rheological cutting time was much higher ( $r = 0.979$  and  $0.980$ , respectively;  $P < 0.0001$ ). These results clearly suggest that milk from animals under HS had unexpected behavior during the curd firming stage of coagulation, which would have a negative impact on cheese making process control operations. The reasons for this altered firming behavior and the real impact that would have on cheese production still need to be elucidated.





M-85

**Intake, digestibility and milk production of goats fed with cactus pear (*Opuntia ficus-indica* l. miller) in substitution to corn meal**

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This study aimed to evaluate the effects of replacing corn meal by cactus pear in the diet of lactating goats on the food consumption, apparent DM and nutrients digestibility, ingestion behavior, blood parameters, milk production and feed costs. A replicated 5 x 5 Latin square experimental design using ten multiparous alpine goats (40 ± 6 kg) was used including five periods of 15 days each and five treatments with the following substitution levels: 0, 25, 50, 75 and 100% cactus pear. Dry matter consumption increased linearly ranging from 1950 to 2315g/goat/day (4.38 to 5.23% LW). On the other hand, the extract ether consumption reduced linearly ( $P < 0.05$ ) with values ranging from 111 to 39 g/goat/day. The apparent digestibility coefficient of dry matter, organic matter, crude protein, neutral detergent fiber and total carbohydrates increased linearly. However, Detergent Acid Extract Ether detergent acid was reduced linearly and Detergent Acid Nutrient Fiber was not significantly affected. Considering blood variables, a linear reduction in urea was observed, ranging from 9.43 to 7.52 mmol/L. Regarding ingestion behavior, an increased on the variables standing eating and urinary frequency was seen, and a decrease in the frequency of search for water. The milk production was not significantly affected and therefore no effect on the gross average profitability was detected. However, the average gross margin and average profitability were significantly influenced by the substitution, with values ranging from US\$ -1.47 to US\$ 3.37 per day and from -17.51 to 91.55%, respectively. In conclusion, corn meal can be successfully replaced by cactus pear in the diet of lactating goats. Besides the fact that there is no reduction in milk production, an increased profitability for smallholder producers and the decrease of water intake by the animals could be of special interest for semiarid regions.



**M-86**

**Production and quality of Alpine goat milk by using urea in place of soybean meal**

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The study was conducted to evaluate the effect of partial substitution of soybean meal by urea in the ration of alpine milking does on the physico-chemical composition, fatty acid profile, and sensory characteristics of the milk. Ten multiparous alpine goats, distributed in a 5 x 5 Latin square and five levels of urea (0.0; 0.5; 1.0; 1.5 e 2.0%) were used in five experimental periods of 17 days each - 12 days for adaptation and 5 days for data collection. There was no effect on the density index (g/cm<sup>3</sup>), acidity (°D), protein (%), total dry extract (%), dry defatted extract (%), ashes (%) and sensory attributions. Substitution of soybean meal by urea increased the concentration of milk fat and short chain fatty acids. However, sensory characteristics of the milk was not altered and acceptable by the taste panel.



M-87

### **Goat cheese whey: Immunoglobulins quality and Chitotriosidase activity during 90 days after partum**

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It is well known that immunoglobulins are proteins which pass to the whey after cheese-making. Colostrum gradually changes further to become mature milk, which is called transitional milk. The objective of this study was to analyze the evolution of immunoglobulin contents in goat cheese whey samples from partum to a 90-days period. Goat colostrum and milk samples were collected from the farm of Universidad de Las Palmas de Gran Canaria (Las Palmas, Spain) at partum and 1, 2, 3, 4, 5, 15, 30, 60 and 90 days after partum from 10 Majorera dairy goats. 5 mL of milk was poured in a glass test tube and maintained in a 30°C water bath, and then 100 µL of freshly prepared chymosin at 1 mg/ml was added. The resultant whey was collected and assayed for IgG, IgM, IgA, and Chitotriosidase (ChT) activity. Statistical analyses were performed using SAS package. Colostrum at day 0 did not clot and no cheese whey samples were recovered at this time. ChT activity in whey ranged from 1,175 at day 1 to 167 nmol/mL/h, at the end of the experiment. Colostrum ChT activity decreased continuously as time passed. IgG colostrum concentration was the highest at partum and then it dropped fastly. The evolution of IgM and IgA was similar to that describe previously for IgG. The stabilization of IgG, IgM and ChT activity was reached after 15 days, while IgA equilibrium was reached at d 5 after partum. In conclusion, cheese whey is richer than milk in immunoglobulins, and its use for dairy industry must be supervised to avoid the possible interferences in the production due to immunological components.



**M-88**

**Somatic cells: a potential tool to accelerate the low-fat goat cheese proteolysis**

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The current demand of healthy products and the dairy products diversification have increased the interest in low-fat cheese and goat cheese. When these two characteristics are combined, the result is a flawed cheese, with similar shortcomings to other low-fat cheeses. As a result, it is necessary to seek alternatives. Somatic cells present lysosomal enzymes, such as cathepsin B, cathepsin D, cathepsin G and elastase; many of which pass to the milk where they cause more intense proteolysis and lypolysis. The aim of this study was to evaluate the effects of somatic cells taken from healthy goats by centrifugation on fresh low-fat cheese made with raw or pasteurized milk. Miniature cheeses were made at levels of somatic cells: 200,000 and 2,000,000 cells/mL. The cheeses were ripened for 1 and 7 days. Somatic cells addition increased the proteolysis of  $\alpha$ S1-caseins,  $\alpha$ S2-caseins, and para-k-casein in low-fat cheeses elaborated with raw goat milk after 7 d of ripening; however, all caseins were reduced when pasteurized goat milk was used in cheese-making. This study proposes the use of somatic cells as a tool to increase the softness of low-fat cheese texture, thereby improving it. Furthermore, its use could be extended to full-fat cheese to accelerate the maturing process.



M-89

### **Somatic cells effect on low-fat goat cheese lipolysis**

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Somatic cells present lysosomal enzymes many of which pass to the milk where they cause more intense proteolysis and lipolysis. There are several opinions about the real effects of somatic cells on cheese, mainly due to the other collateral changes that occurs with the increase of somatic cells. The aim of this study was to evaluate the effects of two levels of somatic cells (200,000 or 2,000,000 cells/mL) on lipolysis of fresh cheese elaborated with full-fat and low-fat goat milk, using pasteurized and non-pasteurized milk, and ripened at 1 and 7 days. Somatic cells were isolated by centrifugation from healthy goat milk and added to milk with a low somatic cells count. The total free fatty acids content (FFA) was determined using the copper soap method modified for cheese analysis. The FFA concentration in dry matter basis was always higher in full-fat cheeses than low-fat cheeses, but FFA expressed in fat basis in cheese increased as fat content decreased. These results suggest that other parameters appear to have an influence on lipolysis in low-fat cheese. The small globule size found as fat content decrease in cheese may be more susceptible to lipase action. The lack of fat and the faster FFA liberation in low-fat cheeses may promote early FFA catabolism that occurs in cheese, with effects on the taste of the final product.



M-90

**Goat milk characteristics as an important source of milk compared to other milks  
in the nutrition of inhabitants in Egypt**

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To study the importance of goat milk as a key role in the nutrition of the inhabitants compared to camel and ewes milks, milk samples of Baladi does, Barki ewes, and Maghrabi camels were collected during early, mid and late lactation stages from the animal breeding flock of Maryout-Research Station, Desert Research Center, Alexandria, Egypt. All animals were housed in semi-open barns and fed on berseem hay plus concentrate mixture and sweet sorghum. Milk samples were analyzed for total solids, fat, total protein, lactose, ash, pH, titratable acidity and specific gravity. Goat's milk showed the highest specific gravity value ( $P > 0.05$ ) during mid-lactation. Fat content was highest during early lactation while lactose content was lowest at late lactation ( $P > 0.05$ ) with minor changes of total protein, ash and total solids contents along lactation season. Camel's milk showed highest values of specific gravity during early lactation and highest values of PH during late lactation ( $P > 0.05$ ). Fat, total protein, lactose and total solids contents recorded maximum values during early lactation ( $P > 0.05$ ). Ewe's milk showed lower PH values during early lactation ( $P > 0.05$ ). Fat content recorded highest values at late lactation while maximum values of total protein were observed during mid-lactation ( $P > 0.05$ ). Lactose content recorded maximum values at early lactation. Highest values of total solids were observed during mid-lactation ( $P > 0.05$ ). Ewe's milk showed higher values of PH, acidity, specific gravity, fat, protein, ash and total solids compared to goat's and camel's milks while camel's milk showed the highest values of lactose content ( $P > 0.05$ ). In conclusion's during the different stages of Goat's milk is an important tool to define milk processing strategies for the nutrition of the inhabitants compared to ewe's and camel's milks.



N-3

**Voluntary intake and digestibility of various summer fodders in sheep and goats**

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Study was conducted to compare the voluntary intake and digestibility of sheep and goats fed janter (*coriandrum sativum*), guar (*cyamopsis tetragonolba*), and cowpea (*Vigna sinensis*) in small ruminants. For this purpose, 90 female animals (45 sheep and 45 goats) were randomly selected and divided equally in six groups having three replicates ( $n = 15$ ) in each species under  $2 \times 3$  factorial arrangements. Three fodders (jantar, guar and cowpea) were randomly fed to their respective replicates in both goats and sheep. Results showed that eating time was significantly higher in goats than sheep. Ruminating time was statistically ( $P < 0.05$ ) different between sheep and goats. Sheep and goats showed different eating patterns on offered fodders. Drinking time was not different ( $P < 0.05$ ) among both species. Playing, resting and other activities were higher in goats than sheep. Dry matter intake was statistically ( $P < 0.05$ ) different between both species on offered fodders. CP, NDF, ADF intake was also greater in sheep than goats. Dry matter digestibility was similar in sheep and goats on jantar, cowpea while, statistically different ( $P < 0.05$ ) on guar. DM digestibility was better on jantar than other fodders in case of sheep but in case of goats better digestibility was on cowpea followed by jantar and guar. CP digestibility was similar in sheep and goats on jantar and cowpea except guar it was different statistically ( $P < 0.05$ ) among sheep and goats. NDF, ADF digestibility was similar among both species. Weight gain, feed efficiency and cost of production were similar ( $P < 0.05$ ) between sheep and goats.





N-4

### Performance of sheep and goats kept under different feeding management systems

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A study was conducted to evaluate the performance of Lohi sheep and Beetal goats under different feeding management system. Ninety females consisting of 45 Lohi sheep (approximately 13 month of age and  $22.1 \pm 0.69$  kg body weight) and 45 Beetal goats (approximately 15 months of age  $19.9 \pm 0.47$  kg average body weight) were used. The animals were divided into six equal groups, three in each species under  $2 \times 3$  factorial arrangements. one group of both species was grazed for 8 hours (Extensive), Second group of both species was grazed for 4 hours and stall fed for 4 hours (Semi-intensive) while the third group of both species was stall fed for 8 hours (Intensive). All treatment groups were fed lucern fodder and 240 g concentrate ration/animal/day. Results showed that dry matter intake was higher ( $P < 0.05$ ) in sheep than goats under extensive ( $794.26^a \pm 6.19$  vs.  $733.32^b \pm 2.15$  g/d), semi-intensive ( $746.43^b \pm 10.79$  vs.  $661.44^c \pm 7.37$  g/d) and intensive ( $753.51^{ab} \pm 9.72$  vs.  $658.43^c \pm 9.99$  g/d) system. Within species differences were significant on extensive system, while similar on semi-intensive and intensive system. Crude protein intake was statistically similar in sheep and goats on extensive ( $142.71^{ab} \pm 5.06$  vs.  $131.95^{ab} \pm 5.37$ ), semi-intensive ( $136.30^{ab} \pm 4.35$  vs.  $127.87^b \pm 4.80$ ), while different on intensive system ( $144.43^a \pm 5.35$  vs.  $127.92^b \pm 4.33$ ). Within species crude protein intake was similar under three systems. NDF, ADF intake was higher in sheep than in goats on all treatments ( $P < 0.05$ ). The average daily gain was higher ( $P < 0.05$ ) in sheep than in goats under extensive, ( $98.14^a \pm 4.61$  vs.  $82.59^b \pm 4.04$ ), semi-intensive ( $83.33^b \pm 5.77$  vs.  $66.29^c \pm 3.46$ ) whereas, it was similar under intensive system ( $62.59^{dc} \pm 2.04$  vs.  $49.62^d \pm 4.04$ ). The feed efficiency was lower in goats than sheep. The cost of production per kg gain was lower ( $P < 0.05$ ) in sheep than in goats under extensive, semi-intensive and intensive system of feeding.



N-5

### Comparative performance of sheep and goats fed under intensive management system

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Study was conducted to compare the performance of sheep and goats under confine situation. For this sixty animals (lambs n = 30, 10 month of age 19.5 kg body weight and kids n = 30 10month of age 11.5 kg body weight) were selected and divided equally in four groups, 2 each for lambs and kids. The both species were allotted two treatments i.e. fodder *ad libitum* with concentrate supplement 240 grams and total mixed ration *ad libitum* under 2 × 2 factorial arrangement. Results demonstrated that dry matter intakes were significantly ( $P < 0.05$ ) higher in lambs than kids on TMR and fodder with concentrate supplement respectively. CP, NDF, ADF intake was significantly ( $P < 0.05$ ) better in lambs than kids. Average daily weight gain was significantly ( $P < 0.05$ ) supplementary in lambs than kids on total mixed ration, but similar on fodder with concentrate supplementation. Feed efficiency was similar among lambs and kids on total mixed ration, but significantly ( $P < 0.05$ ) higher on fodder plus supplement. The cost of average daily gain per kg was better on fodder with concentrate supplementation than TMR in case of kids but it was similar in case of lambs. Dry matter digestibility was significantly ( $P < 0.05$ ) greater in kids than lambs on total mixed ration and similar on fodder plus supplement. CP digestibility was significantly ( $P < 0.05$ ) better in kids than lambs on total mixed ration, but similar on fodder plus concentrate supplementation between kids and lambs. NDF digestibility was significantly ( $P < 0.05$ ) higher in lambs than kids ( $51.41^a \pm 1.89$  vs.  $46.09^b \pm 1.79$ ), but on fodder plus supplement better in kids than lambs ( $60.06^a \pm 2.46$  vs.  $53.36^b \pm 1.03$ ) were significantly different. ADF digestibility was significantly ( $P < 0.05$ ) higher in lambs than kids on total mixed ration but similar on fodder plus concentrate among species. It is concluded that kids perform better than lambs on fodder with concentrate supplementation economic point of view, while lambs performance remains similar on both diets.



## N-10

**Effect of feeding condensed tannins in carob pulp, on milk yield, fatty acids and physico-chemical composition of goat milk**

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This work aims to investigate the possible improvement of dairy production, physico-chemical and fatty acids composition of milk that can result from the incorporation of condensed tannins (CT) from carob pulp (*Ceratonia siliqua*) in goats diet. For this, 21 lactating local goats are divided into three groups. The control group (T0) received a concentrate feed supplementation without CT. In test groups T8 and T15, CT was incorporated respectively with 8% and 15% DM using carob pulp. T15 treatment affects negatively the milk production ( $P < 0.05$ ). Moderate incorporation of CT (T8) was accompanied with an increase in milk production (90.44 vs 70.54 and 83.83 kg,  $P < 0.05$ ), in dry matter content of milk (13.86% vs. 12.8% and 12.99%,  $P < 0.001$ ) but with a milk less stable (2.30 vs. 2.03 and 2.10 g/l of lactic acid,  $P < 0.01$ ) and less fat (4.36% vs. 4.39% and 5.19%,  $P < 0.001$ ) respectively for T8, T0 and T15. High CT incorporation (T15) provides milk with more protein (3.6% vs. 3.11% and 3.38%,  $P < 0.005$ ) and slightly more degraded dry extract (8.66% vs. 8.42% and 8.63%,  $P = 0.05$ ) respectively for T15, T0 and T8. T15 treatment is accompanied by an improvement of desirable fatty acids ( $P < 0.05$ ), unsaturated fatty acids ( $P < 0.05$ ) and polyunsaturated fatty acids ( $P < 0.05$ ). Indeed, there is a particularly significant increase ( $P < 0.01$ ) of elaidic acid (C18:1n9t), linoleic (C18:2n6c) and especially the omega 3 fatty acid (C18:3n3). High CT incorporation in lactating goats' diet improves chemical and nutritional quality of milk but with a decrease in milk production. Food resources, particularly high containing CT shrubs are abundant on pasture used by goat breeding. In these regions, milk production could be improved by optimizing tannins effect on fatty acids bio-hydrogenation and proteins complexation using an appropriate CT treatment. However, determination of the optimal dose of the appropriate treatment use in goat must to be undertaken.



N-12

### **Characterization of botanical composition and biomass production of silvopastoral grazing in Moroccan Rif**

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The study was conducted in Taghbalout grazing land in the Moroccan Rif Mountains to assess biomass production and botanical composition of major species and their nutritional value. The site is located near to Chefchaouen city at 580 m above sea level and used exclusively by goat's herds. Four sampling plots were selected using the method of stratification. The site is characterized by a high diversity of pastoral flora (125 species) dominated by shrub and herbaceous plant. Biomass produced is 1726 kg DM/ha, composed 62% by *Erica arborea*, *Arbutus unedo* and *Lavendula stoechas*. These pastoral species have a digestible dry matter content exceeding 50%. *Lavendula stoechas* is the species most selected by goats and has six times less of total phenols (50.4 g/kg DM), total tannins (49.3 g/kg DM), condensed tannins (3.0 g/kg DM) and hydrolysable tannins (46.3 g/kg DM) than *Erica arborea* and *Arbutus unedo*. The succession of years of drought and the overuse of pastoral resources has reduced the palatable pasture species and has allowed the appearance of low pastoral interest species such as *Daphne gnidium* and *Arisarum vulgare*.



N-14

**Seasonal weight loss in the Boer Goat: From productive characterization to physiological profiling**

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Tropical climates are characterized by the existence of a dry and a rainy season. During the first pastures lack in quality and quantity and consequently animals lose weight in what is usually defined as seasonal weight loss (SWL). SWL is the major constraint to animal production in Tropical and Mediterranean countries. Central areas of South Africa such as the Free State province are particularly affected by SWL. The region is traditionally used for ruminant production and particularly sheep. Recently, goat production has shown a growing tendency caused by an increase in the demand for goat meat. Boer goat is perhaps the most important goat breed from S. Africa and is now an international breed being imported to the rest of Southern Africa, Australia, Brazil, United States and Europe as a selected meat producing genotype. We have evaluated the effect of SWL on the productive profiles of Boer goat bucks particularly at the level of growth characteristics, meat and carcass traits. In parallel, we have also conducted several studies on physiological aspects: reproductive traits (semen and testicular development profiling), muscle and plasma lipid profiling, nitrogen metabolism (plasma and muscle free aminoacids), as well as carcass mineral contents. Regarding productive performance, supplemented animals showed a higher live weight and cumulated feed intake, with carcass cuts from non supplemented animals representing a higher percentage of the total carcass, especially cuts where muscle depots are higher (legs, best end chops and prime cuts). Regarding the serum amino acid profiles, we concluded that in the goat they are strongly affected by undernutrition, suggesting that the degradation of small carbon chain amino acid has a higher efficiency than degradation of long carbon chain amino acid. At the reproductive level, results indicate a detrimental effect of the absence of supplementation on characteristics such as sperm cell abnormalities, testicular volume or scrotal circumference. In this presentation we will provide an overview on the major results obtained in the above mentioned experiments aiming to integrate all the results.



## N-15

**Body composition and nutritional mineral requirements for maintenance and gain to saanen male kid goats from 30 to 45 kg of body weight**

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In Brazil, goat diet formulation still use nutritional requirements and foods composition values recommended by international committees, which not effectively predict animal response in national condition, became hard the fed programs. In order to complement this issue, this work was developed with aim to determine the nutritional mineral requirements for maintenance and gain of Saanen male goats, from 30 to 45 kg of body weight. Thirty male goats, fed *ad libitum*, initially weighing  $30 \pm 1.02$  kg, were used. Six goats were slaughtered at 30 kg of live weight, representing initial body composition, six with approximately 37.5 kg, representing intermediate composition, and other six with 45 kg, representing final body composition. To determine maintenance requirements 18 animals were divided into six groups of three animals and subjected to three nutritional levels: 0, 30 and 60% food restriction. On slaughter moment, the gastrointestinal tract was washed and weighed to determine empty body weight. Body composition was determined by direct method, in that carcasses and gastrointestinal tract were frozen and subsequently ground and homogenized to collected sub-samples that were freeze-dried and ground in a ball mill for subsequent determination of composition. The requirements were determined by comparative slaughter from body composition of animals that were slaughtered at beginning represents the initial composition. So, minerals body composition was estimated at: 0.26 to 0.23% potassium, 1.92 to 1.72% calcium, 0.05 to 0.06% magnesium, 0.82 to 0.68% iron, 0.05 to 0.06% copper, 0.29 to 0.31% zinc and 0.01% manganese, for animals from 30 to 45 kg of live weight. Daily net requirement for maintenance was estimated at: 0.80 to 1.20 g iron, 0.05 to 0.07 g potassium, 0.58 to 0.87 g calcium, 0.01 to 0.02 g magnesium, 0.02 to 0.03 g copper, 0.02 to 0.03 g zinc, and 0.005 to 0.008 g manganese, for male Saanen goats from 30 to 45 kg of live weight. And, daily weight gain net requirements at: 4.17 to 3.96 g iron, 1.60 to 1.64 g potassium, 11.83 to 12.05 g calcium, 0.56 to 0, 75 g magnesium, 0.52 to 0.64 g copper, 2.48 to 2.95 g zinc, and 0.81 to 1.13 g manganese, per kg of live weight gain to animals from 30 to 45 kg of live weight.



N-18

**Apparent total tract digestibility, ammonia and blood urea nitrogen in growing goats fed stover and supplemented with agroindustrial byproducts**

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Low quality roughages intake and digestibility can be improved by protein supplementation. To investigate the effect of poultry litter-molasses supplementation in sorghum stover apparent digestibility and nitrogen retention eighteen growing goats ( $19.7 \pm 1.1$  kg BW) were used. All goats were fed corn stover (5.1% CP and 64.2% NDF) and randomly allotted to one of three treatments in a complete randomized design. The control group was fed only with sorghum stover, the second group (MPWCS) was fed with sorghum stover plus 120 g of supplement (molasses-poultry litter-cottonseed, 30:40:30; 15.2 % CP), and the third group (MPFM) received sorghum stover plus, 120 g of supplement (molasses-poultry litter-feather meal, 30:40:30; 25.4 % CP). Sorghum stover and supplements were fed individually once a day. Apparent digestibility of nutrients was performed by total fecal and urine collection during the last five days of experimental period, total fecal output was recorded and subsamples of 10 % wet weight were taken for DM, OM, NDF, ADF and N analyses. The last day of the experimental period blood samples were collected via jugular vein puncture in all goats, centrifuged within one hour at  $3500 \times g$  for 20 min, serum was stored at  $-20^{\circ}\text{C}$  and analyzed for BUN (colorimetric kit CONCEPTA™). Rumen fluid was collected from three goats of each treatment by esophageal tube, samples were acidified with 2 ml HCl 50%, centrifuged at  $3500 \times g$  for 20 min and supernatant stored at  $-20^{\circ}\text{C}$  and analyzed for N-NH<sub>3</sub> by spectrophotometry (Spectrophotometer DR 5000™). Feed intake was not influenced ( $P = 0.29$ ) by supplementation. Dry matter and organic matter retention were similar between treatments ( $P = 0.37$  and  $0.64$ , respectively). Supplemented goats showed higher nitrogen retention ( $P < 0.01$ ) than goats in the control group. NDF digestibility was not affected ( $P = 0.20$ ) by supplementation, however ADF retention was lower ( $P = 0.02$ ) in supplemented goats. Ammonia nitrogen (N-NH<sub>3</sub>) concentration in rumen fluid was higher ( $P < 0.01$ ) in supplemented goats. Supplementation did not influenced blood urea nitrogen ( $P = 0.40$ ). Supplementation with molasses-poultry litter and whole cottonseed or molasses-poultry litter and feather meal improve rumen nitrogen availability and nitrogen retention in growing goats fed with low quality roughages.





N-22

**Effect of exogenous fibrolytic enzymes on *in vitro* ruminal fermentation kinetics and energy utilization in goats of three Mexican tree fodder species**

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Factorial experimental design (3 x 3) was used to evaluate the effect of exogenous fibrolytic enzymes (EFE) on *in vitro* ruminal fermentation kinetics and energy utilization of three browse tree foliages (*Pithecellobium dulce*, *Heliocarpus velutinus* and *Guazuma ulmifolia*). A commercial EFE mixture product (Fibrozyme, Alltech Inc., Nicholasville, KY, USA) was added to browse species leaves as following: at three levels: 0 (control), 3.5 and 7.0 mg/g to DM browse tree foliages. Browsers species were harvested during dry season (April/May 2009) and incubated with goat ruminal inoculum. Chemical composition, plant secondary metabolites (PSM): (total phenolics (TP), saponins (SAP), aqueous fraction (AF)) as well as *in vitro* assaying of ruminal gas production kinetics was determined, while the short chain fatty acids (SCFA) and metabolizable energy (ME) were estimated. Data were analyzed using an ANOVA procedure from SAS. Addition of EFE improved the fermentation kinetics of the browse tree leaves. CP content, *P. dulce* was higher ( $P < 0.05$ ) than the remaining tree species. NDF and SAP concentration of *G. ulmifolia* was higher ( $P < 0.05$ ). *P. dulce* and *G. ulmifolia* had high ( $P < 0.05$ ) contents of TP. GP24 of *P. dulce* at the high EFE level (i.e., 7 mg EFE/g DM) showed a higher ( $P < 0.01$ ) ruminal fermentation after 24 h of incubation than *G. ulmifolia* (at 0 mg EFE/g DM) and the interactions among tree species and enzyme treatment was also affected. Gas production parameters (b, c), were affected ( $P < 0.01$ ) by enzymes treatment while the lag phase was not affected by interaction. The lower ( $P < 0.01$ ) extent of gas production occurred in *G. ulmifolia* at 0 mg EFE/g DM as well as the c and b values. *P. dulce* with high levels of EFE (7.0 mg/g DM) showed the highest ( $P < 0.05$ ) values for ME and SCFA while the *G. ulmifolia* without EFE showed the lowest values for ME and SCFA. Addition of EFE improved the fermentation kinetics of the browse tree leaves.



N-23

### **Survival rate and mineral composition of four fodder tree species for meat goats**

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A field study was initiated at the Center for Environmental Farming Systems located in Goldsboro, NC to evaluate the survival and mineral composition of *Morus alba L.* (MAL) and three leguminous tree species, *Robinia pseudoacacia L.* (RPL), *Albizia julibrissin Durazz* (AJD) and *Gleditsia triacanthos L.* (GTL). Trees were planted in double row plots (12 trees per row, planted 1 m apart within row and 3 m between row) following a randomized complete block design and 4 field replicates. Plots measured 11 m by 3 m and were spaced 6 m apart. One year old seedlings were planted in March 1995. After being browsed in spring-summer each year, trees were coppiced to 0.5 m in February. Minerals were determined by inductively coupled plasma mass spectrometry from hand-plucked samples. One year after planting, survival rates were similar ( $P > 0.05$ ) for RPL (99.0%), GTL (98.0%) and MAL (99.0%) but lower for AJD (94.0%;  $P < 0.05$ ). By 2002, no differences ( $P > 0.05$ ) were observed in the survival rates of RPL (92.7%), GTL (92.7%) and MAL (78.1%), whereas ADJ had decreased to 49% ( $P < 0.05$ ). The overall survival rates in 2011 were highest for GTL (90.6%) but similar ( $P > 0.05$ ) to RPL (75%) despite of an 18% decrease in the latter since 2002. Conversely, the survival rates for MAL (19.8%) and AJD (26.0%) were much lower ( $P < 0.05$ ) due to repeated deer herbivory and fusarium wilt, respectively. Concentrations of Ca (1.10, 0.74, 1.57, 0.79%;  $P < 0.05$ ), P (0.18, 0.40, 0.47, 0.21%;  $P < 0.05$ ) and Zn (29.4, 28.3, 44.1, 30.1 mg/kg;  $P < 0.05$ ) were adequate in all tree species, respectively RPL, GTL, MAL, ADJ, although the Ca/P ratio was high for RPL (6.1;  $P < 0.05$ ). The K (2.37, 2.01, 3.05, 1.87%;  $P < 0.05$ ) and Fe (avg: 182 mg/kg) concentrations were in excess of National Research Council (NRC) requirements for all tree species. The Mg concentrations were similar ( $P > 0.05$ ) in GTL (0.19%), RPL (0.26%) and ADJ (0.26%) but in excess of NRC requirements in MAL (0.44%;  $P < 0.05$ ). Finally, the Mn concentrations ( $P < 0.05$ ) were slightly above NRC requirements for GTL (40.1 mg/kg) and ADJ (51.1 mg/kg) and above required values for RPL (82.1 mg/kg) and MAL (73.6 mg/kg). These results indicate that RPL and GTL have mineral profiles sufficient for growth, lactation and reproduction of meat goats and thus have potential to play an important role in these enterprises. Further research will have to be undertaken to assess how to best integrate these fodder tree species in mixed silvopastoral systems.



N-26

**Effects of ruminal butyrate infusion and papillae enlargement on hay intake, rumen growth and growth performance of growing goats**

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The present study was aimed to investigate the effect of ruminal butyrate infusion and papillae enlargement on hay intake, growth performance and rumen growth in growing goats. Eight goats (20-22 kg BW) were randomly assigned in two groups (n = 4 each). Butyrate (B) group was ruminally infused with buffered sodium butyrate (0.3 g/kg) whereas control (C) group received same amount of buffer. The experiment lasted 4 weeks. Molar proportion of Ruminal butyrate significantly raised ( $P < 0.05$ ) after infusion and remained elevated for 3.5 h. Molar proportion of acetate and propionate dropped significantly for 1.5 h in B group compared to C and then gradually returned to the pre-infusion value. Ruminal fluid pH did not change between the groups. The papillae length and width significantly increased ( $P < 0.05$ ) in B group which led to 48.6% increase in surface area compared to C. Rumen empty weight and rumen weight expressed as percent body weight was however, higher but not statistical significant in B than in C group. Rumen weight expressed as percent of whole stomach was significantly higher ( $P < 0.05$ ) in B group than in C. Hay intake was not significantly different for first two weeks and then tended to be higher in third week and progressively increased ( $P < 0.05$ ) in the final week of the experiment in B compared to C group. Overall hay intake throughout the experiment period tended to be higher in B compared to C group. Final body weight did not differ between the groups; however the average daily weight gain was significantly higher ( $P < 0.05$ ) in goats with B group compared to C. It was concluded from the present study that ruminal butyrate infusion caused papillae enlargement, increased hay intake and thereby improved rumen growth and growth performance in growing goats.



N-27

***In vitro* fermentation kinetics of regional feedstuffs used in goat production practices in Northwest Mexico**

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Several by products produced in Northwest Mexico represent an important feeding resource for goat production, although scarce information is available on their fermentation kinetics. Thus, a study was carried out to determine the nutritive value of conventional and unconventional regional feedstuffs commonly used in goat nutrition practices in the subtropics of Northwest Mexico through *in vitro* gas production estimations. Three individual samples of each: cull apple meal (CAM), cull raw chickpeas (CRC), cull cooked chickpeas (CCC), cull cooked beans (CCB), broom sorghum (BS), meat and bone meal (MBM), poultry feather meal (PFM), fishmeal (FM), canola meal (CM), cotton seed meal (CSM), sesame seeds meal (SSM), safflower meal (SM), and wet distillers grain (WDG) were collected. Samples of 500 mg were prepared for *in vitro* gas production analyses, and used as the replicates and statistical unit. *In vitro* evaluations for each individual sample were performed in three runs of incubations in 100 ml glass syringes in different weeks. *In vitro* gas production after 96 and 24h, partitioning factor and microbial protein synthesis were determined. Fermentation parameters were obtained using the equation:  $p = a + b(1 - e^{-ct})$  by PROC NLIN. All data were analyzed using ANOVA for a completely randomized design. All the studied variables were different among feedstuffs ( $P < 0.05$ ). The gas produced from the slowly degradable b fraction (ml/500 mg DM) was highest for CCB (91), CCC (77), CRC (70) and BS (70) and lower for WDG (61) and CAM (55). The fractional rate of gas production c (% h<sup>-1</sup>) was highest for CM (0.111), intermediate for CCB (0.069) and CCC (0.066), and lowest for PFM (0.011). *In vitro* gas production (ml/500 mg DM) at 24h was highest for CCC (180), CCB (178) and CRC (175); intermediate for CAM (121), BS (112) and WDG (111); and lowest for FM (32). Values regarding the PF (mg substrate truly degraded/ml gas produced) were higher for SSM (4.8) and FM (4.5) and lowest for PFM (2.0). Microbial protein synthesis expressed as purine content (μmol) was highest for CCB (14.2), and lower for CCC (9.5). *In vitro* gas production data supported the important potential of the agricultural by products cull chickpeas and beans as feeds for goat production in the subtropics of Northwest Mexico.



N-28

### **Crude Protein and mineral concentrations in grasses, browse and a legume species from four swayback affected sheep and goat farm locations of Central Trinidad**

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A survey was carried out of a suspected swayback condition on sheep and goat farms of Central Trinidad. Neonates displayed an inability to stand at birth or hind limb ataxia progressing to paraplegia in the delayed forms. About 50% and 30% of apparently normal and affected animals combined (n = 172) had low serum Cu (< 0.50 mg/L) and P (< 40 mg/L) levels. The objective of the study was to evaluate crude protein (CP), Cu, and mineral levels, of grazed or zero grazed local forages, in relation to the clinical condition, and nutritional requirements of sheep and goats. The individual forages collected were those of grasses (n = 48): *Paspalum fasciculatum* (n = 11), *Bracharia mutica* (n = 8), *Axonopus compressus* (n = 6), *Hymenachne amplexcaulis* (n = 4), *Sporobolus indicus* (n = 3), *Pennesetum purpureum* (n = 3), *Cynodon dactylon* (n = 2), *Bracharia radicans* (n = 2), *Bracharia bryzantha* (n = 1), *Leesia hexandra* (n = 1), *Echinochloa colonum* (n = 1), mixed unidentified grasses (n = 5); browse (n = 10): *Wedelia tribolata* (n = 1), *Alternanthera tanella* (n = 1), *Ludwigia hysopifolia* (n = 1), *Sturcium sporganiphora* (n = 1), *Sida malvaceae* (n = 1), *Caperonia palustis* (n = 1), *Corchurus olithorus* (n = 3), *Rolandra fruticosa* (n = 1), and legume *Leucaena leucocephala* (n = 1). Means  $\pm$  SD of CP and mineral levels determined, were evaluated according to nutritional requirements for sheep and goats (AFRC, 1991; 1998; NRC, 2007). Twenty one percent, and 38% of Ca levels in grasses would neither supply minimum (< 2.1g/Kg DM), nor pregnancy (< 3.0) nor lactation (< 3.0) requirements, respectively. Two percent percent, 30%, 45% of Mg levels in grasses would neither supply estimated minimum (< 1.2 g/Kg DM), nor late pregnancy (< 1.5) nor early lactation (< 1.8) requirements for sheep. Thirteen percent, 17%, 71% of P levels in grasses would neither supply minimum (< 1.6g/Kg DM), nor pregnancy (< 2.0) and lactation (< 3.0) requirements, respectively. Forty percent of grasses had Na levels below lactation requirements for sheep (< 0.09%), while 76% had levels below maintenance requirements for lambs (< 1.8 g/Kg DM). Fourty nine percent of grasses were critically deficient (< 5.0 ppm) in Cu. Phosphorus, Ca, Mg, Na levels found in grasses were likely limiting productivity of sheep and goats while low forage Cu and P levels were probably associated with low serum Cu and P levels of animals of swayback affected farms. A few browse species could be considered as Ca, Na, Cu, and Mn accumulator plants.



N-29

### **Relationship between molecular and systemic adaptation of renal electrolyte handling to low N diet**

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A previous study has demonstrated that low nitrogen (N) feeding affected the electrolyte homeostasis in growing male Saanen goats, including adaptive mechanisms of the kidneys and bones, despite effective N recycling mechanisms characteristic for ruminants. Decreased plasma concentrations of insulin like growth factor 1 (IGF-1) and calcitriol and an increased plasma concentration of the bone resorption marker CrossLaps (CTX) were detected. IGF-1 was shown to influence glomerular filtration rate, calcitriol synthesis and renal phosphate (Pi)-reabsorption (Guler *et al.*, 1989, Dubois-Ferriere *et al.*, 2011, Caverzasio *et al.*, 1989), whereas calcitriol is known as one main regulator of calcium (Ca) reabsorption. Furthermore, our *in vitro* studies showed an increased protein expression of the main renal sodium-dependent Pi transporter NaPi IIa and accordingly a decreased protein expression of one of its upstream regulators, the parathyroid hormone receptor (PTHr) in the animals fed a low N diet. Since the impact of these molecular findings is not known yet, the aim of the present study was to evaluate the consequences of these changes due to low N feeding for the electrolyte excretion *in vivo*. Twelve male white Saanen goats were fed either a diet high or low in N-content (6 animals per group), identical to the animals used for the previous study. These feeding conditions were maintained for 6 weeks. During this time, N, P and Ca balance studies were performed over 6 days. In addition, blood samples were collected to measure concentrations of urea, Ca, Pi, IGF-1, calcitriol and parathyroid hormone (PTH) to confirm an adaptation to the feeding. In the low N fed animals the daily N excretion and the plasma urea concentration were decreased, whereas the N balance remained unaffected. In contrast to the previous molecular findings the Ca and Pi excretions, balances and as well plasma Ca and Pi concentrations did not differ between the two feeding groups. However, the plasma IGF-1 concentration was decreased in the animals fed low N as already observed previously. Linear regression analyses showed that plasma calcitriol concentration was negatively correlated to plasma PTH concentration and to urinary Ca excretion, although plasma PTH concentration was unaffected by the feeding. The decreased urinary N excretion associated with an unaffected N balance indicates compensation of the dietary N reduction by endogenous N recycling. Different than expected, the urinary electrolyte excretion and the electrolyte balances *in vivo* were not influenced by low N feeding in the present study, despite modifications of renal Pi transport protein expression in the previous *in vitro* study. Nevertheless, decreased IGF-1 and by trend decreased calcitriol plasma concentrations again suggest an influence of the dietary N reduction on the electrolyte homeostasis. The negative correlation between calcitriol and PTH and Ca excretion, respectively, approves the existence of specific regulatory mechanisms of electrolyte homeostasis under dietary N reduction in growing goats.





N-30

**Effects of calcium restriction on the gastrointestinal calcium absorption in goats in comparison to sheep**

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In contrast to sheep as grass and roughage eaters, goats are classified as 'intermediate feeders' and 'concentrate selectors', which choose less fibrous parts of plants (Hofmann 1989). This behaviour enables them to adapt to a broad range of feeding conditions (Provenzy *et al.* 2003). Whether alterations in gastrointestinal absorption of inorganic nutrients contribute to this adaptation has rarely been investigated to date. The present study was carried out to compare the effects of an alimentary calcium (Ca) restriction on goats and sheep, respectively. Twenty female animals of each species aged six to seven months were divided into two groups and fed a diet adequate (0.9% to 1.10%) or reduced (0.22% to 0.25%) in Ca content for four to eight weeks. Plasma samples were analysed for calcitriol, the bone resorption marker CrossLaps®, ionised Ca ( $\text{Ca}^{2+}$ ), total Ca (Cat) and phosphate (Pi). Five animals of each group were sacrificed for determination of Ca flux rates across gastrointestinal epithelia using standard Ussing chamber technique. Furthermore, the protein expression of structures involved in the intestinal absorption of Ca (the transient receptor potential vanilloid type 6 Ca channel TRPV6, calbindin-D9k and the plasma membrane Ca-ATPase PMCA) was quantified by means of Western blot analysis. The Ca restricted diet induced an increase in plasma concentrations of calcitriol and CrossLaps® in both species indicating a hormonal response to the challenge of Ca homeostasis and an enhanced mobilisation of Ca from the bone. Regarding plasma macromineral concentrations goats, in contrast to sheep, developed neither hypocalcemia nor hyperphosphatemia under the Ca restricted diet. Ruminal Ca flux rates were unaffected in both species whereas a significant increase of intestinal Ca transport could be demonstrated for goats, but not for sheep. Furthermore, the expression of duodenal calbindin-D9k and jejunal TRPV6 was significantly increased only in goats. From these results it can be concluded that goats compensate more efficiently for a challenge of Ca homeostasis than sheep kept on the same feeding regime. Further studies are required to clarify whether the intestinal absorption of other inorganic nutrients can be altered significantly, too. Such compensatory mechanisms would explain why goats are able to adapt to a large variety of vegetation especially in areas providing food of low nutritive values.





N-31

### **Effects of ruminal butyrate infusion on papillae growth and SCFA absorption in rumen of goats**

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This study aimed to investigate the effect of ruminal butyrate infusion on rumen papillae growth and ruminal short chain fatty acids (SCFAs) absorption in goats. Eight rumen fistulated goats (20-22 kg BW) were randomly assigned into two groups (n = 4), fed by 200 g/d concentrate with two equal portions on 0800 and 1700 h and hay ad libitum. Butyrate (0.3 g/kg) dissolved in buffer was infused 1 h before morning feeding to rumen of goats in B group, whereas the same amount of buffer to goats in control (C) group. The experiment lasted for 4 weeks. On the last day the ruminal fractional absorption rates of SCFAs were estimated by H-Val-Cr method. Molar proportion of Ruminal butyrate significantly raised in B ( $P < 0.05$ ) 30 min after infusion and remained elevated for 3.5 h. Molar proportion of acetate and propionate dropped significantly for 1.5 h in B compared to C and then gradually returned to the pre-infusion level. Ruminal content pH did not change between the groups. The papillae length and width significantly increased ( $P < 0.05$ ) in B group which led to 48.6% increase in surface area compared to C. The organ weight of rumen, expressed as percent of four stomachs, was significantly higher ( $P < 0.05$ ) in B group than in C. Compared to C group, the hay intake in B progressively increased and it was significantly higher ( $P < 0.05$ ) in the last week of the experiment. Fractional rates of propionate and butyrate absorption were significantly higher ( $P < 0.098$ ) in goats of B group compared to C, however, the fractional rates of acetate and total short chain fatty acids remained unchanged between groups. These data show that ruminal butyrate infusion caused papillae enlargement thereby improved rumen SCFA absorption in goats.



N-32

**Effects of yeast culture diet supplementation on the blood, biochemical indicators of dairy goats**

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Yeast cultures are recently used as probiotic in diets of ruminants to create more advantageous rumen environmental which is one of the most important factors not only to obtain optimum milk yields but also good animal health. The aim of study was to evaluate the effect of yeast culture supplementation (*Saccharomyces cerevisiae*) on selected, biochemical indicators in blood serum of goats. The experiment was carried out on 18 dairy goats divided into control (n = 9) and experimental (n = 9) groups during the last week of pregnancy till 150 days of lactation. The based diet consisted of corn silage, wilted grass silage and concentrates, supplemented with a mineral and vitamin mixture. The diets were balanced according to INRA-norm. The supplement of yeast culture was added to the concentrate mixture fed to the experimental group (10 g/day/goat). The blood samples were collected on 7, 30 and 150 days of lactation. The serum samples were examined according to biochemical parameters using the INTEGRA (Roche, Switzerland) apparatus. At the end of experiment the activity of aspartate transaminase and alanine transaminase and content of albumin and total protein were significantly higher in experimental group. The contents of macroelements such as Ca, Na, K, Mg and Cl were higher but Fe lower in blood serum of goats from the experimental group. There was no difference in P content. The activity of lipase was significantly higher in experimental group only on 30 days of lactation. There were tendencies to higher content of total cholesterol, low density lipoprotein, high density lipoprotein and glucose in blood serum of goats in experimental group. There were no differences in creatinine content which is the indicator of kidney profile and in total bilirubin content, which is one of the parameter of liver profile. Almost all blood serum parameters changed during lactation paralelly in both groups, but in experimental group were more balanced. Research was realized within the project "BIOFOOD – innovative, functional products of animal origin" no. POIG.01.01.02-014-090/09 co-financed by the European Union from the European Regional Development Fund within the Innovative Economy Operational Programme 2007 – 2013.



N-33

**The impact of inactive dry yeast on milk production and lactation curves of primiparous and multiparous Saanen goat does**

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Twenty-four Saanen goat does during the lactation period were used, from the parity until the 200th day of lactation. Fifteen multiparous and nine primiparous were distributed in a completely randomized design and in a factorial arrangement (3 diets x 2 parturition order). The diets were composed of soybean meal (SB), soybean meal plus inactive dry yeast (SMDY) or inactive dry yeast (DY) used as the protein source. The corn silage was responsible for 40% of the mixture. The purpose was to evaluate the dry matter intake (DMI), the lactation curves and the body weight (BW). The Wood's nonlinear model was assumed for the analysis of the lactation curves, and for DMI and BW was adopted cubic regression by Bayesian inference. DMI increased during the early lactation independent from the diet and parturition order. Primiparous goat does fed with SMDY diet had reduction in DMI during the early lactation. The primiparous goat does receiving the SB diet showed increase in DMI until the end of lactation. The DMI for multiparous was similar among diets. For primiparous, the early milk yield increased for the SMDY and DY diets, with opposite tendency for multiparous. The inclusion of inactive dry yeast in the diets reduced the increase rate of yield until lactation peak for primiparous, but for multiparous the opposite was observed. The SMDY diet reduced the decline rate of yield after peak for primiparous, whereas for multiparous the inclusion of inactive dry yeast in the diet increased the decline rate of yield during this period. The highest average daily milk yield for primiparous was obtained when they were fed with SB diet, while the multiparous highest milk yield was observed in DY diet. The BW was not influenced by different diets, but the goat does lost weight until, approximately, the 78.5th day after parturition, around the peak of lactation. In conclusion, the inactive dry yeast can be used to replace soybean meal in diets for multiparous Saanen goat does with good results.



N-34

**Lactation curve parameters of Saanen goats feeding with increasing dietary energy levels, with protected fat supplementation**

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The goal was to evaluate the protected fat supplement to increase energy level in the diet for Saanen goats and its effects on body weight, dry matter intake (DMI) and the lactation curve parameters. Twenty multiparous Saanen goats ( $63.5 \pm 10.3$  kg) were distributed in a completely randomized design in four treatments with the following energy levels in the diets: 2.6 Mcal of metabolizable energy per kg of dry matter (Mcal ME/kg DM) - control diet; 2.7, 2.8, and 2.9 Mcal ME/kg DM - with added fat as calcium salts of long chain fatty acids (protected fat-Lactoplus®). The treatments showed 28.2, 50.1, 70.3 and 90.6 g of the ether extract per DM kg, respectively. The roughage:concentrate used was 60% of corn silage and 40% of concentrate. The animals were evaluated until 180 days in milk, and goats were housed in individual stalls and milked twice daily. Lactation curves were obtained by measuring daily milk production, using the Wood's non-linear model. DMI was controlled daily, and goats were weighted weekly. There was no effect among treatments on body weight, with the lowest result in the 90 days in milk ( $62.15 \pm 11.5$  kg). Then, the animals began to recover their body reserves, with higher DMI for treatments with protected fat than control treatment. The analyse of lactation curve parameters did not showed effects among on early milk yield (2.72 kg), incremental production rate until lactation peak (0.127), and decline production rate after lactation peak (0.004). Fat supplementation altered the lactation curve, promoting lactation peak later and with greater persistence, which resulted in an increase in total milk production, with better productive results in 2.85 Mcal ME, producing 648.80 kg of milk in 180 days in milk. In conclusion, raising the level of dietary energy for Saanen goats up to 2.85 Mcal ME/kg DM, with protected fat supplementantation, increases milk production without altering dry matter intake and body weight.



N-36

### **Ingestion of tropical tree fodders with different tannin content differs between sheep and goats**

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The present study assessed the effect of tannins content of tree fodder on the intake of sheep and goats. Two experiments were carried out. During the first experiment, twelve goats ( $24.7 \pm 2.6$  kg) were assigned to a cross-over design (3 periods) with three forage trees species which differed in the tannin content: T1= *Lysiloma latisiliquum* (high), T2= *Piscidia piscipula* (medium), T3= *Brossimum alicastrum* (nil). Forages were harvested daily and were supplied *ad libitum* for 3 hours. Treatment groups T4, T5 and T6 mirrored T1, T2 and T3 but with the addition of 50 g PEG/kg DM forage. All treatments had 6 animal replicates. The basal diet consisted of *Pennisetum purpureum* grass and concentrate feed. During the second experiment nine sheep ( $29.3 \pm 2.3$  kg) were employed in a cross-over design (four periods) with the same treatments as in goats. It was observed that forage intake was different between treatments ( $P < 0.05$ ) but effect of PEG supplement was found ( $P > 0.05$ ). Intake of *B. alicastrum* (T3) was higher in both experiments ( $672.68 \pm 34.9$  vs.  $778.1 \pm 22.9$  g DM for goats and sheep respectively). However sheep had lower tannin rich forage intake compared with goats ( $339.9 \pm 22.9$  vs.  $423.8 \pm 34.9$  g DM for T1,  $370.9 \pm 22.9$  vs.  $455.1 \pm 34.9$  g DM for T2) ( $P < 0.05$ ). On average, PEG did not affect feed intake in both experiments ( $526.5 \pm 28.5$  vs.  $507.9 \pm 28.5$  g DM for goats and  $502.083 \pm 18.7$  vs.  $490.5 \pm 18.7$  g DM for sheep). These results suggest that the ingestion of tropical tree fodders with different tannin content differs between sheep and goats. However, PEG did not modify forage intake in any of the forages. Sheep were more selective than goats. Likewise goats were able to ingest higher amount of tannins than sheep.



N-37

### **Artificial milk feeding in Creole goats with or without probiotics**

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In Mexico, there is industrial or empresarial caprinoculture, with high technology, but there is also a family or marginal caprinoculture without integral management. In order to study the effect of artificial milk feeding using or not probiotics in Creole goats with 7/8 of Nubian blood, 24 kids 12 female and 12 male were used at random in 3 treatments and in two kidding times 1). 8 kids with artificial feeding using 1/3 goat milk, 1/3 bovine replacement milk and 1/3 milk with bifidus probiotics 2). 8 kids with artificial feeding with 1/3 goat milk, 1/3 bovine replacement milk without probiotics. 3). 8 Kids suckling from their mothers naturally. This study was done at 19°14' north latitude and 99°14' west longitude and 2250 masl. The kids stayed with its mothers for 3 days in order to suckle colostrum. The kids were weighted each week in a balance with a minimum register of 100 g for 8 weeks until weaning. The kids were separated at day 4 after birth and were fed two times a day morning/afternoon with a 600 milliliter bottles each time. The milk mix was heated to 37 – 39°C. At the same time creep feeding concentrate and Lucerne hay was offered ad libitum from birth to total weaning exactly 60 days for each kid. For statistic analyze ANOVA with born weight as covariant was used. In probiotic fed kids the daily gain was better; 128 g/day versus 120 g/day in kids with maternal milk ( $P > 0.05$ ), 61 g/day in kids without probiotics in the first 30 days ( $P < 0.5$ ). And 264 g/day versus 115 g/day from 30 to 60 days until weaning in day 60 of life probiotics versus artificial feeding without probiotics ( $P < 0.05$ ). The artificial lactation with growth promotors was better than without probiotics and similar to natural suckling. The kids accepted the bottles with rubber nipples and weaning was sudden, the kids had a good grower and were docile.



N-38

### **Creep feeding in creole goats**

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In order to study the effect of creep feeding on kids growth before starting the milking in Creole goats with 7/8 of Nubian blood, 24 kids 12 female and 11 male were used at random in two treatments. 1) Creep feeding with commercial concentrate with 17% of protein *ad libitum*. 2) Without creep feeding. The mothers were fed lucerne hay, corn silage and oat hay. The kids were weighted each week in a balance with a minimum register of 100 g during 8 weeks until weaning. The kids were managed as half milk system with night separation from yhrir mothers. For statistical analysis ANOVA with born weight as covariant was used. The initial weight was 2.5 kg in both groups and final weight was 6 kg in treated group versus 5.5 in control group there were no significant differences ( $P > 0.05$ ). For daily weight gain there weren't any significant differences also ( $P > 0.05$ ), these daily gains were very variable throughout the 8 weeks of work. In intensive systems with Creole goats in 1.8 kilos of milk/day in the first 8 weeks of lactation and half-milk systems the practice of creep feeding is not useful, because the kids without creep feeding eat the same solid food offered to the mothers.





N-39

### **Posweaning growth in young female kids**

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In order to evaluate posweaning growth at central Mexico located at 19°14' north latitude and 99°14' west longitude at 2,250 masl. 10 female kids at weaning were split at random in two groups. 1) Feeding on lucerne hay and concentrate with 13% of protein *ad libitum* and group 2) The same food but with day control, offered once a day in the morning 300 g concentrate/animal/day equivalent to 4% of live weight at the beginning of the trial and one kilo of lucerne hay/animal/day for 16 weeks. The first weighting was done on the weaning day exactly at 60 days after birth. The balance used was an electronic machine with 100 g as minimum scale. For statistical analysis ANOVA with weaning weight as covariant was used. Group two controlled feeding was better than *ad libitum* feeding 15 versus 13 kilos at the end of 16 weeks period ( $P < 0.01$ ). There are papers with information about feeding once a day, then the metabolism is slow and some energy is preserved as grease in tissues. In Creole goats with 7/8 of Nubian blood, controlled feeding was better than feeding *ad libitum* with a commercial concentrate with 13% of protein.



N-43

**Mineral contents of the selected plants grazed by goats during the dry season  
under extensive condition in semiarid area in Brazil**

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Rio Grande do Norte (RN) in Brazil is a semiarid region called Caatinga receiving an annual rainfall less than 400 mm. During the long dry season, rainfall is scanty, thus, most forage species are withered. Farmers leave their goats to graze freely on indigenous pasture in their big farms. During the dry season, grazing animal's forage intake is too low to meet energy, protein and mineral requirements. Hayashida *et al.* (2008; 2010) had reported the low blood plasma phosphorus (P) and copper (Cu) concentration (9th ICG) and high whole blood selenium concentration (10th ICG) of the grazing goats during the dry season. They had suggested the possibility of the mineral imbalance. But there is scanty information regarding the feed mineral contents in the area. The objective of this study was to determine the mineral contents of plants grazed by the goats in the area during the dry season. The study was conducted in 4 farms of Mossoró, RN (5° 2' S, 36° 8' W) in January, February and September, 2006. An average of 200 goats per farmer is under free range grazing throughout the year without any concentrate supplementation. Forty-two plant samples and 1 salt sample were collected by hand plucking method in the natural pastures owned by 4 farmers. Mineral contents were analyzed after wet ashing. There were various parts of the plants grazed by the goats, such as leaves, stems, twigs, pods and fruits, respectively. Goats grazed and browsed even the plants called as toxic plants at the end of the dry season. Overall mean contents of the potassium (K) (20,310 ± 2,494 mg/kg DM), calcium (Ca) (14,024 ± 1,551 mg/kg DM), magnesium (Mg) (3,982 ± 461 mg/kg DM) and iron (Fe) (521 ± 96 mg/kg DM) were higher than the upper limit levels of the required range (K: 8,000 mg/kg DM, Ca: 5,200 mg/kg DM, Mg: 800 mg/kg DM, Fe: 100 mg/kg DM, respectively) recommended by McDowell (1985). Several samples contained lower P, zinc (Zn) and Cu than the lower limit levels of the range (S: 1,400 mg/kg DM, P: 1,600 mg/kg DM, Zn: 20 mg/kg DM, Cu: 4.0 mg/kg DM). The low plant Cu content might result in the low blood plasma Cu concentration of the grazing goats reported by Hayashida *et al.* (2008). It was also suggested that the high contents of macro minerals might affect the absorption of some elements.



N-45

### **Perirenal fatty acid profile of goat grazing on dry areas of Mendoza, Argentina**

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This study was aimed to determine the fatty acid profiles of goats grazing on desert rangeland of Mendoza, Argentina. Six Criollo male kids were castrated (60 days old) and raised grazing forage species of the natural field until slaughter (12 months). Samples of perirenal fat were taken and sent to the Meat Quality Laboratory, Faculty of Agronomy, UBA, for fatty acid profile determination (by gas chromatography). The goats reached 26.2 kg of live weight at slaughter with a carcass dressing of 49.4 % and a cold carcass weight of 12.9 kg. The saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids percentages were 67.9, 28.8 and 3.2, respectively. These values are very similar to those found in fat depots of other goats and desert sheeps. The main fatty acids were stearic (31.4%), palmitic (27.1%), and oleic (19.0%). The major unsaturated acid (UFA) were oleic constituting 59% of total unsaturated fatty acids. Whereas, the main SFA were stearic and palmitic, comprising 46.2% and 39.8% of total SFA, respectively. An inverse relationship between stearic and oleic acids ( $r=-0.94$ ,  $P < 0.001$ ) was found. This, coupled with the high concentration of stearic acid (1.65 times greater than oleic acid) would indicate a relatively high activity of the stearyl-CoA desaturase enzyme in these grazing goats. The relatively high concentrations of stearic acid could be because forage increases the rumen activity and therefore increases biohydrogenation of dietary UFA. However, this is not a problem for human health since the effect of stearic acid on human cholesterol levels is considered neutral. The percentage of desirable fatty acids (DFA, UFA plus stearic acid) was 63.5, being within the range (64.1% - 67.1%) reported for goats fed with and without concentrate supplementation. The n-6/n-3 ratio (2.55) is within the reported desirable range for human health of less than 5:1. Based on these results, it is possible to conclude that consumers should not consume large amounts of perirenal or internal fat of these goats due to the saturation of their fatty acids. However, based on the lipid profile of perirenal fat, it could be presumed that the meat quality would be good from the viewpoint of human health, despite the tendency of grazing goats to accumulate more saturated fatty acids.



N-49

### **Effect of physiological state of grazing goats on dietary intake and composition in an arid rangeland of Mendoza, Argentina**

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Total intake, botanical composition and nutritional quality of diet of grazing goats in different physiological states were assessed in the wet season (summer). In a desert rangeland in the northeast of Mendoza, twelve Criollo goats, six lactating and six dry, were gun-dosed a controlled-release capsule containing n-dotriacontane (C32) and n-hexatriacontane (C36) with a nominal release rate of 50 mg day<sup>-1</sup> (CAPTEC Ltd, Auckland, NZ). Samples of faeces were collected from the rectum daily on days 5 to 10 after dosing. Forage diet components (grasses, shrubs and trees, n: 15), identified from previous studies, were sampled. Forage and faeces samples were analysed for n-alkanes by gas chromatography. Goat diet composition was estimated from the n-alkanes pattern in forage species and faeces. Total dry matter intake (DMI, g day<sup>-1</sup>) was computed from the estimated C32 dose and the n-alkanes contents in the diet and faeces. Plant samples were analysed for crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF) and total tannins (TT). One-way ANOVA and Tukey's multiple comparison tests were used to detect differences in diet composition, total forage and nutrient intake between animal groups. All n-alkanes from C23 to C35 were measurable in the plant samples. Diet was composed mainly of shrubs and trees (80 %), followed by grasses (20%), in all goats. Lactating goats consumed lower ( $P < 0.05$ ) proportion of shrubs and more grasses and trees (69:21:10) than dry goats (85:14:1). *Panicum urvilleanum* was the most abundant grass (2-39 %), and *Tricomaria usillo*, *Mimosa ephedroides*, *Lycium spp.*, *Capparis atamisquea* and *Prosopis flexuosa* were the most important woody species. Total forage intake was 63 % higher ( $P < 0.05$ ) in lactating ( $2439 \pm 846$  g DMI day<sup>-1</sup>) than dry goats ( $1491 \pm 468$ ). Considering only the primary forage species in the diet, CP intake were 217 and 83.4 g d<sup>-1</sup> for lactating and dry goats respectively ( $P < 0.05$ ), there were no differences between groups of goats for NDF, ADF and TT intake. These results show that lactating and dry goats grazing on desert rangeland selected similar species, but in different proportions and the forages selected by both groups of goats were appropriate to meet their CP requirement. These findings suggest that goats are able to modify their dietary intake and composition according to their physiological state.



N-50

**Influence of fatty acid enriched diets on white and brown adipose tissue distribution in goats**

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Aim of the project was to investigate the possible influence of fatty acid enriched diets on white (WAT) and brown (BAT) adipose tissue distribution among different subcutaneous and visceral deposits in goats by mRNA quantitative expression of Uncoupling Protein 1 (UCP1) and Uncoupling Protein 2 (UCP2). Samples were obtained from ten  $29.8 \pm 2.8$  days old healthy suckling kids whose mothers were fed with either two different diets (A and B) enriched with different fatty acids (Stearic Acid = diet A, Fish Oil = diet B). Seven different adipose tissue samples were taken from each animal, equally distributed between controls, diet A and diet B. Subcutaneous fat was taken from sternum, armpit cavity, base of the tail and withers; visceral fat was taken from perirenal, omental and pericardial depots. Tissues were also collected from the liver as reference samples. Tissue samples for the mRNA expression analysis were immediately kept in RNAlater and stored at  $-80^{\circ}\text{C}$ . Total RNA was extracted using a commercial kit specific for tissues with high-fat content (Qiagen) and then retro-transcribed using the iScript kit Biorad. The resulting cDNA was finally amplified using a Real Time PCR. Relative expression of both UCP1 and UCP2 was calculated with the comparative  $\Delta\Delta\text{Ct}$  method, using HPCAL1, GAPDH and LRP10 as reference genes. Statistical analysis of the data was carried out as well. Real Time PCR results showed different expression of UCP1 and UCP2 between subcutaneous and visceral adipose tissue depots, but not among different diets. In particular, UCP1 (exclusively expressed in brown adipose tissue) is mostly expressed in visceral adipose tissue deposits. In conclusion, brown and white adipose tissue is clearly differently distributed among subcutaneous and visceral adipose tissue deposits in kids even though changes in mother's diet have no influence on their distribution.



N-51

**Intake and ruminal parameters in goats fed sugarcane as a substitute of corn silage**

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The experiment was conducted to evaluate in natural sugar cane as a substitute of corn silage in the dry matter intake, ruminal parameters (pH and ammonia), production of short chain fatty acids and degradation kinetics of roughage and concentrate in adult goats in maintenance. Four non-lactating goats rumen fistulated were used and arranged in a 4 x 4 latin square design, using levels of substitution of 0, 33, 67 and 100% as independent variable. The levels of substitution of corn silage by sugar cane did not affect the dry matter intake, daily weight gain and ruminal pH, which did not occur with ammonia that had a quadratic effect, with maximum concentration for 74.43% of sugar cane. However, the relation Ac:Pr linearly decreased with the increase of sugar cane in substitution of corn silage. The effective degradability, potential, the soluble fraction of dry matter and neutral detergent fiber of roughage did not have significant effect in the different ruminal environments formed by the levels of substitution of corn silage by sugar cane. The degradability of dry matter of sugarcane, corn silage and concentrate had values of 66.79, 72.62 and 93.06% respectively, in 96 hours for roughage and 48 hours for concentrate, of incubation. The effective degradability, with rate of passage of 0.05 h<sup>-1</sup>, of dry matter and crude protein of concentrate showed quadratic effect in the different ruminal environment, observing maximum degradation in the level of 51.00 and 61.71% of sugar cane, respectively. The neutral detergent fiber degradability had values of 37.10 and 51.82% for sugarcane and corn silage, respectively, in 96 hours of incubation, and 96.42% for crude protein of concentrate in 48 hours of incubation. The sugar cane as a substitute of corn silage can be fed to adult goats in maintenance without changing the dry matter intake.



N-54

**Milk production and composition from goats fed sugarcane replacing corn silage**

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The experiment aimed to evaluate the milk production and composition from goats fed diets, with roughage concentrate relation of 40:60, containing levels of 0, 33, 67 and 100% replacing corn silage by sugarcane. Eight Alpine goats were arranged in two balanced Latin Squares 4 x 4 for a period of 72 days. To milk production evaluation, the goats were milked twice a day, at 0730 and 1500 h and the milk production registered during five consecutive days in the different experimental periods. Samples of milk from two days of milk control in the ratio 2/3 from the morning milk and 1/3 from the afternoon milk, were collected in 30 ml plastic tubes containing preservative bronopol (2-bromo-2-nitropropano-1,3-diol), and sent to laboratory to constituents analysis. There were determined the contents of protein, fat, lactose, total solids, nonfat dry extract and milk urea nitrogen. Data were submitted to variance analysis by the computer program SAEG (Sistema de Análise Estatística e Genética) version 9.0 (UFV, 2000) and the means that presented significant effect to treatment were studied by regression analysis, separating the effects in linear, quadratic and cubic, adopting 5% as level of significance. There were not find significant differences in milk production that was 1.512 kg/day, milk production corrected to 3.5% of fat, which was 1.549 kg/day. The concentration of protein (3.4%), fat (3.6%), lactose (4.4%), total solids (12.2%) and nonfat dry extract (8.6%) were not influenced by treatments, which did not occur with the concentration of milk urea nitrogen (mean of 11.71 mg/dL), that increased with the level of participation of sugarcane. The sugarcane can replace corn silage, in the relation roughage concentrate 40:60 and be used to feed milk goats without alter milk production and the content of protein, fat, lactose and total solids.





N-55

### **Ingestive behavior of goats fed sugarcane replacing corn silage**

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The research aimed to evaluate the ingestive behavior of lactating goats fed diets with roughage concentrate relation of 40:60, containing levels of substitution of 0, 33, 67 and 100% of corn silage by in natura sugarcane. Eight Alpine lactating goats were distributed in two Latin Squares 4 x 4, according to milk production, during 72 experimental days. The animals were maintained in individual pens where received the diets (*ad libitum*), twice a day. The ingestive behavior observation was performed each 10 minutes during 24 hours, totalizing 144 observations in each experimental period. During night observation, the environment was maintained with low intensity artificial lighting to not interfere the animals' behavior. The studied parameters were time spent in the feed (TSF), rumination (TSR), leisure (TSL), mastication (TSM), dry matter and neutral detergent fiber feed efficiency (DMFE) and (NDFFE), dry matter and neutral detergent fiber rumination efficiency (DMRE) and (NDFRE), number of day ruminal bolus (BOL) and mericicas day mastication (NMM). The TSM was calculated by the sum of TSF and TSR. At the same day there were registered the count of number of mericica mastication by ruminal bolus (MMnb) and the time spent with the mericica mastication of each ruminal bolus (MMTB), with a digital chronometer. To obtain these measurements there were done observation in three ruminal bolus mastication in different period over the day (10-12 and 18-20). Data were submitted to variance analysis by the computer program Statistical Analysis System (2001) and the means that presented significant effect in the treatments, by linear, quadratic and cubic regression, adopting significance level of 1%. There was not effect in different treatment in TSF (250 min/day) and TSR (300 min/day). However, there was difference ( $P < 0.01$ ) for TSM and its effect was linear. There was linear effect ( $P < 0.01$ ) for TSL and it was greater to treatment with 100% of corn silage. It was not found difference for DMFE (621 g MM/h). However, the NDFFE was significant ( $P < 0.01$ ) and its effect was quadratic and the worst value in the treatment with 67% of sugarcane (134 g NDF/h). There were no differences for DMRE (543 g DM/h), NDFRE (132 g NDF/h), BOL (450 n°/day) and NMM (26700 n°/day). The sugarcane can replace corn silage because it does not alter times of feed and rumination of goats.



N-56

**Dietary fatty acids on subcutaneous adipose tissue modulation in transition dairy goats**

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The goal of the present study was to evaluate the metabolic and immune response of periparturient dairy goats to dietary supplementation with fish oil or stearic acid. 15 multiparous alpine dairy goats were involved in the trial. Starting from the last week of gestation until 3 weeks after kidding date the experimental diets, based on alfalfa and mix hays and a concentrate mix, were added either with protected fish oil (FO) or with stearic acid (ST). Feed intake, body weight, energy balance, milk production and composition were measured weekly. Adipose tissue biopsies were performed on day -7, 7 and 21 relative to kidding date and samples were immediately fixed in formalin, paraffin embedded and Hematoxylin Eosin stained. The results discussed in the present work are relative to a subsample of 8 goats, representative of the two experimental groups. Hematological and histological data were analyzed by a Generalized Estimating Equation (GEE) in IBM SPSS 19.0 was used. Production parameters were analyzed by a MIXED repeated model in SAS 9.2. No differences were observed between FO and ST in milk production, BCS, weight, dry matter intake and milk components except for a higher milk protein percentage in the 7 to 21 d period for ST. BHB serum content was higher in ST overall the experiment, whereas NEFA and ALAT serum content were higher at day 7 in FO compared to ST ( $P < 0.08$ ). ALAT was higher also at day 21 in FO. Treatment had no effect on blood cellular component except for WBC in FO group, where a significant decrease at 7 d was observed. WBC and HCM parameters were in the physiological range for dairy goats during transition period. Histologic adipose tissue analysis revealed a significant decreased adipocytes surface between -7 and 21 d in ST, whereas in FO the adipocyte surface reduction was related to the -7 to 7 d interval reaching a plateau until day 21. The EB pattern and the NEFA serum content at 7d in particular for FO are well correlated with histologic observations indicating goats were using fat depots to cope their negative energy balance. NEFA levels did not confirm the histological evidence at day 21 for ST suggesting a possible different action on subcutaneous adipose tissue during time. Results suggest a modulation in lipid storage management during periparturient negative energy balance by saturated vs. unsaturated dietary fatty acid supplementation that did not affect production levels of goats.



N-60

**Supplementation in pre-birth of goats kept in tobiatã-grass pasture (*Panicum maximum cv. Tobiã*) in productive and reproductive performance**

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Were used 60 goats (20 Alpine breed, 17 Anglo-Nubian breed and 23 crossbred Boer), with average body weight of  $49.33 \pm 1.41$  kg, kept on pasture of *Panicum maximum cv. Tobiã* and supplemented with two levels of concentrated: 300 (NS30) and 600 g/kg (NS60) of the daily requirements in relation to dry matter intake, evaluated from pre-breeding season, average 110 days of lactation. The milk recording was realized every 14 days, estimating the characteristics of the production curve: time to peak (TP), peak production (PP) and milk production until 110 days of lactation (MP) the constituents: fat, protein, lactose, total solids (TS), dry extract defatted (DED), urea nitrogen (UN) and somatic cell count (SCC), and the prolificacy of the goats and the birth weight of the kids. The racial group influenced the lactation curve, and Alpine goats and Anglo-Nubian showed higher TP, PP and MP. The levels of protein, TS and DED were influenced by the racial group, and crossbred Boer presented the highest levels. The levels of fat, lactose and the SCC log were influenced by the treatment, and the NS30 with the highest values, and by the racial group, the crossbred Boer presented the highest values for fat and SCC log, and the crossbred Boer and Alpines had the highest values for lactose. The UN was influenced by the stage of lactation. The prolificacy and the birth weight were influenced by racial group and the treatment, being that the Anglo-Nubian and crossbred Boer from NS presented best results. The kids of single birth had superior birth weights. The Anglo-Nubian breed can be indicated for this production system, by presenting good milk production and body condition. Supplementation NS60 favored the birth weight and prolificacy.



N-61

**Tolerance to sun and physiological parameters of goats in grazing (*Panicum maximum cv. Tobiata*)**

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Were used 60 goats (20 Alpine breed, 17 Anglo-Nubian breed and 23 crossbred Boer), primiparous and multiparous, with average body weight of  $49.33 \pm 1.41$  kg, kept on pasture and supplemented with two levels of concentrated: 300 (NS30) and 600 g/kg (NS60) of the daily requirements in relation to dry matter intake, evaluated from pre-breeding season until average 110 days of lactation. The animals were kept on pasture rotated established with *Panicum maximum cv. Tobiata*. Visual observations of tolerance of goat in the sun were realized monthly each 15 minutes, during the period that the animals remained in the pasture. Respiratory rate and rectal temperature were evaluated monthly, being measured at 0900, 1300 and 1700 h. The temperature and the relative humidity were registered every hour in days of data collection. The racial group influenced the respiratory rate and the rectal temperature at 1300 h, and the crossbred Boer showed physiological parameters more appropriate that lead to increased tolerance of heat. Treatments did not modify the physiological variables. The Anglo-Nubian showed more resistance to radiation direct sunlight, staying most of the time in the sun, and being the most indicated for the production system on the pasture.



N-62

**The estimation of nutrient digestibility by faecal near-infrared spectroscopy in goats is reliable also when diets contain quebracho tannin**

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The estimation of diet digestibility of grazing ruminants is still a challenging task to animal scientists. Since it is impossible to conduct controlled digestibility trials, several indirect methods have been developed, which are often not robust against secondary plant compounds like tannins. The objective of the presented analysis is to estimate organic matter (OM) and crude protein (CP) digestibility in goats fed on diets containing quebracho tannin (QT) by faecal near-infrared spectroscopy (F.NIRS). Faecal samples were derived from a digestibility trial conducted near Sohar (Northern Oman). Samples of three diets tested in this experiment were used ( $n = 34$ ). Goats were offered a basal diet (BD) consisting of 50% *Chloris gayana* hay, 46.5% crushed maize and 3.5% soybean meal (DM basis). Experimental diets contained in addition to the basal diet 2 or 4% of QT (T2, T4). Faecal samples were dried at 60°C and ground to 1 mm. Chemical composition of feed, refusals and faeces was determined by standard protocols in Germany. Faeces samples were measured with a Foss NIRSystems spectrometer (400-2500 nm, 2 nm intervals). Cross-validation equations were calculated using the modified partial least-square regression method. The quality of the calculated equations was assessed by  $R^2$  and RSC value (ratio of standard deviation of the laboratory results to standard error of cross-validation). A successful calibration is indicated when  $R^2 > 0.9$  and  $RSC > 2$ . The mean OM digestibility (DOM) of BD, T2 and T4 was 85.2, 82.6 and 79.2% ( $P < 0.01$ ), respectively. The mean DCP was 77.7, 73.9, 69.3% ( $P < 0.01$ ) for diets BD, T2 and T4. These results confirm the negative influence of QT on nutrient digestibility. The  $R^2$  and the RSC-value of the DOM calibration equation were 0.98 and 3.36, for the DCP equation quality indicators were 0.977 and 3.05. The excellent  $R^2$ - and RSC-values show that the calibrations for the given dataset were successful and robust. Differences between measured and from the derived calibrations predicted DOM and DCP were not significant from zero for all treatments. In conclusion, these results show that nutrient digestibility can be reliably estimated by F.NIRS. The presence of QT in faeces does not influence the accuracy of the F.NIRS estimations. In studies with grazing livestock the F.NIRS method can be therefore advantageous compared to other methods estimating the digestibility of the feed ingested, provided that robust calibration equations are available.



N-63

**Feeding peripartal dairy goats with saturated or unsaturated lipid supplements:  
effects on plasma, colostrum and milk fatty acid composition**

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The objective of this study was to determine the effects of feeding fish oil (FO) or stearic acid (ST) on fatty acid (FA) composition of colostrum, milk and plasma in dairy goats during the peripartum period. Starting from the last week of gestation until 3 weeks after kidding, fifteen multiparous Alpine dairy goats were fed two experimental diets (alfalfa, mix hays and a concentrate mix), added either with 30 (before kidding) or 50 g/head/d (after kidding) of FA from FO (rich in EPA, C20:5 n-3 and DHA C22:6 n-3) or ST. Blood samples were collected weekly, for determination of total plasma FA composition. Individual colostrum, sampled within the first 24 h postpartum, and milk samples on day 7 and 21, were analyzed for main components. Separate aliquots of colostrum and milk were stored at -20°C and subsequently analyzed by GC to determine FA composition. Data were analysed by GLM or MIXED repeated procedures of SAS 9.2. Dietary lipid supplements produced significant changes in plasma FA profile (expressed as g/100 g total FA). In particular, EPA and DHA were increased after 21d of supplementation in FO vs. ST group (3.96 vs. 0.44 for EPA and 2.19 vs. 0.76 for DHA). A significant increase of plasma EPA content in FO goats was assessed since 7 d of supplementation. No differences were detected for milk production and milk quality except for higher milk protein content in ST group. FO enhanced EPA and DHA levels in milk fat both at 7d of lactation (0.32 EPA and 0.25 DHA) and 21 d of lactation (0.46 EPA and 0.21 DHA). Preliminary data evidenced no differences in colostrum possibly because lipid supplementation time before kidding was not enough, but these data need to be confirmed. In conclusion, the present study confirms that modifications of dietary FA composition deriving from the utilization of different dietary lipid sources produce valuable variations of plasma FA profile, starting from 7 d of supplementation. Dietary strategies aiming at enhancing n-3 LC-PUFA concentration in goat milk may be effective. In the present study a greater proportion of EPA and DHA through dietary supplementation with FO has been observed in milk but not in colostrum.



N-66

### **Dietary fatty acids on subcutaneous adipose tissue modulation in transition dairy goats**

Invernizzi, G., D. Corbani, J.M. Caputo, A. Campagnoli, L.F. Pisani, V. Bronzo, A. Agazzi, S. Modena, G. Savoini

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The goal of the present study was to evaluate the metabolic and immune response of periparturient dairy goats to dietary supplementation of saturated or unsaturated sources of fatty acids. Eight second-parity twins-diagnosed alpine dairy goats were fed either stearic acid (ST) or fish oil (FO) from the last week of gestation until 21 days on milk giving 30 g/head/d and 50 g/head/d extra fatty acids than the common administered basal diet respectively before or after kidding. Adipose tissue biopsies and blood samples were performed on day -7, 7 and 21 relative to kidding date. Histological samples were immediately fixed in formalin, paraffin embedded and Hematoxylin Eosin stained. Obtained data were analyzed by a Generalized Estimating Equation (GEE) in IBM SPSS 19.0. Production data were analyzed by a MIXED repeated model in SAS 9.2. No differences were observed between FO and ST on body condition score, body weight, and dry matter intake. Higher mean BHBA serum content was found in ST group, whereas NEFA and ALAT serum content were higher at day 7 in FO compared to ST ( $P < 0.08$ ). Moreover, ALAT was higher also at day 21 in milk in FO goats. Both dietary treatments had no effect on blood cellular component except for a decreased WBC content in the first week of lactation in FO group. Anyway in both ST and FO goats WBC and HCM contents during the whole trial were within the physiological ranges for dairy goats during transition. Histologic adipose tissue analyses revealed a significant decreased adipocytes surface between -7 and 21d in ST, whereas this reduction in FO was limited to the two weeks around kidding, reaching a plateau until day 21 of lactation. Energy balance pattern and the NEFA serum content are well correlated with histologic observations, especially for FO group at 7d in milk, indicating goats were using fat depots to cope their negative energy balance. NEFA levels did not confirm the histological evidence at day 21 for ST suggesting a possible different action on subcutaneous adipose tissue during time. Results suggest a modulation in lipid storage management during periparturient negative energy balance by saturated vs. unsaturated dietary fatty acid supplementation that did not affect production levels and immune response in terms of blood cellular components of goats.





N-70

### **Dry matter production of plant communities and goat selection during dry season in rangelands of the northeastern Mendoza, Argentina**

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To evaluate the relationships between productivity of plant communities and goat selection during the dry season (winter), seven females of a free-ranging Creole goats herd ( $n = 150$ ) were fitted with GPS collars to record the grazing itineraries. Plant communities were determined by an unsupervised classification of a Landsat-5 satellite image and subsequent field corroboration. The positions corresponding to grazing were overlaid on the classified image to calculate the selection index (SI): ratio between the proportion of grazing positions within a plant community and the proportional area of that plant community. In 13 sites, the available dry matter production (DM) of the main forage species was estimated by the closest individual method. The record of height, average diameter and distance of the nearest individual along linear transects, allowed to determinate plant density of woody species and estimated the forage phytovolume by referring each plant to the ideal volume of a cylinder. Available production was harvested from 10 plants per species to determinate the relationship between phytovolume and DM production by linear regression. An ANOVA procedure was used to analyze differences in the DM production and in the SI. The relationship between DM production and SI was determined by linear regression. We identified 4 different plant communities: semi-closed woodlands of *Prosopis flexuosa* (Algarrobal), open woodlands of *Prosopis flexuosa* with *Tricomaria usillo* and *Atriplex lampa* (Algarrobal abierto), open woodlands of *Tricomaria usillo* (Usillar) and shrublands of *Larrea divaricata* (Jarillal). The DM production ( $\text{kg ha}^{-1}$ ) of Algarrobal abierto (363.25) was higher ( $P < 0.05$ ) than that of Algarrobal (175.29), Usillar (172.50), and Jarillal (130.49). The SI of Jarillal (0.56) and Algarrobal (0.68) were lower ( $P < 0.005$ ) than those of Algarrobal abierto (1.33) and Usillar (1.33). There was a positive relationship ( $r=56$   $P < 0.0001$ ) between the SI and DM production. The DM production of the most selected communities had a great contribution of species that had been determined as preferred by goats in previous studies: 22% *P. flexuosa*, 22% *A. lampa* and 18% *T. usillo* in Algarrobal abierto and 50% *T. usillo* in Usillar. Concluding, during the dry season, the DM production could be considered one of the factors influencing the grazing behavior of goats that selected mainly the plant communities that offer greater amount of available forage, especially of preferred species.



N-71

### **Replacement of corn silage by sugarcane in diets of dairy goats: intake and digestibility**

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The intake of dry matter and other nutrients was evaluated in lactating goats fed with cane sugar instead of corn silage. In three 4 x 4 Latin squares were distributed 12 Saanen goats with average weight of  $45.22 \pm 5.3$  kg and  $42.23 \pm 2.66$  days of lactation at the beginning of the experiment. The diets were 0, 33.3, 66.6 and 100% levels of replacement of corn silage by cane sugar and roughage:concentrate ratio of 50:50. The experiment consisted of four periods of 21 days, 14 (animal adaptation) and 7 (data collection). The voluntary intake of dry matter and other nutrients was measured by the difference between the quantities supplied and remains, which were weighed daily before feeding, while during the collection period was made a sample equivalent to 10% of total scrap, which were readily pre-dried in a forced air oven at 60°C for 72 hours, the same procedure was done for samples of wet food (corn silage and cane sugar). The substitution of corn silage by cane sugar was not significant ( $P > 0.05$ ) dry matter intake (kg/day, %LW and g/kg LW<sup>0.75</sup>), organic matter, crude protein, non-fiber carbohydrates, total carbohydrates, neutral detergent fiber and total digestible nutrients, but a negative linear effect was observed ( $P < 0.05$ ) for the consumption of lipids and acid detergent fiber. To calculate the apparent digestibility coefficient (ADC) was estimated fecal dry matter production through the relationship between the consumption of indigestible neutral detergent fiber (NDFi) and its concentration in the faeces by in vitro incubation for 240 hours of samples food, orts and feces. The apparent digestibility of dry matter (DM), organic matter (OM), ether extract (EE), crude protein (CP) and total carbohydrates (TC) decreased linearly ( $P < 0.05$ ) with increasing substitution of corn silage by cane sugar. The digestibility of acid detergent fiber was affected quadratically ( $P < 0.05$ ) by substitution of corn silage by cane sugar, while didn't influence ( $P > 0.05$ ) on the apparent digestibility of non-fibrous carbohydrates. The substitution of corn silage by cane sugar compromises the digestibility of diets with no changing food intake and may only be used as forage for lactating goats with low nutritional requirements.



N-72

**Water intake of dairy goats fed with cane sugar in replacement of corn silage**

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The intake of water was evaluated in lactating goats fed with cane sugar instead of corn silage. In three 4 x 4 Latin squares were distributed 12 Saanen goats with average weight of  $45.22 \pm 5.3$  kg and  $42.23 \pm 2.66$  days of lactation at the beginning of the experiment. The diets were 0, 33.3, 66.6 and 100% levels of replacement of corn silage by cane sugar and roughage:concentrate ratio of 50:50. The experiment consisted of four periods of 21 days, 14 (animal adaptation) and 7 (data collection). The animals were distributed individually in wooden cages equipped with plastic buckets with a capacity of 6 liters for delivery and measurement of drinking water *ad libitum*. Water intake via food from animals fed diets containing higher levels of substitution of corn silage by cane sugar showed a linear increasing ( $P < 0.05$ ), while the drinking water decreased linearly ( $P < 0.05$ ). There was no significant influence ( $P > 0.05$ ) with the substitution levels of corn silage by cane sugar, for the variable and search for water in relation to drinking water per kg dry matter (water/kg DM) consumed per kilogram of metabolic live weight (água/kgPV0.75). The cane sugar instead of corn silage did not alter the water intake of dairy goats, can be used as exclusive roughage.



N-74

**Effects of quebracho tannin and activated charcoal on the digestibility and nutrient excretion of goats under subtropical conditions (Oman)**

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Carbon and nitrogen turnover from organic fertilizers depends on C/N ratio and fibre content. Hence, condensed tannins which are able to induce 'ruminal escape protein' and shift N excretion from urine to faeces, can be used to increase N concentration and slow down its release by forming tannin-protein complexes. Through feeding activated charcoal more long-lived C species might be excreted, which can be a useful tool when aiming at maintaining soil fertility, and increasing C sequestration in the soil. Therefore the aim of the present study was to evaluate the effects of adding quebracho tannin (QT) and/or activated charcoal (AC) to goats' diets on nutrient digestibility and excretion. A digestibility trial (completely randomized design) was conducted on a farm near Sohar (Northern Oman, mean annual temperature: 27°C and 102 mm precipitation), over three subsequent periods. In each period, 24 male Jebel Akhdar goats (37.4 ± 3.1kg), were randomly distributed to six treatments (12 replicates/treatment), and were fed 800 g DM basal diet (50% Rhodes grass hay (*Chloris gayana*), 46.5% crushed maize and 3.5% soybean meal) for 21 days followed by 7 days of quantification of feed intake and faecal excretion. Experimental diets contained in addition to the basal diet 2 or 4% of QT (T2, T4), 1.5 or 3% of AC (C1.5, C3) and a combination of both (2% QT, 1.5% AC (TC)). Faecal samples, feed refusals and representative samples of feed offered were dried at 60°C and analysed in Germany following standard procedures. ANOVA was conducted by mixed model procedure in SAS with period, treatment and their interaction as fixed effects and animal as random effect. The intake of OM, and NDF was neither affected by the addition of QT nor AC; however the intake of N was lower in treatments TC, T4 and C1.5. Inclusion of QT affected the OM and CP digestibility significantly negative, which led to an increase in faecal N concentration. The digestibility of NDF was affected by both QT and AC and so contributed to the higher manure C concentration. Accordingly, this study demonstrates that the addition of up to 4% QT increased N concentration in manure, while the C content increased by the addition of both QT (TC, T2, T4) and 3% AC. Therefore we conclude that manure quality can be improved by QT and AC supplementation of goats. Further studies are currently carried out to determine the N balance and the microbial protein synthesis in the rumen and hindgut of goats receiving the QT and AC.



N-75

### **Nutrient and secondary metabolite concentrations of browse species consumed by goats and deer in northeast Mexico**

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In semiarid rangelands of Northeast Mexico, browse constitutes the main diet of goats and white-tailed deer. During the dry season, energy, protein and mineral deficiencies in forages may be a cause of low production and reproductive problems. A study was conducted during late June and early July of 2010, to determine the chemical composition of 6 native browse species available in the range, and *Leucaena* (*Leucaena leucocephala*), introduced as a protein bank available for goats and deer, in a ranch located in Juarez, Coahuila, in Northeast Mexico. Browse species were Chaparro prieto (*Acacia rigidula*), Guajillo (*Acacia berlandieri*), Huisache (*Acacia farnesiana*), Guayacán (*Guaiacum angustifolium*), Navaja (*Condalia spathulata*) and Clepe (*Zizyphus obtusifolia*). Five leaf samples (approximately 250 g) were obtained for each browse species, oven dried (55°C) and analyzed independently for crude protein (CP = N x 6.25), ash, ether extract (EE), ash-free NDF (NDFom), ash-free ADF (ADFom), lignin (permanganate), cellulose, hemicellulose (calculated), neutral detergent insoluble ash (NDIA), neutral detergent insoluble nitrogen (NDIN), total phenols and condensed tannins. Concentrations were also determined for Ca, P, Mg, K, Na, Fe, Mn, Zn, Cu, Se and Mo using an Optima 2000 DV Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES). Mean concentrations ranged for: CP, 14.6 to 26.3% (SEM ± 1.00); ash, 6.5 to 13.0% (SEM ± 1.32); EE, 0.3 to 4.3% (SEM ± 0.21); NDFom, 30.0 to 55.0% (SEM ± 1.37); ADFom, 18.3 to 39.2% (SEM ± 1.21); lignin, 9.9 to 28.3 (SEM ± 0.80); cellulose, 6.0 to 17.0 (SEM ± 1.24); hemicellulose, 2.8 to 18.2% (SE ± 1.24); NDIA, 0.25 to 0.56% (SEM ± 0.05); and NDIN, 0.96 to 2.62% (SEM ± 0.23). Mineral concentrations ranged for: Ca, 1.46 to 2.14% (SEM ± 0.07); P, 0.06 to 0.17% (SEM ± 0.011); Mg, 0.09 to 0.35% (SEM = 0.014); K, 0.55 to 1.29 (SEM = 0.037); Na, 0.04 to 0.088% (SEM = 0.004); Fe, 76.1 to 199.0 ppm (SEM ± 7.03); Mn, 23.4 to 65.9 ppm (SEM ± 2.02); Zn, 10.7 to 22.1 (SEM ± 0.57 ppm); Cu, 1.52 to 5.58 ppm (SEM ± 0.44); Se, 0.28 to 0.58 (SEM = 0.026); and Mo, 0.28 to 0.58 ppm (SEM = 0.026). Significant differences in condensed tannin levels ( $P < 0.05$ ) were obtained, with *Leucaena* having the lowest (3.5%) and Guayacan the highest (12.5%). Total phenol concentrations were highest ( $P < 0.05$ ) for Chaparro prieto (13.8%) and *Zizipus* (15.6%), and lowest for Hízache (7.9%).



N-76

**The effect of Prickly Pear Cladode size (*Opuntia Ficus indica*, var. *Copena*) as supplement in goats on blood glucose concentration curve**

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The effect of the cladode size of prickly pear as a supplement in goats located in semi-arid climate was evaluated by the blood glucose concentration. A study with two experimental periods of 21 days each using 10 Nubian adult male were performed in metabolic cages (15 days of adaptation, 6 days of food consumption sampling and the last day of blood glucose sampling and analysis), in order to perform the blood collection, the animals were cannulated in the jugular vein. Small Cladode size were  $147.03 \pm 19.2 \text{ cm}^2$  and large cladode were  $705.25 \pm 101.3 \text{ cm}^2$ . Food intake of the experimental diets were restricted (56 g DM/kg BW 0.75), the treatments were T0: Fasting group (24 hours before of blood sampling), T1 control (maintenance ration with 7.5% CP and 87% organic matter), T2: 80% control diet + 20% (dry matter) of Small Cladode, T3: 80% control + 20% of large cladode. The glucose basal concentration was obtained by the average of 3 samples at intervals of 30 min before to feeding time, and the curve of glucose was obtained by mean of blood sampling every 30 minutes during 10 consecutive hours after feeding, the glucose concentration (mg/dl) was measure with an equipment One Touch Ultra ® test. The results were analyzed by a repeated measures design, considering two factors, the difference of glucose in the basal concentration with the glucose concentration at each time, and the result of each glucose measurement averaged over each time. The results were: basal glucose concentration did not differ ( $P < 0.01$ ) between groups, the means were : T0:  $44.3 \pm 5.56$ , T1:  $49.5 \pm 4.78$ , T2:  $55.85 \pm 18.6$  and T3:  $51.35 \pm 9$  mg/dl, however, there were differences between times ( $P < 0.01$ ), with the highest concentration at 2.5 hours (T0:  $51.5 \pm 6.9$ , T1:  $55.5 \pm 7.46$ , T2:  $73.07 \pm 37.34$ , T3:  $55.78 \pm 12.83$  mg/dl) and 4.5 hours after feeding, except T0 that showed a decrease after 3 hours of the sampling (T0:  $45.0 \pm 9.11$ ; T1:  $61.5 \pm 9.38$ , T2:  $71.9 \pm 41.04$ , T3:  $59.0 \pm 15.16$ ). On the other hand, there was no difference between treatment ( $P > 0.05$ ) in the increase or decrease glucose concentration in relation to the basal concentration, but has differences between sampling times ( $P < 0.05$ ). Glucose has two peaks in blood concentration at 3 and 4 hours post feeding, which did not occur in the case of animals of T3 (fasting). In conclusion use of cladode with different size (age) don't have effect on glucose concentration.



N-77

**Evaluation of Opuntia and Mesquite Pod as alternatives in the supplementation of goats in the semiarid region of Mexico: in vitro degradability of DM, In vitro gas production**

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In order to evaluate the effect of use of roasting (150°C/45 min) mesquite pod (*Prosopis laevigata*) (RMP) or raw mesquite pod (RMP), and the use of two species of prickly pear cladode (*Opuntia ficus indica* (OFI) and *Opuntia megacantha* (Om) as alternatives to supplementation in goats, the nutritional composition was evaluated using in vitro dry matter (DM) degradability, in vitro gas production and in vitro Volatil fat acids (VFA), CO<sub>2</sub> and CH<sub>4</sub> production. Roasting of pod caused an increase ( $P < 0.01$ ) in crude protein linked to acid detergent fiber content and lower content of hemicellulose, content of the soluble fraction (a) was lower, an increase the fraction of slow degradation (b) causing lower degradability potential ( $P < 0.001$ ). Gas production was higher ( $P < 0.01$ ) in the RMP, with a lower fractional rate of gas production (c). In OFI was observed a lower DM, Organic Matter (OM) and Neutral detergent fiber (NDF) content ( $P < 0.01$ ), and had a higher ash content, Acid detergent fiber, and crude protein; OFI showed a higher degradation potential of the DM ( $P < 0.01$ ), but lower gas production (ml/g of DM). Finally, the VFA production was not different ( $P > 0.05$ ) between treatment, however, showed a higher percentage of butyric acid in RMP, the total gas production (ml/g of DM) was lower ( $P > 0.05$ ) in the RMP, which resulted in lower total production of CO<sub>2</sub> and CH<sub>4</sub>. In conclusion use of RMP and OFI can reduce the CH<sub>4</sub> production, and mesquite pods and prickly pear could be interesting forage to goat supplementation.





N-78

**Effect of roasted of mesquite pod on the concentration of blood glucose and insulin in Nubian Goats of Semiarid region of Mexico**

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The effect of the roasted of mesquite pod (*Prosopis laevigata*) as supplement in goats in semiarid zone of Mexico was evaluated by the blood glucose and insulin concentration, this study was performed using 10 Nubian adult male goats, in two periods of 21 days, animals were in metabolic cages (15 days in adaptation and 6 food sampling, last day of blood glucose and insulin analysis), the design was cross over. In order to perform the blood collection, the animals were cannulated in the yugular vein. The rations were restricted to once a day to 56 g dry matter (DM)/kg BW 0.75, the rations were: T1 (control: 7.6% PC and 87.5% OM), T2: 80% control ration +20% of (DM) of raw mesquite pod and T3: 80% of control ration +20% roasted Mesquite pods. Glucose and Insulin basal concentration was the mean of glucose and insulin blood concentration to -60, -30 and 0 minutes before offering the food, the curve of glucose or insulin was the concentration in blood every 30 minutes until minute 300, statistical analysis was performed using repeated measures, basal concentration was considered as a covariate. Roasted of pod had no effect ( $P < 0.01$ ) on blood glucose basal concentration between treatments, basal concentration of glucose was: T1:  $61.1 \pm 2.0$ , T2:  $60.3 \pm 2.8$  and T3:  $61.3 \pm 2.7$  mg/dl, the ranges of variation were 51 to 61 mg/dl, showing a concentration average of T1:  $56.63 \pm 2.0$ , T2:  $58.5 \pm 2.7$ , T3:  $57.9 \pm 1.3$  mg/dl. The analysis of the difference between the basal glucose concentration and concentration each time, the T1, presented a means of -1.24, T2: 1.005 and T3: 0.24. The basal insulin concentration was T1:  $0.30 \pm 0.07$ , T2:  $0.154 \pm 0.05$ , T3:  $0.41 \pm 0.12$  ng/ml, without differences ( $P > 0.01$ ) and the overall means of the ten sampling was T1:  $0.31 \pm 0.16$ , T2:  $0.206 \pm 0.08$ , T3:  $0.31 \pm 0.16$ , with an average difference between basal concentration and each time sample T1:  $0.08 \pm 0.01$ , T2:  $0.10 \pm 0.05$ , T3:  $0.17 \pm 0.06$ . Conclusion: The response in the glucose curve was very variable, without presenting an effect of treatments like insulin response, and the roasted of pod did not have effect on glucose and insulin blood concentration.



N-81

**Factors influencing feed intake, growth performance, and behavior by Boer wethers with an automated feeding system**

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Effects of the number of Boer wethers (initial age and body weight of  $0.78 \pm 0.014$  yr. and  $34.4 \pm 0.90$  kg, respectively) per automated feeder, allowing only one animal to consume feed at a given time, and length and time of feeder access on feed intake, growth performance, and behavior were determined during a 10-wk period. Treatments were 6 and 12 wethers per  $6 \times 6$  m pen and feeder with continuous access (C-6 and C-12, respectively); 2 and 4 wethers per feeder with 8 h/day access during daytime (D-2 and D-4, respectively); and 4 and 8 wethers per feeder with 16 h/day access at night (N-4 and N-8, respectively). Therefore, maximal feeder occupancy time per wether was 4 h for C-6, D-2, and N-4 and 2 h for C-12, D-4, and N-8. Dry matter intake (DMI) was greater for continuous vs. restricted feeder access ( $P = 0.001$ ) and for night vs. daytime access ( $P = 0.025$ ) (2.04, 2.01, 1.45, 1.50, 1.92, and 1.76 kg/day; SE = 0.133), and feeder occupancy time per wether tended ( $P = 0.071$ ) to be greater for continuous access (1.83, 1.55, 1.23, 1.34, 1.51, and 1.25 h/day for C-6, C-12, D-2, D-4, N-4, and N-8, respectively; SE = 0.238). Rate of DMI was similar among treatments ( $P > 0.15$ ). There were effects of continuous vs. restricted ( $P = 0.012$ ) and D vs. N ( $P = 0.051$ ) access on average daily gain (ADG), as well as a tendency ( $P = 0.078$ ) for an interaction between time and length of restricted access (237, 252, 174, 207, 247, and 211 g for C-6, C-12, D-2, D-4, N-4, and N-8, respectively; SE = 16.4). ADG:DMI tended ( $P = 0.073$ ) to be greater for night than for day access ( $P > 0.05$ ) (128, 130, 97, 117, 150, and 127 g/kg; SE = 14.8), although residual feed intake (RFI) was greater ( $P = 0.003$ ) for continuous vs. restricted access and tended to be less for day vs. night access ( $P = 0.119$ ) and for 2 vs. 4 h/day of maximal occupancy time per wether ( $P = 0.150$ ) (121, 20, -63, -165, -16, and -14 for C-6, C-12, D-2, D-4, N-4, and N-8, respectively; SE = 53.4). In summary, continuous feeder access allowed high ADG, but resulted in relatively inefficient feed utilization as assessed by RFI. Restricting feeder access to daytime minimized DMI compared with continuous access, which was due to factors other than feeder occupancy time and rate of DMI; however, efficiency of feed utilization for daytime access based on RFI, particularly for D-4, was high relative to continuous access. In conclusion, restricting feeder access influenced feed intake, growth performance, and behavior, with results impacted by time of access.



N-82

### **Effects of creep grazing and stocking rate on diet selection and nutritive value of does and kids**

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Effects of creep grazing and stocking rate on diet selection and nutritive value of Spanish does with Boer × Spanish kids and Boer × Spanish does with 3/4 Boer–1/4 Spanish kids were determined in ten 0.4-ha grass/forb pastures of the American Institute for Goat Research of Langston University, Langston, Oklahoma, USA. There were four treatments, three involving stocking rate and one creep grazing, with two animal groups per treatment. Groups had 4 does with 8 kids for the low SR (L), 6 does with 12 kids for a moderate SR (M), and 8 does with 16 kids for both the high SR (H) and creep grazing treatments (C). Kids on the C treatment also had access to similar 0.4-ha pastures but that contained the tree legume mimosa (*Albizia julibrissin* Durazz) planted in rows. This species was used because of the high nutritive value of leaves (23.9% CP, 22.9% NDF, 5.7% ADL, and 91.8% in vitro true DM digestibility (IVDMD)) and ready consumption by goats. Each pasture consisted of four equal-size paddocks that were rotationally grazed twice during the 76-day study. A direct observation and simulation method was applied to determine botanical composition and nutritive value of the diet selected by does and kids. There were no effects ( $P > 0.05$ ) of stocking rate or animal type on the diet selected. Diets were higher ( $P < 0.05$ ) in grasses vs. forbs (79.5 and 78.2% grasses vs. 20.5 and 21.8% forbs for does and kids, respectively). However, mimosa leaves were 53% of the diet consumed by C kids, with grasses and forbs at 23 and 24%, respectively. As a result, the C kids selected a diet higher ( $P < 0.05$ ) in CP (20.6%) and IVDMD (88.1%) and lower in NDF (31.0%) and ADL (5.1%) compared with diet averages for kids on the stocking rate treatments (18.2% CP, 55.5% NDF, 6.3% ADL, and 74.6% IVDMD). In conclusion, when exposed to similar forage conditions botanical composition and nutritive value of the diet selected by does and kids were similar, although when kids had access to a creep grazing area nutritive value of the diet was improved by preferential consumption of mimosa tree leaves.



N-83

**Nutritive value of *Parkinsonia aculeata* and *Acacia rigidula* foliage treated with polyethylene glycol**

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A study was performed to evaluate the nutritional value of *Parkinsonia aculeata* and *Acacia rigidula* which are readily selected by grazing goats in the semiarid region of Northern Mexico. The effect of PEG on in vitro gas production profiles and its neutralizing effect on tannins were estimated from a total of 72 samples of the foliage of the two species from 3 sites (China, Linares and Ramones in Nuevo Leon, Mexico) for 6 months (January-June 2010). The contents of DM, OM, CP, EE, NDF, ADF, lignin, hemicellulose, cellulose and tannins were estimated. In vitro gas production was carried out in glass syringes. Microbial protein synthesis (MPS), partitioning factor (PF) and ME were also calculated. Data were analyzed as a 2 x 3 x 6 factorial experiment using the SPSS program. Correlation coefficients between gas parameters and tannin content were performed. Mean comparisons with and without PEG were performed using Tukey's test. A significant interaction ( $P < 0.001$ ) Species x Site x Month was recorded in the contents of CP. The overall mean for CP was 17%. A significant ( $P < 0.001$ ) effect of month was registered in ash, OM, NDF, ADF, lignin, hemicelulose, cellulose and EE contents. Means were 15.5 %, 78.6%, 42.2%, 26.5%, 13.5%, 15.6%, 13.4% and 2%, respectively. Interactions S x S x M were recorded in tannin concentrations ( $P < 0.001$ ), the overall mean was 14.5%. Regarding the gas produced at 24 h, a S x S x M interaction was registered ( $P < 0.001$ ). Means for this variable without and with PEG were 56 and 75 ml/500 mg DM, respectively. A month x species interaction was obtained in the content of ME ( $P < 0.001$ ), means without and with PEG were 1.2 and 1.5 Mcal/kg MS. The PF was affected by month and species ( $P < 0.001$ ). Means were 3.6 and 2.6 mg of truly degraded substrate/ml gas produced without and with PEG, respectively. An interaction S x S x M ( $P < 0.001$ ) was recorded in the synthesis of microbial protein. The overall mean was 5.0 and 4.8  $\mu\text{mol}$  without and with PEG, respectively. Overall mean comparisons indicated that MPS was similar ( $P > 0.05$ ) after inclusion of PEG, while ME content was higher and PF lower ( $P < 0.001$ ). Correlations indicated that tannins affected negatively gas production at 24 h, ME content and PF ( $P < 0.001$ ). It is concluded that PEG addition improved in vitro fermentation and ME content of the studied native species, being the largest benefit in *Parkinsonia aculeata*. This scenario predicts higher nutrient availability for rumen microbes due to PEG.



N-86

### **Radical scavenging protection of *Acacia farnesiana* fruits extracts on porcine kidney cells**

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The strategy of plants to produce plant bioactive compounds (PBC) to diminish defoliation and to limit high ingestion rates of plant biomass is an important factor that alters rumen ecology of goats browsing on semiarid rangelands. The PBC are feared to cause detrimental effects on animal performance largely due to a deficient use of protein. In contrast, beneficial effects of some PBC encountered on shrublands species (e.g. *Acacia farnesiana*) have been previously reported. One of the argued benefits is the protection against reactive oxygen species (ROS). However, the advantages and limitations about radical scavenging protection are still debatable. Therefore, we tested the protection of fruits extracts of *A. farnesiana* against hydrogen peroxide ( $H_2O_2$ ) on proximal tubule epithelial cells of porcine kidney (LLCPK1, Lilly Laboratory). Samples of ground material of Acacia fruits (200 g) were extracted for 24 hours at room temperature with three different extractants: methanol, methanol:water (80:20 v/v) and acetone. All extracts were filtered, washed and concentrated to 200, 100 and 50 ppm. Each concentration was placed in 8 wells of a cell culture plate and a solution of  $H_2O_2$  (20mM) was added (12.5 $\mu$ L). 24 wells with the same concentrations distribution did not received  $H_2O_2$  to detect if the experimental extracts produced a pro-oxidant effect on the cells. Subsequently, plates were incubated during 2 h/37°C with DMEM and washed with PBS (250  $\mu$ L). After incubation, a solution of 5-(and 6-)carboxy-2',7'-dichlorofluorescein (carboxy-DCF) (15 $\mu$ M) was added (250  $\mu$ L). To confirm the presence of ROS over the cell cytoplasm, the porcine kidney cells were observed with a microscope at minimum light. To display the emission ( $\lambda = 535$ nm) of the carboxy-DCF over the cytoplasm, an ultraviolet light lamp and a selective filter ( $\lambda = 488$ nm) were used. The fluorescent green color was photographed and quantified using the NIS-Elements software (2.3 and 3.0 versions). None of the extracts without the addition of  $H_2O_2$  displayed ROS. In conclusion, 200 ppm of methanol:water extract showed the smallest intensity of oxidative damage, displaying the best protection against ROS. The significance of natural antioxidants encountered in *Acacia farnesiana* fruits consumed by goats on semiarid rangelands may have implications on ruminant health and may modify the quality parameters of milk and meat, however these should be further confirmed.



N-87

### **Influence of banana by-products in the milk yield of Canarian goats**

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The main objective of this research is the evaluation of banana packaging industry by-products for goats feeding. Canary Islands are the most important producers of bananas in Europe (over 345,000 tons of bananas per year). The production of banana packaging by-products is estimated around 35 million kg of fresh matter. These by-products can be an important source in animal feeding and can minimized important problems as the high cost of Canarian goat industry and environmental risks. Forty five lactating goats of the Canarian dairy breeds were randomly divided into three groups of 15 animals each. CD group was used as control and given a conventional diet (CD), whereas BD1 and BD2 group were offered the experimental diets containing increasing amounts of banana by-product silage. CD ration consisted of pelleted lucerne, supplemental feed (mixture of cereals and legumes) and festuca hay, whereas that for the experimental groups was pelleted lucerne, supplemental feed, festuca hay and banana silage (BD1: 15% DM and BD2: 30% DM). The amounts of the diets fed, which were made isoenergetic and isonitrogenous, in order to meet requirements for production of 3,000 g milk/day. The evolution of the milk production was determined using the A4 method of control of the International Committee for Animal Recording (ACAR) modified for this experiment. The first milking record was made approximately 90 days after birth and the experimental period lasted for 5 months. Milk yield recording and milk composition analysis (fat, protein, lactose and non-fat-solids) were performed every 15 days. Milk samples were analyzed using a Milko Scan 133B apparatus. The inclusion of banana silage in the diet of lactating goats did not affect milk yield throughout lactation. Total milk yields (CD, BD1, BD2) were 320, 294 and 332 L in 150 days of lactation respectively. As has been described in previous feeding experiments, diet did not affect protein values. The mean percentages of proteins ranged between 3.93 and 4.32%, considerably higher when compared with other studies on Canarian goats. Analyzing the fat content, CD1 and CD2 values were higher, with significant differences ( $P < 0.01$ ), in all the periods controlled. After 90 days, milk fat content in the CD2 group was 20% higher than that of the goats fed the conventional diet ( $P < 0.01$ ). These differences decreased after 150 days (13%). Lactose was the most stable of the milk components.





N-88

**Effect of feeding agroindustrial by-products in the milk yield of Canarian goats**

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The cost of raw materials used in animal feeding is one of the most important problems in the sector that has to import over 80% of the food consumed by livestock. The use of agroindustrial by-products in animal nutrition can be adopted as a strategy to reduce feeding costs and also to cope with the need to recycle waste material which is costly to dispose of. Giro Ambiental® silage made mainly from brewer and flour industry waste could be a cheaper alternative of similar quality as imported feeds. The objective of this experiment was to analyze the effect of fermented silage diets using agroindustrial by-products on milk production. Forty five lactating goats of the Canarian dairy breeds were randomly divided into three groups of 15 animals each. CD group was used as control and given a conventional diet, whereas GD1 and GD2 groups were offered the experimental diets containing increasing amounts of banana by-product silage. CD ration consisted of pelleted lucerne, supplemental feed (mixture of cereals and legumes) and festuca hay, whereas that for the experimental groups part of the supplemental feed was substituted by Giro Ambiental® silage (GD1: 18% DM and GD2: 36% DM). The evolution of the milk production was determined using the A4 method of control of the ACAR modified for this experiment. The first milking record was made 90 days after birth and the experimental period lasted for 5 months. Milk samples were analyzed from each goat every 2 weeks for fat, protein, lactose and non-fat solids using a Milko Scan 133B apparatus. No significant differences were detected for milk yield in the controlled period. CD goats showed higher daily milk values than those fed experimental silage, except for the first period where the GD2 group was more productive. The average daily milk yield at 60 days was 22% higher in CD group, this difference decreased quickly after 90 days, equalling GD registers as lactation progressed. In 120 and 150 days controls the differences between groups were null. The effect of diet on the protein content was moderate. GD1 and GD2 values were higher than CD values in all the controls, but significant differences appeared only at 60 and 90 days of experiment. Analyzing the fat content, GD1 and GD2 values were higher with significant differences ( $P < 0.01$ ) in the controls at 60, 90 and 150 days. After 90 days, milk fat content in the GD2 group was 20% higher than that of the goats fed the conventional diet ( $P < 0.01$ ).





N-89

**Effects of feeding whole date palm fruits on feed intake, growth performance and meat quality of Omani goats**

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The objective of this study was to evaluate the potential of using low grade whole date palm fruits for feeding Omani goats. Twelve Omani Dhofari weaned male goats ( $17.5 \text{ kg} \pm 2.2 \text{ kg}$  body weight; BWT) were divided into two groups according to body weight. The Control group was fed 350 g/d of a General Ruminant commercial pelleted diet (Oman Feed Mill, General Ruminant pellets). The Treatment group was fed 250 g/d of non-pitted whole date fruits plus 100 g of the commercial concentrate feed. Both groups received extra 500 g of Rhodesgrass (*Chloris gayana*) hay. The experiment lasted for nine weeks. Water and mineral blocks were provided ad libitum. Animals were weighed at the start of the trial and bi-weekly thereafter. Daily feed intake was determined. A 10-day complete collection digestibility trial was carried out on 12 goats, preceded by a 7-day adaptation period. Date palm fruits contained 65.4% dry matter (DM) and 7.7, 3.5, 5.4, 23.4, 9.6 and 60.2 crude protein (CP), ether extract (EE), ash, crude fiber (CF), acid detergent fibre (ADF) and neutral detergent fibre (NDF) of the DM. The commercial concentrate contained 15%DM crude protein. The DM, CP, EE, ADF and NDF digestibility for the Control diet were 76.6, 75.3, 85.9, 69.8 and 62.5% vs. 78.3, 58.3, 73.9, 78.3 and 72.3% for Treatment goats. The average daily body weight gain for the Control group was  $83 \pm \text{g/d}$  and  $64 \pm \text{g/d}$  for date-fed goats. The feed conversion ratio (kg feed/kg BW) was  $7.12 \pm 0.76$  and  $7.09 \pm 2.66$  for the Control and date-fed goats, respectively. There were no negative health effects on date-fed goats. There were no significant differences in meat quality parameters (pH, color, sarcomere length and water holding capacity) between Control and Treatment goats. This study indicated that whole date fruits may be used for feeding Omani goats without compromising their performance. This will enable better utilization of excess and wasted date fruits and enhance revenues for farmers by using cheaper feed resources.



N-91

**Soil cover by native herbaceous layer in a caatinga area subjected to combined grazing of cattle, goats and sheep in Serra Talhada, Pernambuco, Brazil**

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The experiment was conducted at the Unidade de Execução de Pesquisa (UPE) of Empresa Pernambucana de Pesquisa Agropecuária, in Serra Talhada, State of Pernambuco, Brazil, to determine the soil cover in a herbaceous layers of a native caatinga. A botanical survey was conducted to determine biomass availability to the animals. Metal rectangles of 1.0 m x 0.5 m were randomly distributed along the main axis of the pasture where 12 transects set. From each transect two samples were collected during every survey period, which occurred every 28 day, totaling 72 samples. In each rectangle the weights of the dried green leaves from trees and shrubs, as well as the amount of stubble on the soil. Data were statistically analyzed in a split plot of a completely randomized design. The percentage of soil cover ranged according to forage availability in the different periods of the year. In the rainy period soil cover reached a maximum of 77.5%, and in the dry season it reached peaks of 80.6%, with an annual average of 68.5% coverage of biomass. Therefore, it was observed an increasing biomass production on the soil with the progress of the dry season due to the vegetation senescence.



N-92

**Similarity of diets of cattle, goats and sheep grazing in caatinga vegetation in Serra Talhada, Pernambuco, Brazil**

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The experiment was conducted at the Unidade de Execução de Pesquisa (UPE) of Empresa Pernambucana de Pesquisa Agropecuária (IPA), in Serra Talhada, State of Pernambuco, Brazil, to determine the similarity of diets of cattle, goats and sheep grazing on native caatinga by the similarity coefficient. It was established comparisons between combinations of rangeland diets composed by woody, herbaceous dicots and grass plants selected by the animals through esophageal fistula. Diet compositions were identified by microscopic spots. In relation to the woody species, the highest rates were observed in the rainy season. The percentages found for goat and sheep varied from 63.5% during the rainy period to 43.4% in the dry period. For herbaceous dicots it was observed a similarity of 60.2% for cattle and sheep in the dry period they were similar in the dry season and 25.8% for goats and sheep in the rainy period. Regarding the grasses, diets were similar during the dry period, with low rates as a 0% for goat and sheep, while in the rainy period the similarity was of 63.9% for cattle and sheep. The highest rates of preference for grass were observed in sheep and cattle diets in both periods, while goats preferred herbaceous dicots in the dry period and woody species in the rainy period. It was concluded that is a grazing combination with the three species must be recommended due to the complementarity of species utilization during the distinct periods of the year.



N-93

**Crude protein (CP) in diets of cattle, goats and sheep grazing on Caatinga vegetation in Serra Talhada, State of Pernambuco, Brazil**

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The experiment was carried out at the Unidade de Execução de Pesquisa (UPE) of Empresa Pernambucana de Pesquisa Agropecuária (IPA), in Serra Talhada, State of Pernambuco, Brazil, to determine the crude protein (CP) content in diets of cattle, goats and sheep grazing on caatinga vegetation. Chemical analyses were performed in the Animal Nutrition lab at the University Federal Rural de Pernambuco. The average values were 13.9%, 14.4% and 15.4% in cattle, goats and sheep diets, respectively, which did not differ significantly ( $P > 0.05$ ). However, CP contents differed significantly ( $P > 0.05$ ) when compared their values, from the rainy and dry periods, whose average in the three species were 17.9% and 11.9%, respectively. CP in diets of goats and sheep were, respectively, 17.0% and 16.6% in the wet period and 11.7% and 10.6% in the dry period. It was concluded that the protein contents of ruminant's diets are in satisfactory levels in the caatinga rangeland studied, both in dry and rainy periods.



N-94

**Economical evaluation of diet of goats weaned at different ages until their 180 days, in the semiarid region of Northeast Brazil**

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This work had as objective to evaluate feeding costs of goats Saanen subjected to intensive system, fed until their 180 day and weaned at different ages: 50, 60 and 70 days of age. The research was carried during a rainy period at the Fazenda Experimental of Universidade Estadual Vale do Acaraú-FaEx/UVA, in Sobral, Ceará, Brazil. The kids stayed with their mothers for five days after birth to suckling colostrum. After this period and up to 35 days they were daily fed with two liters of goat milk in two meals. After the 35th day until weaning the same amount of milk was provided only in the afternoon. In addition, concentrate and voluminous foragens were available in known amounts to adjust diets. Costs were calculated on intake of solid and liquid diets. The experimental design was a completely randomized, with eight replications (eight animals per each weaning age). The results were subjected analysis of variance by the Statistical Analysis System (SAS-version 9.1) and mean values were compared by Duncan test at 5% probability. The weaning weight differed ( $P < 0.05$ ) in all treatments and were similar ( $P > 0.05$ ) after 180 days in the groups weaned at 60 and 70 days. The total cost of diet was higher ( $P < 0.05$ ) in the group weaned at 70 days (R\$ 580.96), which showed increases of 14.9% and 17.6% compared with cost in groups weaned at 50 (R\$ 504.26) and 60 days (R\$ 579.87), respectively. The total costs for each kid in each treatment were R\$ 120.18 (50 days), R\$ 158.19 (60 days) and R\$ 185.15 (70 days). It was concluded that it is possible to reduce costs during a 180 day feeding period by reducing weaning age, unless the body development is affected.



N-95

**Incorporation of destoned and dried olive cake in fattening goat kids feeding:  
effect on fattening performances, carcass characteristics and fatty acid  
composition of meat**

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An experiment was carried out to evaluate the effect of the incorporation of destoned and dried olive cake in kids' diet on the fattening, carcass characteristics and fatty acid composition of meat. Eighteen male kids were assigned to two homogenous groups of nine each with similar initial live weight (12.8 kg vs. 12.0 kg) and age (117.6 vs. 110.6 days), respectively, called "T" and "Ts". Kids of group T were fed oat hay ad libitum and concentrate composed of barley, wheat bran, maize and faba bean. Barley was partially replaced by olive cake (25% DM of concentrate) in the Ts group. Live weight was recorded at the beginning and the end of fattening and ADG was calculated. After slaughter the hot and cold carcass weight was recorded, carcass yield estimated and samples of meat (*Longissimus dorsi*) were collected for the analysis of fatty acid profile. The use of destoned and dried olive cake in the fattening kids' diet did not affect the slaughter weight (16.9 kg vs. 17.6 kg), ADG of fattening (49.5 g vs. 54.2 g), and carcass yield (44.6% vs. 43.8%). The proportion of  $\omega$ -3 (0.15 vs. 0.13),  $\omega$ -6 (0.11 vs. 0.06) and saturated (47.82 vs. 48.23), unsaturated (52.18 vs. 51.74) and polyunsaturated (0.26 vs. 0.19) fatty acid were similar in the two groups (T and Ts). The results obtained support the possibility of the incorporation of olive cake in the diet of fattening kids' diet without affecting the fattening performances, carcass characteristics and fatty acid profile of meat.



N-96

### Productive and reproductive performance in dairy goats fed hydroponic green fodder

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A study was conducted to evaluate the productive and reproductive performance of dairy goats, fed an oat straw-based diet containing different levels of hydroponic green wheat (HGW; *Triticum aestivum* L.), hydroponic green corn (HGC; *Zea mays*), cottonseed meal (*Gossypium hirsutum*) and rolled corn (*Zea mays*). Variables related to Dry matter intake (DMI), Intestinal Digestible protein intake (IDPI) and Milk feed unit intake (MFUI) (estimated according to the French System), daily weight gain (DWG), fertility, prolificacy and survival rate of kids, were estimated. Forty Alpine goats, initial live weight of  $35.1 \pm 4$  kg and of  $9 \pm 1$  months of age. Animals were fed one of the following dietary treatments: T1: 70% of oat straw, 30% of HGW; T2: 70% of oat straw 30% of HGC; T3: 70% of oat straw, 15% rolled corn and 15% cottonseed meal; T4: 70% of oat straw, 15% of HGW, 7.5% rolled corn and 7.5% cottonseed meal and T5: 70% of oat straw, 15% of HGC, 7.5% rolled corn and 7.5% cottonseed meal. Studied variables were analyzed according to a completely randomized design using the GLM procedure of SAS. The DMI in T5 diet was higher (934 g/d;  $P < 0.05$ ) than in T4, T1, T3 and T2 (903, 892, 891 and 793 g/d, respectively). The IDPI varied from 36 to 67 g/d and was higher (in T3 and lower in T2). The MUFI was lower in T2 (0.75/d) and higher in T5 (0.88/d;  $P < 0.05$ ). In early gestation the DWG varied from 65 to 127 g/d (T2, T5 respectively). During the last three months of pregnancy, DWG in goats fed T1 was 139 g/d, whereas values of 120 and 103 g/d were registered in T3 and T4, respectively. Lower DWG than 100 g/d of were observed in T5 and T2. Fertility was higher in goats fed T1 (100%,  $P < 0.05$ ). Prolificacy in T2 registered the highest value (200%;  $P < 0.05$ ) and the best survival rate of kids was registered in T1 (88%;  $P < 0.05$ ). The cost of diets containing hydroponic forage T1 and T2 (0.20 dollars) mean a reduction of 25% compared with the control diet T3 (0.27 dollars) while T4 and T5 diets reduce the cost by 15%. It is concluded that the inclusion of hydroponic green wheat forage in diets for dairy goats is a valuable alternative to counter high concentrate feed prices.





N-97

### **The incorporation linseed in the diet of fattening goats improves growth rate and fatty acid profile of meat**

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Trial objective was to determine if the incorporation of linseed in the diet of fattening kids during 90 days would influence growth rate, carcass yield and fatty acid profile of meat and adipose tissue. Ten animals were allocated to two groups; T (n = 5) and Ts (n = 5) adjusted for age (120.2 vs. 129.8 days) and live weight (17.55 vs. 17.36 kg). Kids of group T received oat hay ad libitum and a concentrate ration composed by barley and sunflower meal, replaced by linseed in the Ts group. Live weight at the end of fattening was recorded and ADG estimated. After slaughter, the weight of hot and cold carcass was recorded, carcass yield estimated and samples of meat (*Longissimus dorsi*) and perirenal adipose tissue were collected for the analysis of fatty acid profile. The effect the diet on fattening performance and fatty acid profile of meat and adipose tissue was analysed by the GLM and LSD procedure of SAS. The utilisation of linseed in the diet of growing kids enhances weight at slaughter (23.1 kg vs. 19.8 kg) and ADG (48.2g vs. 18.5g) but no significant difference was observed for carcass yield (40.8% vs. 41.4%). The utilisation of linseed improves the proportion of  $\omega$  3 (0.16 vs. 0.82),  $\omega$  6 (0.53 vs. 0.96), polyunsaturated (0.83 vs. 1.96) and unsaturated (48.1 vs. 43.84) and lowers the proportion of saturated fatty acid (51.9 vs. 56.16 kg) in meat kids but these differences weren't statistically significant. In perirenal adipose tissue, no differences were observed between the two groups (T and Ts) for the proportion of  $\omega$  3 (0.46 vs. 0.48),  $\omega$  6 (0.67 vs. 1.04), polyunsaturated (1.26 vs. 1.56), unsaturated (31.26 vs. 31.75) and saturated fatty acid (68.65 vs. 68.21 kg). Results indicate that the incorporation of linseed in the diet of fattening kids improves their growth rate and fatty acid profile of meat.



N-98

### **Inclusion of hay of the invasive weed *Hypparrhnia rufa* in goat diets**

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The objective of this experiment was to determine the effect of inclusion of hay of the invasive weed *Hypparrhnia rufa* (HHR) on intake and digestibility of dry matter (DM), crude protein (CP), and neutral detergent fiber (NDF) in diets based on native tropical grass hay (NTH). The experiment was conducted in the Small Ruminant Project at the University of Puerto Rico using ten creole goats in a reversible design experiment with five replicates per treatment. The goats fitted with faeces collection bags, housed in individual cages equipped with two-chamber feeders, and were assigned to one of two treatments; 100% NTH (mixtures of *Panicum maximum*, *Sorghum halapense* and *Dichanthium annulatum*; 87.12% MS, 4.70% CP, 67.81% NDF) or a diet containing 80% NTH and 20% HHR (89.78% DM, 4.21% CP, 80.50% NDF). The forage was offered daily at 3% of live weight on a dry matter basis. There were two experimental periods each with seven days of adaptation to diets and five days of data collection to determine total forage consumption and digestibility. Three criteria of consumption were calculated. Total forage consumption and consumption in relation to animal body weight were similar in goats fed either 100% NTG or 80% NTG and 20% HHR (1243 vs. 1263 g/d and 2.53 vs. 2.44 %, respectively). Native tropical grass hay consumption in relation to its offer was higher ( $P < 0.05$ ) in goats fed with 100% NTG than those fed with the diet containing 80% NTH and 20% HHR (88.26 vs. 81.93%). *Hypparrhnia rufa* hay consumption in relation to its offer and in relation to total forage consumption was 42.16% and 10.63% respectively. The apparent digestibility of DM (56.70 vs. 56.21%) PB (63.52 vs. 58.57%) and NDF (55.48 vs. 57.205) was similar between the respective treatments. In summary, the inclusion of 20% HHR hay in diets for goats did not affect total forage consumption and digestibility of DM, CP and NDF. The goats consumed HHR 10% of the total forage offered amount that could represent the ideal replacement level in diets for goats based on tropical grass hay.



N-99

### **Supplementation of a phytogetic feed additive on nutrient utilization, growth performance and immune status in kids**

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Eighteen Jamunapari kids (3 months;  $9.1 \pm 0.36$  kg) were used to assess the effect of a phytogetic feed additive (PFA) on nutrient utilization, growth and immune status during a 120-days study. The phytochemical formulation was prepared by mixing three different herbs viz. *Withania somnifera*, *Boerhavia diffusa* and *Holarrhena antidysenterica* in fixed proportions (based on the results from preliminary in vitro studies). The kids, divided into three equal groups, were supplemented with the PFA at 0 (PFA-0), 1.5 (PFA-1.5) and 2.5 (PFA-2.5) percent of DM intake. All the animals received a basal diet of wheat straw and concentrate. BW was recorded fortnightly and DM intake monitored daily. Immune response studies were carried out during the last three weeks of feeding. A metabolism trial conducted following 90 days of feeding trial revealed that the overall DMI (g/d) was similar across the groups. The intake of DM and OM showed a linear ( $P < 0.05$ ) increase with PFA addition; however there were no effects on fibre digestibility. Intake and excretion (both faecal and urinary) of nitrogen remained unaffected by dietary treatments. The nitrogen retention (g/day) was  $0.93 \pm 0.18$ ,  $1.32 \pm 0.20$  and  $1.47 \pm 0.29$  in the respective groups, indicating no effect of phytochemical feed additive supplementation on nitrogen metabolism. Cell-mediated immune response, assessed as cutaneous delayed-type hypersensitivity (DTH) response to intradermal inoculation of phytohemagglutinin-P, was improved significantly ( $P < 0.05$ ) in kids under both the PFA groups; however, maximum DTH was observed in kids under PFA-1.5 group. Humoral immune response of the animals, measured as antibody response to *Fasciola gigantica* antigen, however, was found similar among the three groups. Further, mRNA expression of cytokines INF- $\gamma$  and IL-4 determined following 7d of immunization with *F. gigantica* antigen using real time PCR revealed that INF- $\gamma$  gene expression was down-regulated in both the PFA groups; conversely, IL-4 gene expression was up-regulated and more so in the PFA-2.5 kids. The dietary treatments imparted no influence ( $P > 0.05$ ) on the average daily gain (g) which was  $36.1 \pm 1.7$ ,  $37.8 \pm 2.1$  and  $39.5 \pm 1.2$  for the three groups, respectively. The feed conversion ratio was also comparable across the treatments. It is concluded that the supplementation of the phytogetic formulation as a feed additive had stimulating influence on nutrient utilization besides influencing the cell-mediated immune response of growing kids.



N-100

### **Ameliorative efficacy of dietary selenium against high dietary arsenic**

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An experiment was conducted using 15 adult Muzaffarnagari rams to assess the potential of dietary selenium as an ameliorative agent against sub-clinical arsenic toxicity. The rams were divided into three equal groups viz. CON, As (@1 mg As/kg LW) and As-Se (supplemented with arsenic @1 mg As/kg LW along with Se @ 15 µg/kg LW). The experiment was conducted for a period of 150 days; there was with daily recording of feed intake, fortnightly recording of live weight changes and monthly assessment of clinical chemistry of the experimental animals including erythrocytic antioxidant and thyroid hormonal status. A metabolism trial was conducted following 45 days of feeding. The results revealed that dietary arsenic tended to be lower ( $P = 0.086$ ) upon As supplementation but increased to comparative levels of control group when supplemented with Se. There was no influence of the dietary treatments on the digestibility of organic nutrients. Nitrogen metabolism data revealed that with a similar intake level, the retention (as percent of intake or absorbed N) was higher ( $P < 0.05$ ) in both the As supplemented groups owing to a reduction ( $P < 0.05$ ) in its urinary excretion. Rams in As groups exhibited reduced ( $P < 0.05$ ) levels of serum cholesterol and globulin irrespective of Se supplementation. The serum levels of AST and ALP exhibited increases ( $P < 0.05$ ) in As rams; however Se supplementation apparently had subtle positive effects. There was a lowering ( $P < 0.05$ ) in the circulating thyroxine level in the serum of As rams as compared to the control, while that of the As-Se group was comparable to both. A significant impact of As supplementation was evident on the erythrocytic antioxidant indices in terms of a reduced ( $P < 0.05$ ) GSH level in both the As supplemented groups accompanying an increased ( $P < 0.05$ ) level of SOD. The activity of catalase was depressed ( $P < 0.05$ ) upon As supplementation but its activity increased to become at par with the control group when supplemented with Se. The lipid peroxidation level was increased in the As supplemented group. Overall, the data indicates that As supplementation significantly affected the antioxidant status; which responded positively to supplementation with Se. It is concluded that supplementation of selenium as an ameliorative agent against dietary arsenic significantly improved the observed decline in feed and nutrient intake in rams besides positively influencing the erythrocytic antioxidant defence and metabolic profile.



N-101

### **Performance of Brazilian Native Goats submitted to a mix supply under thermal stress conditions**

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Feed intake can be decreased by environmental stresses, such as a combination of high temperatures and humidities, and this can cause negative effects on milk production, reproductive performance and growth. In the last two months of pregnancy a decreased feed intake can be strongly related with low performance of the kids and lower milk production. The Caniné is an autochthone Brazilian breed, that developed in a Semiarid region, so these animals are very adapted to hot weather. For this reason, the farmers many times believe that these goats don't need a racional management, so this study was conducted to verify the effects of a mix supply under body weight and blood parameters related to energy and protein balance, during the hot and wet season, in Northeast of Brazil. Sixteen Caniné adult goats, on the last stage of pregnancy were used; all received *Cynodon dactylon* hay *ad libitum* and concentrate. Eight of these goats didn't received mix supply (NS) and other eight goats were supplied (S) with a mineral and proteic mix, which had the following composition. Once a week, during three months, the animals were weighed and was collected a sample of blood, for biochemical and hormonal analysis. Daily feed intake (g) was lower in supplied group (S = 55.71; NS = 65.83), maybe because of the higher energy and protein amount of the mix supply. All biochemical and hormonal values were normal, but were found significative differences between the groups in energetic and protein balance. Supplied goats showed higher concentrations of total protein, g/dL (S = 6.52, NS = 5.49) and globulin (S = 3.83; NS = 6.63). Energetic balance also was better in supplied animals, signed by cholesterol means concentrations, mg/dL (S = 58.02; NS = 53.13), glucose averages, mg/dL (S = 44.49; NS = 33.45). Thyroid hormones concentrations were higher in supplied goats, as shown, T4, ng/dL (S = 0.24; NS = 0.15) and T3, µg/mL (S = 1.73; 1.41); this can favour lactating activity because thyroid hormones increase metabolic rates and lactogenic factors. Kidney and liver functions were not affected by the supplementation, as indicated by no significative differences, respectively on urea levels, mg/dL (S = 37.52; NS = 37.23), Creatinin levels, mg/dL (S = 0.81; NS = 0.91), AST, U/l (S = 220.55; NS = 187.38), ALT, U/l (S = 25.98; NS = 25.31). It was concluded that even native breeds must be supplied on late pregnancy, once a time that Caniné goats supplied showed a better performance.



N-102

**Effects of pasture access regime on yield and composition of milk produced by  
Alpine goats**

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Thirty-two Alpine does ( $56 \pm 1.6$  kg initial BW,  $2.1 \pm 0.13$  kg initial milk production, and  $2.1 \pm 0.20$  parity) were used to evaluate effects of different pasture access regimes on milk production and composition, as well as other conditions such as forage intake, digestion, grazing behavior, energy utilization, and internal parasitism. The experiment began at  $26 \pm 2.5$  days in milk and lasted 24 wk. Treatments were access to grass and (or) legume pasture from 0800 h, after the morning milking at 0700 h, to 1600 h (SET), continually (CG), the time of no dew (i.e., leaf surface moisture below a threshold level) until milking at 1600 h (ND-M), and the time of no dew until sunset (ND-D). When not on pasture does were housed in confinement in treatment groups. The SET, CG, and ND-M does were supplemented with 1.5% BW (DM) of concentrate (17% CP and 86% TDN) immediately after the 1600 h milking, whereas does on ND-D were supplemented at sunset. The ND-M and ND-D does were fed alfalfa hay when length of pasture access was less than 6 h, with the level based on length of pasture access. Milk yield was recorded daily and milk samples were collected every 2 wk. Milk yield and concentrations of protein, fat, lactose, total solids, and solids-non-fat were similar among treatments ( $P > 0.05$ ). Treatment did not affect ( $P > 0.05$ ) milk concentrations of lauric (C12:0;  $3.8 \pm 0.18$ ), myristic (C14:0;  $10.5 \pm 0.30$ ), palmitoleic (C16:1;  $1.2 \pm 0.06$ ), linoleic (C18:2;  $1.9 \pm 0.54$ ), or linolenic acids (C18:3;  $0.2 \pm 0.07$ ). However, there were differences in levels of butyric (C4:0) (2.7, 2.5, 2.9, and 2.6%; SEM = 0.08), caprylic (C8:0) (2.7, 2.4, 2.9, and 2.7%; SEM = 0.10), capric (C10:0) (8.7, 7.6, 9.5, and 8.8%; SEM = 0.40), and palmitic acids (C16:0) (29.6, 29.3, 32.2, and 29.2%; SEM = 0.57), with a low value for CG in many instances. There were differences in concentrations of stearic (C18:0) (15.3, 17.0, 14.0, and 15.3%; SEM = 0.54) and oleic acids (C18:1) (23.0, 24.0, 20.3, and 23.4% for SET, CG, ND-M, and ND-D, respectively; SEM = 0.66) as well, with generally high levels for CG ( $P < 0.05$ ). In conclusion, the different pasture access regimes did not affect milk yield or composition but did influence proportions of many fatty acids in milk.





N-106

**Emission of enteric CO<sub>2</sub> and CH<sub>4</sub> in a Dynamic Flow Chamber in Murciano-Granadina goats: the effect of replacing fibrous carbohydrates for starchy carbohydrates**

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Ruminants produce CH<sub>4</sub> and CO<sub>2</sub> as a result of enteric fermentation of carbohydrates in rumen. The amount of these gases being produced depends on various factors such as diet composition, genetics, management, etc. One of the main factors driving these emissions is feeding. Few is known about the effect of different carbohydrates sources in diet on enteric emissions from goats. The main aim of this study was to evaluate the effect of two diets on enteric CH<sub>4</sub> and CO<sub>2</sub> emissions from goats measured in a respiratory chamber. The first diet (F) was based on fibrous carbohydrates (17.99% protein, 37.44% NDF and 16% starch) while the other one (S) contained a higher amount of starchy carbohydrates (17.90% protein, 14, 08% NDF and 35.54% starch). 18 goats Murcia-Granadina goats were used in this experiment. Animals were divided in 6 experimental groups (3 animals each) with an average weight of 45.7 kg. Goats were in mid-lactation period with an average ( $\pm$  sd) milk production of  $1.84 \pm 0.44$  kg/day. All groups consumed both diets following a crossed design. A one-week adaptation period to the diet was followed before measurements. Gas emissions were determined during approximately 26 hours throughout a mass balance in a controlled flow chamber, considering the concentration differences between the inlet and outlet air and airflow rate. A photoacoustic monitor (INNOVA 1412) was used to determine concentrations that were registered each 5 minutes. The results indicate a lower ( $P < 0.005$ ) CO<sub>2</sub> emission for F diet (average  $\pm$  sd  $17.73 \pm 3.17$  and  $26.37 \pm 2.27$  L CO<sub>2</sub>/animal and hour for F and S respectively). The same tendency was found for CH<sub>4</sub> emissions, which resulted significantly lower ( $P < 0.005$ ) for the fibrous diet ( $0.86 \pm 0.30$  and  $1.75 \pm 0.26$  L CH<sub>4</sub>/animal and hour for F and S diets respectively). Regarding the CH<sub>4</sub>/CO<sub>2</sub> ratio, it was also lower ( $P < 0.05$ ) for the F diet ( $0.046 \pm 0.001$ ) than for S diet ( $0.060 \pm 0.001$ ). According to these results, diet F resulted in lower enteric emissions from dairy goats. Despite the higher NDF content, other factors such as fat content could be affecting the CH<sub>4</sub> emission of diet F.





N-108

**Effect of beta-carotene supplementation on the onset of puberty and levels of blood metabolites (urea and total protein) in goats**

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Goat production systems in northern Mexico have environmental constraints, as well as reproductive seasonality of inadequate balance of nutrients, especially protein, energy, and low body condition, which can promote significant changes in the sensitivity of the hypothalamic-pituitary-gonads, affecting the reproductive function. Nutritional supplementation affects the reproductive chain of events from gametogenesis until puberty, which is linked to food supply. Beta-carotene (BC) is a biological compound that has multiple functions and plays an important role in reproductive function. The objective was to evaluate the effect of BC supplementation on the onset of puberty and its possible relationship to changes in serum total protein (TP) and urea (UR) in prepubertal goats. The research was conducted at the Goat Research Unit South-URUZA-UACH (26° NL, 103° W, 1.117 m) from June to October in conditions of natural photoperiod. We worked with goats than 3 months of age with a mating  $\frac{3}{4}$  Saanen and  $\frac{1}{4}$  Alpina (n = 17), were fed a diet to meet 110% of their nutritional requirements. Both body weight (BW) and body condition (CC) were recorded every 15 days prior to feeding. In June, the goats were randomly divided into two experimental groups: 1) Beta-carotene (beta, n = 9; 20.83 ± 2.83 kg, 3.28 ± 0.19) and 2) Control (CONC, n = 8, 19.34 ± 2.80 kg, 3.13 ± 0.19.) Group BC received a supplementation of 200 mg goat-1 d-1. From June to October sampling was conducted weekly blood tests to measure progesterone (P4). Goats with serum P4 levels ≥ 1 mg mL-1 in two consecutive samples were considered reproductively active. Comparisons between treatments for PV, CC and serum levels of PT and UR were performed by ANOVA. The percentage of goats in ovarian activity did not differ ( $P > 0.05$ ) between treatments. There were no differences in serum concentrations of PT and UR. Difference ( $P \leq 0.05$ ) in the pattern of secretion of PT and UR with respect to time for the BC group. The serum concentrations of PT and UR could be associated with onset of puberty in goats supplemented with BC.



N-109

**The nutritional supplementation during late gestation increases the birth weight of the kids but not colostrum yield in subtropical grazing goats kidding in late summer**

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Previous studies had shown that when grazing goats from subtropical Mexico kidded during autumn (dry season), the inclusion of corn in the diet during the last 12 days of gestation increases the colostrum yield at parturition, but not the birth weight of kids. The objective of the present study was to determine if corn supplementation provided during more days before delivery (last 24 days) could increase the weight of kids and colostrum yield when parturitions take place in late August. Forty-six multiparous creole goats were mated in late March by means of the “male effect” technique. During gestation, all animals were maintained under semi-arid grazing conditions; however 24 days before the mean date of delivery females were conformed in accordance to their body condition score and live weight in 2 groups. Goats from control group (n = 18) were fed during whole gestation exclusively with available vegetation in the grazing areas. Goats from supplemented group (n = 28) in addition to grazing, they received individually during last 24 days of gestation 0.6 kg of corn/day in two fractions (50% at 0700 h and 50% at 1600 h of the day). Colostrum yield and their components and the birth weight of the kids were compared between groups by using the two sample t test. The birth weight of the kids was higher in supplemented ( $3.2 \pm 0.08$  kg) than in control group ( $3.0 \pm 0.09$  kg;  $P = 0.04$ ). However, colostrum yield at parturition did not differ between control ( $0.471 \pm 0.05$  kg) and supplemented mothers ( $0.600 \pm 0.07$  kg;  $P = 0.151$ ). The fat, protein and lactose contents in colostrum did not differ between control ( $9.1 \pm 0.4\%$ ,  $17.1 \pm 1.0\%$  and  $2.5 \pm 0.2\%$ , respectively) and supplemented mothers ( $9.2 \pm 0.5\%$ ,  $17.8 \pm 0.9\%$  and  $2.6 \pm 0.2\%$ , respectively;  $P \geq 0.58$ ). We conclude that in semi-arid grazing goats that given birth in late summer, a corn supplementation provided during the last 24 days of gestation increases the birth weight of the kids, which probably improves the income of goat producers from the sale of heavier kids. However, the colostrum yield and their components were not improved due the corn supplementation.



N-110

**Modification of milk and cheese fatty acid profile, affected by terpenes  
administration to dairy goats**

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A study of the relationships between the intake of terpenes and their presence in milk and derived cheese was conducted. Eight dairy goats were divided in two equal groups, representing control (C) and treatment (T). In T group oral administration of a mixture of terpenes,  $\alpha$ -pinene, limonene and  $\beta$ -caryophyllene, was applied over a period of 18 days. Kefalotyri cheeses were made with bulk milk of the two groups at three times. Individual milk samples were collected regularly and fatty acid profile were determined from C and T milk during the period of terpenes administration. Physicochemical properties, sensorial evaluation and fatty acid profile of the produced cheeses were also investigated. The data obtained were subjected to analysis of ANOVA. The results showed that terpenes administration had some effects on fatty acid profile of milk. Small but significant changes were observed for the C8, C16:1, και C18:3 contents, where C8 και C18:3 showed higher values than the control samples and C16:1 lower. However, when fatty acid contents were analyzed as major groups (saturated, mono- and polyunsaturated) no significant changes were observed. In cheese fat contents were lower and total protein higher in T than C. Saturated fatty acids C4, C10 and C12 and the monounsaturated C16:1 were found in lower concentration in cheeses of the T group. The concentration of CLA, was found at significantly ( $P < 0.05$ ) higher levels in T cheese, unlike to milk where no differences were observed. Moreover, the sensory analysis revealed that the cheeses of group T have had higher scores than the control, for the characteristics of color and taste and higher total scores. Based on these results, we conclude that terpenes consumption affect the characteristics of goat dairy products. Moreover, the fatty acid profile of goat dairy products might be manipulated to maximize the content of beneficial fatty acids, through terpenes administration.



N-111

**Promoting use of ligneous fodder, for goats feeding in tropical area: integration of *Harwickia binata* Roxb. on dairy goats (Murciano-Granadina) diet in Senegal**

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In order to contribute to dairy goat feeding in tropical area, a study was done to promote the use of ligneous (local or introduced) feeds by livestock breeders, in semi-extensive or extensive breeding. The study was conducted during three months, with three (03) lots containing each five (05) Murciano-Granadina goats, multi parturient, in beginning of lactation. It was held in a Senegalese rural community farm in Gandiaye (near Kaolack, east of Dakar). All animals received as basic feed, *Panicum maxima* in green state, distributed *ad libitum*. This basic ration was completed by a commercial concentrated feed, distributed without weighing, for the pilot lot according to the practice of the farmer; whereas every goat of the lot 1 received a complementary feed containing 94.80% of DM; 11.8% of crude protein (CP); 2.6% of calcium (Ca); 0.36% of phosphorus (P) and 0.63 of milk fodder unit (UFL), composed by 500 g of *Hardwickia binata* dried leaves and 500 g of commercial concentrated feed, and each animal of the lot 2 received 250 g from of *H. binata* dried leaves and 750 g of concentrated feed, totalising 92.41% of DM; 13.9% of CP; 3.19% of Ca; 0.50%; and 0.71 UFL. After two (02) months of measure, animals of the lot 1 had consumed  $278,256 \pm 94.63$  g of the complementary ration (concentrated and ligneous dried leaves), or 927.52 g by goat per day, those of the lot 2 had consumed little more:  $292,627 \pm 35.65$  g, which represents 975.42 g by goat per day, that means almost the totality of a kg of complementary ration distributed. However, for milk production, goats of the lot 1 produced a quantity of milk slightly superior to that produced in the lot 2:  $276.65 \pm 0.24$  litres, against  $274.4 \pm 0.26$  litres respectively. It represents a daily production by goat of  $0.92 \pm 0.24$  litres for lot 1, which is not significantly different from that of lot 2, which's  $0.91 \pm 0.26$  litres. The milk produced was in good quality too. In addition, those productions are significantly more important ( $P < 0.001$ ) that the pilot lot goat production ( $0.59 \pm 0.26$  litres by goat per day). Bromatological analysis of *H. binata* dried leaves result reveals a moderate crude protein rate 07.96 %; 1.36 % of Ca; 0.09% of P and 0.47 UFL. This study demonstrates the interest of the use of *H. binata* leaves to feed dairy females. It shows also, the benefit of good rationing management of dairy animals, according to the production level.



N-113

**Response of dwarf goats to nutritional content of hydroponic green forage (HGF) produced from various cereal seeds in a tropical environment**

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The main objectives of this investigation were: to compare the nutritional value of HGF from barley, wheat, corn and oats seeds; to determine the adequate level of feed to be substituted for barley, wheat, corn and oats fodder in dwarf goats; and to determine the economic sustainability of the production of HGF in goat supplementation under the environmental and economic conditions of Puerto Rico. Ten (10) dwarf goats were offered a partial substitution of concentrated animal feed to a mix of HGF per 3% of their weight. Of that percentage, 2 percent consisted of HGF alone, while the remainder 1% was grass hay. Mineralized salt and water were supplied as well. Four (4) treatments were provided, in order to compare the goat's nutritional response to HGF: T1 (Wheat), T2 (Barley), T3 (Oats) and T4 (Corn). Grains were disinfected and pre-germinated in plastic trays measuring 21" x 10" x 2" or 53cm x 25cm x 5cm before they were placed in the greenhouse for their further development during a maximum period of 12 days. Forage was weighted on days 6, 8, 10 and 12 and a HGF sample of each grain was analyzed for its content of dry matter. During 12 days 9 goats were fed with each treatment alone, except for one animal randomly selected that served as control and fed with a complete concentrated mixture. The first 7 days were considered an adaptation period. Post consumption data was gathered during the last five days of feeding. A change in weight was observed after 12 days, being T1 the feed mixture the one causing the most weight loss. Weight loss with T2 was fewer. In cases, *Rizophus sp.*, *Penicillium sp.*, and *Aspergillus sp.* fungi were detected. T3 and T3 could not be grown because a spontaneous fermentation process started after 72 hours in the greenhouse, in spite of all the control efforts and strategies employed. In conclusion, high tropical temperatures (of  $90.2 \pm 3.29^{\circ}\text{F}$  or  $32.33 \pm 3.66^{\circ}\text{C}$ ), presence of fungus, low content of dry matter in HGF, and the use of an irrigation (sprinkler) system during the germination and development of the seeds, resulted in nonviable production of HGF under Puerto Rico's tropical conditions in the municipality of Gurabo.



N-116

**Effects of rumen protected leucine on immune function and protein synthesis in skeletal muscle of Inner Mongolia White Cashmere goats**

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It has been shown that BCAAs, especially leucine may play a role in immune function and protein synthesis. But the Studies were poor on Inner Mongolia White Cashmere Goats. This paper was studied on effect of the different levels rumen-protected leucine on Immunity Function and protein synthesis in skeletal muscle of Inner Mongolia White Cashmere Goats. In the experiment, twelve growing wethers of IMWCG with the same father were divided into four groups in a free random block design as follow: Control group (group A), 0.5 g/d RPLeu group (group B), 1 g/d RPLeu group (group C), 1.5 g/d RPLeu group (group D). The experiment lasted 1 month. The body humoral, cellular immune responses and protein synthesis in skeletal muscle were measured. The levels of serum IgG , IgM , sCD4 and sCD8 were detected by Enzyme-Linked Immunosorbent Assay techniques (ELISA) to investigate effect of RPLeu on body immune function and the 4E-BP1 and p70S6K in mTOR signaling pathway were examined by means of Western-blot to investigate effect of RPLeu on Protein synthesis in Skeletal Muscle of IMWCG. The results showed that RPLeu products can improve the content of IgG and IgM in the blood serum, and decreased the level of serum soluble CD4 and CD8 antigen in IMWCG, the 4E-BP1 phosphorylation state and Phosphorylation of p70S6K of experiment groups were higher than control group in goat tissue. The experiment indicated that RPLeu plays an important role in enhancing the body immune function and protein synthesis. Meanwhile, feeding group C the levels of serum IgG, IgM, sCD4 and sCD8 were 10.80 mg/mL, 1.29 mg/mL, 5.03 ng/mL and 4.83 ng/mL, the 4E-BP1 and p70S6K phosphorylation state were 75.81% and 78.03%. it was better than other groups ( $P < 0.05$ ).



N-117

**Effects of dietary on expression and distribution of urea transporter-B in Inner Mongolia White Cashmere Goats**

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The aim of this study was designed to determine the effects of dietary on the expression and distribution of urea transporter-B (UT-B). 18 castrated Inner Mongolia White Cashmere goats (initial BW=34.95±2.37kg), fitted with permanent ruminal fistula were randomized separated into 2 groups fed a cracked corn-based diet or a swelling corn-based diet for 28 d, with supplements fed to achieve 7.5%, 10.5% and 13.5% total dietary CP. On the last day of the experiment, goats were killed and samples taken for western blot analyses for UT-B. Immunoblotting using a rabbit polyclonal antibody to UT-B confirmed the presence of distinct 30-34 KD protein bands in all 72 tissues analyzed. Comparing various samples, the results showed that the compound stomach were evidently higher than intestinal tract, the liver was notably more ( $P < 0.05$ ) than the parotid gland, significantly higher ( $P < 0.01$ ) than kidney. The high crude protein level of ration could impetus the expression of UT-B protein in fore-stomach, ileum, cecum, caecum and kidney, while inhibit expression of the protein in duodenum. However, in the parotid gland, abomasum and the liver, the expression and distribution of UT-B protein was less affected. Swelling corn ration could increase the protein expressing in abomasum, duodenum, cecum, caecum and kidney, and reduce the UT-B expression in ileum and liver. It seems that UT-B is regulated by dietary intake in cashmere goats.





N-118

### **Effects of photoperiod on digestion and cashmere growth of Inner Mongolia White Cashmere Goats**

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Abstract: This research was to study the effects of photoperiod manipulation on Inner Mongolia White Cashmere Goats during telogen period. Twenty selected castrated Inner Mongolia White Cashmere goats (BW23-25kg, 2 years old) were randomly allocated into two groups, i.e. short-day photoperiod (SDPP) and natural day photoperiod (NDPP) groups. The results showed that there was a significant difference in cashmere production and apparent dry matter digestibility between the two treatments. The apparent dry matter digestibility of the SDPP group was  $78.34\% \pm 3.44$ , which was 3% higher than that of the NDPP group. The total cashmere production in SDPP group increased by  $338.83 \pm 72$  g, or 71% higher than that of the NDPP group from MAY to OCTOBER. The difference of cashmere fineness between the two groups was not significant ( $P > 0.05$ ). The cashmere length was still in the range of textile standard. Thus, shifts in cashmere growth related to photoperiod treatments may provide an environmental and economic benefit to profits to alter production and health in White Cashmere goats as they transition into telogen period.



N-119

**Study on partitioning of proteins (amino acids) in White Cashmere Goats fed diets with different dietary metabolizable glucose levels**

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This paper mainly studied on partitioning of proteins (amino acids) in Inner Mongolia White Cashmere (IMWC) goats fed diets with different dietary metabolizable glucose (MG). 9 castrated Inner Mongolia White Cashmere goats (initial BW = 23-25kg), fitted with permanent ruminal fistula and duodenum cannula were randomized separated into 3 groups ,fed three different dietary MG levels , with infusion to achieve the Muscle 85% + Cashmere 15% ideal absorbable amino acid pattern in duodenum were designed to investigated the effect of dietary MG level on the partitioning of proteins (amino acids) in IMWC goats by isotope technique and arterio-venous catheter technique. The results showed that dietary MG levels could have a great impact on the metabolism and partitioning of amino acids in IMWC goats, and it was also suggested that there was a proper ratio between MG and MP, the proper MG/MP ratio was about 1.06 for cashmere production and 1.64 for whole body.



N-120

### Nutrient intake and health status of grazing goats supplemented or not with heather

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Some bioactive plants such as tannin-containing heather can reduce parasitic infections by gastrointestinal nematodes, enhancing goat performance. Thus, goats could select to feed on heather despite its low nutritive value to maintain a better health status. The aim of this work was to evaluate the effects of heather supplementation on diet selection, nutrient intake, and gastrointestinal nematode infections in grazing goats. Four 0.5 ha-paddocks with *Agrostis capillaris*-dominated grasslands were established in western Asturias (northern Spain). Twelve Cashmere goats with their kids were allocated in each paddock from April to November. In two of the paddocks, goats were offered freshly cut heather (mostly *Calluna vulgaris*) every 3 days, whereas no heather was supplied in the other two. Diet selection (pasture-heather) and daily dry matter intake (DMI) of goats were estimated in two periods (June and October) using alkane markers. Samples of pasture and heather were analysed for crude protein (CP), neutral and acid detergent fibre (NDF, ADF) and acid detergent lignin (ADL), and their daily intakes calculated. Faecal samples were collected monthly for faecal nematode egg count (FEC). In June, mean heather percentage in the diet of supplemented goats was 21%. Total DMI per metabolic body weight was not affected by heather supplementation (mean 64 g DM kg BW<sup>-0.75</sup> d<sup>-1</sup>), indicating a total replacement of pasture by heather. As a consequence, CP intake was lower while ADF and ADL intakes were higher ( $P < 0.05$ ) in supplemented than in pasture-fed goats. In October, heather percentage in the diet of supplemented goats was 35%, and total DMI was lower than in June in both supplemented and non-supplemented goats (31 and 27 g DM kg BW<sup>-0.75</sup> d<sup>-1</sup>, respectively). Thus, goats again substituted pasture for heather to a large extent (68%). ADF and ADL intakes were higher ( $P < 0.01$ ) in supplemented goats, with no differences for CP intake, partly due to the lower CP contents in the autumn pasture. FEC increased less ( $P < 0.05$ ) across the grazing season in supplemented goats (46% reduction level in relation to non-supplemented goats). In spite of the nutritionally poorer intake, heather-supplemented goats showed more favourable BW changes. In conclusion, goats chose to feed on tannin-containing heather instead of grazing only on more nutritious pasture. Goats sacrificed nutrient intake in the interests of health, which ultimately improved their productive responses.



N-121

**Performance and parasitic infections of goats grazing on ryegrass-clover pastures and heather or gorse-dominated shrublands**

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It is widely accepted that the type of vegetation, i.e. the botanical composition and the subsequent nutritive quality, greatly affects nutrient intake and performance of goats. However, goat performance may be also affected via health status because of the role of some plant secondary compounds on parasitic infections and/or toxicity. The objective of this study is to compare the performance and parasitic status of non-lactating goats during summer-autumn grazing (after weaning their kids) on three common vegetation types in the northwest of the Iberian Peninsula: perennial ryegrass (*Lolium perenne*)-white clover (*Trifolium repens*) improved pastures (P), heather (*Ericaceae*)-dominated shrublands (heathlands strictly speaking, H), and gorse (*Ulex gallii*)-dominated shrublands (G). Cashmere goats (4 per paddock in 2010, 6 per paddock in 2011) grazed four paddocks of 0.5 ha (P) or 0.6 ha (H and G) per vegetation type from late July to late October. Goats were monthly weighed and their body condition (BC) scored. Parasitic infection by gastrointestinal nematodes was assessed by faecal egg counts (FEC). In both years, body weight (BW) and BC changes were more favourable in P and H than in G. Goats gained BW during the whole experimental grazing season in P and H (4.2 and 37.5 g/day in P, 10.8 and 28.3 g/day in H, in 2010 and 2011, respectively), whereas goats lost BW in G (-35.0 and -5.2 g/day in 2010 and 2011, respectively;  $P < 0.01$ ). BC changes were 0.00, -0.04 and -0.45 in 2010 ( $P < 0.05$ ), and 0.15, 0.10 and -0.00 in 2011 ( $P = 0.16$ ), for P, H and G, respectively. FEC were more reduced in H than in P and G, accounting for 741, 5372 and 2128 eggs/g in October 2010 ( $P < 0.001$ ), and 641, 2581 and 2503 eggs/g in October 2011 ( $P < 0.01$ ) in H, P and G, respectively. These results support previous evidence on the anthelmintic effect of heather, presumably owing to its tannin content. Therefore, the lower nutritive value of H vegetation (even compared with G regarding the protein contents) is offset by its positive effect on goat health, achieving similar performances to those observed in good quality pastures. Goats could be managed on heathlands between weaning and mating with no apparent detrimental effects on subsequent reproductive performance. This allows a more flexible grazing management, e.g. preserving the improved pastures for more demanding animals, reducing feeding costs and getting more sustainable meat production systems.



P-6

**Is the FAMACHA© system an appropriate method for anemia detection in goats under poor-resource conditions in Cuba?**

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Gastrointestinal parasitism is one of the most important constraints for goat production in the tropics, especially under poor-resource conditions. Control methods, in this kind of productive systems, rely on frequent anthelmintic treatments bringing about the emergence of anthelmintic resistance. A research aimed at evaluating the use of the selective drenching system FAMACHA© for anemia detection was conducted in a goat herd under poor-resource conditions. During five months, 50 crossbred goats were monthly examined for packed cell volume (PCV), faecal egg count (FEC), body condition score (BCS), circulating eosinophils (EO) and, color of the ocular mucosa (COM) through the FAMACHA© chart. Evidence has proven that the color chart is an appropriate tool for anemia detection in production and poor-resource conditions. Animals with pink-pale or pale mucosa (categories 3, 4 and 5 of the FAMACHA© chart) had significantly ( $P \leq 0.05$ ) higher FEC and EO and lower BCS. Among the goats, 55% showed low to moderate FEC (0-700 epg), and only 18.5% had a high infestation rate (+ 2000 epg). Sensitivity under these conditions was 89.1%, while specificity was 23.6%. The use of the FAMACHA© color chart in animals reared under poor-resource conditions could contribute to reduce the unnecessary use of anthelmintics, and consequently decrease the selection pressure for anthelmintic resistance, which is high in this kind of systems in Cuba.



P-7

**In vivo anthelmintic activity of *Phytolacca icosandra* against *Haemonchus contortus* in goats**

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The *in vivo* anthelmintic (AH) activity of the ethanolic extract from leaves of *Phytolacca icosandra* was evaluated in goats artificially infected with *Haemonchus contortus*. Parasite naïve goats were artificially infected with 3000 *H. contortus* infective larvae per animal. Once the infection was patent (day 28 post-infection) all the animals were sampled to determine the fecal egg counts (FEC) for five consecutive days. Two groups of animals balanced for their FEC and body-weight (BW) were formed (n = 6/group): the non-treated control group and the treated group in which goats were individually administered with the ethanolic extract of *P. icosandra*. The extract was administered orally using gelatin capsules (250 mg/kg BW) which were dosed on two consecutive days using a pill-dispenser. Fecal samples were collected from each animal from the day of dosage (Day 0) on a daily basis to determine the number of eggs per gram of feces (EPG) for 15 days post-treatment (PT). The FEC of the two groups were compared using the repeated measures analyses of variance using the log transformed data Ln (FEC+1). The presence of saponins, coumarins, flavonoids, steroids and terpenoids were detected by standard methodologies in the extract. The *P. icosandra* ethanolic extract was further analyzed by gas chromatography (GC) coupled to a mass spectrometry (GC/MS). A significant reduction in FEC was observed in the treated group compared to the control from day 7 until day 15 PT ( $P < 0.05$ ). The highest percentage reduction (72%) was found on day 11PT. No adverse reactions were observed in all treated animals for the entire trial. The GC/MS analysis of the organic extracts revealed the presence of three fatty acids as compounds with highest abundance. The three compounds that were identified by their mass fragmentation patterns were: 2-Pentadecanone, 6, 10, 14-trimethyl (retention time: RT 10.3 minutes), Pentadecanoic acid, 14-methyl-, methyl ester (RT 10.8 minutes) and Hexadecanoic acid, ethyl ester (RT 11.2 minutes). It is concluded that the *P. icosandra* ethanolic extract obtained from leaves showed *in vivo* anthelmintic activity against *H. contortus* when administered orally to goats at a dose of 250 mg/kg BW on two consecutive days. The dose used did not cause any negative effects on the health of goats.



P-9

***In vitro* susceptibility of *Mycoplasma agalactiae* reveals differences related to epidemiological characteristics**

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*Mycoplasma agalactiae* is the main causative agent of contagious agalactia, a disease responsible of severe economic losses in small ruminants. It produces arthritis, keratitis, and severe mammary infections. In endemic areas, the disease is not always associated to an explosive outbreak and chronically infected herds are characterised by the presence of asymptomatic carriers, isolation of mycoplasmas in bulk tank milk and sporadic mastitis. These epidemiological characteristics make it a difficult disease to control. Considering the characteristics of the disease in endemic areas, we designed this study with the aim of evaluate the antibiotic susceptibility of *M. agalactiae* endemic field strains. A total of 16 isolates were studied. *M. agalactiae* isolates came from 4 groups, isolated from mastitis samples, from asymptomatic auricular carriers, from semen in asymptomatic animals and from bulk tank milk. The minimum inhibitory concentration (MIC) for each antibiotic was determined taking into account the active base. Antibiotics used were, Streptomycin, Erythromycin, Doxycycline, Ciprofloxacin, Enrofloxacin, Tylosin, Gentamicin, Norfloxacin, Spiramycin, Kanamycin, Spectinomycin and Neomycin. The MIC test was carried out in microtitre plates with PH medium supplemented with 0.5% pyruvate and 1% glucose and phenol red, the correspondent solution of active base of antibiotic and *M. agalactiae* culture, to a final volume of 200 µl. *M. agalactiae* strains were cultivated and diluted to a final concentration of 10<sup>3</sup> – 10<sup>5</sup> CFU/ml. Plates were sealed and incubated at 37°C and examined daily until the positive control (antibiotic free) changed its colour. MIC was defined as the minimum antibiotic concentration with no bacterial growth. MIC ranges showed high differences between isolates and antibiotic. Erythromycin presented the highest MIC range, and as has already been reported although it results a valid antibiotic for other mycoplasmas is not useful for treating mycoplasmas belonging to the hominis group and it is not recommended for treating contagious agalactia. Enrofloxacin and Ciprofloxacin presented the lowest MIC range and are the most suitable candidates for treating this disease. Considering the different groups of isolates incorporated in the study, we found that isolates from mastitis samples presented a higher MIC than the rest. This result may be related to the chronically use of antibiotics in herds with sporadic mastitis.





P-10

**Decrease of *Mycoplasma mycoides subsp. capri* viability in goat colostrum subjected to pasteurization or SDS treatment**

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The aim of this study was to evaluate how pasteurization and treatment with sodium dodecyl sulphate (SDS) influence the viability of *Mycoplasma mycoides subsp. capri* (Mmc) in goat colostrum. Approximately 80 ml colostrum samples ( $n = 7$ ) were obtained from Murciano-Granadina goats within 24 hours after birth, and tested to be free of *Mycoplasma spp.* Samples were inoculated with PG3 (NCTC 10137) reference strain in a final concentration of 109 CFU/ml, and divided into four aliquots of 20 ml corresponding to four treatment conditions: Two aliquots for pasteurization at 56°C or 60°C during 30, 60, 90 and 120 minutes in a water bath, and two aliquots treated during 10 minutes at 37°C with SDS (Sigma-Aldrich® L4390) at final concentrations of 0,1% and 1%. From each condition of time and treatment, we obtained an aliquot in order to evaluate quantitative effect according to Albers and Fletcher's (1982) simple method of viable mycoplasma quantification, and qualitative effect. For qualitative analysis, we considered the extraction or not of SDS by centrifugation and dilution in PBS before culturing, in order to avoid extending its effect during incubation period. For pasteurization, analysis of variance (560 determinations), showed that all factors studied had an effect on Mmc viability. There was a statistically significant difference ( $P < 0.001$ ) between the temperatures used. At 56°C, qualitative analysis showed mycoplasma growth in all times of treatment. Quantitatively, at 56°C there was a significant reduction ( $P < 0.05$ ) on viability at 30 and 60 minutes, which remained constant after then. At 60°C, only one sample showed colonies at 30 minutes whether qualitative and quantitative analysis and no colonies were observed after 60 minutes. For SDS, the use of 0.1% concentration had no effect in Mmc viability. At 1%, the result depended on the removal or not of SDS: All samples in which SDS was not removed showed a lack of viability of Mmc, while 5 of the samples in which SDS was removed, were positive for Mmc growth. In conclusion, pasteurization of goat colostrum at 56°C causes a significant decrease on Mmc viability, and inactivates it when applying 60°C during 60 minutes. Use of SDS as goat colostrum's treatment is ineffective at 0.1% concentrations, and it depends on period of action when using 1%, being insufficient ten minutes of treatment.



## P-11

**Reduction of gastrointestinal nematode egg output in goats fed tannin rich fodder (*Acacia penatulla*) or coffee waste (*Coffea arabica*)**

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The aim was to investigate the effect of feeding goats with tannin rich (TR) foliage of Chimay (*Acacia penatulla*) or coffee waste (*Coffea arabica*) on the fecal egg count (FEC) of goats infected with *Haemonchus contortus*. Twenty-nine goat kids, four-months old (16 kg LW) were used. The kids were infected with 3,500 *H. contortus* L3 (Yucatan strain). Animals were kept in individual metabolic cages. The experimental groups consisted of six kids except for the control with 5 animals (with similar average LW and FEC). The following groups were formed: CG = control group fed 500 g fresh basis (FB) of concentrate feed; CH = group fed with 500 g FB of Chimay foliage; CH + PEG = group fed 500 g FB of Chimay foliage plus 50 g of PEG; COF = group fed a mixture of 200 g of dry coffee waste plus 300 g FB of concentrate feed; COF + PEG fed the same as the COF group plus 50 g of PEG. All the groups were also fed with 500 g FB of *Pennisetum purpureum* grass in addition of their diet. Feed intake was measured daily from day 26 PI until the end of the study. Fecal samples were obtained directly from the rectum of kids to determine the FEC every second day from day 21 post-infection (PI) until day 51 PI when animals were humanly slaughtered to recover their abomasum. Worm burdens were determined as well as the female worm lengths and fecundity (eggs in uterus). FEC data was analyzed by a non-parametric Kruskal-Wallis procedure. Significant reductions were observed in the FEC between the CG vs. COF and CH groups ( $P \leq 0.001$ ). The median FEC of COF and CH groups during the experiment were 332 and 373 while the CG was 1076. On other hand, the feed intake were, COF: 370g, COF + PEG: 287g, CH: 440g and CH + PEG: 453g, the CG consumed all their feed. Worm burdens as well as other post-mortem data are currently analyzed. In conclusion, *H. contortus* FEC was reduced by the intake of coffee waste and chimay fodder. These results support the use of tannin rich fodders and by products as nutraceuticals for the control of gastrointestinal nematodes in goats.



P-15

**Effects of (-)-Epigallocatechin-3-gallate (EGCG) on viability of *Haemonchus contortus* and immune responses in white blood cells of goats *in vitro***

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Effects of (-)-Epigallocatechin-3-gallate (EGCG; a polyphenol in green tea extracts) on viability of third-stage larvae (L3) of *Haemonchus contortus* and cytokine gene expression in white blood cells (WBC) of goats were investigated in *in vitro* experiments. Approximately 20 viable L3 in 10  $\mu$ l phosphate buffered saline (PBS) were delivered to each well of a 96-well culture plate containing 200  $\mu$ l of PBS with EGCG at concentrations of 0, 50, 100, 250, 500, 1000, 3000, or 5000  $\mu$ g/ml in triplicate. Plates were incubated in a humidified incubator with 5% CO<sub>2</sub> and 95% O<sub>2</sub> at 37°C. Viability of larvae was determined by microscopy at 12, 24, 48, 72, and 96 h after exposed to EGCG. Data were analyzed with a MIXED model. Viability decreased ( $P < 0.01$ ) with increasing dose of EGCG and with increasing time. The reduction of viability after 96 h was 3, 21, 41, 48, 45, 92, 100, and 100% for 0, 50, 100, 250, 500, 1000, 3000, and 5000  $\mu$ g/ml of EGCG, respectively. To test the effect of EGCG on cytokine gene expression in goat WBC stimulated with L3 *H. contortus* antigen,  $1.5 \times 10^6$  of isolated WBC in 3 ml of RPMI-1640 were seeded into 75-ml flasks in duplicate. Cells were cultured in a humidified incubator with 5% CO<sub>2</sub> and 95% O<sub>2</sub> at 37°C. Treatments were control (without antigen or EGCG), antigen (20  $\mu$ g protein/ml) only, antigen plus 5  $\mu$ g/ml EGCG, and antigen plus 50  $\mu$ g/ml EGCG. Cells were harvested at 0, 1, 2, 4, 12, and 24 h after treatment for gene expression analysis. Total RNA of cells was extracted using TRIzol reagent and reverse-transcribed for first strand cDNA using iScript™ cDNA Synthesis Kit. Real-time PCR amplification was performed using SsoFast™ EvaGreen® Supermix. Data of gene expression were analyzed by GLM. L3 antigen up-regulated expression of IL-4, IL-6, IL-10, IL-12, IL-17, IFN- $\gamma$ , and TNF- $\alpha$ , but depressed IL-2 ( $P < 0.05$ ). EGCG synergistically up-regulated expression of IL-4, IL-6, and IL-17, but down-regulated IL-12 in the cells stimulated with L3 antigen ( $P < 0.05$ ). In conclusion, EGCG may have anthelmintic effect on *H. contortus* as well as indirect influence through regulating immune responses of lymphocytes. Further work is needed to investigate whether EGCG can exert anthelmintic effects in live animals.



P-17

**Cross-infection between tropical goats and heifers with *Haemonchus contortus***

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Developing effective biological control without the systematic use of anthelmintics is necessary to reduce the impact of gastrointestinal nematodes on small ruminants. Therefore, grazing management systems that use different host species to dilute nematodes in pasture appear to be promising for worm control. A trial was carried out to investigate the specificity of *Haemonchus contortus* for goats and cattle and to evaluate cross-infection between ruminant species. The effect of an experimental infection of 12 heifers by the free-living stages of *H. contortus* collected from goats (500 larvae per kg live weight) was evaluated and compared to uninfected controls. After 28 and 35 days, egg excretion was measured. The experimental infection of heifers by *H. contortus* was not significant, with no egg excretion. These results, i.e., the lack of cross-infection of GIN between goats and cattle, suggest that integrated grazing using such animals could be employed for pasture dilution and decontamination.



P-21

**Goat–parasite interactions: from knowledge to control - the COST action  
CAPARA**

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Goats and sheep are infected with the same parasitic species. They provoke similar pathophysiological changes and economic consequences. However, until now, the majority of data on the host–parasite interactions have been accumulated from ovine studies. Comparison of the interactions between parasites in sheep and goats illustrates how the inference of data acquired from one small ruminant species compared to a second one can lead to errors. This sometimes causes dramatic consequences in the control of these infections. It also illustrates alternative potential approaches for control. If exploiting the immune response combined with strategic treatments seems an efficient option in sheep, exploiting the feeding behaviour, including the potential to self-medicate on natural resources might be as valuable in goats. CAPARA is an EU COST Action (FA0805) which has been launched in 2009 to set up a multidisciplinary network of research teams centered on 26 countries in Europe plus worldwide connections. The Teams are working on ways to a) propose improved integrated methods of control specifically adapted to goat parasite infections; b) provide better recommendations on the use of antiparasitic drugs resulting in reduced drug abuses and improved animal welfare at the farm level; c) harmonize drug regulations according to EU legislation; d) improve goat breeding and support EU policy for traditional farming and e) preserve the landscape, territory and European culture. The expected results of CAPARA are to generate direct data useful for goat industry and to provide comparative insights to better understand the balance between the various regulatory mechanisms to counteract parasite infections and how they interact depending on the host species. Overall CAPARA aims at delivering holistic approaches including analysis of the host–parasite relationships and integrating environmental factors such as providing goats with the ability to browse.



P-23

**Evaluation of digestive strongyles faecal egg count, FAMACHA® score, hematocrit and milk yield in goats. Preliminary results**

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Infections with digestive strongyles (*Nematoda: Strongylida*) are a major cause of pathology in goats, causing chronic alterations in the digestive tract, which affects weight gain and milk yield. With the aim of determining the digestive strongyles prevalence of a goat herd, and its relation with some physiological aspects: hematocrit (HTO) and FAMACHA® score, and production aspects: body condition and milk yield, 32 penned goats naturally infected with *Haemonchus contortus* and *Trichostrongylus spp.* were evaluated, during their sixth week of lactation. Digestive strongyle prevalence was 78.13%. Mean concentration of nematode eggs in the faeces was 281 eggs per g faeces (EPG) with mean HTO being 21.7% and FAMACHA® scores ranging from 3 to 5. Body condition of all animals ranged from 1 to 2. Average milk yield was 1.17 l/day. No relationship was observed between prevalence and EPG with others variables ( $P > 0.05$ ). However, due to the presence of haematophagus strongyles, it is important to monitor animal performance and welfare in order to determine the actual impact of strongylosis on productive health.



P-24

**Afebrile heartwater in goats**

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Heartwater is a very serious limiting factor for sheep and goat production in most of sub-Saharan Africa. Since its occurrence is limited to Africa, apart from a few islands in the Caribbean, most if not all knowledge, research and control methods have to come from within the subregion. Thus important findings and observations on heartwater need to be shared between affected countries for their mutual benefit. While the usual or common clinical presentations have been well described and can be used to make a presumptive diagnosis of heartwater with a good measure of confidence, this is not always the case, and animals with heartwater may be misdiagnosed as they do not fit the expected syndrome, signs and lesions. One important aberrant form found frequently in the Channel breeds of cattle (Jersey & Guernsey) and goats is afebrile heartwater. The signs, lesions, characteristics and treatment of cases that have been investigated are described. The most constant features of afebrile heartwater comprise normal temperature and symptoms associated with generalized oedema, especially hypersensitivity. Diseases or conditions that need to be considered for differential diagnoses include hypophyseal abscessation, plants containing cardiac toxins and feeding chicken litter containing high levels of ionophores. Confirmation that the disease under investigation is afebrile heartwater entails rapidly making a tentative diagnosis based on history and signs seen, and later the response to presumed appropriate treatment. It has been speculated that afebrile heartwater is usually associated with the peracute form of heartwater. However, thus far reports of peracute heartwater have always recorded a fever reaction. Afebrile heartwater presents similarly to peracute heartwater but without the febrile reaction. Peracute cases of heartwater have a high mortality rate leading to confirmation of the disease on post mortem. Partial exsanguination of peracute heartwater cases reduces the mortality rate. Recognition of afebrile heartwater is important to prevent deaths and identify the need for appropriate control measures.





P-27

### **Q Fever Report in goats of Torres municipality, Lara State, Venezuela**

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Q fever is a worldwide distribution zoonosis, caused by a rickettsia, *Coxiella burnetii*, which can infect almost all species of domestic and wild animals, being cattle, sheep and goats the main reservoirs in human contamination. In goats symptomatology is associated with abortions and birth of weak offspring. In the state of Lara, Venezuela, a participatory diagnosis made with goat producers in the Trinidad Samuel parish of the Torres municipality, the high rate of abortions and birth of weak offspring, casted as one of the main problems identified by producers. This led to the realization of a study to determine possible causes for these high rates, including the presence of *C. burnetii* (Q fever) in these goats' herds. For this study, 315 females were taken from 924 goats of the population under technical assistance and blood was drawn from the jugular vein for the serodiagnosis of *Coxiella burnetii*, which was done by Elisa test, as prescribed by the commercial IDEXX. The results showed a total of 191 positive samples, representing 61% of the total. Found seropositivity is very high and could be one of the causes of such reproductive problems reported by producers.



P-28

### **Paratuberculosis (Johne's disease) in the Dutch dairy goat industry**

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The objectives of a recently started paratuberculosis project within the Dutch dairy goat industry are to profile the occurrence of paratuberculosis on twenty selected dairy goat farms, and to design a plan of approach to control the paratuberculosis situation. The elected enterprises were selected based on the outcome of a comprehensive survey related to their overall farm management, as well as their envisioned paratuberculosis status. On-farm prevalences were obtained by paired serology using an ELISA (Institut Pourquier, Montpellier, France) for detection of antibodies against *Mycobacterium avium subsp. paratuberculosis* (Map) in individual serum and milk samples, and the presence of Map DNA by PCR in faecal and dust samples. Cut-off values of the S/N ratio's of  $\geq 25$  -  $< 30$  for low positives and  $\geq 30\%$  for positives in serum, and  $\geq 15$  -  $< 20$  for low positives, as well as  $\geq 20$  for positives in milk for Map antibodies were used. Per farm, serum and milk samples from approximately 50, non-randomly selected goats were tested and from approximately 20 of these animals' faecal samples were obtained. Farm management factors related to possible dissemination of Map within and between farms are being discussed in participant forum groups, and at a later stage with their veterinary practitioners. Overall, 142 out of 1011 (14%) serum samples were positive for Map antibodies, whereas 13 (1.3%) scored low positive. In the paired individual milk samples 74 out of 1008 (7.4%) tested positive and 5 (0.4%) low positive in the ELISA. This resulted in a 92.8% agreement between serum and milk samples. Of the faecal samples 76 out of 371 (21%) tested positive for Map DNA. At the time of submission of this abstract the dust samples had not yet been processed. There are marked differences in outcomes between farms. On three farms none of the sampled individuals tested positive for either MAP DNA or MAP antibodies. Seven farms had relatively high prevalences of antibody levels and/or MAP's, and the remaining ten had intermediate paratuberculosis prevalences. The participants have been discussing the outcomes and have started designing plans to control the paratuberculosis situation on their enterprises. Preliminary conclusions based on these data are that the overall prevalence of paratuberculosis on the 20 elected dairy goat farms is at least 15%, although marked differences exist between enterprises. The participants are currently negotiating the best paratuberculosis control plans.



P-29

**Histopatologic description of a Caprine arthritis-encephalitis. First communication in Argentine Republic goats**

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Caprine arthritis-encephalitis (CAEV) is a viral disease caused by a lentivirus that persistently infects goats characterized by arthritis in adult and encephalomyelitis in kids. In Argentina, the first case of the disease with a seropositive animal and macroscopic lesion was reported in 2005, until then was considered an exotic disease. Samples were collected from three Anglonubian goats seropositive to CAEV virus by ELISA test, showing only clinical signs of enlargement of carpal joint and udder indurations at palpation. Samples for histological analysis from central nervous system, lung, lymph nodes, udder, synovial membrane, tendons and tendons sheaths and third eyelid were processed routinely, embedded in paraffin block and sections (5 µm) were cut and stained with hematoxylin and eosin. The microscopic analysis showed perivascular focal and isolated accumulation of lymphocytes, macrophages and plasma cell in the nervous central system, low prominent interstitial pneumonia focus with mononuclear cell infiltrates in the alveolar septae and perivascular and peribronchial region. Other lesions include paracortical hyperplasia zone in lymph node, with loss of germinal centres architecture, proliferation of synovial lining cells and subsynovial and connective tissue infiltration by lymphocytes, plasma cell, macrophages and multinucleated giant cells, and synovial villus with dense lymphocyte accumulation resembling a lymphoid follicle. The udder showed severe interstitial mastitis, with connective tissue hyperplasia and infiltration with mononuclear cells in the mammary gland, organization of ectopic lymphoid nodules and degeneration and loss of acinar and ductular epithelium. The microscopic lesions in the third eyelid consisted in lymphocytic hyperplastic nodules and mononuclear inflammatory cell infiltration of glandular tissue and connective tissue under epithelial line. The present study is the first description of a histopathological lesion of the CAEV in the country and confirms the value of histology as an auxiliary method of diagnosis of this disease, especially when a serology test is not available. The more spectacular lesions correspond to the udder and periarticular tissue. It's noticeable that while macroscopic lesions were only observed in joints and udder, also were observed histological lesions in other organs such as lung, central nervous system and third eyelid. Damage to third eyelid has not previously been described in the literature.



P-30

**Humoral immune response in different goat breeds against *Rhipicephalus appendiculatus* tick infestation**

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Changes in serum gamma globulin levels, numbers of replete female ticks, and tick mass were used as parameters to monitor the humoral immune response (antibody mediated immune response) elicited by *Rhipicephalus appendiculatus* adult ticks. Three consecutive tick infestations were applied in South African Indigenous goats, crossbred goats (Saanen x Indigenous) and Saanen goats under laboratory conditions. During three consecutive tick infestations the serum gamma globulin levels increased in all three breeds, while the mean replete female tick numbers and tick mass decreased. Even though all three goat breeds exhibited a humoral immune response, the South African Indigenous goats showed a stronger humoral immune response than the Saanen and crossbred goats.



P-31

**In vitro anthelmintic effect of *Psoralea bituminosa*, *Ruta graveolens* and *Ruta pinnata* against *Haemonchus contortus***

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The control of parasitic diseases in small ruminants is mainly addressed by the use of synthetic anthelmintics. However, the incorrect and indiscriminate use of these products has resulted in the emergence of parasite resistance. Plants with anthelmintic activity have been extensively used in folk veterinary medicine and may constitute new therapeutic and prophylactic alternatives to control parasitic diseases. A previous prerequisite is the investigation of the activity of the different plant extracts by using *in vitro* assays. In the present study, different plants belonging to the Canary Islands flora have been assessed for their anthelmintic effects against *Haemonchus contortus*, which is one of the most important gastrointestinal nematodes of small ruminants, causing high rates of mortality and economic losses in livestock production. The anthelmintic effect of the plants *Psoralea bituminosa*, *Ruta graveolens* and *Ruta pinnata*, the last one being an endemism of the Canary Islands, was evaluated by the larval mobility test. The results showed that after 24 hours incubation with different concentrations of Met-OH extracts the anthelmintic activity of *R. pinnata* was higher than those observed for *P. bituminosa* and *R. graveolens*. The differences could be even detected at the highest concentration of extract used in the *in vitro* assays (12.5 mg/ml), where *R. pinnata* produced paralysis of 94.84% of the larvae population, while the same concentration of *P. bituminosa* and *R. graveolens* only caused 36.82 and 31.31% of movement arrest, respectively. The anthelmintic activity of *R. pinnata* at the highest concentrations was similar to the results obtained with levamisole, the synthetic anthelmintic used as positive control. Based on these results we can conclude that *R. pinnata* could be considered as a candidate for treatment of haemonchosis in small ruminants. This activity could be transferred to other parasites, not only goat parasites but other animal or even human parasites, whose convectional pharmaceutical treatment is increasingly being limited as a result of the growing anti-parasite drug resistant.



P-32

***Eimeria ninakohlyakimovae* infection modulates the transcription of E-selectin gene in caprine endothelial cells**

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*Eimeria ninakohlyakimovae* is an important coccidian parasite of goats causing severe diarrhea in young animals. Its first schizogony takes place in endothelial cells of the ileum resulting in the formation of macroschizonts. Host endothelial cells are highly immunoreactive cells, able to produce a broad range of adhesion molecules upon activation (i.e. E-selectin) which regulate signaling between the cells and the immune system. In the present study we have analysed early innate immune reactions to *E. ninakohlyakimovae* by determining the transcription of E-selectin gene in infected and control host cells. For this purpose, caprine umbilical vein endothelial cells (CUVEC) were infected with *E. ninakohlyakimovae* sporozoites. The sporozoites were excysted from sporulated oocysts of the GC *E. ninakohlyakimovae* strain and CUVEC were isolated from caprine umbilical cords of newborn kids under aseptic conditions using collagenase treatment. Endothelial cells were seeded in flasks and fed with complete endothelial growth medium (ECGM). Confluent CUVEC monolayers were infected with 300,000 freshly excysted sporozoites per 25 cm<sup>2</sup> flasks. Infected and uninfected in vitro cultures of CUVEC were incubated at different time points: 0, 4, 12 and 24 hours, 4 and 8 days p.i. Real time RT-PCR techniques were used to determine transcript levels of E-selectin gene in infected cells and negative controls. The *in vitro* tests were performed in duplicates and triplicates were used for Real Time PCR procedures. The analysis of the results demonstrated that *E. ninakohlyakimovae* infection induces an upregulation of the transcription of E-selectin gene, particularly evident at four hours p.i., suggesting that infection of CUVEC with *E. ninakohlyakimovae* results in proinflammatory reactions mediated by upregulated adhesion molecule genes (E-selectin).



P-33

**Formic acid inactivation of Caprine Arthritis Encephalitis virus in colostrum**

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Caprine Arthritis-Encephalitis Virus (CAEV) is a lentivirus which causes synovitis, arthritis and mastitis in adult goats and encephalomyelitis in kid goats. The primary route of CAEV transmission in goats is from dam to kid through ingestion of colostrum/milk containing CAEV. Traditionally, prevention of CAEV transmission for eradication protocols include removal of kids from infected dams prior to consumption of colostrum, and the administration of heat inactivated colostrum/milk or feeding colostrum replacers and segregation. However, heat inactivation of colostrum/milk can be time consuming and not available for environments without electricity or heat source. Formic Acid historically has been used in dairy calves for room temperature stabilization of milk and for its antimicrobial properties without detrimental effects on passive transfer of essential immunological components or nutritional elements of colostrum and/or milk. The objective of this study was to evaluate the utility of Formic Acid (FA) to inactivate CAEV in colostrum. Cell free colostrum was spiked with CAEV ( $10^5$ TCID<sub>50</sub>), then treated with varying amounts of formic acid (8% solution) to acidify colostrum to a pH of 3, 4, 4.5, and 5, for 15 or 30 minutes. pH was returned to 7.5 with NaOH (5N). Residual viral particles (TCID<sub>50</sub>) were enumerated utilizing the virus titration assay on goat synovial membrane cells. Acidification of CAEV spiked colostrum to a pH of 3 and 4 after a 15 and 30 min resulted in a 99.99% of reduction of infectious virus particles, Acidification of spiked colostrum to a pH 4.5 and 5 did not significantly reduce the virus infectivity in compare with the non-acidified colostrum. Preliminary results demonstrate that acidification of Colostrum spiked with CAEV to a pH of 4 or less for a minimum of 15 minutes results in effective inactivation of CAEV. Future studies include *in vivo* efficacy studies.





P-35

***In vitro* nematicidal activity of furfural and 2-hydroxybenzaldehyde against lungworms of goats**

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The aim of this study was to assess *in vitro* the efficacy of aldehydes furfural and 2-hydroxybenzaldehyde against freshly first-stage larvae (L1) of *Muellerius capillaris* and *Neostromylus linearis* in faeces of dairy goats. Faeces were collected from the rectum of the goats and L1 were recovered according to the Baermann technique. The larvae were identified with a microscope 40x especially for *M. capillaris* (90%) and *N. linearis* (10%). The anthelmintic activity was assessed through larval development test using Cellstar 96-well cell culture plates (Greiner Bio-One). Each treatment was represented by about 25 L1 per well. Stock solutions of furfural and 2-hydroxybenzaldehyde were prepared using a 0.1 M phosphate-buffered saline solution (PBS). Buffered solution was used as control for the correction of paralysis data. Furfural and 2-hydroxybenzaldehyde were tested against nematodes at dosages ranging from 419.2 to 6,707.0 mg/L and from 17.8 to 1,420.0 mg/L, respectively. The bioassays were performed adding 0.1 mL of stock solution to 0.1 mL of aqueous solution containing the L1 in each well. Every treatment was replicated per experiment six times. Plates were covered with tin foil and kept in the dark at 25°C; L1 were counted after 1, 24 and 48 hours of incubation using an inverted microscope at 10x. Nematodes were ranked in the two categories: motile or paralyzed. The percentages of paralyzed larvae were corrected by eliminating the natural death-paralysis in the control according to the Schneider Orelli formula. EC50 was calculated using the probit program of Minitab 16 software. The 2-hydroxybenzaldehyde showed higher activity than furfural. The highest nematicidal activity was for 2-hydroxybenzaldehyde after 48 hours with  $EC_{50} = 85.7 \pm 46.0$  mg/L. While furfural exhibited the highest activity after 24 hours with  $EC_{50} = 1701 \pm 1261$  mg/L. The results obtained indicate that furfural and 2-hydroxybenzaldehyde possessed larvicidal activity. In the future these compounds may find an application as anthelmintics in veterinary practices. This preliminary study could be useful to perform further *in vivo* studies.



P-36

**The use of molecular biology (PCR-RFLP-Sequencing) for detecting *Anaplasma sp* (*Rickettsial, Anaplasmataceae*) in goat and determine its prevalence in two provinces in the north of Morocco**

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A survey was conducted in 2011 in two provinces of the north of Morocco to detect the presence of hemoparasite *Anaplasma* and determine its prevalence in goats. A total of 153 goats blood samples, Chefchaouen (102) and Tangier (52) were analysed by a two rounds PCR. Primers ER16SD/EbR3 and ER16SD/EbR2 were used respectively for the first and the second round. To differentiate *Anaplasma sp*, an RFLP test was performed using the restriction enzyme (Hin6I) and the plug (Y/Tango) at 37°C. The PCR product 146 Pb was purified by using a Kit QIAquick of purification PCR (QIAGEN, Belgium). The PCR purified product was cloned on the plasmide vector PCR2.1®-TOPO® MT following the method TOPO MT Cloning® (Invitrogen®, U.S.A). Results confirmed the presence of *Anaplasma ovis* in goats within variable prevalence, Chefchaouen 65.68% (67/102), Tangier 74.50% (38/51). This study showed that goats anaplasmosis is caused by *Anaplasma ovis* in Morocco and its highly prevalent 68.62% (105/153).



P-37

### **Tick infesting goats in Morocco**

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Few works had been carried out on ticks infesting small ruminants in Morocco. Of some 14 tick species recorded in the country, 6 species of different genera were collected from goats, 3 belonging to the genus *Hyalomma* and 3 to the genus *Rhipicephallus*. Some of those species (*Rhipicephalus bursa*) are known to be vectors of diseases such as anaplasmosis, which causes important economic losses goats breeding. Nevertheless, their distribution, the seasonal abundance and populations dynamic are very poorly studied. Climatic diversity of the country and the economic importance of goats breeding in certain regions are factors that call for more efforts to study the tick problem in goats. More studies are needed within national and regional programs to assess vector distribution and dynamics, interaction of different parasites, their virulence and carrier states in order to establish suitable control measures.



P-38

**Are goats suitable for FAMACHA© training?**

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Goats and sheep are the species of farm animal with the highest growth rate in Paraná State. The main problems facing Paraná State flocks are gastrointestinal parasites and anthelmintic resistance. One of the newest resources used to slow down the development of anthelmintic resistance is the FAMACHA© system, a selective method for controlling gastrointestinal verminosis in small ruminants. Although the FAMACHA© system is suitable for the identification of anemic animals of both species, few articles discuss the use of goats during the FAMACHA© training. It is well established that to use the method it is necessary a hands-on-practice training of evaluators. The purpose of the present research was to evaluate whether there are differences in efficiency of FAMACHA© training when it is used goats or sheep. During June 2009 to May 2011, 32 trainings were conducted in different cities in Paraná State (Brazil), with a total of 1126 people trained. On the day before training, an experienced person evaluated the mucosa of animals, sheep or goats, and hematocrit of each animal was evaluated, to access if the FAMACHA© score given was correct. 20 animals were then chosen and, during the training, the animals were placed in lateral decubitus to allow conjunctiva exposure to be assessed by all the participants in row. Usually, the groups were composed of 15 to 25 persons, among farmers, students, animal scientists and veterinarians. At the beginning of the training, each participant received a sheet to mark, after each evaluation of conjunctiva, the FAMACHA© score given. Subsequently, the scores of each evaluator were compared with the hematocrit value of the animal to obtain errors. In all trainings, 255 goats and 685 sheep were evaluated. The average error when sheep were used was 1.445 with a standard deviation of 1.332, while the average error when goats were used was 1.353 with standard deviation of 1.002. Preliminary analyzes showed no difference in error scores between the two species, making it possible to carry out an effective training using the two species. Therefore, goats can be successfully used in FAMACHA© trainings.



P-39

**FAMACHA test and accounts fecal of eggs per gram (EPG) in Caninde goats**

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The FAMACHA test is used to assess the occurrence of endoparasitism by analyzing of the ocular mucosa, having 1 to 5 degrees (1 for a healthy and pink mucosa and 5 to white mucosa to indicative of serious parasite). This study aimed to correlate the data FAMACHA with EPG of parasites per gram of feces of Caninde goats. Six measurements were performed in 20 animals, totaling 120 examinations. For analysis of the FAMACHA was made a visual inspection of the ocular mucosa, always performed by a single examiner. The data were analyzed using SAS (1999). There was a positive correlation between FAMACHA and EPG ( $P < 0.01$ ), indicating that this procedure was efficient in diagnosing endo parasitism disease. Was observed that there is no statistical difference ( $P = 0.63$ ) between levels of EPG and FAMACHA method (46% level 5 and 57% presence of *Trichostrongylides*) in Caninde goats raised in the Brazilian semiarid region, with a FAMACHA being used to assess the sanitary condition of a goat herd. We concluded that the FAMACHA method was effective in diagnosing and endoparasitism disease resistance Caninde goats, when created in the Brazilian semiarid region.



P-40

**Correlation analysis between FAMACHA test and body condition score (BCS) in Canindé goats adaptability evaluation**

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The FAMACHA method is used to evaluate the occurrence of endoparasitic diseases by analyzing the ocular mucosa, having 1 to 5 degrees (1 for a healthy mucosa pink and white mucosa for up to 5 indicating severe parasitic disease). This study aimed to correlate the data with the FAMACHA body condition score (1 to very thin and 5 to very obese) Canindé native goat, raised in the Brazilian semiarid region. Twenty goats were used for 12 months, totaling 240 analyzes. For data collection we used visual observation of the individual ocular mucosa left (FAMACHA) and palpation and observation to determine the body condition score. Both features were made by a single examiner. Data were analyzed previously by SAS (1999). The results showed that the varieties show good correlation index ( $P = 0.23$ ) between body condition score and FAMACHA, with levels 1 and 2 of the FAMACHA happening in most animals (62%), indicating that are resistant to disease. The FAMACHA scores between 3 and 4 occurring in 28% and the level 5, occurring in 10% of the animals. It follows that the Canindé goats is well adapted to Brazilian semiarid conditions and that these indices can be used to assess the level of adaptability animal to semi-arid environment, as reflected most likely hit their physiological condition and can be used to assist the breeding of race, focusing on resistance to endoparasites.



P-43

### **Histopathological classification of the different stages of lymph node granulomas from PPD test positive goats**

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Tuberculosis (TB) is currently of considerable importance worldwide. The pathognomonic histological characteristic of tuberculosis is the formation of a tuberculous granuloma. Tuberculous granuloma formation in mammals is thought to be the result of chronic antigenic stimulation. A granuloma can be defined as a focal accumulation of inflammatory cells in which macrophages, epithelioid macrophages, multinucleated giant cells and lymphocytes predominate. The aim of this study was to classify the histopathological stages of granulomas from PPD (purified protein derivative) test positive goats. Samples from 48 PPD test positive goats from a total of 98 positive animals were collected at slaughter as part of a tuberculosis surveillance program which took place in Gran Canaria in 2010. Retropharyngeal (RF), preescapular (PE), mediastinal (MD), mesenteric (MS), hepatic (H), mammary (MA) and ileocaecal (IC) lymph nodes, and the ileocaecal valve (V) were collected. Tissues were fixed in neutral-buffered formalin (10% formaldehyde) embedded in paraffin wax and stained with haematoxylin and eosin (HE) for histopathological examination. Granulomas were classified into four stages according to Wangoo et al. (2005). Granulomatous lesions were observed in 37 MS, 32 MD, 23 PE, 19 RF, 14 V, 10 MA, 6 IC, and 3 H. The different stages observed, taking into account the lymph nodes with only one type of stage, were: MS (12, 0, 1 and 8, stage I, II, III and IV respectively), MD (8, 1, 2 and 15), PE (11, 0, 0 and 9), RF (3, 1, 1 and 13), MA (2, 0, 1 and 7), H (1, 0, 0 and 2), IC (2, 0, 0 and 0) and V (8, 0, 0 and 2). Lymph node granulomas that formed in response to experimental intratracheal infection with *Mycobacterium bovis* in bovine have been classified into four stages. In the present study we observed those four stages in the samples analyzed. Mycobacterial granulomas are dynamic, the cell populations changing over the course of infection. This scheme should assist in standardizing descriptions of goat tuberculous lesions naturally infected in lymph nodes and in determining the stages of granulomas. Further studies are needed to characterize the inflammatory cell composition in each stage.





P-44

**Prevalence of antibodies anti *T. Gondii* in goats in the province of Guanenta  
department of Santander, Colombia**

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Toxoplasmosis is a parasitic zoonosis more prevalent in the world. The goat is susceptible to infection with *Toxoplasma gondii* during pregnancy can cause fetal death, abortions, mummification, stillbirths, weak offspring. Consumption of products and byproducts is particularly relevant in the transmission of the agent. The objective of this study was to determine the prevalence of antibodies anti *T. gondii* in goats in the province of Guanenta and provide epidemiological history of the area. Methodology: We analyzed 400 blood samples from goats, Guanenta Province: Barichara, Villanueva, San Gil, Aratocha, Cepitá, analyzed by IFI using a dilution of 1/20. Taking into account the age, sex and location. Surveys were conducted to understand the production system, health management, breeding and number of inhabitants per fold. The prevalence found was 54.5% (218/400). The variable sex workers tested positive on 8.80% (35/400) of males and 45.8% (183/400) of females. According to the variable age in goats  $\leq$  a 1-year prevalence was 8.5% (34/400), 15% (60/400), between 1 year and 2 years, and 31% (124/400) of two years on. With respect to the variable location where positive: the municipality of San Gil 58.14% (25/43), Cepita 56.92% (74/130), Aratocha 53.61% (52/97), Villanueva 52.94% (45/85), Barichara 48.89% (22/45). The study makes evident that the presence of *T. Gondii* in Guanenta province, being important to take precautions and control measures to reduce the risk of contracting the disease.



P-45

**Digestive strongyle infection in dairy goats under an intensive management system**

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Due to the impact on health and production caused by gastro-intestinal parasites in goats, a study was carried out to determine the prevalence and abundance of gastro-intestinal strongyles parasites in housed milking goats (*Capra hircus*) exposed to a natural infection from conserved forage and their relationship with milk production. For the first five months of lactation, prevalence of gastro-intestinal strongyle infection was 85.3%, with a mean faecal egg count of 784 eggs per g (EPG). Strongyle prevalence and faecal egg count values varied by month ( $P < 0.05$ ). Milk production did not vary with time with mean values of 823.5 ml/goat/day ( $P > 0.05$ ). There was no relationship between milk production and parasitological parameters ( $P > 0.05$ ), suggesting some individuals within the herd were expressing considerable resilience to strongyle parasite infections.



P-46

**Comparison of pooled vs. individual faecal egg counts to evaluate infections with gastrointestinal nematodes in goats?**

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The infections with gastrointestinal nematodes (GIN) remain a main parasitic threat for the health and welfare of goats and the economy of goat farming when bred in outdoor conditions. Nowadays, the high prevalence of resistance to the 3 main families of chemical anthelmintics (AH) and the constraints imposed in their use in caprine production because of the possible residues in milk impose to use these molecules with caution. One way to improve their use is to rely the decision of treatment with the diagnosis of the intensity of GIN infection. The mean individual fecal egg count (FEC) based on 10 to 20 goats within the flock has been widely used as an indirect measurement to estimate the level of infection. However, the cost of the analyses limits their use by farmers. FECs relying on pooled samples might represent a mean to reduce the overall cost. The aim of this study was to compare and to evaluate the correlations between the measurements of FEC relying on either i) mean individual data from 10 goat samples (IS), or ii) pooled sample from the same animals (PS); or iii) pooled sample after mechanical homogenization by crushing (HS). The survey relied on individual samples taken from 10 to 12 goats obtained in 95 farms in the southern part of France. The egg per gram (epg) were respectively: 841 (IS), 753 (PS) and 821 (HS). Significant correlations were found between i) the IS and PS epg values ( $R^2 = 0.896$ ,  $P < 0.01$ ; ddl = 93), ii) the IS and HS epg values ( $R^2 = 0.862$ ,  $P < 0.01$ ; ddl = 93), and iii) the PS and HS epg values ( $R^2 = 0.834$ ,  $P < 0.01$ ; ddl = 93). These results suggest that measurements of FEC relying on pooled faecal samples seems a valuable tool to increase the frequency of data in epidemiological surveys on caprine farms during a grazing season.



P-47

**Host-feeding pattern of biting midges *Culicoides* and mosquitoes in Canary Islands, Spain: potential implications for disease transmission**

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Flying blood-sucking insects play a main role under a veterinary perspective as blood feeders and vectors of a diversity of pathogens. The direct costs, draining resources from their hosts, or indirect costs, imposed by those pathogens transmitted by them, adversely affect the survival probability and health status of livestock and wild species. Furthermore, climate change and human activities have largely contributed to the introduction and spread of some of the diseases transmitted by flying blood-sucking insects during the last decades. Therefore, further studies are necessary in order to identify the potential insect vectors of diseases present in a particular area and identify their host feeding pattern. Here, we captured two insect groups, biting midges *Culicoides* and mosquitoes, in one farm in Gran Canaria and one farm in Tenerife. The bloodmeal origin of engorged females was determined using a recently developed molecular approach based on the Barcoding of Life program that aims to provide a reference library of COI sequences of all organisms on the Earth. The morphological identification of biting midges and mosquitoes revealed the presence of one morphospecies of biting midges belonging to *Culicoides obsoletus* group and five different species of mosquitoes including *Culex theileri*, *Culex pipiens*, *Culiseta longiareolata*, *Anopheles atroparvus* and *Anopheles cinereus*. In order to identify at the species level the biting midges captured, we sequenced the barcoding region from 20 individuals. Two haplotypes differing in a single base between them were identified, both belonging to *C. obsoletus* species. Moreover, we successfully identified the bloodmeal origin from 89 biting midges *C. obsoletus*, 121 *Cx. theileri* and four *Cx. pipiens* using amplification and sequencing of a fragment of the vertebrate COI gene. The analyses revealed that *C. obsoletus* females fed on goats and sheep, *Cx. theileri* fed blood on goats, sheep, dogs, cattle, cats, humans and chickens and *Cx. pipiens* fed on goats and chickens. Our results support that both goats and sheep in Canary Islands suffer the attack of different flying blood-sucking insects including biting midges *Culicoides* and mosquitoes. Also, because the biting midge *C. obsoletus* is considered a potential vector of bluetongue viruses, our results confirm the potential bluetongue circulation in case of virus introduction into the islands.



P-48

### **Goat Farming in Pakistan; Peste des Petits Ruminants is a threat**

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Livestock are natural factories to convert roughage (grasses, shrubs, etc) into quality-food i.e. milk and meat. Goats are well-admired and documented worldwide for providing food in terms of milk and meat. They are playing a key role in supporting millions of people who are poor, landless and living in the rural areas. Pakistan at present is having > 60 million head of goats consisting of about 37 well- recognized breeds found in different regions of the country. Goats play a significant role in the country's economy by producing approximately 366 thousand tons of mutton. The main stock occurs in form of nomadic and transhumant production system but the goat farming at commercial level for meat production is also growing. Although the goat farming on commercial level is escalating in the country yet there are threats which results this initiative into a loss. Among these threats, PPR outbreaks are causing huge damages. During the recent times, three outbreaks of PPR were confirmed at these commercial farms in various regions of Punjab province. The disease started with in one to two months of the establishment of these farms as the animals were purchased from different livestock markets. Disease started with sudden onset of respiratory and enteric clinical signs and spread quickly. Disease caused mortality of 20-40% and morbidity of 40-60% within a time period of 01 to 03 weeks. The main reason for these outbreaks was the endemicity of PPR in Pakistan and there is no recommendation to use PPR vaccine in routine for goats. So it is recommended that in an endemic country like Pakistan where goat farming is much important for food security issues, there should be proper importance given to PPR and other diseases which are discouraging the investment in goat farming.



R-2

### **Glutamate supply and the onset of puberty in goats: Serum pattern of blood metabolites and metabolic hormones across time**

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In peripuberal mammals, increases in the pulsatility of gonadotropin-releasing hormone (GnRH) is the main responsible for an augmented release of LH and FSH as well as gonadal growth and activation, involving a complex network of GnRH & glutamatergic neurons. Yet, those metabolic cues triggering the onset of puberty remain elusive. The current study evaluated the effect of glutamate supply upon the onset of puberty and possible links to changes in serum concentrations of cholesterol [COL], glucose [GLU], total protein [TP], urea [UR], and the metabolic hormones insulin [INS] and triiodothyronine [T3]. The study was conducted from June to November in prepuberal female goats ( $n = 18$ ; 3 mo. old, 7/8 Saanen-Alpine, 1/8 Criollo, 26° north) randomly assigned to two experimental groups: i) excitatory amino acids (EAA,  $n = 10$ ;  $16.52 \pm 1.04$  kg LW,  $3.4 \pm 0.12$  body condition score [BCS], receiving an intravenous infusion of 7 mg/kg live weight [LW] of L-glutamate, twice a week, and ii) control (CC,  $n = 8$ ;  $16.1 \pm 1.04$  kg LW,  $3.1 \pm 0.12$  BCS) receiving saline. Blood samples were obtained twice a week, for assessing progesterone [P4], as well as in a monthly basis to evaluate serum metabolites and hormones. Mean final LW and BCS were  $23.2 \pm 0.72$  kg,  $3.53 \pm 0.10$  units, without differences between experimental groups. The EAA group depicted not only an earlier onset ( $6.9 \pm 0.3$  vs.  $7.5 \pm 0.4$  mo.;  $P < 0.05$ ) but an increased percentage of goats depicting puberty ( $70 \pm 0.28\%$  vs.  $25 \pm 0.26\%$ ;  $P < 0.05$ ). No mean serum differences ( $P > 0.05$ ) between treatments occurred for INS ( $1.2 \pm 0.06$  ng/mL), GLU ( $89.6 \pm 1.8$  mg/100 mL), COL ( $61.30 \pm 1.80$  mg/mL), TP ( $65.28 \pm 2.46$  mg/mL) and UR ( $23.42 \pm 0.95$  mg/mL), but serum T3 concentrations, favored to the EAA-supplemented goats ( $1.55 \pm 0.03$  vs.  $1.39 \pm 0.04$  ng/mL). In addition, a treatment x time interaction occurred ( $P < 0.05$ ) across time for T3, INS & COL with increases by the last third of the experimental period, concurrent with the onset of puberty. Results indicate that, in peripuberal goats, glutamate acts as a cue for sexual maturation in a glucose-independent pathway, while INS, T3 & COL seem to act as key metabolic modulators for the establishment of puberty. Whether the actions of glutamate supplementation upon INS, T3 & COL may directly affect either hypothalamic centers regulating the pulsatile release of GnRH or indirectly throughout peripheral cues reflecting T3-INS-COL actions on somatic development, remain to be determined.



R-7

**Efficiency of alfaprostol in heats and pregnancy synchronisation in African dwarf goat (*Capra hircus hircus*)**

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In order to study the efficacy of heat and pregnancy synchronisation of alfaprostol (PGF2 $\alpha$  analogue) in the West African dwarf goat (*Capra hircus hircus*), thirty two animals (4 bucks and 28 females) were used. Two doses of 2mg of alfaprostol were injected intramuscularly to each animal at 11 days interval. All behaviours related to heat was registered, but only females accepting mounting by the male were considered in oestrus. Following the treatment, 67.86% of females were observed in oestrus. However, the appearance of those heats was spread over 13 days, with 78.95% occurring between the first and seventh days after the second injection of alfaprostol. 42.10% of goats mated returned into heats within the 21st days following the acceptance of the male and only 45.45% of the remaining females maintained the pregnancy until kidding; the season during the treatment has been hardly suspected. The heats induced in African dwarf goats by alfaprostol were not very synchronous; this synchronisation technique should not be very suitable for systematic artificial insemination in african dwarf goats. Insemination on observed oestrus would yield better results of fertility.





R-11

**Characterization and cryopreservation of South African goat semen**Lehloenya, K.C.1, F.V. Ramukhithi<sup>1,2</sup>, T.L. Nedambale<sup>1,2,3</sup>, J.P.C. Greyling<sup>3</sup>*(1) Tshwane University of Technology; (2) Agricultural Research Council, (3) University of the Free State, South Africa.*

This study was conducted to evaluate fresh and frozen-thawed semen parameters of South African unimproved indigenous ( $\pm 49$  kg) and Boer goats ( $\pm 51$  kg). Electro-ejaculator was used to collect semen from 6 bucks aged 3-4 years (3 Boer and 3 SA unimproved indigenous goats). Following collection, fresh semen was evaluated for volume, pH, sperm concentration and motility. The semen samples of each buck were divided into two equal portions. One part was centrifuged in SOFaaci solution to remove seminal plasma and the other one was not. Both samples were extended with Fraction A of an egg yolk-Tris based extender, at a ratio of 1:1 and equilibrated at 25°C for 1 h. Following equilibration, semen samples were diluted 1:1 with Fraction B of an egg yolk-Tris based extender, equilibrated at 5°C for 2 h and loaded into 0.25 mL polyvinyl straws. For freezing, the rack carrying semen straws was suspended for 10 min in liquid nitrogen vapour keeping a gap of 5 cm between the surface of liquid nitrogen and the semen straws. The semen straws were then loaded into a canister and stored in liquid nitrogen tank at -196°C, until thawed. Data were analysed using Stata® V10 software. Unimproved indigenous and Boer goats had similar semen volume. However, unimproved indigenous goats had higher sperm motility (89.3 %) and low sperm concentration ( $603.5 \times 10^6$  mL) compared to Boer goats (76.9 % sperm motility and  $723.7 \times 10^6$  mL sperm concentration). The progressive sperm motility, immotile sperm and semen pH differed significantly ( $P < 0.05$ ) between the two breeds. Cryopreservation decreased semen pH and sperm motility for both Boer and unimproved indigenous goats regardless of seminal plasma removal or not. In conclusion, reduction in the sperm motility after freeze-thawing process is still a problem and requires further research on diluents and techniques that give protection to sperm during cryopreservation.



R-12

**Reproductive performances and milk yield of Draa goats under a breeding system of 3 kiddings in 2 years**

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The Draa goat is a local breed of southeastern and southern Moroccan oases. This aseasonal breed, which can breed throughout the year, is prolific and has a good milk potential comparatively to other Moroccan goat populations. In order to improve its raising conditions and its productivity, a breeding system based on 3 kiddings in 2 years was developed in the experimental station of the National Institute of Agricultural Research at Errachidia. This system was based on two groups of 40 does each, which were mated alternatively in three different seasons (February 1-March 15, June 1-July 15 and October 1-November 15) during six years. Results showed that conception rate and litter size at birth averaged 0.85 and 1.47 kids, respectively. The litter weight was 3.30 kg at birth and 13.1 kg at 90 days. Milk yield averaged 80 kg during 124 days lactation. The mating season didn't influence either conception rate, litter size at birth or milk yield ( $P > 0.05$ ). Based on these performances, annual live weight weaned and milk yield produced by Draa does were 120 kg and 20 kg, respectively. Therefore, this breeding system seems to be able to exploit the potentialities of Draa breed and to allow the improvement of its productivity, and hence meet the requirements of agricultural intensification in oasis areas.



R-15

**The time of oestrus and ovulation is not modified by the level of body condition score in the Blanca Andaluza goat**

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Previously, our group has demonstrated that goats with lower level of nutrition that bring on lower body condition score (BCS) showed lesser LH concentrations during the circannual period, independently of the photoperiodic regime. The time of ovulation depends on the adequate LH surge and, in his turn, the time of artificial insemination depends on the moment of ovulation. The Blanca Andaluza goat is an endangered Spanish goat breed and the artificial insemination is a very important technique that allows their survival and recovery program. This study was performed to test the hypothesis that the time of oestrous and ovulation could be modified by the level of BCS and as consequence determines a modification on their artificial insemination protocol. Fifteen entire, adult and non-pregnant goats were used. They were distributed into two groups according to the level of BCS: low (2.50, n = 9), medium (2.75, n = 3) and high ( $\leq 3.00$ , n = 7). At mid-December, oestrus was synchronized by intravaginal sponges containing 20 mg of fluorogestone acetate (Chronogest®; Intervet, Salamanca, España) for 12 days. Forty eight hours before pessary withdrawal a double i.m. dose of 0.8 ml of a prostaglandin F2a analogue (6 mg per goat of luprostiol; Prosolvin® Intervet, Salamanca, España) and 400 U.I. of eCG (Foligon®; Intervet, Salamanca, España) was performed. From the withdrawal sponge oestrous behaviour was controlled every 4 hours using vasectomized bucks with marking harnesses. To evaluate the occurrence of ovulation, ultrasonographic scanning was performed every four hours using an Aloka SSD-500 connected to a 7.5 MHz linear probe. No differences between groups were observed on oestrous expression that was observed at  $29.3 \pm 1.5$  h after sponge removal. Moreover, no effect of the BCS on time of ovulation was observed ( $54.5 \pm 1.8$  h after sponge removal). Our result indicates that for this breed and during the breeding season, the moment of ovulation is not different between the used BCS levels. Further studies are required to determine if lower BCS induces modification on the moment of ovulation after a synchronization treatment using intravaginal pessaries that requires an adjustment of the moment of artificial insemination. This work was supported by Grant RZ2010-00001-00-00 from I.N.I.A.-C.I.C.Y.T. (Spain). The authors wish to thank the Asociación Nacional de Criadores de Cabra Blanca Andaluza (ABLANSE) for supply of animals.



R-16

**The use of melatonin implants at the winter solstice did not improve the oestrous or ovarian response in females Mediterranean goats**

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The aim of the present study was to assess the effect of melatonin implants inserted at the winter solstice associated or not to the male effect in Mediterranean females goats on oestrous behaviour and ovarian response. Four balanced groups of females according to their body weight and body condition score were used. Two groups were submitted to a melatonin treatment inserted at the winter solstice (21st December) (n = 31, M group) and the other females, remained as control group and were not submitted to hormonal treatment (n = 31, C group). The half of each group was exposed (MALE) or not (CMALE) to the male effect. The females that were submitted to the male effect were isolated from males during 41 days and the females that were not submitted to the male effect remained in permanent contact with males from the onset of the experiment. At joining, all entire males used, were fitted with marking harnesses, and oestrous activity was recorded daily by direct visual observation. The occurrence of ovulation was assessed by the presence of *corpora lutea* observed by transrectal ultrasonography ten days after oestrous detection using an Aloka SSD-500 connected to a 7.5 MHz linear probe. No differences between groups on the oestrous behaviour (92% of response) or the ovarian activity (81%) associated to the oestrous behaviour were observed. These results indicate that the melatonin implant inserted at the winter solstice did not improve the oestrous or ovarian response to the male effect in Mediterranean goat females at the end of the breeding season, but nevertheless this period could be adequate to induce a breeding period, even without any treatment. This work was supported by Grant PETRI 95-0964.OP from C.I.C.Y.T. and RZ2010-00001-00-00 from I.N.I.A.-C.I.C.Y.T. (Spain).



R-17

**The onset of the reproductive activity of Blanca Andaluza goat kids born in autumn is modified by the level of body condition score**

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The Blanca Andaluza goat is an endangered Spanish goat breed. This breed is raised using semi-extensive or extensive systems based on the grazing of natural pastures. The systems are characterized by a large land surface per animal, few sanitary problems and grazing as an integral part of animal feeding with variations on the food availability. As consequence the nutrition is a key point to obtain adequate reproductive performances at this kind of livestock that avoid the survival of this breed. The objective of the present study was to determine the onset of the reproductive activity of the Blanca Andaluza goat kids that were born in autumn depending on the level of body condition score (BCS). Forty-two goat kids born in autumn (September) were used. They were divided into two groups according to their BCS: group with low ( $\leq 2.50$ ,  $n = 21$ ) and group with high BCS ( $\geq 2.75$ ,  $n = 21$ ). From the onset of the experiment, oestrous activity was tested daily using young entire aproned or vasectomised bucks with marking harnesses. Ovarian activity and ovulation rate were determined by the presence of *corpora lutea* observed by transrectal ultrasonography ten days after oestrous detection. The onset of the breeding activity according to the first detected oestrous was modified by the BCS ( $P < 0.001$ ). The goat's kids with higher BCS showed an earlier onset of the breeding activity (25th August  $\pm 1.9$  vs. 11st October  $\pm 7.5$  days, for high and low group, respectively). On the whole, the mean onset of the breeding activity was 18th September  $\pm 5.3$  days. However, the ovulation rate at the first detected oestrous was no different between groups ( $1.10 \pm 0.05$  *corpora lutea*,  $P > 0.05$ ). This result indicates that the BCS is a parameter that clearly modifies the onset of the reproductive activity in the Blanca Andaluza goat kids, as consequence an adequate nutrition level during the prepubertal period is necessary to obtain an earlier onset of the breeding activity. Moreover, in the whole, this breed initiates their breeding activity slightly before than other Spanish goat breeds. This work was supported by Grant RZ2010-00001-00-00 from I.N.I.A-C.I.C.Y.T. (Spain). The authors wish to thank the Asociación Nacional de Criadores de Cabra Blanca Andaluza (ABLANSE) for supply of animals.



R-18

### **Goat semen freezing using different concentrations of glycerol in the Colombian Creole, Alpine and Saanen**

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The knowledge and introduction of protocols for controlling reproduction in goats, facilitates the organization of the system, more efficient use of manpower and resources, according to supply and demand conditions in the markets. Semen preservation techniques have enabled the efficient use of players with desirable characteristics, yet are gaps in the knowledge of biotechnological processes that merit research to deepen understanding and understanding of physiological mechanisms that determine the observed responses. In proceedings of goat semen cryopreservation, we evaluated the effect of different concentrations of glycerol on sperm quality after thawing. Ejaculates were taken to Colombian Creole goats (n = 4), Alpine (n = 4) and Saanen (n = 3). The semen was diluted in fraction A - citrate-fructose - 2.9% and 20% egg yolk. Temperature was lowered to 5°C (2 hours) and stabilized for 2 hours. Each ejaculate was divided into three aliquots and diluted in a fraction B Glycerol concentrations of 6, 7 and 8%. Semen was packaged in 0.5 ml straws. Each with a minimum of motile spermatozoa. The straws were frozen in liquid nitrogen and thawed at 37°C/60 seconds for examination. ANOVA was performed for a completely randomized design with a 3 x 3 factorial design, with analysis using the SAS - Duncan test. The optimal level of glycerol concentration was 7%. This percentage will get valid results post-thaw, with respect to the variable quality of the sperm cell. This is reflected in the recovery of motility, lower sperm average mortality, lower rates of abnormalities secondary and higher percentage of normal sperm. The semen of Colombian Criollo has the best average post-thaw, considering quality as an indicator of recovery of progressive motility and increased percentage of live sperm cells. The goats with frozen semen diluents containing glycerol levels between 6% and 8%, has good average sperm quality post - thaw, in terms of: normal, vitality and motility recovery. This opens the possibility of using thinner with either glycerol concentrations employed.



R-20

**The inhibition of 17 $\beta$ -estradiol synthesis by letrozole affects spermatogenesis in Saanen bucks (*Capra hircus*)**

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The presence of estrogens in serum has been demonstrated in males from several species. However no information is available for the buck. Furthermore, knowledge of the role of estrogens in the male is incomplete. The objectives of this study were: 1) To investigate the presence of 17 $\beta$ -estradiol (E2) in the blood of the male goat 2) To investigate the effects of P450-aromatase inhibition by the competitive, non-steroid inhibitor letrozole, on spermatogenesis and agonistic behaviour. Twelve Saanen bucks were used, randomly assigned to one of two groups, 6 control and 6 with letrozole treatment. Letrozol was orally administered (2.5 mg/day) for 15 days. Serum samples were obtained from the jugular vein every third day 5 days before beginning of the treatment, during treatment and 5 days after the end of it. Serum E2 and testosterone (T4) concentrations were measured by an enzyme immunoassay. Simultaneously, the agonistic behaviour of the goats was recorded daily for 3 h evaluating butts, threats, chases and avoidance to investigate dominance hierarchies in the groups. Scrotal circumference was measured and semen collected by artificial vagina every 4 days. Semen characteristics were evaluated: volume, color, mass and individual motility, concentration, viability and acrosome integrity. ANOVA and Mann-Whitney post-test were used for analysis of data. No differences in agonistic behaviour were found between groups. Average E2 and T4 concentrations before treatment were:  $36.04 \pm 7.52$  pg/ml, and  $2.23 \pm 0.79$  ng/ml. Letrozole treatment significantly increased T4 concentrations but did not change E2 levels ( $P < 0.05$ ). Scrotal circumference significantly decreased after letrozol administration ( $27.3 \pm 0.2$  vs.  $26.1 \pm 0.1$  cm). Ejaculate volume and sperm concentration decreased ( $0.6 \pm 0.0$  vs.  $0.4 \pm 0.0$  ml,  $P < 0.0001$ , and  $870.8$  millions  $\pm 1.8$ /ml vs.  $797.8$  millions  $\pm 4.0$ /ml,  $P < 0.0001$ ), respectively. Mass and individual motility began to significantly decrease after the 5th sampling ( $90.7 \pm 1.3$  vs.  $85.0 \pm 1.3$ , and  $90.71 \pm 1.3$  vs.  $80.5 \pm 4.7$ , respectively). In addition dead sperm cells increased in the letrozole group after the 4th sampling ( $11.3 \pm 1.1$  vs.  $16.5 \pm 0.4$   $P < 0.0001$ ). Cells with an intact acrosome were more frequent in the control group compared to the letrozole group. Our results show that low levels of E2 are present in the buck serum. Inhibition of P450-aromatase resulted in sperm parameters alterations, indicating that estrogen synthesis may be important for male reproduction.





R-21

### **Seasonal freezability on buck semen**

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In order to study the effect of seasons on freezability of buck semen at 19° parallel in the north hemisphere. The effect of season on the frozen goat semen quality in three diluents was evaluated. We used four males of Alpine and Anglo Nubian breed, obtaining semen by artificial vagina, twice a week, two ejaculations per session. Each ejaculate was divided into four aliquots as follows: fresh semen, frozen semen in milk diluents, frozen semen in lactose, frozen semen in sucrose. From each ejaculate the following parameters were evaluated: volume of ejaculate (ml), sperm concentration (109/ml), progressive motility percentage in fresh semen and after thawing. Once a week the males were bled to assess the level of serum testosterone (ng/ml). The results were evaluated by analysis of variance test, using breed and the male as block and progressive motility of fresh semen as a covariate. There was an effect of the season, the diluent ( $P < 0.0001$ ) and interaction season-extender ( $P < 0.005$ ) on progressive motility of sperm on thawing. Moreover there was no effect of race and the number of ejaculated on the same property ( $P > 0.05$ ). In conclusion, there was no effect of breed, and the number of male ejaculate on motility of thawed semen. We are reporting a significant effect of season, type of diluents and the interaction of these, on the motility of thawed semen. Fall and winter are the best seasons for freezing semen, because you get the best after thawing motilities, showing better results to freeze and thaw of sperm in these times. The best motility was obtained with sucrose-egg yolk based diluent. Best motilities of semen after thawed were obtained on sucrose-egg yolk during all seasons. The ability of sperm to freeze and thaw was similar during the winter season for all diluents, making it the best time to freeze semen.



R-24

**The effect of exogenous anabolic steroids on growth performance, testicular and seminal characteristics of yearling breeding Boer goat bucks**

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The effect of anabolic steroid treatment on young Boer goat bucks (12 months of age; mean body weight of  $47.0 \pm 3.8\text{kg}$ ) to improve performance artificially, was investigated. Bucks were individually housed, randomly allocated to two treatment groups and fed a pelleted maintenance diet (8.5 MJ ME/kg and 13% CP). Bucks in the first group ( $n = 9$ ) received a weekly i.m. injection of 25 mg Deca-durabolin (testosterone) for a total period of 16 weeks. The remaining bucks ( $n = 10$ ) served as the controls. At the end of the 16-week treatment phase an additional 12 week recovery monitoring phase (no treatment) was implemented. During the trial, semen was collected (artificial vagina) weekly, where semen volume, colour, pH and sperm density and motility was recorded. The body parameters recorded weekly included body weight, scrotal circumference and volume. The body parameters found to be significantly ( $P < 0.05$ ) affected by treatment with the anabolic steroid, was scrotal circumference and volume. This degeneration of the scrotal measurements was ascribed to the negative feedback system induced by the exogenous anabolic steroid treatment (androgenic effect). By the end of the recovery period, the difference in scrotal circumference and volume between the treatment groups had decreased to 7% - with the treated bucks still recording a significantly ( $P < 0.05$ ) lower scrotal volume, compared to the control group ( $584.4 \pm 87.3$  ml vs.  $640.0 \pm 81.0$  ml respectively). Despite this reduction in scrotal circumference and volume none of the seminal parameters recorded in the trial (i.e. sperm motility, semen volume and pH, sperm concentration and percentage live sperm) were significantly affected by the steroid treatment. It would also seem as if the inhibitory effect of steroid treatment on testicular development was only temporary and that young males for breeding can recover without any apparent loss in fertility, as measured by semen quality. The lack in body weight response of this illegal practice, could possibly be ascribed to the age of the animals and the relatively low energy content of the diet.



R-27

**Trehalose supplementation in a defined media for goat semen cryopreservation lessens ATP loss after thawing**

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The development of defined media for semen cryopreservation is highly desirable since it would ensure a higher reproducibility of results and biosafety of freezing media. Current study aimed to develop a defined media for goat semen cryopreservation. Ejaculates were obtained by artificial vagina from 3 adult goats (*Capra hircus*) aged 4 years and pooled semen was frozen with the addition of glycerol (4%; v/v) in 4 different extenders: (a) recommended Tris-based extender supplemented with 20% egg yolk (v/v) (CTR); (b) CTR extender (CTR defined); (c) CTR extender supplemented with 20% egg yolk (v/v) and trehalose 160 mM (TRH); (d) CTR extender supplemented with trehalose 160 mM (TRH defined). Osmolality of the tested media was 380-390 mOsm/kg. Viability, computer assisted sperm analyzer (CASA) motility parameters and ATP intracellular concentration was evaluated before and after thawing. Trehalose significantly enhanced sperm viability after thawing compared with CTR extender (54.6 vs. 35.4% live cells;  $P < 0.01$ ), and no differences were observed between defined and un-defined media supplemented with trehalose (39.7 vs. 54.6 respectively) and control (31.4 vs. 35.4, respectively). Percentages of progressive motile ( $34.9 \pm 3.7$  in TRH vs.  $22 \pm 3.7$  in CTR,  $12.4 \pm 3.7$  in CTR defined and  $18.3 \pm 3.7\%$  in TRH defined extenders;  $P < 0.05$ ) and rapid spermatozoa ( $40.7 \pm 3.7$  in TRH vs.  $25.3 \pm 3.7$  in CTR,  $16.9 \pm 3.7$  in CTR defined and  $21.6 \pm 3.7\%$  in TRH defined extenders;  $P < 0.05$ ) were significantly higher in un-defined extender supplemented with trehalose compared to the other groups. In addition, no differences in ATP intracellular concentration were observed between fresh and frozen semen in TRH defined media ( $119.1 \pm 14.4$  vs.  $89.7 \pm 14.4$ , respectively), and these values were significantly higher compared to the other groups ( $50.7 \pm 18.5$  in CTR defined,  $41.3 \pm 18.5$  in TRH and  $18.9 \pm 18.5$  nmol/10<sup>9</sup> sperm in CTR;  $P < 0.05$ ). In conclusion, our data evidenced that the addition of trehalose in a defined extender ensures spermatozoa survival to the freezing and thawing procedures and prevents the severe energetic loss caused by cryopreservation.



R-28

### **High susceptibility to vitrification procedures of in vitro matured goat oocytes**

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The improvement of female gamete cryopreservation gives a new opportunity to avoid the erosion of animal resources and contributing to maintain biodiversity in the world. Goat oocytes have been cryopreserved using different approaches and stages of development, but very few studies have been conducted on vitrification of in vitro matured goat oocytes. This study was designed to evaluate the effects of vitrification procedures on survival and developmental competence of in vitro matured goat oocytes compared to sheep oocytes. The vitrification protocol utilized in this study has already been successfully applied in the ovine species in our laboratories. Briefly, in vitro matured goat and sheep oocytes were incubated in Dulbecco Phosphate Buffered Saline without  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$  containing 20% FCS (PBSCaMg free/FCS) supplemented with 7.5% dimethyl sulfoxide (DMSO) and 7.5% ethylene glycol (EG). After 3 min, oocytes were transferred to the same medium containing trehalose 0.5 M, 16.5% DMSO and 16.5% EG and immersed into  $\text{N}_2$  using cryotop as device. After warming, both vitrified goat and sheep oocytes were morphologically evaluated to survival. The developmental competence of vitrified/warmed goat oocytes (VWG) and vitrified/warmed sheep oocytes (VWS) were assessed after in vitro fertilized and in vitro cultured up to the blastocyst stage in standard conditions. Fresh goat (FG) and fresh sheep (FS) oocytes were utilized as control. Data were analyzed using Chi square test. Survival rate was significantly lower in VWG oocytes compared to VWS (50/81 vs. 57/65;  $P < 0.01$ ), while no differences were observed on the survival rate among VWS, FG and FS. Cleavage rate was significantly lower in VWG and VWS oocytes compared to the relative fresh control (15/50 and 36/57 vs. 43/55 and 52/60 respectively;  $P < 0.05$ ). Moreover, VWG oocytes showed lower cleavage rate compared to VWS oocytes (15/50 vs. 36/57,  $P < 0.01$ ). Blastocyst output was highly reduced in vitrified oocytes compared to control. No blastocyst was produced in VWG group, with significantly lower rate compared to VWS (0/50 vs. 6/57;  $P < 0.05$ ) and fresh control (0/50 vs. 16/55;  $P < 0.01$ ). We conclude that low developmental competence evidenced in vitrified goat oocytes could be related to high sensitivity to vitrification procedures, but also to low efficiency of in vitro embryo culture itself. (Supported by Fondazione Banco di Sardegna).



R-29

### **Assessment of protein pattern modifications during goat sperm capacitation by 2D gel electrophoresis**

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Sperm capacitation in goat requires three steps before in vitro fertilization to determine the ability to bind and penetrate the oocyte envelopes. These steps are in order: washing from seminal plasma, percoll centrifugation and 59 min in vitro culture. The aim of this work was to determine goat sperm polypeptides before and after capacitation using bidimensional polyacrilamide gel electrophoresis (2D-PAGE). Ejaculates were threefold washed in 15 ml PBS by 10 min centrifugation at 900 g. Ten microliter of pelleted spermatozoa were used to starting point in protein analysis (before capacitation) while the residual was stratified in 3 ml 45/90% percoll gradient and centrifuged at 1,100 g for 15 min. Pelleted semen was cultured in SOF for 50 min and used to test the fertilizing ability and protein analysis. To assay fertilizing ability treated spermatozoa were coincubated with in vitro matured goat oocytes in SOF for 24 h at 5% O<sub>2</sub> and 5% CO<sub>2</sub> and then cultured for 9 days in the same medium supplemented with aminoacids. Cleavage and blastocyst rates were registered. To protein analysis, treated sperms were threefold frozen/thawed, extracted protein were quantified and 200 µg were used for 2D-PAGE (pH 3-10 IPG and 11% SDS-PAGE). Electrophoretic gels were silver stained and analysed using PD Quest Advanced 2D software (Biorad). Results showed that the capacitation treatment enabled spermatozoa to penetrate oocytes and produce embryos. Fertilized oocytes (n = 60) cleaved at high rate (76.7%) and 17 blastocysts were produced (28.35%). Statistical analysis of silver stained electrophoretic gels showed that 273 spots (matching rate 29%) differ between before and after capacitation gel electrophoresis. Gel electrophoresis of sperm treated only with percoll, without subsequent in vitro culture, differ from the control in 174 spots (matching rate 35%) and, consequently, 99 spots are modified during in vitro culture. The more distinctive alterations are in the basic protein clusters at 70, 100 and 120 kDa, in the neutral protein clusters at 40, 50, 100, 110 and 130 kDa and at 20 kDa acidic protein cluster. In conclusion capacitation in vitro using percoll treatment and culture in vitro of goat spermatozoa before in vitro fertilization modify the 35% of the protein pattern enabling spermatozoa to fertilize. Most of above mentioned modifications are induced by percoll treatment. Further analysis are needed to characterize protein modifications.



R-30

### Reproduction practices and efficiency in dairy goat herds in Greece

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The objective of the study was to describe current practices and to assess efficiency in reproduction of dairy goat herds in Greece. For this reason, 60 randomly selected goat herds (23,426 goats) from 16 prefectures were surveyed from September 2011 to March 2012. Data were collected during pre-scheduled on-farm visits, using a case-specific questionnaire. The latter comprised general questions about livestock and management practices including reproductive management and performance. Descriptive statistics were calculated and herds were clustered by means of hierarchical and k-means cluster analysis using as grouping variables litter size, abortion, stillbirth rate, and fail-to-conceive rates. The recognized clusters were compared using ANOVA followed by Bonferroni as post-hoc test. All the analyses were performed using SPSS 18©. The average herd comprised  $390.0 \pm 325.4$  adult does,  $29.0 \pm 25.6$  bucks and  $83.0 \pm 73.4$  yearlings. Mean age at first mating was  $8.7 \pm 3.25$  months, whereas duration of breeding season was  $5.4 \pm 1.95$  months taking place from May to August. Average litter size was  $1.6 \pm 0.25$  kids. The mean abortion, stillbirth and fail-to-conceive rates were  $0.05 \pm 0.055$ ,  $0.02 \pm 0.025$  and  $0.10 \pm 0.086$  (from 0.0 to 0.34), respectively. Cluster analysis produced four clusters each one having  $\geq 10$  flocks (from 10 to 20 flocks). Average litter size and abortion, fail-to-conceive and stillbirth rates were 1.22, 0.04, 0.09 and 0.03 for cluster 1, 1.70, 0.04, 0.07 and 0.01 for cluster 2, 1.97, 0.05, 0.05 and 0.02 for cluster 3 and 1.47, 0.07, 0.16 and 0.02 for cluster 4. Comparisons between clusters produced significant differences ( $P \leq 0.001$ ) regarding annual milk yield, litter size and fail-to-conceive rate. Namely, annual milk yield per doe was significantly ( $P \leq 0.01$ ) lower in cluster 1 herds compared to clusters 2 and 3 and significantly higher ( $P \leq 0.01$ ) in cluster 3 herds compared to clusters 1 and 4. Moreover, mean litter size of herds in clusters 1 and 3 were significantly ( $P \leq 0.001$ ) lower and higher, respectively, compared to the other two clusters. Fail-to-conceive rate was significantly higher in cluster 4 compared to clusters 2 and 3 ( $P \leq 0.01$ ). Significant differences exist among goat herds in reproductive efficiency and considerable improvement in reproductive performance can be achieved by adopting the appropriate measures. Herd clustering can be useful when devising such projects. The work was funded by FP7 project SOLID No 266367.



R-31

### **Employ of purified FSH and LH for embryo production and their cryopreservation by different methods in goats**

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Two experiments were carried out with the aims to evaluate the efficiency of in vivo embryo production protocols and storage of embryos in goats. Experiment I - For embryo production, fifty goats were synchronized for estrus (FGA vaginal sponge, 45 mg, 9d, plus PGF2alpha, 50 µg, 7th d) and subdivided into three homogeneous experimental treatment groups (n = 13) corresponding to the following superovulatory treatments over 3 days with six decreasing doses of purified gonadotrophic preparations (total dose of 250IU pFSH): A) control, FSH/LH ratio = 1:1 kept constant throughout the treatment; B) FSH/LH ratio = 2:1 kept constant throughout the treatment; C) FSH/LH ratio = 2:1 and decreasing daily FSH/LH ratio in the 3 days of treatment (3.4 – 1.7 – 0.8, respectively). The goats were checked for estrus and hand mated. Ovarian response and embryo production were assessed at 7th d after estrus. The onset of oestrus occurred earlier ( $P < 0.05$ ) in the groups A (25.2 h) and C (25.4 h) compared to the group B (33.4 h). The percentages of goats producing embryos resulted higher ( $P < 0.05$ ) in the groups A and C (92.3 and 76.9%) than in group B (57.1%). Group A proved higher ova recovering and transferable embryos compared to the group B (8.5 and 89.7% vs. 3.6 and 54.2%;  $P < 0.05$ ). Experiment II - Four freezing methods were evaluated based upon post-thaw embryo quality: CF1) conventional slow freezing by 1.5 M ethylene glycol (EG) solution; CF2) conventional slow freezing by 3.0 M methanol (MET) solution; QF) quick freezing by solution of EG 3.0 M + saccharose 0.25 M + 5% fetal calf serum (FCS), exposure of embryos at N vapour (2 min) followed by their plunging into liquid N; V3) vitrification by three solutions at increasing concentration of glycerol (GLY) and EG (GLY 1.4 M; GLY 3.4 M + EG 1.4 M; GLY 4.6 M + EG 3.4 M, respectively) and direct immersion into liquid N. At thawing, embryo viability was evaluated on the basis of their morphological features. QF and V3 methods proved the higher ( $P < 0.01$ ) transferable embryos percentages (75.7 and 77.4%) compared to CF1 and CF2 methods. In conclusion, the results indicate that treatments B and C did not improve superovulatory response compared to treatment A; cryopreservation methods QF and V3 affected the best morphological features of embryos after thawing and could be suitable for embryos storage.





R-35

**Effect of donor cell types on the in vitro developmental potential of caprine interspecies somatic cell nuclear transfer embryos**

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This study aim to evaluate the effect of donor cell types namely, fetal fibroblast (FF) and ear fibroblast (EF) cell on the in vitro developmental (IVD) potential of cloned caprine embryos generated through caprine-bovine interspecies somatic cell nuclear transfer (iSCNT) approach. Bovine oocytes were collected from abattoir and subjected to in vitro maturation (IVM) for 22 - 24 hours. The matured bovine oocytes were allocated into 3 groups in which 2 groups will be reconstructed (cloned) with caprine FF and EF cells, respectively while the remaining group was parthenogenetically activated (PA) as a control group for this study. The cloned caprine embryos and PA embryos were cultured in vitro for 7 days in a modified KSOMaa culture medium system and the IVD rate of the embryos was recorded. The fusion rate of caprine FF cell with enucleated bovine oocyte (82.2%) was significantly ( $P < 0.05$ ) higher compared to caprine EF cell with the bovine enucleated oocyte (74.6%). The rates of cleavage and development to the 4-cell and 8-cell stages for caprine iSCNT embryos derived from EF cell was significantly ( $P < 0.05$ ) higher compared to caprine iSCNT embryos derived from FF cell. However, when approaching morula and blastocyst stage, the IVD competency of both EF- and FF-derived caprine iSCNT embryos did not differ significantly ( $P > 0.05$ ). The blastocyst rates between PA embryos (12.7%) and EF- (9.0%) as well as FF- (13.5%) derived cloned embryos did not differ significantly ( $P > 0.05$ ). In conclusion, both the caprine FF and EF cell had similar potential to support the development of caprine iSCNT embryos to the blastocyst stage.



R-36

### **Sperm capacitation and acrosome reaction *in vitro* to indirectly assess fertility of young goat bucks**

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Reproductive capacity of males intended to mate a big number of females can be assessed by both direct and indirect tests of fertility. The indirect are widely used because they are cheaper, easier and quicker to perform than the direct tests; however they are less precise to predict male fertility. The objective of this work was to assess the capacity of spermatozoa from different males to carry out the process of capacitation and acrosome reaction. For this, ten young Alpine goat bucks, 18 months of age, were tested for their sperm capacity to suffer capacitation and acrosome reaction. Semen (5 ejaculates from each male) was collected by artificial vagina, washed to remove seminal plasma, resuspended in a special medium (TALP) and incubated at 38°C in 5% CO<sub>2</sub> in air. One aliquot of sperm diluted in TALP was added 2 µg/ml of progesterone while other was incubated without progesterone. Before and after incubation, progressive motility, capacitation status (CTC assay) and acrosome integrity (lectins, PSA-FITC) were assessed. Sperm variables were compared between males taking into account the difference of each variable before and after incubation (Time 0 minus Time 4 hrs) by Kruskal-Wallis ANOVA. Regarding sperm motility there were differences between males ( $P < 0.05$ ) both with and without progesterone; however, sperm incubation with progesterone better revealed differences among males. With respect to acrosome integrity there were no differences between males regardless of progesterone; however, data from each male were less dispersed when incubated in presence of progesterone. On the other hand, there were no differences between males on the proportion of non-capacitated acrosome-intact spermatozoa (Pattern F of CTC assay) regardless of progesterone. In conclusion, sperm incubation to promote capacitation in the presence of progesterone to induce acrosome reaction revealed some differences between males.



R-38

**Effect of the type of egg yolk–based extenders and the removal of seminal plasma on sperm cryopreservation of goat from Blanca de Rasquera breed**

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In order to accelerate the preservation of this Catalanian goat breed in extinction danger, we proposed the constitution of a sperm bank from breeders previously selected in early ages in function of their genetic variability. First, the main objective was to reduce the heterogeneity of the cryopreservation method and the potential risk of microbiological contamination by replacement of fresh egg yolk by pasteurized powered egg yolk. Simultaneously, we studied the effect of the fresh clarified egg yolk, obtained by centrifugation of fresh egg yolk twice at 10,000 x g for 45' at 4°C. In addition, we also assessed the effect of the seminal plasma on sperm freezability of young males. Briefly, fresh ejaculates from 6 bucks (1 year old) were collected by artificial vagina and immediately mixed in equal quantities. Then the pooled semen was split into two samples. One sperm sample was washed by centrifugation and then the pellet was split into three equal aliquots and re-suspended in an extender containing 15% (v/v) of different type of egg yolk (powered, fresh or fresh clarified) supplemented with 5% glycerol in a Tris-based medium. The other semen sample was directly split into three equal aliquots and re-suspended in the same extenders, but containing 2% (v/v) of different type of egg yolk (powered, fresh or fresh clarified). The sperm cryosurvival after thawing, determined by eosine-nigrosine stain (mean ± SE, n = 6), was significant higher ( $P < 0.0001$ ) when the spermatozoa were washed and preserved in extenders containing 15% of egg yolk, showing not significant differences between powered ( $44.0 \pm 7.5$ ), fresh ( $48.1 \pm 5.9$ ) and fresh clarified egg yolk ( $42.3 \pm 2.8$ ) based media. Likewise, when whole semen was preserved in extenders containing only 2% of egg yolk, even the sperm survival was quite lower in the three tested extenders, not differences either were found between powered ( $4.4 \pm 1.8$ ), fresh ( $6.0 \pm 1.2$ ) and fresh clarified ( $3.0 \pm 0.4$ ) egg yolk based media samples. Nevertheless, the sperm quality motion characteristics, analysed by a computer-assisted sperm analysis system (ISAS®), were similar between all the treatments ( $P > 0.05$ ), except the total motility ( $P < 0.0001$ ), suggesting that the pasteurized powered egg yolk is effective for freezing goat sperm, but the removal of seminal plasma on goat sperm cryopreservation is still recommended. Supported by INIA (RZ2009-00008-00-00), Generalitat de Catalunya (2009SGR0621 and CUR-DIUE) and FSE and Fundacion Carolina.



R-39

**Effect of the buffer system, cryoprotectant and presence of antioxidant on motile sperm population characteristics during goat sperm cryopreservation**

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Our aim was to study the effect of the buffer system Tes-Tris (TEST) compared to the Tris and citric acid buffer system on sperm motion characteristics during goat sperm cryopreservation, analysed by a computer-assisted sperm system (ISAS®). Both systems were simultaneously tested in a 1% (w/v) soybean lecithin or in a 15% (v/v) powered egg yolk-based media supplemented both with 5% glycerol. Also, we assessed the effect of the inclusion of 5 mM of butylated hydroxytoluene (BHT) as an antioxidant. Briefly, fresh ejaculates from 6 Blanca de Rasquera bucks (1 year old) were collected by an artificial vagina and immediately mixed in equal quantities. The pooled semen was washed by centrifugation, and then the pellet was split into 8 equal aliquots and re-suspended in one of the 8 different extenders before freezing. In order to test the presence of separate sperm subpopulations, samples of each different treatment were taken and analysed by ISAS system after thawing. Motility data were analyzed, with the clustering procedure FASTCLUS, dividing the thawed motile sperm population in four separate subpopulations (SP), showing significant differences ( $P < 0.0001$ ) in their motion characteristics. On the other hand, significant differences were found on the percentages of distribution of these four subpopulations (SP1 =  $22.2 \pm 3.7$ ; SP2 =  $5.3 \pm 2.8$ ; SP3 =  $1.2 \pm 0.8$  and SP4 =  $71.3 \pm 6.6$ ;  $P < 0.0001$ ; mean  $\pm$  SD; n = 6) between treatments. Considering that the present results are still preliminary, we could conclude that separate subpopulations of spermatozoa with different motility characteristics coexist in the thawed motile sperm population showing different behaviour in the different cryopreservation extenders, suggesting that more analysis should be tested in order to investigate the role of these subpopulations on the fertilization success. Supported by INIA (RZ2009-00008-00-00), Generalitat de Catalunya (2009SGR0621 and CUR-DIUE) and FSE.



R-40

### **Effect of different cryoprotectants on refrigerated sperm before cryopreservation of small ruminant semen**

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In an attempt to study different strategies on small ruminant sperm cryopreservation, first we tested diluents free from additives of animal origin as egg yolk after sperm refrigeration. In addition, as glycerol is potentially cytotoxic, we also tested the efficiency of trehalose as an alternative on the subsequent sperm cryopreservation. Therefore, this experiment was designed to assess the effect of the inclusion of 0.6 mM of butylated hydroxytoluene (BHT) or 1% (w/v) soybean lecithin or 15% (vol/vol) powered egg yolk supplemented with 5% glycerol or 100 mM of trehalose in a Tris-based medium on refrigerated sperm. Briefly, fresh ejaculates from 6 young bucks (1 year old) were collected by an artificial vagina and immediately mixed in equal quantities. Spermatozoa were washed by centrifugation, and then the pellet was split into six equal aliquots, resuspended in one of the six different extenders and refrigerated for 4 hours at 5°C before freezing. Likewise, fresh ejaculates from 8 young rams (1 year old) were collected and processed as buck semen samples. Sperm cryosurvival after refrigeration was determined by eosine-nigrosine stain and sperm motion parameters analysed by a computer-assisted sperm analysis system (ISAS®). The highest sperm viability percentage (mean  $\pm$  SE, n = 6) on refrigerated goat sperm was observed in egg yolk based media supplemented with trehalose ( $68.0 \pm 5.9$ ), not showing significant differences with the others extenders, except with the viability of the samples in BHT based media supplemented with 5% glycerol ( $38.1 \pm 4.8$ ,  $P < 0.001$ ) or trehalose ( $40.8 \pm 7.0$ ,  $P < 0.001$ ). On the other hand, also the worse results on refrigerated ram sperm were observed when the spermatozoa were preserved in BHT based medium supplemented with 5% glycerol ( $34.6 \pm 3.3$ ,  $P < 0.001$ ), showing only significant differences with the sperm viability obtained in egg yolk based media supplemented with glycerol ( $54.1 \pm 6.3$ ) and in soybean lecithin based media supplemented with trehalose ( $52.2 \pm 3.4$ ), meanwhile the observed viability in all the others refrigerated samples was similar. Nevertheless, the sperm quality motion characteristics were quite different between all the treatments in these two species, suggesting that more analysis should be made in order to explain these differences and their biological significance. Supported by INIA (RZ2009-00008-00-00), Generalitat de Catalunya (2009SGR0621 and CUR-DIUE) and FSE and Fundacion Carolina.



R-41

**Melatonin treatment in spring and reproductive performances in Sarda goat breed**

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Seasonal reproductive activity in goats living in temperate zones is under photoperiodic control. The organic informer of daily sunlight is the melatonin hormone, secreted by epiphysis, mainly during dark hours. Exogenously administered melatonin from continuous slow release implants has been shown to advance the onset of the breeding season in goat males and females by mimicking the stimulatory effect of short days. The aim of our research was to study the effect of exogenous melatonin on fertility and litter size in Sarda goat breed. The study was conducted on a farm located in Sardinia (latitude 39° 05' N). Two hundred adult, non-pregnant, lactating, female Sarda goats, aged between 4.5 and 6.5 years at the beginning of the experiment and kidded from at least 5 months, were chosen. The reproductive activity of all the goats was recorded during the two years preceding the study. Animals were divided into 2 groups (M and C) of 100 heads each: group M on May 1st received subcutaneously a single slow-release implant at the base of the left ear, containing 18 mg melatonin (Melovine®, Ceva-Vetem, Agrate Brinaza, MI), while group C received no treatment. On June 5th, 8 buck were introduced in the two groups and removed after 40 days. Of each animal kidding date and number of born kids were recorded. The number of kidded does in group M at 160 days from ram introduction was higher compared to group C ( $P < 0.05$ ). After 190 days from males introduction the same number of kidded does was recorded in groups M and C. No statistical differences were found in litter size between the two groups. Results show that when treated and untreated groups were kept together, the difference in fertility rate between groups is attenuated, which is the result of a carry-over effect. Compared to previous years the goats showed an advanced kidding date of approximately two months, and a greater concentration of the parturitions. The carry-over effect is of great importance in reproductive management of Sarda goats as it allows treating also only a portion of the flock to obtain an improvement in the reproductive efficiency of the entire flock.



R-42

**Pregnancy-associated glycoprotein (PAG) in pregnant Boer goats assessed by ELISA with different antisera**

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The present investigation addresses the PAG profile of pregnant Boer goats and the question whether it is possible to detect pregnancy in goats with the use of an ovine or bovine assay system. Measurement of pregnancy-associated glycoprotein (PAG) in blood is in the process of becoming an established means of pregnancy detection in cows. PAG is produced by trophoblast and placenta cells and appears in maternal blood where it may serve as a reliable indicator of the presence of a viable fetus. The occurrence of PAG in pregnant females has been established in several ruminants, including the goat. Jugular blood samples were drawn twice weekly from 8 pregnant Boer goat does from mating until several weeks after parturition. Blood was assayed for PAG by ELISA (Friedrich and Holtz, 2010, *Reprod Dom Anim* 45, 142-146) using caprine (AS706), ovine (AS780) and bovine (AS726) polyclonal antibodies (provided by J.F. Beckers, Liège, Belgium). The PAG profile established when using caprine antiserum was characterized by a rapid increase to a climax of 69 (SEM 9) ng/ml 56 days after conception, followed by a gradual decline to 16 (SEM 3) ng/ml at parturition and 0.3 (SEM 0.07) ng/ml four weeks postpartum. With ovine antiserum a similar profile was recorded, though at a slightly higher level with maximum 92 (SEM 14) ng/ml. With both antisera the difference between pregnant and non-pregnant does permitted a reliable pregnancy diagnosis from 4 weeks of pregnancy onward. In an assay system based on bovine antiserum, PAG levels were no different from those achieved with the other antisera up to 2 weeks of pregnancy. The subsequent increase, however, was extremely low, reaching a maximum of merely 3.1 (SEM 0.2) ng/ml and remained there until after parturition. When using a different scale, however, it became evident that, though the PAG pattern was different, the increase over the level of non-pregnant does reached significance as soon as 3 weeks after conception. It may thus be concluded that it is possible to reliably detect pregnancies in goats by measuring the PAG concentration in blood from 4 weeks of pregnancy onward when using caprine or ovine antisera and from 3 weeks of pregnancy onward in a bovine assay system. With the bovine pregnancy test becoming increasingly available worldwide, this finding may be of practical relevance for goat owners.





R-43

### **Ultrasound vs. laparoscopic assessment of the number of ovulations in superovulated goats**

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Ever since the availability of endoscopy ovaries may be inspected in situ without full-fledged surgical intervention. A possible alternative would be the use of B-mode ultrasonography. Both approaches were applied to assess the ovarian response in 50 superovulated Boer goat does. From the end of treatment until 48 hours after the end of standing estrus echographic (ALOKA SSD-500, Japan, equipped with transrectal 7.5 MHz linear array transducer ALOKA UST-5561-7.5) inspection of ovaries was conducted at 12 hour intervals. Follicles were measured and recorded diagrammatically. Follicles more than 4 mm in diameter disappearing between two consecutive observations indicated the number of ovulations. Five days after standing estrus, the same does were subjected to laparoscopic inspection. Animals were fixed on a laparoscopic cradle in dorsal recumbency, tilted head-down at an angle of 45° and two cannulae were punched through the abdominal wall cranial to the udder to permit insertion of an endoscope and a manipulation probe. The abdominal wall was elevated by raising one of the cannulae, permitting the operator to visualize and count *corpora lutea*. No tranquilizer was used, the abdomen was not insufflated and the operation took no longer than 2 to 3 minutes. The animals did not get particularly excited. Paired t-test compared ovulation numbers assessed by both methods. The 12.2 (SEM 0.8) ovulations determined by ultrasonic imaging agreed closely with 11.4 (SEM 0.8) *corpora lutea* visualized laparoscopically. Of 50 coupled cases there was complete agreement in 13 does (26%), an overestimation by ultrasound assessment in 24 does (48%) and an underestimation in 13 does (26%). The relationship between the two methods, analyzed by Microsoft Origin Version 4.1 (1992) amounted to  $r = 0.82$  ( $P < 0.001$ ). Laparoscopy, being a direct approach, requires skilled personnel and elaborate equipment and, although being minimal-invasive, puts strain on the animals. Moreover, with increasing numbers of *corpora lutea*, accurate counting is becoming increasingly difficult. Ultrasound imaging conducted before and after expected ovulation, is less laborious and more animal-friendly. It does take a certain amount of skill and experience to locate ovaries and correctly identify ovarian structures. But once this has been accomplished, the method may be recommended as an equivalent option.



R-44

**Effect of pFSH and eCG on superovulatory responses in Malaysian crossbred goat**

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An experiment was carried out using Malaysian crossbred (Boer x Katjang) goat (*Capra hircus*) to evaluate the efficacy of gonadotrophin source on ovarian responses during superovulation. Oestrus was synchronised by inserting controlled intravaginal drug release (CIDR) for 14 days and 125 µg of PGF2α (Estrumate) was injected intramuscularly at Day 12. All the donor goats were divided into 2 groups, namely Groups 1 and Group 2, and were received 1500 IU of eCG (Folligon) through single intramuscular (i.m.) injection and 200 mg of pFSH (Foltropin-V) through multiple i.m. injection, respectively. Gonadotrophin treatments were started from 1 day before the CIDR removal. For ovulation synchronisation, 1000 IU of hCG (Ovidrel) were injected i.m. through two equal dosage on Day 15 and Day 16. Ovarian responses of both treatments were evaluated during laparotomy session on Day 7 after CIDR removal. All the does (100%) of both the treatment showed sign of oestrus and responded to the treatments by ovulating at least 4 follicles. The average embryo recovery was  $4.5 \pm 2.06$  for Group 2 which was significantly ( $P < 0.08$ ) higher than Group 1 ( $0.25 \pm 0.25$ ). Average number of CL, anovulatory follicles and unfertilised oocytes for Group 1 and Group 2 were  $9.75 \pm 3.32$  and  $9.25 \pm 1.11$ ,  $12.5 \pm 4.85$  and  $17.75 \pm 2.43$ ,  $1.75 \pm 1.75$  and  $4.00 \pm 2.12$ , respectively. No significant ( $P > 0.05$ ) differences were found for number of CL, anovulatory follicles and unfertilised oocytes between the groups. In conclusion, superovulatory treatment using pFSH can provide more efficient means of producing embryos than eCG in the Malaysian crossbred goat, however, further studies are needed to optimise the dosage of pFSH for goat superovulation under Malaysian condition.



R-45

### **Dynamics of modifications in structural and functional characteristics of buck sperm during cryopreservation**

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Changes in sperm structure and function occur due to processing of semen. The present study was designed to investigate the influence of stages of cryopreservation upon buck sperm. Semen ejaculates from three mature bucks (replicates =5 ), diluted with tris-citric acid egg yolk glycerol extender at 37°C, cooled to 4°C over 90 minutes, equilibrated at 4°C for 2h, filled into 0.5 ml straws, placed in nitrogen vapors and frozen until thawed and analyzed. Semen was assessed for percentage motility, acrosomal and plasma membrane integrity, live sperm and morphology after dilution, cooling, equilibration and thawing. Mean percentage motility after dilution ( $86 \pm 1.4\%$ ) was reduced significantly ( $P < 0.05$ ) due to cooling and equilibration ( $77.6 \pm 1.3\%$  and  $74.6 \pm 1.4\%$ ), furthermore, it decreased significantly ( $P < 0.05$ ) after freezing and thawing ( $42.3 \pm 2.5\%$ ). Mean percentage of live sperm was higher ( $P < 0.05$ ) after dilution ( $89.3 \pm 1.4\%$ ) compared to cooling ( $84.8 \pm 1.8\%$ ) and equilibration ( $80.2 \pm 2.5\%$ ) and further reduced ( $P < 0.05$ ) after freezing and thawing ( $56 \pm 3.4\%$ ). Sperm morphology dropped significantly ( $P < 0.05$ ) from  $96.4 \pm 0.3\%$  after dilution to  $88.8 \pm 1.3\%$  at cooling and further decreased ( $P < 0.05$ ) after freezing and thawing ( $81 \pm 1.9\%$ ). Mean percentage of sperm with normal plasma membrane after dilution ( $82.2 \pm 1.1\%$ ) was significantly reduced ( $P < 0.05$ ) at cooling or equilibration ( $73.8 \pm 1.8$ ) and further decreased ( $P < 0.05$ ) after freezing and thawing ( $50.1 \pm 2.9\%$ ). The percentage of sperm with normal acrosome did not differ significantly due to dilution, cooling or equilibration ( $85.8 \pm 1.7\%$ ,  $83.2 \pm 1.6\%$ ,  $81.7 \pm 1.8\%$ ) but reduced significantly after freezing and thawing ( $45.2 \pm 2.8\%$ ). In conclusion, maximum damage to motility, plasma membrane and acrosome integrity and morphology of buck sperm occurs after freezing and thawing followed by cooling.



R-46

**Estrus-induced female goats are not able to stimulate the ovulatory activity in seasonal anestrus subtropical goats**

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The anestrus season of Mexican goats raised at 26°N lasts from February to August. This study was carried out in April and May to determine if the hormonal-induced estrus female goats are able to stimulate the ovulatory activity of seasonally anestrus does by the phenomenon known as the “female effect”. Two groups of anovulatory females were used (n = 10 each). The control group was completely isolated from males and females. The Experimental group was put in contact during 18 days with ten previously estrus-induced females by the insertion of a vaginal sponge impregnated with 20 mg of fluorogestone acetate for 11 days, followed by an intramuscular injection of 300 UI of eCG 24 hours before sponge removal. In addition, these females received intramuscular injections of 4 mg of estradiol cypionate at sponge removal and every two days to extend the estrous behavior of treated does. In Experimental females, ovulations were determined by transrectal ultrasonography on day 18 after introducing the estrus-induced females. Proportions of does that ovulated in Control and Experimental groups were compared by the  $\chi^2$  test. The ovulation rates (number of *corpora lutea*) were compared by the Kruskal-Wallis test. The proportion of females that ovulated did not differ between Control (0/10) and Experimental groups (2/10;  $P > 0.05$ ). Similarly, the ovulation rate did not differ between Control (0) and Experimental groups ( $1.5 \pm 0.1$ ;  $P > 0.05$ ). In conclusion, the estrus-induced goats are not able to stimulate the ovulatory activity of does during the seasonal anestrus.



R-47

**Motriz activity is stimulated on female goats artificially induced to estrus**

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During estrus, female goats display sexual behaviors to attract the buck. This study was carried out to measure the mount behavior and motriz activity in induced-estrus female goats. We used two groups (n = 10, each) of anovulatory multiparous 3-4 year old goats. In Treated Group, estrus was induced and synchronized by the insertion of a vaginal sponge impregnated with 20 mg of fluorogestone acetate for 10 days; 48 h before sponge removal, 250 IU of eCG and 250 mg of sodium cloprostenol were i.m. administrated. Females from the Control Group also received the insertion of vaginal sponges as described above; however, 48 h before sponge removal, 2 ml of sterile distilled water was i.m. injected to avoid the induction of estrus. Following sponge removal in both groups, mount behavior and motriz activity (difference between the time that female goats were laying on floor and the time stand on) were registered by means of videotape recorded during 1 h every 12 h during 72 h. Motriz activity data were analyzed using Mann-Whitney U test. Mounts data were analysed using a  $\chi^2$  test. Most females from the Treated group displayed mount behaviors (60%; 6/10) compared with those from Control Group (0%; 0/10,  $P = 0.003$ ). The 100% (35/35) of the mounts was made by females of Treated Group while the goats of the Control Group did not displayed mounts (0/35); ( $P < 0.0001$ ). Female goats from the Treated Group displayed more motriz activity ( $14.8 \pm 2.01$  min, laying on floor) compared with the females of Control group ( $36.7 \pm 1.53$  min laying on floor;  $P < 0.001$ ). We concluded that mount behavior and motriz activity are stimulated in female goats with induced-estrus.



R-48

**Changing males between groups of female goats does not improve the ovulatory response during the male effect**

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When male goats are changed from one group of females to a new one, they increase their sexual behavior. We determined whether the daily changes of male goats among subgroups of females improved the ovulatory activity of goats exposed to the male effect. Males were rendered sexually active during the rest season by exposure to 2.5 months of long days from November 1st. In April, during the seasonal anestrous, the sexually active males ( $n = 3$ ) were put in contact with three subgroups of females (1 male/12 females) during 19 days. These males remained all the time with the same subgroups of females (Control Group). Other males ( $n = 3$ ) were put in contact with three other subgroups of females (1 male/12 females) during the same period. These males were changed daily among the three subgroups each morning at 0800 h (Experimental Group). The sexual behavior (ano-genital sniffing, nudging and mounts) of Control and Experimental males were registered from 0800 to 0900 h on day 0 (day of introduction of males in the subgroups of females); then, sexual behavior was measured in both groups of males on days 1, 2 and 8 after changing the Experimental males between the subgroups of females. The proportions of goats that ovulated and the ovulation rates (number of *corpora lutea*) were determined by transrectal ultrasonography on day 19 after introducing the males. Variables of male sexual behavior and proportions of does that ovulated were analyzed by the  $\chi^2$  test. The ovulation rates were analyzed by the Kruskal-Wallis test. The frequency registered in the four days of observation revealed that ano-genital sniffing (330), nudging (801) and mounts (6) was lower in the Control than in the Experimental Group (917, 2044 and 21, respectively;  $P < 0.05$ ). The proportion of females that ovulated was the same in the Control and the Experimental Groups (92%; 33/36 in both groups;  $P > 0.05$ ). In contrast, ovulation rate was greater in the Control ( $1.7 \pm 0.1$ ) than in the Experimental Group ( $1.3 \pm 0.1$ ;  $P < 0.05$ ). In conclusion, the daily change of males from one group of females to another one does not improve the ovulatory activity of goats.



R-49

**Social rank of the long-day treated male goats does not affect their ability to stimulate the ovulatory activity of female goats exposed to the male effect**

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The aim of this study was to assess if the social rank of the sexually active male goats affect their capacity to induce the ovulatory activity in anestrus female goats exposed to the male effect. Twelve 2.5 year-old male goats were raised in an open pen and subjected to artificial long-days (16 h light/day) from November 1st to January 15 to stimulate their sexual activity during the sexual rest (February-April). On March, they were observed 2 h daily (0900-1100) during seven consecutive days to determine all events of agonistic interaction (butts, threats, chases, and avoidance). From these interactive behaviors, an index of success (IS) for each male goat was calculated. The males were then classified into three ranking categories: Low (IS = 0.0–0.33; n = 3), Medium (IS = 0.34–0.66; n = 6) and High hierarchy (IS = 0.67–1.0; n = 3). On March 31, a group of anovulatory female goats (n = 27) were exposed to 3 males from Low hierarchy category. Another group of does (n = 27) was exposed to males with Medium hierarchy and the third group (n = 24) was exposed to 3 males with High hierarchy category. The three groups of females remained in contact with the males during 18 days. Ovulation and ovulation rate (number of *corpora lutea*) were determined by transrectal ultrasonography on day 6 and 18 after exposure to males. The proportions of ovulated goats and ovulation rate were analyzed with Chi<sup>2</sup> and the Kruskal-Wallis tests, respectively. The total proportion of females that had ovulations during the first 6 days of exposure to males did not differ ( $P > 0.05$ ) between groups (62, 70 and 79% for goats exposed to males of low, medium and high hierarchy, respectively). The ovulation rate in the first ovulation was similar ( $P > 0.05$ ) between females exposed to Low ( $1.6 \pm 0.2$ ), Medium ( $1.3 \pm 0.2$ ) and High hierarchy males ( $1.6 \pm 0.2$ ). In the second ovulation, the proportion of females that ovulated was 88% (24/27), 96% (26/27) and 91% (22/24) for goats stimulated with Low, Medium and High hierarchy males, respectively ( $P > 0.05$ ). Similarly, the ovulatory rate in the second ovulation was not different ( $P > 0.05$ ) between groups ( $1.4 \pm 0.1$ ,  $1.6 \pm 0.1$  and  $1.8 \pm 0.2$ , for females exposed to Low, Medium and High hierarchy males, respectively). These results indicate that social status of long-days treated male goats does not affect their ability to stimulate the ovulatory activity of female goats exposed to the male effect.





R-50

### **Sexual behavior and scrotal circumference of the photoperiod-treated male goats is affected by social rank**

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We determined if the social rank of the sexually active male goats affect their sexual behavior and scrotal circumference size. Twelve 2.5 year-old male goats were raised in an open pen and subjected to artificial long-days (16 h light/day) from November 1st to January 15 to stimulate their sexual activity during the sexual rest (February-April). On March, during seven consecutive days at the time that they received their food, males were observed continuously 2 h daily (0900-1100) to determine all agonistic interactions (butts, threats, chases, and avoidance). From these behaviors an index of success (IS) for each male was calculated, based on its ability to displace other individuals within the group. Three ranking categories were obtained within group: Low (IS = 0.0–0.33; n = 3), Medium (IS = 0.34–0.66; n = 6) and High hierarchy (IS = 0.67–1.0; n = 3). The body weight (BW) and scrotal circumference (SC) were determined every two weeks from November 1st until March 30. On March, each male was individually exposed during 1 h to 10 anestrus goats in a pen test to determine the frequency of nudging, sniffing and mount attempt. ANOVA revealed an effect of time ( $P < 0.001$ ) in BW and SC ( $P < 0.001$ ) and an interaction between group and time of experiment ( $P < 0.001$ ) in both variables. BW was highest in High and Medium hierarchy males compared with the Low hierarchy ones during all the study ( $P < 0.001$ ). No differences were registered between High and Medium hierarchy ( $P > 0.05$ ). Photoperiodic treatment stimulated an increase of SC and sexual behavior during the non-breeding season in all males. However, the response of Low hierarchy males was delayed and the values were lower those registered in High and Medium hierarchy males. In High and Medium hierarchy males, SC increased progressively from February 1 ( $25.5 \pm 1.3$  cm and  $25.4 \pm 0.5$  cm, respectively) and peaked on March 30 ( $28.8 \pm 1.4$  cm,  $28.2 \pm 0.5$ , respectively). On the contrary, in Low hierarchy males, the SC started to increase in March 1st ( $23.7 \pm 0.7$ ), a month later than High and Medium hierarchy bucks and maximum values were registered on March 30 ( $25.2 \pm 0.9$ ). Similarly, the sexual behavior (nudging and sniffing) displayed by High and Medium hierarchy males was higher than Low hierarchy ones ( $P < 0.001$ ). No differences were registered in mount attempt between the three groups of males ( $P > 0.05$ ). We conclude that sexual behavior and scrotal circumference size of the long-days treated male goats is affected by social status.



R-51

**The naive male goats subjected to long days does not reduce the sexual response of the anovulatory female goats exposed to the male effect**

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This study was conducted to determine whether naive male goats rendered sexually active by photoperiodic treatment stimulate the reproductive activity of anestrus female goats subjected to the male effect. Five male goats sexually experienced and five naive male goats were submitted to 2.5 months of artificial long days to stimulate their sexual activity during the non-breeding season. One group of multiparous females ( $n = 50$ ) was exposed to sexually naive males and another group ( $n = 50$ ) was exposed to sexually experienced males. The sexual behavior of males (ano-genital sniffing, nudging and mounts) was registered by 1 h during the first 3 days of contact with does. The female goats that ovulated and the ovulation rates were detected by ultrasonography. The sexual behaviors of the naive sexually males, sexually experienced males and the proportion of female that ovulated were compared between groups using a Chi-square test. The ovulations rates were analyzed by the Kruskal-Wallis test. The sexual behaviors of the sexually experienced males was greater [ano-genital sniffing (1081) and nudging (2045)] than in those naive males (431 and 1510, respectively;  $P < 0.001$ ). The mounts were not different (37 and 24, respectively;  $P = 0.155$ ) between both groups. The percentage of females that ovulate (82%, 41/50 and 83%, 42/50  $P = 1.0$ ) and the ovulation rates ( $1.5 \pm 0.08$  and  $1.4 \pm 0.08$ ) did not differ significantly ( $P = 0.154$ ) between those interacting with sexually experienced and naive males. This results show that naive sexually active males subjected to long days stimulate the reproductive activity of anestrus goats exposed to the male effect in similar way that the sexually experienced males.



R-54

**Early pregnancy diagnosis and monitoring fetal growth in Majorera goats**

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Trans-abdominal ultrasonography was used to determine early pregnancy and fetometry as biparietal-diameter (BPD), femur-length (FL) and kidney-length (KL). Twenty-five pregnant goats (11 singles, 14 multiple) were monitorized daily from day 20 to 31 after mating, every 2 days from day 31 to day 43 and then weekly from day 43 to day 148 of gestation. Two-dimensional, real-time ultrasound images were obtained using a linear phase-array transducer with frequencies from 5 to 12 MHz (Aloka 500). Early pregnancy was diagnosed as the presence of a gestational sac in the uterine lumen and fetal viability as the detection of heartbeats. The BPD was visualized on a longitudinal scan of a fetal head; the distance was recorded when the parietal bones were parallel in order to standardize the measurement. FL was determined by measuring along the femur diaphysis but excluding the distal femoral epiphysis. Finally, the KL was measured from upper to lower pole; thickness and width of kidney were measured in a transverse foetal section. The first sign of pregnancy (gestational sac) was observed at day 20 after mating in 4 goats and was absolutely accuracy (100%) by day 28 of gestation onwards. Heart beat was observed as early as day 24 of gestation (12%; 3/25) and it was almost completely recordable by day 32 (96%; 24/25). Singles and multiple pregnancies were differentiated on day 32 of gestation. Fetal structures increased at a linear rate to parturition. BPD increased from  $14.0 \pm 0.5$  mm on day 45 to  $55.10 \pm 0.60$  mm on day 148; FL increased from  $12.43 \pm 0.64$  mm on day 45 to  $72.60 \pm 0.80$  mm on day 148. KL increased from  $18.5 \pm 0.6$  mm on day 87 to  $36.15 \pm 0.20$  mm on day 148. The relation between gestational age and BPD and FL was highly ( $P < 0.0005$ ) significant. No differences were observed between single and multiple pregnancies regarding the development of embryonic or fetal structures. In addition, it was observed a high correlation ( $r = 0.827$ ,  $P < 0.001$ ) between the BPD and the neonatal body weight at kidding. This study confirmed the capacity of the B-mode real-time ultrasonography as a reliable mean for early detection of gestation as early as 24–28 days after mating, and the effectiveness for BPD, FL and KL measuring for the determination of fetal age from day 45 of gestation onwards.



R-55

### **Post-thaw sperm quality of caprine semen samples preserved in a dry shipper**

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The present study assessed the efficacy of a dry shipper to preserve semen samples of Majorera bucks. During the breeding season, semen was collected from each buck, once a week for 3 consecutive weeks, using an artificial vagina. All semen samples were assessed for volume, sperm concentration and percentages of motile spermatozoa, sperm cells with intact acrosome membrane integrity and abnormal morphology. After pooled, semen samples were centrifuged twice at 700 x g for 15 min (room temperature, 20-22 °C), and diluted (1:3) in a Tris-yolk extender to reach a final concentration of 800 x 10<sup>6</sup> spermatozoa/mL. Before chilling, a new dilution was produced by adding (in three steps, 10 minutes apart) a second diluent at room temperature in a similar volume to the first dilution to result in a final concentration of 400 x 10<sup>6</sup> spermatozoa/mL, 12% egg yolk and 4% glycerol. The semen was packaged in 0.5-mL straws, and the straws were put in a container with water (25°C), being chilled in a cooler from room temperature to 5°C over 2 hours and then the straws were kept at 5°C for 3 more hours (equilibration time). After equilibration, semen straws were frozen and stored in liquid nitrogen (LN). Thirty days after freezing, half of the frozen straws were transferred from LN to a dry shipper (DS). Then, thawing was performed at 1, 2, 3, 5 and 7 days and the percentages of motile spermatozoa, acrosome intact spermatozoa and abnormal spermatozoa were determined. Buck semen samples showed equivalent levels of progressive motility (between 50 and 60%) and intact acrosome membrane (around 70%) during the first three days of storage in both procedures (NL vs. DS); however, from the fifth day of storage onwards, a notable decrease in semen quality was observed in the samples preserved in DS, showing a dramatic fall in the semen viability after 7 days of preservation (12.3% and 36.8%, progressive fast spermatozoa and acrosome integrity, respectively). The percentage of abnormal cells was low in all samples (range: 0.0-10.0%), and no significant differences were obtained throughout the experimental period when both storage protocols were tested. In our study, the sperm viability was maintained at similar levels during the first three days of storage, starting to decrease from day 5 onwards. Buck semen may be more labile to repeated handling when stored in the DS compared when the semen is preserved in liquid nitrogen.



R-57

**Effects of times for cooling equilibration and freezing method on post-thaw characteristics of caprine sperm**

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The aim of the present study was to assess the influence of different times (30, 60, 120, 240 minutes) of cooling equilibration and different times of exposure (5, 15 minutes) to liquid nitrogen vapors over the post-thaw semen quality in caprine samples. Semen (two ejaculates per buck) was collected from six males and after individual evaluation, the semen was pooled and diluted in a washing solution (250 mM Tris, 28 mM glucose, 104 mM citric acid) at 37°C and centrifuged twice at 700 x g for 15 min (room temperature). The supernatant was removed and semen samples were diluted in a Tris-based freezing medium (250 mM Tris, 28 mM glucose, 104 mM citric acid, 12% egg yolk), reaching a final concentration of  $800 \times 10^6$  spermatozoa/mL. Then, a new dilution was produced by adding a second diluent (250 mM Tris, 28 mM glucose, 104 mM citric acid, 12% egg yolk, 8% glycerol) at 20°C in a similar volume to the first dilution to result in a final concentration of  $400 \times 10^6$  spermatozoa/mL, 12% egg yolk and 4% glycerol. The diluted semen was divided into four aliquots: aliquots A, B, C and D, that were equilibrated at 4°C for different amount of time (30, 60, 120 and 240 minutes, respectively). After the equilibration periods, the semen was packed in 0.5 mL straws, and the semen straws (aliquots A, B, C and D) were subdivided in two groups and exposed to nitrogen liquid vapors for 5 and 15 minutes, respectively. Finally, the straws were plunged into and stored in the liquid nitrogen. Post-thawing assessment confirmed that semen samples equilibrated at 4°C for 120 and 240 minutes showed no differences in the percentages of total motile spermatozoa and progressive spermatozoa, regardless of subsequent exposure to 5 or 15 minutes of liquid nitrogen vapors. However, semen equilibrated for 30 and 60 minutes presented a lower percentage ( $P < 0.05$ ) of total and progressive fast spermatozoa than those observed in the C and D groups. No significant differences were observed in the percentages of abnormal spermatozoa of frozen-thawed semen among the experimental groups (ranging from 34 to 39%). Within the same equilibration period, only the semen samples equilibrated for 30 minutes showed significant lower percentages ( $P < 0.05$ ) of acrosome integrity post-thaw. The results of the present study confirmed that the post-thaw sperm quality (sperm motility and acrosome integrity) was influenced by the time of cooling equilibration and the time of exposure to liquid nitrogen vapors.



R-59

**Time and appearance of the LH surge in response to ovulation induction with GnRH or hCG in superovulated goats**

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The study was conducted to determine the most suitable time for fixed-time artificial insemination in superovulated goats. Thirty pluriparous Boer goats with plasma progesterone levels exceeding 5 ng/mL received 1 mL of the prostaglandin F<sub>2α</sub> (PG) agent Dinolytic® (5mg Dinoprost, Pfizer, Germany) followed, 7d later, by a GnRH agonist (1 mL Receptal®, 0.004 mg buserelin, Intervet, Unterschleissheim, Germany) and after 7 more days another dose of PG. Superovulation was brought about by injections of 4, 4, 2, 2, 2 and 2 AU of pFSH (Stimufol® provided by J.F. Beckers, Liege, Belgium), administered at 12 h intervals beginning 2 d before the second PG treatment. Eighteen h after the last FSH injection 10 of the does received an i.m. injection of 1 mL Receptal®; 9 received 500 IU hCG (Chorulon®, Intervet, Unterschleissheim, Germany) and 11 received 1 mL physiological saline. Blood samples were drawn via permanently indwelling jugular catheters at 20 min intervals from 1 h before until 4 h after the ovulation inducing treatment; at 1 h intervals for the next 3 and at 2 h intervals for another 32 h. Plasma LH was determined by ELISA (Moeller, 1991, Diss. Goettingen). The LH surge induced by Receptal® was steeper and higher than that following hCG or saline treatment, peak amplitude being 88.9 (SEM 3.0) ng/mL vs. 50.4 (SEM 6.1) and 69.7 (SEM 8.6) ng/mL after hCG and saline, respectively ( $P < 0.05$ ). Duration of the surge was 7.2 (SEM 0.6) h vs. 11.2 (SEM 0.8) and 12.1 (SEM 0.6) h ( $P < 0.05$ ). Area under the LH curve (overall mean: 323.5 h ng/ml) and clearance rate (overall mean: 1.9 L/h) did not differ among groups. Functionally relevant parameters differing among groups were degree of synchronization and average interval between treatment and onset of LH surge. The surge commenced within 1.0 (SEM 0.03) h after Receptal®, as compared to 11.8 (SEM 0.3) h after hCG and 14.9 (SEM 1.2) h after saline ( $P < 0.05$ ); the peak was reached 1.6 (SEM 0.2) h, 3.7 (SEM 0.8) h and 2.7 (SEM 0.3) h later ( $P < 0.05$ ). Ovulation was observed echographically to occur, on average, 22 h after the LH peak. It is thus critical to bear these differences in mind when intending to employ fixed-time insemination protocols in goats.





R-60

**Prostaglandin-based protocol to synchronize ovulations induced by the male effect in Murciano-Granadina goats during the non-breeding season**

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The male effect is known to be an effective bio-stimulation tool, inducing fertile ovulations in anoestrus Murciano-Granadina goats between 7 to 9 days after male introduction. Further, the luteolytic effect of PGF<sub>2</sub> $\alpha$  is well-known and successfully applied in goats. Therefore, the combination of the male effect with PGF<sub>2</sub> $\alpha$  may represent an interesting alternative for ovulation synchronization, avoiding the drawbacks of the use of classical hormonal treatments, such as the presence of residues of progestagens in meat and milk or the appearance of anti eCG antibodies. Thus, new oestrus and ovulations may be induced by the injection of a single dose of prostaglandin during the luteal phase induced by the buck effect. The objective of the present work was to determine the ovulatory response of Murciano-Granadina goats induced by the prostaglandin injection following male effect and to establish the most suitable day for its administration after male introduction during the non-breeding season. Thirty four females were totally isolated from males at least one month before the introduction of males and a male:female ratio of 1:10 was carried out during the male effect. Goats were divided into two experimental groups, receiving an i.m. injection of 75  $\mu$ g of cloprostenol (PGF<sub>2</sub> $\alpha$  analogous) on day 13 or 17 after male introduction. Male-induced oestrus was seen in 100% of goats at  $8.5 \pm 1.4$  days (mean  $\pm$  SD) after male introduction. Oestrus following PGF<sub>2</sub> $\alpha$  injection was observed in 76% of goats of group of day 13, and in 100% of goats of group of day 17. LH surges were detected at  $48.7 \pm 7.9$  h and  $51.3 \pm 4.8$  h after prostaglandin administration in females of group of day 13 and 17, respectively. Although no significant differences were observed between groups, a slightly greater synchronization in the occurrence of LH surges was detected in goats of day 17. Nevertheless, the results indicate that administration of prostaglandin both on day 13 and 17 after male introduction is able to induce a high proportion of synchronized oestrus and ovulations in Murciano-Granadina goats during the non-breeding season (This research has been supported by funding from the European Community's 7th Framework Programme FP7-SME-2008-2 under GA N<sup>o</sup>243520. Acknowledgements: Jorge Castillo from ACRIMUR, for his help in the management of the experimental farms.





R-61

### **Changes in small, medium and large follicle numbers in response to co-synch and select-synch**

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Success of estrous synchronization (ES) and artificial insemination (AI) programs in goats are variable. The goal of this project was to evaluate the effects of short-term progesterone treatment, in conjunction with prostaglandin F<sub>2α</sub> (PGF) and gonadotropin-releasing hormone (GnRH) treatments on fertility in dairy goats. Our hypothesis is that ES protocols that optimize follicle growth and maturation prior to ovulation will increase fertility in AI programs. Goats were randomly assigned to: Select-Synch (n = 20) and Co-Synch (n = 20). Ten goats in each of the two treatment groups were subjected to daily US beginning on day of CIDR insertion to evaluate changes in ovarian follicle populations for 26 days. Follicles were classified as small (3.0-5.0 mm), medium (5.1-7.0 mm) or large (> 7.0 mm). AM and PM heat checks started on all animals after CIDR removal and all animals were AI'd 24 hours after first detection of estrus. There were no significant differences between ES protocols for total length of estrus (2228 ± 239 min), interval from CIDR removal to estrus (2075 ± 192 min) or the mean length of estrus after AI (726 ± 179 min). Pregnancy rates were greater with the Select-Synch protocol (9/20; 45.0%) compared to the Co-Synch protocol (5/18; 27.8%), but not statistically different. Changes in small, medium or large follicle populations were not influenced by Select-Synch or Co-Synch treatments (treatment by time interaction; *P* > 0.1). ANOVA indicated that the ES protocols did not influence the average number of small follicles (treatment; *P* > 0.1) but average number of medium follicles were greater in the Select-Synch group compared to those in the Co-Synch group (2.21 ± 0.1 and 1.92 ± 0.1, respectively; *P* < 0.01). The number of small and medium follicles varied over time, independent of ES protocol (day; *P* < 0.01). The number of small follicles peaked three days after CIDR insertion (4.8 ± 0.42) while the number of medium follicles peaked (3.57 ± 0.48) during early diestrus of the subsequent luteal phase. The number of large follicles was not influenced by ES protocol and did not vary over the sampling interval. Short-term progesterone treatment in conjunction with PGF and GnRH treatments can modify small and medium follicle populations. The inability to detect significant changes in the numbers of large follicles may indicate that ES protocols do not optimize follicle growth and maturation in the dairy goat.



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### **The seasonal variation of sexual activity in the Romanian White of Banat goat**

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The objective was to characterize the seasonal variation of the sexual activity of local Romanian White of Banat female goats. The studies were conducted at the experimental farm belonging to the Romanian Goat Association – CAPRIROM, while the biochemical determinations of progesterone concentrations were accomplished at "Ovidius" University (in the Laboratory of Cellular and Molecular Biology) by the ELISA method. The experiment took place between January 12th, 2009 and January 12th, 2011. The female goats were isolated from the males during the experiment. The seasonal variations in the cyclic ovulatory activity were studied by the analysis of the levels of plasmatic progesterone in the blood samples collected twice a week. Between January and February, the progesterone concentrations of White of Banat goats were above the basal level ( $2.45 \pm 0.26$  ng/ml;  $2.25 \pm 0.22$  ng/ml – 1st year vs.  $4.035 \pm 0.77$  ng/ml;  $4.081 \pm 0.73$  ng/ml – 2nd year,  $P < 0.05$ ), while in March, the concentrations decreased ( $1.74 \pm 0.15$  ng/ml – 1st year vs.  $3.105 \pm 0.11$  ng/ml – 2nd year,  $P < 0.05$ ). At the end of spring and in summer, a significant decrease of the progesterone level was observed, down to the basal level ( $1.61 \pm 0.2$  ng/ml;  $0.75 \pm 0.11$  ng/ml;  $0.48 \pm 0.03$  ng/ml;  $0.61 \pm 0.06$  ng/ml;  $0.57 \pm 0.06$  ng/ml – 1st year vs.  $1.364 \pm 0.27$  ng/ml;  $0.72 \pm 0.55$  ng/ml;  $0.62 \pm 0.78$  ng/ml;  $0.66 \pm 0.57$  ng/ml;  $0.69 \pm 0.14$  ng/ml – 2nd year,  $P < 0.05$ ). Progesterone concentrations down to the basal level ( $< 1$  ng/ml) characterized the anoestrus period. In September, the progesterone concentration increased ( $1.73 \pm 0.17$  ng/ml – 1st year vs.  $1.26 \pm 0.46$  ng/ml – 2nd year,  $P < 0.05$ ). In October, November and December the progesterone concentrations increased significantly and all the experimental goats displayed the cyclic sexual activity ( $2.88 \pm 0.23$  ng/ml;  $4.84 \pm 0.19$  ng/ml;  $4.63 \pm 0.51$  ng/ml – 1st year vs.  $3.34 \pm 0.29$  ng/ml;  $4.73 \pm 0.15$  ng/ml;  $4.51 \pm 0.27$  ng/ml – 2nd year,  $P < 0.05$ ).

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