DAIRY GOAT BREED

There are numerous indigenous dairy and meat goat breeds in different parts of the world. Gall (1996) provided detailed description and production data of 160 goat breeds based on size of populations, productivity, and unique characteristics. Levels of milk production from surveys in 46 countries around the world is given for 89 goat breeds. Among these are 4 recognized as high yielding breeds, Alpine, Saanen, Toggenburg, Nubian, which are also called "improver" breeds for developing countries. Breeds that are managed in registry herd books combined with milk recording and sire proving schemes are generally the leaders (Haenlein, 1981, 1996). Thus, individual record performances of Spanish Canaria, Malagueña, Murciana-Granadina goats with 1,300 kg milk in 305 days (Muñoz and Tejon. 1980), for Saanen in different countries milking more than 2,000 kg (Devendra and Haenlein, 2003; Gall, 1996), for Alpine in U.K. and Nordic goats in Norway more than 1,900 kg (Gall, 1996), and records of individual American Toggenburg (3,023 kg), Alpine (2,916 kg), Saanen (2,695 kg), LaMancha (2,454 kg), and Nubian (2,423 kg) have been reported (Haenlein, 1996). Dairy goat breeds have been classified morphologically into three groups (Mason, 1991).

In the US, the most popular six dairy goat breeds are: **Saanen, Alpine, Nubian, Toggenburg, La Mancha, and Oberhasli,** where their pictures are shown below:

Figure 2.2. Swiss Saanen goat. Photo G.F.W. Haenlein.

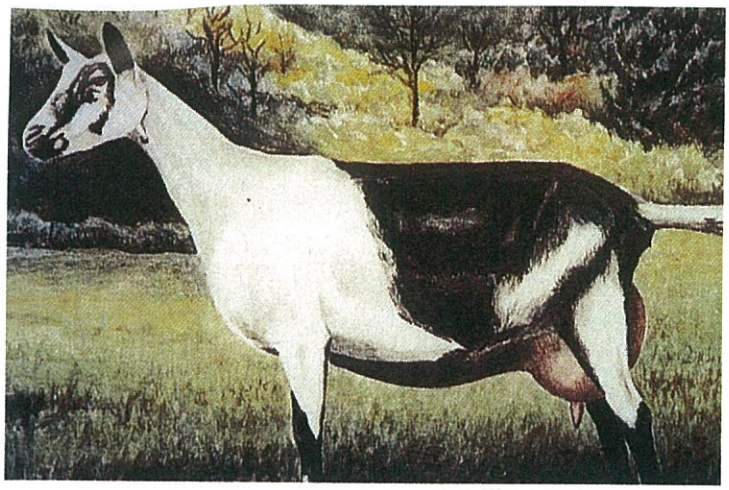

Figure 2.3. American Alpine goat. Photo American Dairy Goat Association.

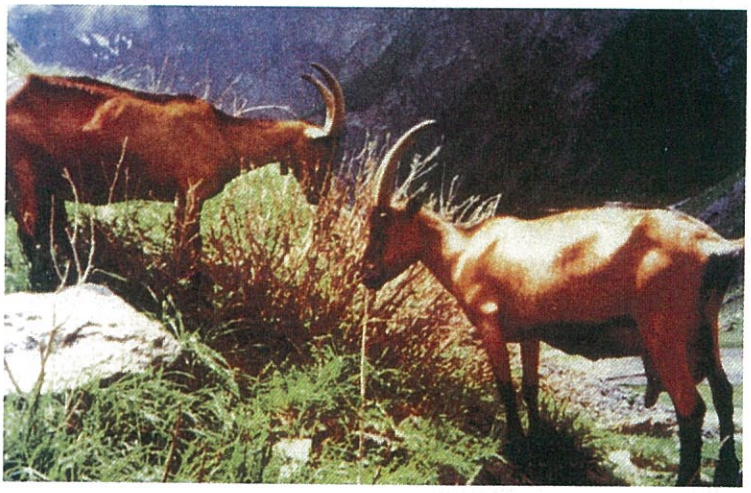

Figure 2.4. American Oberhasli goat. Photo G.F.W. Haenlein.

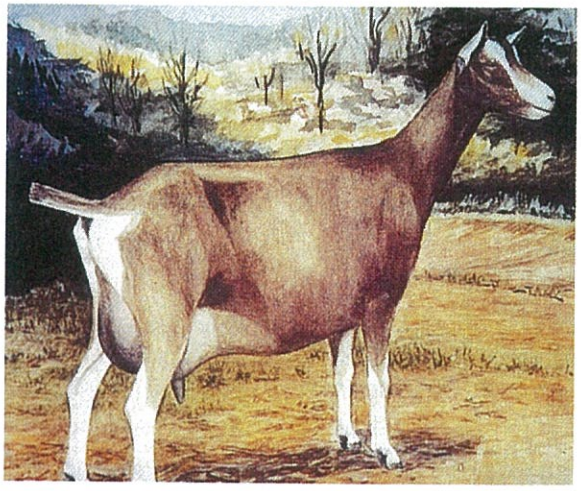

Figure 2.5. American Toggenburg goat; note the unique badger face. Photo American Dairy Goat Association, Spindale, NC.

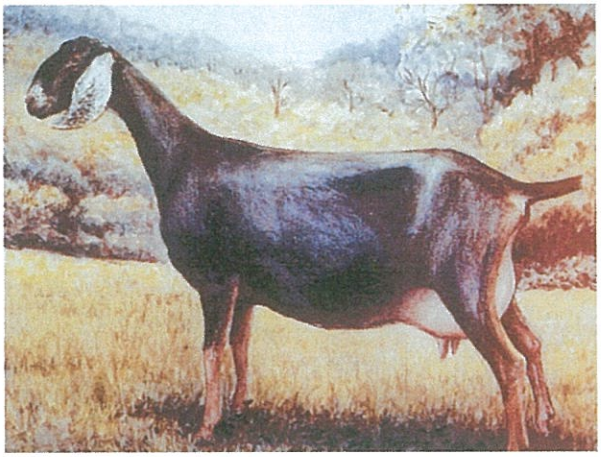

Figure 2.6. American Nubian goat. Photo G.F.W. Haenlein.

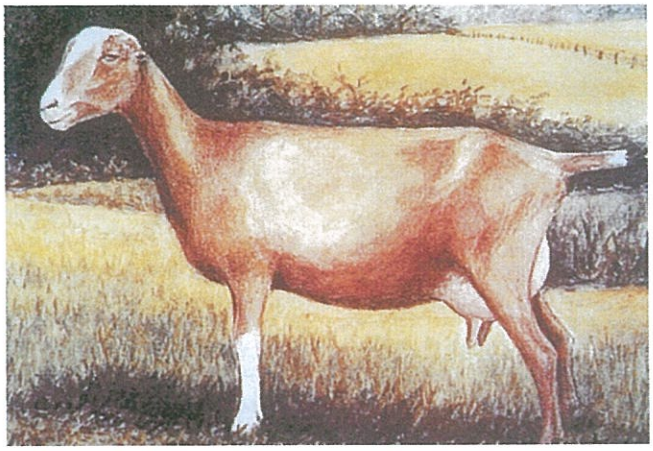

Figure 2.7. American LaMancha goat; note the unique vestigial "gopher" ear. Photo American Dairy Goat Association, Spindale, NC.

Figure 2.8. Spanish Murciana-Granadina goat. Photo Ministeró Agricultura Publ., 1980, Madrid, Spain.

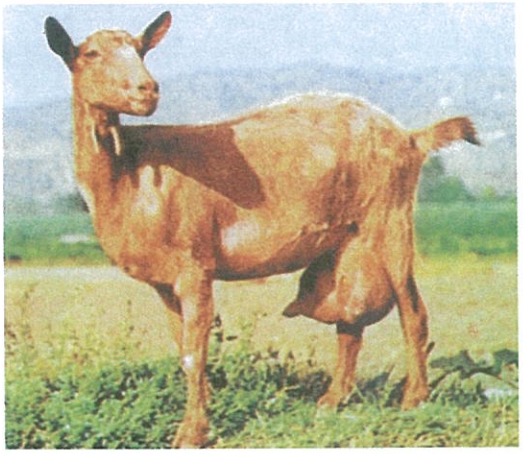

Figure 2.9. Spanish Malagueña goat. Photo Ministeró Agricultura Publ., 1980, Madrid, Spain.

Materials are taken from

Extension Goat Handbook

MACHINE MILKING SYSTEMS

S. B. Spencer
Pennsylvania State U.
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The production of high quality milk depends upon clean, healthy goats, properly fed and cared for, and milked in a clean efficient manner.

Dairy goats may be milked equally well by hand or by machine. In either case, care must be taken to produce a clean, wholesome product and to prevent injury and/or infection of the udder.

Vacuum

The milking unit removes milk from the teat of the animal by the application of a partial vacuum. Vacuum is measured in inches of mercury. The recommended range of vacuum level on the milking system is between 10.0 and 14.0 inches of mercury. The primary effect of the different vacuum levels is milking rate. As vacuum level increases, milking rate increases. Within these vacuum level ranges, no difference in udder infection rates will be noted.

The Milking Unit

The operation of the milking unit is shown in Figure 1. The pulsator causes the machine to switch from the milking phase to the rest phase. As the pulsator operates, it causes the chamber between the shell and the inflation to alternate regularly from vacuum to air source.

During the milking phase, the space between the inflation and shell becomes a vacuum. Equal pressure inside and outside of the inflation causes it to open and the milk to flow.

During the rest phase, air at normal pressure enters between the shell and inflation. Due to the vacuum in the stem the inflation collapses around the teat. The pressure of the collapsed inflation on the teat prevents congestion of blood and body fluids in the teat skin and tissues.

The rate at which the inflation is closed and opened, called the pulsation rate, varies from 40 to 80 pulsations per minute depending upon the manufacturer. The optimum pulsation rate is yet to be determined. The manufacturer's recommendations for a particular pulsator should be followed.

Pulsator Ratio

The pulsator ratio is the length of time the pulsator is in milking position compared to the time it is in rest position. It is expressed as a simple ratio or as percentage of time open to time closed. The ratio should range between 50:50 and 60:40 milk to rest ratio.

Inflations or Teat-cup Liners

Many types of teat-cup shell and inflation combinations are available. Teat size governs the choice of inflation size. In general, large teated animals can utilize larger inflations without discomfort, while the smaller teats are best milked with smaller inflations.

Claw units should be equipped to admit a small amount of air in order to prevent milk from building up in the claw and creating "milk block". An air bleed is necessary on most types of pipeline units.

The Vacuum Pump

The most important consideration with regard to the vacuum pump is that it possess ADEQUATE CFM CAPACITY AT THE OPERATIONAL VACUUM LEVEL. Manufacturers can provide CFM ratings for various vacuum pumps or the CFM delivery can be determined by the use of a flow rate meter.

The size of pump needed for milking machine operation depends upon a number of factors. Among these are:

1. Number of units
2. Size and length of pulsating lines

3. Type of pulsator
4. Type of system (bucket or pipeline)
5. Requirements of other vacuum-operated equipment

The recommended capacity of the vacuum pump(s) used in bucket milking systems is shown in Table 1. Table 2 indicates suggested capacities for pipeline systems.

Table 1. Vacuum Pump Capacities for Conventional Machines in CFM (cubic ft/min)

	ASME Standard	New Zealand Standard
CFM Reserve	10	20
CFM per unit	1	2

Example: Four-unit conventional system

	10 CFM reserve	
1 CFM x 4 units =	4 CFM	
Total	14 ASME	
	20 CFM reserve	
2 CFM x 4 units =	8 CFM	
Total	28 New Zealand	

Table 2. Vacuum Pump Capacities for Pipeline Milking Machines in CFM (cubic ft/min)

	ASME Standard	New Zealand Standard
CFM Reserve	25-30	50-60
CFM per Unit	1.5	3.0
CFM per milk meter	0.5	1.0

Make sure that your system has adequte CFM capacity. Check with your manufacturer for the vacuum pump ratings.

The vacuum pump and the power unit should be installed as close as possible and practical to the center of the milking area. Such locations as a feed room or near a haymow chute should be avoided. The exhaust from the pump should be piped to the outside of the building through a pipe whose diameter is at least as great as that of the pump's discharge port.

Since oil is present in most exhausts, the exhaust should be directed downward and away from the side of the building, which prevents rain water from entering the pump, and also prevents accumulation of oil and dirt on the side of the building.

Servicing the pump should be performed as directed in the service manual. Maintaining the oil level in the sump or supply cup and checking the belt for proper alignment and tension are the two most important maintenance procedures, and should be done every two weeks. Recommended annual or semi-annual service checks will vary with the pump and the manufacturer's specifications.

Vacuum Regulators

Vacuum regulators admit air into the milking system to prevent the vacuum level from going too high. The regulator must have capacity equal to or greater than the vacuum pump capacity. A regulator which is too small may result in excessively high vacuum.

In the bucket milking system, the regulator should be placed between the pump and the first stall cock opening. In the pipeline system, the regulator(s) is usually located between the vacuum pump and the milk receiver. A good location is usually near or on the vacuum reserve tank.

An area should be selected where the air being admitted into the regulator will be relatively clean. Some regulators may malfunction if not properly installed. Make sure that those types that rely on sliding valves are installed in a perfectly vertical position.

The regulator should be checked at least twice a month. Accumulation of dirt in the valve is one of the primary causes of malfunction. The valve seat and moving parts should be cleaned regularly. Most regulators are designed to not require oil for lubrication, since oil tends to collect dust and dirt. The manufacturer's recommendation for maintenance and service should be followed closely.

Regulator performance is affected by basic design. Servodiaphram regulators are the most effective, while weighted level types are the least desirable.

Pipe Sizes

The milking units are operated by a piping system(s) which must be large enough to permit the units to function properly. Restricted vacuum and milk line sizes may result in machine malfunction and lead to teat and mammary gland injury.

The pulsator pipe carries air from the pulsator to the vacuum pump. In the case of bucket milkers, this pipe is the only source of vacuum to the goat.

In the pipeline milker, the sanitary or milk pipe is the source of milking vacuum.

The following pipe sizes are suggested for the vacuum line for bucket milkers. The same size is recommended for the pulsator pipe of pipeline milkers.

Number of Units	Size of Pipe
Up to 5	1 ¼" pulsator pipe
5 to 7	1 ½" pulsator pipe OR 1 ¼" looped (double) line
8 to 12	2" pulsator pipe OR 1 ½" looped (double)

Sanitary or Milk Pipeline

Sanitary milk lines are made of stainless steel or glass. Glass affords visibility, while stainless steel is not as susceptible to breakage. Stainless steel can be welded in place under farm conditions.

The milk pipe must be installed on a continuous slope of 1 to 1½ inches per 10 feet of length. The maximum height of the pipe from the platform where the animals stand should be 5 feet.

Adequate slope, without low spots, facilitates complete drainage of cleaning and sanitizing solutions. Ceiling mounts that are subject to movement because of variable loads on the floors above should be avoided. The line should slope toward the milk receiver so that milk can flow by gravity from the milk-inlet ports to the receiver without flooding.

Risers in milk lines must be avoided, since they cause the line to flood, contribute to the development of rancidity, and cause vacuum fluctuations. In new construction, it may prove desirable to slope the stable or parlor floors toward the milk room in order to keep milk lines as low as possible.

Install low lines where possible. The hoses to the milking units should not exceed six (6) feet in length. Adequate pipeline slope and size are essential to prevent flooding of the system. Flooding causes erratic vacuum changes in the system, which may result in increased udder irritation and a possible increase in the incidence of new infections.

The size of sanitary milk pipe is shown in Table 3.

Table 3. Sanitary Milk Pipe Size (inches)

Pipe Size	Maximum Number of Units per Slope
1½	4
2	8

These sizes apply to conditions where the animal is milked directly into the milk pipeline. Pipes for weigh jar systems operated primarily as milk transfer and wash lines must be of adequate size for washing.

Number of Units

The number of units you should have varies widely, depending upon the type of system, the nature of the goats (fast or slow milking), and the operator. The following table may serve as a guide for the number of units to use.

Table 4. Maximum Number of Milking Units per Operator

Type of System	Maximum Number of Units
Milking area only	2
Elevated single stall	2
Elevated platform	3
Herringbone parlor	6 (units both sides of parlor)

Milking Practices

Good milking practices are essential to keep goats healthy and to achieve good labor efficiency.

During milking, there are two critical periods when udder damage is most likely to occur: at the beginning and the end.

Make sure the animal is properly stimulated for "let-down" prior to attaching the machine. The stimulation should be accomplished in the same manner at each milking. The interval between stimulation and machine application should be short and constant. Ideally, the stimulation to machine-on time should be about one minute. The "let-down" hormone effect lasts about 7 minutes. It is important that the goat be milked out rapidly and the machine removed as soon as the goat is milked out.

Preparation

Washing the udder to remove dirt and at the same time stimuate the goat for "let-down" is usually considered the most satisfactory method. Use clean, lukewarm water with a sanitizer added. Dry the udder with a clean paper towel before applying the machine. Use a strip cup to detect flaky or clotted milk. The strip cup also aids in stimulation because of the manipulation of the teat and udder.

Machine Application

Good milking management will aid in reducing

udder irritation. Do not operate more milking units than can be handled effectively. Adjust the unit properly so that the goat milks out quickly. Proper adjustment also aids in minimizing "fall-offs".

Unit Removal

Machine strip only as long as necessary to remove the milk that is readily available.

Remove the unit gently, taking care to avoid injury to the animal. Shut off the vacuum, then push down on the top of the inflation with the thumb or finger to release vacuum in the teat cups. The unit should then come off readily.

Teat Dipping

Immediately after milking dip each teat in a disinfectant solution which is specifically formulated for this purpose. Follow directions on the label.

CAUTION: Do not use udder or equipment sanitizers as a teat dip unless they are specifically listed on the label for this purpose. Observe the teats regularly to make sure they are not chapped or irritated.

Teat dipping has been shown to give effective control of the common forms of mastitis.

Checks and Maintenance

A regular thorough checking and maintenance schedule is essential to keep equipment in top working condition. The manufacturer of your equipment has specified many items. Follow those instructions carefully.

Several items apply to all systems. The most important are as follows:

DAILY:

_____ 1. Check vaccuum level.
_____ 2. Make sure pulsators are operating properly.
_____ 3. Check rubber parts for breaks, tears, and cleanliness.
_____ 4. Check vacuum pump oil supply and belt tension.
_____ 5. Install clean filters.
_____ 6. Make sure air inlets to claw assemblies are open.

WEEKLY:

_____ 1. Check and clean vacuum regulator.
_____ 2. Inspect and rotate inflations.
_____ 3. Check couplings and stall cocks for leaks and electrical connections.

MONTHLY:

_____ 1. Disassemble pulsator and check for wear. Clean all air passages and screens.
_____ 2. Check condition of vacuum pump oil.
_____ 3. Check CIP (clean-in-place) system for proper cycling and water temperature.
_____ 4. Check pulsator performance with portable test gauge.

ANNUALLY:

_____ 1. Check operation of the vacuum pump. Use a flow rate meter to determine if it is pumping at its rated capacity.
_____ 2. Connect the system and obtain an air flow reading with the system in operation. A loss of more than 10 percent of the vacuum pump capacity indicates excessive leaks in the system.
_____ 3. Check all pipeline gaskets for leaks and condition. Replace as needed.
_____ 4. Check electrical connections and the pulsation control. A voltage meter is suggested to check the electrical pulsation system.
_____ 5. Make all service checks as specified by the manufacturer.

Reviewed by D. L. Ace, Pennsylvania State U., University Park.

Extension Goat Handbook

MILK HOUSE CONSTRUCTION, EQUIPMENT AND SANITATION

D. L. Ace
Pennsylvania State U.,
University Park

The milk house is the final on-farm site of quality control in the milk production process. One could consider the kitchen as a milk house for the very small herd owner since this is where milking equipment is washed and stored and where milk is cooled and stored until used. Regulations governing such a milk and equipment handling area are determined solely by the herd and home owner. However, the person producing milk for sale to the public requires more space and equipment than can be available in a kitchen. Further, milk houses, cooling systems and cleaning and sanitizing of milk handling equipment comes under the watchful eye of the dairy sanitarian and specific features must meet rigid inspection standards in order to legally sell milk publicly.

The United States Department of Health, Education, and Welfare publishes a handbook titled. "Grade A Pasteurized Milk Ordinance" which covers all aspects of milk production. The same rules apply to milk production from both dairy goats and dairy cows. Consultation with a dairy sanitarian will identify those essential building, milk handling and equipment handling needs that must be part of a milk production program. If desirable, a copy of the Milk Ordinance may be obtained by writing to Superintendent of Documents, Washington, DC 20402. There is a charge for the publication.

Milk House Construction and Facilities

The milk house should be used for no other purpose than milk house operations and should have no direct opening into any barn, stable, or room used to house animals. The exception is that some states may permit a direct opening so long as a tight fitting, self closing, solid door is provided.

The size of the milk house is dependent on size of operation and amount of equipment. Installed equipment should be readily accessible to the operator. A sanitarian can guide the herd owner to appropriate measurements. Generally, isles should be at least 30 inches wide with extra work area, if necessary, to permit disassembly, inspection and servicing of equipment. The floor must be smooth and made of impervious material, usually concrete, and graded to drain sites. Drains should not be located under bulk tanks or under the outlet of a bulk tank. Walls and ceilings must be constructed of smooth material, well painted, maintained and in good repair. This suggests that with water in constant use, a good epoxy painted concrete block wall or glazed tile wall surface plus some of the plastic coated ceiling materials are good surfaces to resist water penetration and to clean easily.

Window space equal to 4 square feet per 60 square feet of floor space must be provided or electric lights sufficient to offer a minimum of 20 foot candles of illumination. A combination of light source is most desirable to provide for night lighting. Windows also offer a source of ventilation. If possible, locate the windows so as to provide cross ventilation. Screens on windows and doors are essential to protect against flies and other insects.

Ventilation by mechanical means is desirable and sometimes necessary. Constantly wet conditions may sponsor mold and algae growth on floors and walls and encourage bacterial odors to develop. Ventilation assists in drying the surfaces plus moving fresh air through a milk house to keep musty or foul air to a minimum. Milk houses may have permanently closed windows, such as glass block and mechanical ventilation in such instances becomes critical. Fan size capable of moving 15 to 20 cubic feet of air per minute may be adequate.

Masonry construction offers little protection from cold and will benefit from insulation, especially in prolonged cold spells to prevent freezing of water on floors and walls. With the vast amount of water needed and with pipes, sinks, drains to pro-

tect from freezing it becomes economical to consider insulating the ceiling, walls and floor.

Equipment

Milk should be handled only in materials that are non-toxic and readily cleanable. These materials are glass, stainless steel, certain approved plastics and rubber or rubber-like materials designed for milk handling. Do not use materials such as aluminum or copper bearing metals for handling milk. Containers having tinned surfaces must be free of dents, pits, open seams and any evidence of rust spots. Such areas harbor bacteria and may lead to such defects as oxidized flavors.

The wash and rinse sink should have two compartments with each compartment big enough to hold the largest piece of equipment to be washed. Sanitizing can be done in the sink just prior to milking.

Storage racks or tables for utensils and cans must be available and permit air movement and rapid, thorough drying of all equipment following washing and rinsing. Bacteria growth on surfaces is reduced greatly if the surface is dry.

A separate sink should be available for washing hands of the milkers.

Cool Milk Quickly

Milk should be cooled quickly and held to under 40 °F. The most satisfactory equipment for cooling is the stainless steel farm bulk tank. The tank should be sized to hold 5 milkings. Milk should be stored for not longer than 48 hours. The 5th milking capacity is suggested in case of emergency.

The size of the refrigeration unit should be based upon the rate at which milk enters the tank. The BTU (British Thermal Unit) removal rate should be 90 to 100% BTU loading rate. There are 50 BTU's per pound of milk to be removed, Thus, if 300 pounds of milk are put into the tank in one hour, a refrigeration unit rated between 13,500 and 15,000 BTU per hour should be utilized.

Cooling milk from small herds can present problems. Simply placing milk in a container into a refrigerator is not satisfactory. The milk will not cool rapidly enough by this air cooling method. Containers may be placed in circulating ice water to obtain satisfactory cooling results.

Containers

Milk should be placed in clean sanitized containers specifically designed for milk. Store in a refrigerated space under 40 °F and keep out of the light. Milk is a perishable food. Keep it clean, cold and covered.

Water Source

This must be from a supply properly located and protected and be of adequate quantity and of a safe and sanitary quality. The water supply is periodically tested to make sure it remains uncontaminated.

It becomes obvious that a water supply adequate for a small, hand milking operation may fall far short of needs when milking machines or pipeline milkers and cleaned-in-place systems are installed. The dairy sanitarian can be of help in evaluating total needs.

Sanitation

Good brushes, proper water temperature and the right cleaning materials reduce the effort and increase effectiveness in cleaning and sanitizing milk equipment. On many farms, regardless of size of herd, milking machines, pails and strainers are washed by hand.

Bacteria need three conditions for support of growth – soil (food), moisture and proper temperature. Proper cleaning and sanitizing followed by rapid drying removes these conditions and helps keep bacteria counts low.

Adequate supplies of hot and cold water are essential. If the water is soft it makes the cleaning job easy. Most water supplies are hard, necessitating installation of a water softener or the use of cleaners manufactured especially for use in hard water.

Many cleaners are made for use in soft water and when used in hard water produce whitish residues when the equipment dries. This is called waterstone and milk solids cling to it making cleaning progressively more difficult. Equipment that is difficult to clean frequently is poorly cleaned and high bacteria counts usually result.

A protein film may appear if the cleaning solution is too weak or the wash temperature too low. It first appears as a bluish discoloration on equipment surfaces.

In manual cleaning, a sanitizer as well as a cleaner is needed. Some cleaners, such as quarternary detergent sanitizers and iodine detergent sanitizers, have a sanitizer built in. This does not mean that the final cleaning step of sanitizing before use of equipment can be omitted.

There are two types of cleaners. Alkaline cleaners are preferred because of their ability to remove milk-protein soil and butterfat particles from the equipment. Acid cleaners function by softening water and usually include wetting agents which emulsify and remove fatty deposits if the water temperature is correct.

In any case, follow instructions printed on con-

tainers of cleaners and sanitizers. The following general procedure may be used with many cleaners:

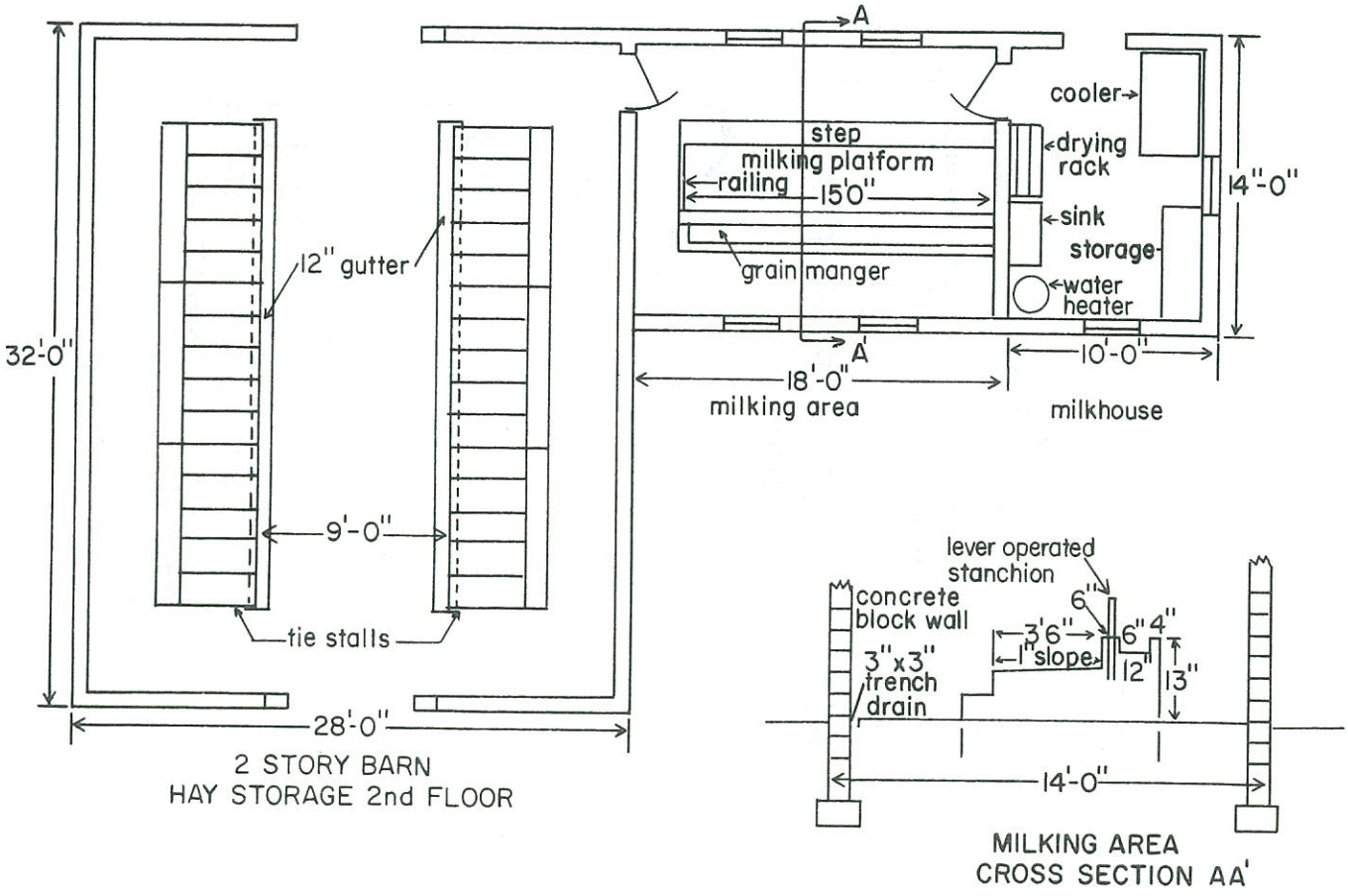
1. Rinse equipment thoroughly with water 100 °F to 120 °F immediately following milking. Water too hot sets the milk film; water too cool does not remove the fat.
2. Prepare a wash solution with water at 120 °F to 130 °F. Use a cleaner compatable with the water supply. Use a thermometer and be sure water temperature doesn't drop below 100 °F.
3. Disassemble and soak all parts and equipment in wash solution for a few minutes.
4. Wash thoroughly using a good brush.
5. Rinse with clear, clean water. Use an acidified rinse if the water is hard (1 oz acid cleaner to 6 gal water).
6. Place all equipment on racks to insure rapid drying.
7. Sanitize all equipment just before milking with a chlorine, iodophor or quarternary ammonium sanitizer. Drain but do not rinse sanitizing solution from equipment.

CIP cleaners (cleaned-in-place) are for use with circulating cleaning systems. These cleaners are chlorinated alkaline with low foaming characteristics. These wash solutions have a pH of about 11.0 so they must be used with some degree of caution.

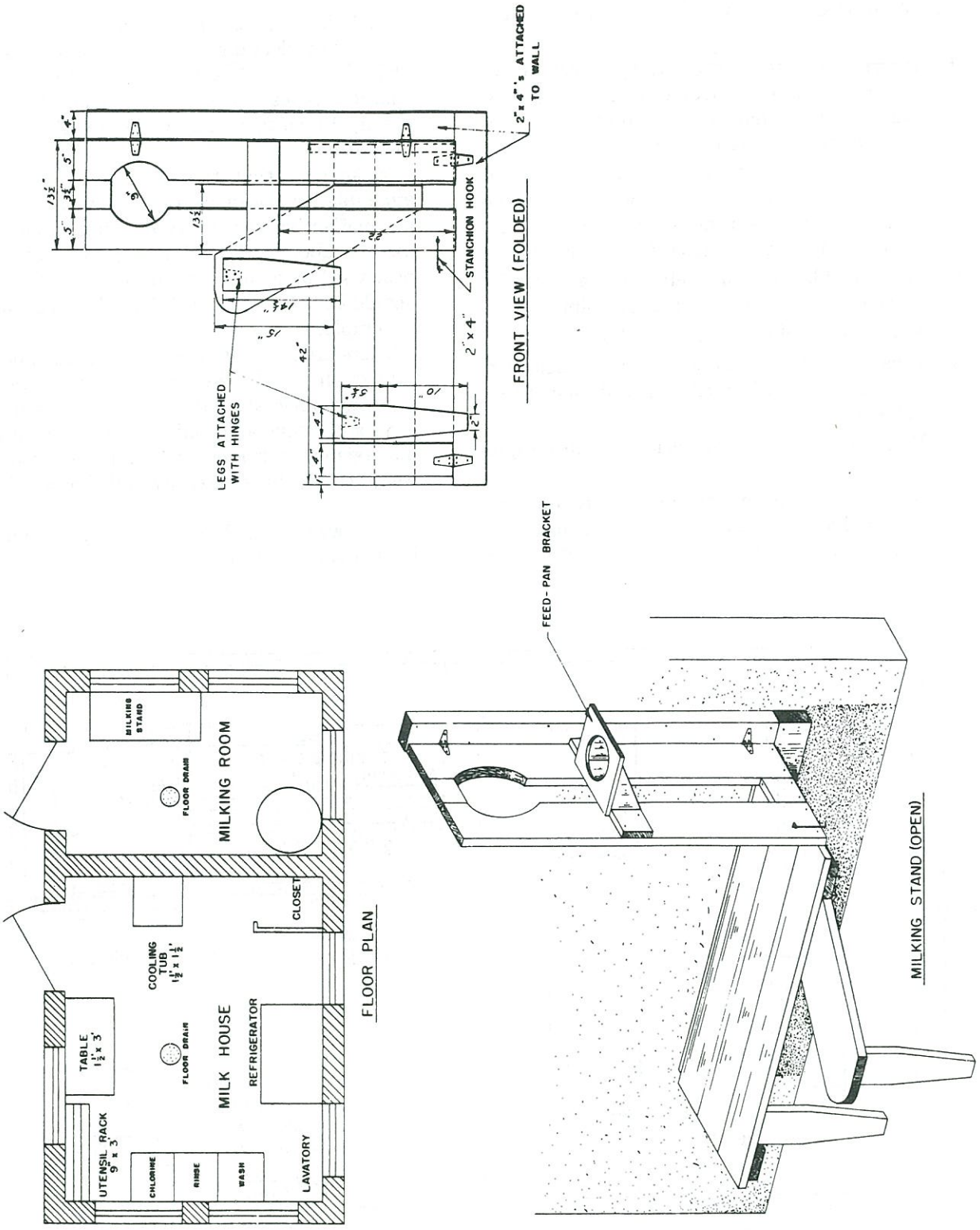
Make sure that there is plenty of hot water available for use in cleaning. Cleaning compounds are ineffective in cool water. Manual cleaners are used at about 110-120 ° F while CIP cleaners are best used at a range of 105-110 ° F. The solution should be a minimum of 100 F when the wash cycle is completed.

There are no shortcuts to producing and protecting quality milk. Regulations and recommendations are aimed at getting the job done within practical and achievable building, milk handling and management routines. The concerned producer will weigh the options carefully and thoroughly.

Reviewed by S. B. Spencer, Pennsylvania State U., University Park.



Milking barn and milk house plan. Drawings courtesy of Cooperative Extension Service, Pennsylvania State University.



Plans for milk house, milking room and milking stand for goats. Drawings courtesy of Cooperative Extension Service, Pennsylvania State University.

Extension Goat Handbook

COMMERCIAL GOAT MILK PRODUCTION

J. A. Yazman
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Many dairy goat breeders reach a point in the development of their herd when they contemplate commercial marketing of their milk. They may have been utilizing most of the milk produced by their herd to raise kids for replacements and for sale as breeding stock. Some milk may have been sold to neighbors or used in raising calves or hogs. Due to expansion of the herd and a good program of breeding and selection, health, and nutrition, the herd milk yield now exceeds the demand of neighbors and the few calves previously raised.

The question arises as to the economics in the production of Grade A goat milk and alternative methods of marketing goat milk. A specific Grade A goat operation located in Central Arkansas will be used as an illustration. The characteristic costs of production and income from sales are unique to this operation. The objective is not to show how much a producer can expect to earn from producing goat milk but to delineate questions which need to be answered in order that a proper economic analysis can be made.

The Petit Jean Goat Dairy

This goat dairy is located atop Petit Jean Mountain, 20 miles southwest of Morrilton, Arkansas. The dairy was constructed as a semi-confinement system with seasonal grazing of fertilized southern grass-clover pastures supplemented by purchased alfalfa hay and commercial mixed concentrates. Pen space was allotted for 125 milking does plus bucks and replacements. Yearling does from five breeds - Alpine, LaMancha, Nubian, Saanen, and Toggenburg - were purchased in 1976 from several different herds in the Southwest US. First kiddings occurred in January of 1977. The budget below is for the 1981 production year.

Table 1. Prices Paid and Received for Inputs and Products (Petit Jean Goat Dairy, Arkansas, 1981)

Item	Unit	Price
Paid For:		
Alfalfa hay	ton	$105.00
16% commercial mixed concentrate	ton	190.00
18% calf starter (for kids)	ton	250.00
Hourly labor, incl. fringe benefits	hr	5.30
Milk hauling	cwt	2.50
Received For:		
Milk, 3.5% butterfat	cwt	14.75
Buck kids, 3 days old	head	5.00
Doe kids, 3 days old	head	15.00
Cull adult does and bucks	head	20.00
Breeding bucks, 7 months old	head	200.00
Breeding does, 7 months old	head	150.00

The milk price received from the Yellville, Arkansas, processor in 1981 for 3.5% butterfat milk was $14.65 per cwt (hundred pounds). An additional $2.00/cwt winter milk bonus in December, January, and February was paid also. However, milk production in those months was only 5% of the 1981 total herd output, making the "adjusted" milk price $14.75/cwt for 1981 in average. Transportation of milk, 150 miles from Petit Jean Mountain to Yellville, cost $2.50/cwt by an independent bulk shipper. Collecting and shipping relatively small quantities of milk over long distances results in high costs per unit transported.

The principal products sold from the Petit Jean Goat Dairy in 1981 were wholesale milk, cull adult does, breeding bucks and does and cull, newborn kids, primarily bucks. No milk was sold raw, on-farm, as this is prohibited by Arkansas law. Cull adults and kids were sold through a local auction barn or on-farm.

The Petit Jean Goat Dairy was designed and licensed as a Grade A goat milk production facility, but in 1981 all milk was sold to an evaporating plant at Yellville, Arkansas. The Yellville market only requires a "manufacturing grade" milk license (Grade C). However, since Grade A facilities had been constructed, little or no additional efforts were required beyond normal repair and maintenance.

1981 Cost Factors

In Table 1 are prices paid for inputs and received for products in 1981. Several points need to be emphasized. The cost of purchased alfalfa hay in many parts of the US has risen dramatically as a result of increased fuel costs. Central Arkansas is "alfalfa-deficient" and good quality baled alfalfa must be transported several hundred miles from Kansas, Oklahoma, or Missouri. Competition from a growing dairy cow and horse population at times makes alfalfa difficult to procure. Several alternatives to alfalfa have been tried by Central Arkansas producers, including hay made from lespedeza, sudan-sorghum hybrids and well-fertilized Bermuda grass. Most have found, however, that dry matter consumption and milk yield are highest when alfalfa is fed. Dairy goats are known for wasting hay by picking leaves, rejecting stems and pulling hay from feeders. Alfalfa pellets offer an excellent low-waste alternative to baled alfalfa. The cost of pellets dry matter are high relative to hay and the cost of investment in storage facilities can reduce the advantage from feeding pellets. Drying and pelleting also can reduce the nutritional quality of pellets, especially digestible protein.

An analysis of the advantage of alfalfa pellets compared to alfalfa hay should include amount of hay lost due to wastage (some waste can be recovered by feeding to other livestock), increased cost of dry matter for alfalfa pellets, annual cost of storage facilities (interest on investment and annual repairs) and differences in nutritional quality which must be compensated for by purchased concentrates.

Early in 1977 it was realized at the Petit Jean Goat Dairy that the labor of one "owner-operator", even when supplemented with additional labor from the family, was not adequate to handle all the chores of a 125-doe operation. Part of the problem was in the nature of the dairy goat production cycle with peak demands for labor in the spring kidding and fall breeding season. Seasonal labor demand overlayed the constant non-seasonal requirement of labor for milking, feeding, daily cleaning and maintenance. Coupled with the need for responsible, motivated, and qualified help in such tasks as kid raising and milking, the labor requirement is an input which deserves close attention in the design and planning of a commercial Grade A dairy goat operation.

1981 Operating Budget

In Table 2 are the 1981 operating costs. "Cash" costs are actual outflows of money paid in the course of the operation of the dairy. "Imputed" costs, in this case interest on equity capital and owner-operator salary, are costs charged against the operation but represent no actual cash outflow. An imputed cost can be defined as "opportunity cost"; that income which might be received if capital or labor were used in its most productive alternative enterprise. The "owner-operator" borrowed no money to buy land, stock, and construct facilities. All $86,000 of the capital cost of land, buildings, fences, stock, and equipment was available without bank financing. Therefore, no yearly cash outlay for interest on borrowed capital was necessary. The opportunity cost of the equity capital an owner-operator has in his facility is that interest he could earn if his assets were liquidated and invested in an alternative enterprise. In this case, there is a 10% imputed cost which is the approximate interest that could be earned in 1981 in a short-term bond or savings account.

An owner-operator's labor also has an opportunity cost. A plumber or electrician who operates a Grade A dairy goat farm, foregoes the salary he could earn in his trade. Along with the opportunity cost of equity capital, an owner-operator "salary" is often over-looked in evaluating true costs of operating a dairy. "Pride of ownership", the pleasure received from owning and milking a productive herd of dairy goats, may compensate for some of the imputed costs but the reality of income

Table 2. Operating Costs for the Petit Jean Goat Dairy for 1981

Item	Cost per Year, $ Total	Per Milking Doe
"Cash" Costs:		
Concentrate feedstuffs	16,499.25	131.99
Hay	7,600.00	60.80
Bedding	375.00	3.00
Hired labor	11,000.00	88.00
Machinery expense	1,010.50	8.08
Veterinary service and supplies	823.00	6.58
Dairy supplies	1,078.00	8.62
Land, building, and fence repair	487.50	3.90
Taxes and insurance	350.00	2.80
Interest on borrowed capital	0.00	0.00
DHIA expense	750.00	6.00
Electricity and phone	1,843.50	14.75
Replacement stock	1,750.00	14.00
Miscellaneous	435.00	3.48
Total "Cash" Costs	44,001.75	352.00
"Imputed" Costs:		
Equipment depreciation	3,060.00	24.48
Interest on equity capital @ 10%	8,600.00	68.80
Owner-operator salary	12,000.00	96.00
Milk fed to replacements	826.56	6.61
Total "Imputed" Costs	24,486.56	195.89

foregone cannot long be ignored.

Imputed, or non-cash costs, included depreciation of equipment, interest on equity capital (all $86,000 of the capital costs of constructing and equipping the dairy is equity as no money was borrowed), an "owner-operator" salary and the milk used to feed replacements ($12.25/cwt).

Concentrate and hay costs made up 47% of the total cash costs. A mixture of alfalfa and grass hay was purchased with alfalfa used primarily for milking does and replacements. Young and early-lactation does, and dry does in late gestation, received the best feeds. Bucks, unbred, and late-lactation does were fed good quality grass hay, trace-mineralized salt, and a minimal supplement of low cost grain. Attention paid to the appropriate distribution of protein and energy in feeding the herd will result in an optimum return of milk per dollar of feed cost.

One full-time laborer was employed at the Petit Jean Goat Dairy in 1981 to supplement the labor of the "owner-operator" who was actually a paid manager. During the peak labor seasons of kidding (late winter-early spring) and breeding (fall), more than 80 hours per week, or 2.0 man equivalents, were required. Hired labor supplied only 40 hours of any week, with the "owner-operator" expected to provide the remainder. This is a common situation on farms where total hours above 40 per week are paid at time-and-a-half or more and where activities at kidding and breeding are critical to the economic health of the operation.

Five replacement bucks were purchased in 1979 at an average cost of $350.00. An alternative would have been to purchase frozen semen from proven sires to produce replacement bucks out of the best does in the herd. The choice of whether to buy bucks or use frozen semen to upgrade the genetic potential of a herd requires careful analysis. There is a need in the US for data recording on dairy goats to identify superior sires with an adequate accuracy. Use of frozen semen from a buck with records on a few daughters in only a small number of herds is risky. However, if semen from "proven" sires is available and replacement bucks were selected from superior does, more rapid genetic progress would be possible at a lower cost than if replacement stock were purchased. Using

AI would allow fewer bucks to be maintained. In the case of the Petit Jean Goat Dairy, only one buck per breed would be needed instead of two. The success with AI in dairy goats will be important in the future development of the dairy goat industry.

Break-even Analysis

Cash and "imputed" costs in 1981 totaled $68,488.31 or $547.90 per milking doe. For the operation to be economically sound, each doe should generate at least $547.90 in income from sale of milk supplemented by the sale of cull adults and kids. The budget in Table 2 does not include costs for raising and selling weaned kids of breeding quality. In the "short-run", for example, a period of one or two years, if each doe had covered cash costs of $352.01 from the sale of her milk, the operator probably would continue to produce goat milk. However, over the "long-run", if imputed costs are not covered, the operation is not economically healthy. A producer realizes this when a new tractor must be purchased or a job is offered at a salary which the cash profits from the dairy operation cannot match.

The price received for milk, net of hauling in 1981, was $12.25/cwt. The cash costs of production per milking doe of $352.01 per year call for a breakeven level of milk production of 2,874 lb per doe. To cover cash plus imputed costs of $547.90, the per doe level of production ought to be 4,473 lb. This level of production greatly exceeds yearly averages recorded for the top producers, Alpine or Saanen dairy goats on Dairy Herd Improvement production tests between 1968 and 1978.

At a given level of milk production, what milk price must be received to "break-even" on the operation? That is, what milk price allows the producer to cover all cash costs or cash costs plus imputed costs? With 1981 cash costs of production of $352.01 per doe, the necessary "break-even" milk prices for production levels of 1,500, 2,000, 2,500, and 3,000 lbs per doe are $23.47, $17.60, $14.08, and $11.73 per cwt, respectively. At these prices per cwt and the respective levels of production, cash costs of $352.01 per doe would be paid for by the sale of milk. Some distortion in this analysis might be expected with higher costs for such inputs as feed and veterinary expenses at the higher average levels of production but the analytical procedure remains the same. Given the same annual levels of production per doe (1,500, 2,000, 2,500, and 3,000 lbs), the "breakeven" prices per cwt milk, f.o.b. farm, necessary to cover cash plus imputed costs ($547.90) are $36.53, $27.40, $21.92, and $18.26, respectively. Unless the price received for milk sold is adequate to cover cash plus imputed costs of production, a producer would receive a better return on his labor and equity capital in an alternative enterprise.

Breeding Stock Enterprise

The analysis above assumes that only replacement doe kids were raised in 1981 sufficient to allow removal of 30 adult does from the milking herd's culls. All buck kids and the remaining doe kids were sold at 3 days of age at $5.00 and $15.00 per head, respectively. As the genetic potential of a dairy goat herd increases, surplus kids sold as breeding stock become a significant source of income to supplement that received from sale of milk. As an example, 50 does and 5 bucks might be raised to seven months of age and sold as breeding stock at $200 and $150 per head, respectively, or a total income of $8,500. The contribution of the breeding stock enterprise is evaluated by considering the cost of producing the seven-month old kids. In Table 3 is an analysis of cash costs for a breeding stock enterprise in 1981. Total cash costs to raise 55 kids to 7 months of age in 1981 would have been $4,878.24. Net income on the sale of 55 kids would have been $3,621.76. Sale of breeding stock would reduce the breakeven level of production necessary to cover cash costs from 2,874 lb per doe to 2,637 lb. To cover cash plus imputed costs, the reduction would be from 4,473 lb to 4,236 lb, assuming a milk income of $12.25/cwt f.o.b. farm. It is important to note that all costs in Table 3 are "cash" costs. If extra investment in land, building, and fencing is required, or additional "owner-operator" labor is needed, imputed costs for the breeding stock enterprise would need to be evaluated.

Other Alternative Sources of Income

Marketing wholesale directly to a milk plant is not the only way to gain income from the milk produced by a dairy goat herd. Alternatives include direct marketing of milk in raw or pasteurized form as fluid or processed products, and growing calves or pigs on high milk diets. Each marketing method has its distinct advantages and disadvantages which a producer needs to accurately evaluate before a decision is made. Direct sale of milk is often an attractive alternative to wholesaling goat milk to a processing plant, especially in those states where raw milk sales are allowed. However, there is also beyond the capital investment required for processing, packaging, and delivery equipment, the labor and management required for direct marketing enterprises. Management time must be adequately compensated at its value in alternative activities or the enterprise is not producing an adequate return. Many producers who investigate direct marketing of their herd's milk

Table 3. Cash Costs to Raise 50 Doe and 5 Buck Kids for Sale as Breeding Stock in 1981.

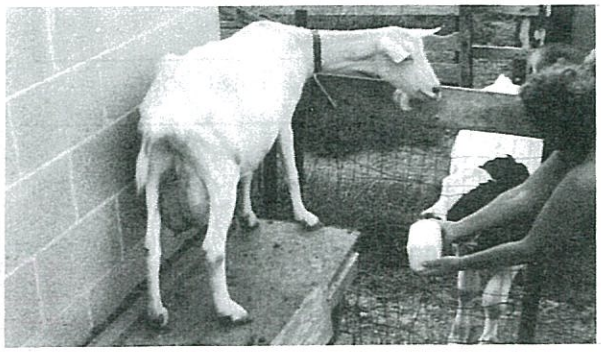
Item	Cost	Total Cost
Milk:		
4 lb per head per day for 56 days @ $.123		$1,515.36
Concentrate:		
0.5 lb per day for 90 days @ $.125	$ 309.38	
1.0 lb per day for 120 days @ $.095	627.00	
		936.38
Labor:		
4 hours per day for 56 days @ $5.50	1,232.00	
1 hour per day for 154 days @ $5.50	847.00	
		2,079.00
Veterinary supplies (including vaccines):		
$1.50 per head		82.50
Registration expenses:		165.00
Advertising		100.00
Total Cash Cost		$4,878.24

find that the time necessary to process and distribute their milk would give a better return if applied to the milk production enterprise in expanding to more goats or better managing the herd already owned.

A large percentage of the goat milk produced in the US is fed to wethers, calves and pigs. Calves are usually dairy breed calves (Holstein most common), bulls and heifers, purchased at or near birth at auction or on contract from local cow dairymen. These are grown to a weight of 300 to 400 lb or greater on goat milk and sold as feeder steers, replacement heifers or heavy veal. Pigs are purchased as feeder pigs and grown to slaughter weight of 200 to 220 lb on a combination of goat milk and solid feed. The returns earned from such enterprises are dependent upon market value of the "finished" product, rate of growth, efficiency of conversion of goat milk to bodyweight gain, overhead costs (buildings, land, equipment, etc.) and labor and management requirements. Losses from mortality and morbidity can mean the difference between profit and loss in calf and swine feeding activities; veterinary and medicine costs are often the result of poor management. Calves maintained on high milk diets for long periods of time (beyond normal weaning) are susceptible to digestive upsets resulting in marginal bodyweight gains. Where specialty markets for wethers for goat barbecues, veal calves, or replacement heifers exist, and where market opportunities for goat milk are limited, using milk to raise livestock can be an economically viable enterprise.

Conclusion

The production costs for 1981 for the Petit Jean Goat Dairy in Morrilton, Arkansas, are presented to illustrate the procedure to evaluate the potential for profitability from the production and marketing of goat milk. Values for various inputs and amounts used to produce goat milk vary from region to region and between herds within a region. The budgeting procedure, however, remains the same: an accurate accounting of all inputs, both cash and imputed, should be made to determine the cost of producing a unit of goat milk. Whatever the method of marketing of goat milk, it is important that the evaluation include return to equity capital and owner-operator labor. Producing high levels of dairy goat milk from a healthy herd and an efficient dairy is an economic managerial and promotional challenge. Without a realistic, continuous economic evaluation, an enjoyable hobby or part-time goat dairy could become a frustrating and expensive enterprise.



Feeding dairy veal or heifer calf herd replacements with goat milk is becoming popular. Photo courtesy of G. F. W. Haenlein, University of Delaware.

Table 4. Assumptions and Calculations for Determining 1981 Annual Operating Costs in Table 1 for the Petit Jean Goat Dairy.

Items	Cost, $
Concentrates:	
Milking does	
125 head x 305 days x 4 lb/day x $.095/lb	$14,487.50
125 head x 60 days x 1 lb/day x $.095/lb	712.50
Bucks	
10 head x 365 days x 1 lb x $.095/lb	346.75
Kids (0-90 days)	
30 heads x 90 days x 0.5 lb/day x $.125/lb	168.75
Kids (91-365 days)	
30 head x 275 days x $.095/lb x 1	783.75
Total Concentrates	16,499.25
Hay:	
60 tons alfalfa/yr x $105/ton	6,300.00
20 tons grass hay/yr x $65/ton	1,300.00
Total Feed Cost	7,600.00
Bedding:	
15 tons bedding hay x $25/ton	375.00
Hired Labor:	
40 hrs/week x 50 wks/yr x $5.50	11,000.00
Interest on Borrowed Capital:	
No capital was borrowed to construct and stock the dairy. If capital was borrowed, interest paid is a cost item	0.00
Replacement Stock:	
All replacement does selected from kids crop	
5 replacement bucks @$350	1,750.00
Equipment Depreciation:	
Milking equipment (5-yr life, 10% salvage value)	
($5,000 original cost - 500 salvage value) ÷ 5 yrs	900.00
Bulk tanks (5-yr life, 10% salvage value)	
($1,000 original cost - 100 salvage value) ÷ 5 yrs	180.00
Pick-up (5-yr life, 10% salvage value)	
($6,000 original cost - 600 salvage value) ÷ 5 yrs	1,080.00
Diesel tractor (10-yr life, 10% salvage value)	
($10,000 original cost - 1,000 salvage value) ÷ 10 yrs	900.00
Total Yearly Depreciation	3,060.00
Milk Fed to Replacements:	
30 head x 56 days x 4 lb x $.123/lb	826.56

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Reviewed by G. F. W. Haenlein, U. of Delaware, Newark.

Extension Goat Handbook

PRODUCTION TESTING

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The number of dairy goat herds has greatly increased in the United States in past years. This has brought increased needs for accurate production and management information.

The National Cooperative Dairy Herd Improvement Program (NCDHIP) is a production-testing and information-gathering system that provides important information for management, breed and pedigree work, genetic evaluations, education and research. The program was developed primarily for dairy cattle, but dairy goat owners also are using the program. However, the number of dairy goats participating in the Dairy Herd Improvement Program is still limited. Participation is sometimes difficult because:

* Goat herds tend to have few animals; therefore, the cost of testing goats may be high when compared with their earning capability.
* Participating goat owners are asked to abide by official Dairy Herd Improvement (DHI) and Dairy Herd Improvement Registry (DHIR) rules, and their breed registry organization's rules; for example, the American Dairy Goat Association (ADGA) and the American Goat Society (AGS).
* Goat owners may be located in areas not readily served by a Dairy Herd Improvement Association (DHIA), or the DHIA may have bylaw restrictions on dairy goats.
* Goats are seasonal breeders, so there may be a period during the year when all does in the herd are dry at the same time; although the herd is to be on test the year around, whether does are milking or are dry.

There are several ways to obtain *official* production-testing information that is acceptable to the breed registry organizations, breed registry programs, and DHI programs. There are also other production-testing programs for obtaining unofficial production data for herd management. Such records are not acceptable to the dairy goat breed registry organizations because of their unofficial status.

Official Production-Testing Programs

The One-Day Test is a dairy goat breed registry program and has its own rules and procedures. These tests, usually held during local fairs or special goat shows, provide opportunity for does to earn "star" recognition. Arrangements must be made, in advance, with the dairy goat breed registry organizations and the local DHIA. The One-Day Test is conducted by a local DHIA supervisor, and there is a special charge. For information and rules concerning the One-Day Test, contact your dairy goat breed registry organization. This test is not part of the DHI program.

The DHI program is a cooperative education and research project between a state's land grant university and the dairy industry. Dairymen through local, state, and national DHIA's carry out the business, operation, and service responsibilities of the testing program. To be eligible to participate in the official testing programs of NCDHIP, one must be a member of a local or state DHIA. Official records are those that are verifiable as having been made in accordance with the National Official DHI Rules, the combined rules for DHIR, and policies approved by the Policy Board for NCDHIP. In some instances, a local DHIA may not be able to accept dairy goat owners as members in a cow-testing organization because of limitations in their bylaws. Some may agree, on the other hand, to provide this official testing service on a contract basis to nonmember dairy goat owners.

Dairy goat owners may apply for membership in a local or county DHIA. When membership is approved, the local DHIA will send a supervisor once a month to weigh, sample, and test each doe's milk for yield and butterfat. The supervisor also gathers the necessary management information

from the herd owner, then fills out and mails the completed sheets to a dairy record processing computer center.

The DHIA member may choose between several *official* and unofficial testing programs, but will be required to pay local, state, and national DHIA and breed organization fees, as appropriate, in addition to service fees for electronic data processing.

A permit to test DHIR must be obtained from the breed registry organization. All official records must comply with national official DHI and DHIR rules, dairy goat breed registry organization rules, and rules established by local, state, and national DHIA's.

Should one be in an area without the services of a local DHIA, or if the local DHIA is unable to provide testing services to dairy goat owners, it is possible to form a dairy goat DHIA separate from the local cow DHIA.

The structure of a new DHIA must conform to state laws and the requirements of the DHIA. In most states a local group would be required to form a nonprofit, tax-exempt organization, (corporation, cooperative, or association) with its own articles, bylaws, board of directors, and to affiliate with the state DHIA. The new DHIA's board of directors would then be responsible for the operation of the testing program, including hiring testing personnel, setting fees, and providing testing services to its members.

The new dairy goat DHIA would be required to operate under the same rules and policies of the National Policy Board of NCDHIP,, the Official DHI and DHIR Rules, in addition to dairy goat breed registry organization rules, and the policies of the state and national DHIA. For assistance in forming a separate dairy goat DHIA, contact the local dairy farm advisor, extension agent, or state extension dairyman.

As a member of a local or state DHIA, one has the privileges and responsibilities of membership as specified in the organization's articles of incorporation, bylaws, and membership agreement. The DHIA has an obligation to provide official tests and quality programs in accordance with the rules, policies, and standards established for the program by the Policy Board for NCDHIP.

Official tests and other program services may be provided to non-DHIA members by contract. Such contract services must be under the direct supervision and jurisdiction of a local DHIA and approved by the state DHIA to assure compliance to the rules, policies, and standards established for the NCDHIP. Such a contract must be specific in outlining rules and responsibilities, operating procedures, rates, schedules, etc. to assure uniformity, accuracy, and integrity of program data.

The *Group Test* (GT) program has been approved for official types of testing programs by the National Policy Board for NCDHIP and the National Sub-Group for Dairy Goats and is now operational in some state and local DHIA's.

The GT is not a "type" of testing program, but a procedure for conducting *official* types of testing programs. The GT enables DHIA-member dairy goat owners to participate in the official DHI and DHIR programs by allowing each group member to perform supervisor (test) responsibilities by testing herds of other group members. Group testing results in *lower costs* for production testing. In addition to fulfilling the requirements for official DHI and DHIR tests, GT members must also abide by special GT rules approved by the National Policy Board for NCDHIP. Each member of the test group is trained to perform supervisor responsibilities when weighing and sampling milk in the herds of other GT members. The milk sample is taken to the official DHIA supervisor or lab, the fat test is performed and the test sheets are forwarded to the dairy record processing computer center. To participate in the DHIR GT program, one must obtain a "permit to test DHIR" from the breed registry organization and be enrolled in the official program with the local or state DHIA. All official group testing is conducted under the jurisdiction and supervision of a local DHIA and the state extension dairyman.

Unofficial Production-Testing Programs

Several other production-testing programs may be provided by the local DHIA to meet individual needs for management. These do not have stringent rules. It should be recognized that unofficial production-testing programs provide valuable data for use in herd management, but because the conditions under which the records are made cannot be verified, they are not accepted by the industry or the breed registry organization officially.

The Commercial Test is performed by the DHIA supervisor, but compliance with official rules is not required. It is basically the same type of service that is provided in the official DHI testing program. There is usually no savings in cost for the commercial test compared with an official DHI test.

The Owner-Sampler Test has responsibilities shared by the owner and the DHIA supervisor. The owner weighs the milk, takes the sample, and records the data. The fat test is performed by the DHIA supervisor or lab. The cost of this test is usually less than other testing programs, because the owners do most of the work themselves.

The DHIA may take other types of tests available to dairy goat owners to meet their

specific needs. These programs are also unofficial and not acceptable to the industry or the breed registry organization, however, provide valuable information for herd management.

Starting a Group Test Program

Timing is important in planning. If dairy goats begin freshening after the first of January, it is recommended that program planning and training take place in October, November, and December. This allows time to form the GT unit and to begin operation as soon as the goats start freshening.

The local DHIA board of directors must approve the local GT program. The local farm advisor or extension agent should explain the basic concepts to the test group. The DHIA board should set rates for the testing service.

After DHIA board approval, a meeting is needed to discuss and study the GT program and all the policies and rules. Production information and benefits to be received from a strong GT program, as well as financial responsibilities should be well understood. Recognize the amount of free time each individual member must give to the GT program. In relation to production or value of milk produced, this cost may seem high.

At least two weeks should elapse before a second meeting is held for those dairy goat owners who are seriously interested in a GT program. Individuals who rush into the program tend to drop out later. This time period should give everyone an opportunity to study the program and procedures. At the second meeting, those who want to set up a GT unit should commit themselves and select a leader for the group.

Success depends on how much time the leader is willing to invest in the group. At this time each potential member should apply to his/her dairy goat breed registry organization for a "permit to test DHIR." While the rules call for a minimum of four herds for a GT unit, try not to form a group unless there are at least five. If the unit starts with only four, and one drops out, the unit cannot continue. Other dairy goat owners may wish to join the GT unit after it has begun. They must contact the DHIA and group leader, and work into the testing schedule.

There must be a group leader in charge. The group leader must attend the DHI supervisor training sessions and help train group members in testing and getting samples to the central laboratory for component testing. Where required, group leaders are trained as DHI supervisors and are licensed. They may conduct tests on member herds outside the group when hired to do so by the DHIA.

Duties of the group leader usually are not burdensome; however, to see that the testing program is conducted as planned and complies with all rules and policies, the leader must work closely with the DHIA supervisor and dairy farm advisor or extension agent.

Problems within the group should first go to the leader for solution. If the leader cannot resolve the problems, the leader should then take them to any or all of the following people in this order: DHIA supervisor, DHIA board of directors, dairy farm advisor, extension agent and/or state extension dairyman. The leader acts as liaison among these groups.

A special training program for all members of the test group must be held before herd testing begins. Training should be conducted by any or all of the following people: DHIA supervisor, dairy farm advisor, extension agent and/or state extension dairyman.

Items to consider in planning:

- procedures for weighing and sampling milk
- animal identification
- recording management information
- handling samples
- supervisors' responsibilities
- herd owners' responsibilities
- delivering samples for butterfat, protein, and somatic cell testing
- herd information required
- services available for goat herds
- computer programs
- what to do when all animals are dry
- official rules and policies
- using production-testing information
- equipment maintenance
- cost assessment of testing and bill collection
- roles, responsibilities, and relationships of group members
- testing schedules
- ethics

The group may want to impose additional rules or guidelines for its members. The adoption of such rules should be by a majority vote of the GT members. These rules must not conflict with official rules of DHIA.

The group members should fully understand that the success of the program is up to each individual member. There can be no shortcuts in the operation of the program. Records must be kept in good order so that any question can be verified. Failure to abide by the rules will jeopardize the GT program and its production records.

National DHI Rules for Group Test

All GT herds must follow the national DHI and DHIR rules for official test. These rules are available from the local DHIA, dairy farm advisor

or extension agent. The following additional rules for GT are required.

1. A minimum of four herds in any single test group (under some exceptional circumstances, states may approve groups with three members).
2. Only those dairy goat owners attending a special training program supervised by the state extension dairyman are permitted to participate in group testing.
3. Scales used in the weighing of milk must conform to standards set by the National Bureau of Standards.
4. All other equipment such as dippers and bottles, etc. must be approved by the state extension dairyman or his county representative.
5. Every DHIR herd is subject to a surprise test (of three milkings) to be called by the state extension dairyman and to be conducted by a DHIA supervisor or a trained group leader of a different group. The herd is subject to a surprise test when the herd or individual does meet certain minimum production-level requirements.
6. All milking must be witnessed, weighed, and sampled by a trained member of the group who is not an owner of the dairy goat herd being tested.
7. All butterfat and other component tests must be made by a laboratory approved by the state extension dairyman.
8. Testing a particular herd by another individual of the group will be determined by the DHIA supervisor or group leader.
9. All other rules and conditions of the testing programs, as outlined by the official DHI and DHIR rules and the dairy goat breed registry organizations, must be complied with.

Surprise Testing Requirements for DHIR

All official DHI and DHIR herds are subject to surprise tests (check tests). A surprise test is designed to verify the authenticity of production, identification, and other details. The surprise test is unannounced and includes a preliminary milking preceding the 24-hour milking period being verified. A surprise test is conducted by a DHIA supervisor or by a qualified group leader for herds participating in the GT program.

The state extension dairyman for NCDHIP shall arrange for surprise tests when:

1. Data and information available indicate rules may have been violated to the extent that regular supervision would not give a true test of the herd or any individuals in the herd.
2. Requested to do so by the Superintendent of Official Testing, the American Dairy Goat Association or the American Goat Society.
3. The following requirements are met:
   - -if an individual doe record, after 90 days, is projected on an actual basis to be at least 3000 pounds milk and/or 105 pounds butterfat
   - -on a Mature Equivalent (ME) basis, after 90 days, the projected record is 3500 pounds milk and/or 125 pounds buttermilk
   - -on a ME basic, after 180 days, the projection is 4000 pounds milk and/orf 140 pounds butterfat.

Value of Production Testing

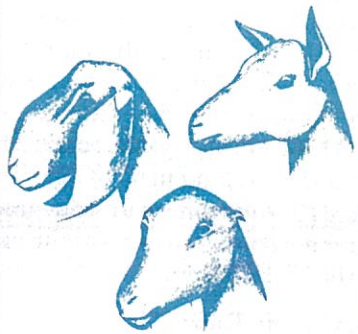
Information from GT, DHI, DHIR or other similar programs has important direct benefits for herd management and long range genetic progeny testing benefits for buck and elite doe selection, contracts, sales and breed improvements. Participating goat owners receive monthly computer printed reports for:

- -each milking doe
- -total herd
- -annual and decade progress
- -merit of bucks used against others available in the area
- -completed and projected records
- -cost accounting, and returns over feed costs
- -income returns of individual herd members
- -animal kidding intervals
- -average age of first milkers
- -average age of all milkers
- -rate of roughage and concentrate feeding in relation to requirement
- -reproduction and health records

Production-testing through the GT program provides the dairy goat owner with valuable herd management information for the improvement of his/her herd, which benefits the whole industry in the long run.

Reviewed by G. F. W. Haenlein, U. of Delaware, Newark.

Extension Goat Handbook



ECONOMICS OF DAIRY GOATS

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There are few goat dairies in the United States that are operated as a commercial enterprise capable of generating enough income to be self-sustaining. Most often the goat enterprise is considered a supplemental source of both income and food. Information compiled by USDA on goats enrolled in official production testing programs (DHIA) (DHIR) indicates that in 1980, 67% of the herds had less than 10 milking does, 23% had between 10 and 20 milking does and herds numbering more than 50 milking does were but 2% of the total.

A Market

Most of the milk produced is consumed at home. Some dairies close to housing developments have been successful in building a jugging business while a smaller number have ventured into pasteurizing, processing and packaging fluid milk, cheese, yogurt and ice cream for distribution to retail sales outlets including health food stores. The number of commercial processors available to which raw milk may be shipped is indeed small. Building or finding a market for goat milk is truly one of the major economic factors to consider if herd size and production is designed to exceed home use needs.

State Requirements

In order to produce milk and sell it legally to a wholesaler, most states require dairy goat milk producers to meet the same requirements demanded of dairy cow milk producers. This includes housing for the animals which would be acceptable from the standpoint of drainage, cleanability, light and ventilation. Milking parlor areas must be constructed so that all floors, stalls, walls, ceilings and feeding facilities are cleanable daily with water under adequate pressure. This mandates that all surfaces in the milking parlor, including the milking equipment, must be made of stainless steel, glass, plastic or washable painted surface which is classified "acceptable" under FDA-state approved standards.

Most milk regulatory agencies require that milk be held in cans or stainless steel bulk tanks at a temperature under 40 ° F. They also require regular inspection by an approved dairy sanitarian at specified intervals.

A discussion of economics of goat keeping may not be a practical consideration for those owners who produce milk for home use and who make up a majority of the dairy goat industry. If it is viewed as an exercise to produce food for the table, a husbandry-hobby pastime; a desire and/or need for goat milk in place of cow milk, then economics may be of secondary or little importance.

Milk Producing Potential

The average production of does on DHIA test in the United States is nearly 1650 lbs of milk per year. That's about 4.5 pounds of milk for each day in the year or just a taste more than two quarts per doe per day. Nature says that fresh does give the greatest amount of milk so production may range from a high of 12 or 14 pounds per day down to zero at the time the doe dries off. Some does may produce between 3000 and 4000 pounds per year while others may produce closer to 500 pounds. Therefore the economics of a goat herd depends on the milk producing potential of the animals. If milk can be sold for 85 cents per quart via a jug sales outlet at the farm or home and 45 cents per quart to a commercial milk processor one can easily calculate the gross income from milk by multiplying quarts sold times price received per quart.

Sale of Stock

A second source of income may be realized from sale of kids not needed for herd replacement

purposes. Most breeders believe that registered animals and milk production records are an essential part of a successful animal merchandising program. Sell a kid at three days of age for $30; a cull doe for $50; a grade milking doe for dairy purposes at $150 and a registered doe for $250 or more; a grade kid at 3 months of age for $65 or if registered for $100 and one can add gross income from all sources contributing to the positive side of the enterprise ledger.

The Home Dairy

Costs are much more complicated to calculate. How fancy do you plan to make the goat dairy? A couple milking does and their offspring can be housed in a small shed that may be of no value except to house the animals. As long as it is clean and dry with plenty of light and fresh air the housing is solved. Does can be milked on a milking stand in one corner and no one is concerned. A milk bucket, milk strainer, some feeding and watering utensils, a means to cool the milk (an ice water bath works great, followed by the household refrigerator for storing milk), then add a fork, shovel, and broom and you're in business.

The Commercial Dairy

However, if plans are to go public with milk sales or sell to a commercial processor and build the herd to 50 or 100 or more milking does then the subject of cost economics changes greatly. Now the thoughts turn to major construction of barns to reduce labor needed to feed the animals and clean out the manure and refuse. Hay and straw storage buildings are needed and if the forages are produced on the farm either purchase and upkeep costs of tillage and crop harvesting equipment or lease of same is necessary. Let's add a milking barn or parlor, a milkhouse, bulk tank, washing equipment, perhaps a milking machine or pipeline milker, electricity, water, detergents and many other items too numerous to mention.

If the decision is to go big and invest in buildings and machinery and truly be a commercial goat dairy, the production level in the milking herd and gross income becomes terribly important. Now, there is interest to pay, mortgage principal to pay, equipment repair costs, veterinary care and the many cost features not of real concern to the owner of one to ten milking does. There is no relevancy to a discussion of economics when considering these two extremes. The best advice on economics is to enter your appropriate level of goat husbandry with open eyes.

At any size of herd there are a number of management practices that will affect greatly the economic outlook of profit perhaps more so than the building and equipment.

Breed Early

Growing young stock to enable breeding at 7 months of age reduces the number of nonproducing animals in the herd at any one time and increases total lifetime milk produced. Animals that are big enough to freshen at 12 months of age but stand around another six to ten months in a non-milking state because the owner doesn't believe in early breeding are costly, nonproduction units in a herd.

Single Breed

Keep one breed of goats. This decision greatly increases genetic improvement potential, especially in a small herd of 20 or fewer does, and reduces the needs for keeping one or two bucks for each breed selected.

Cull Does

Keep only the number of milking does needed for milk demands. To permit the milking herd to multiply because you have become attached to certain animals and cannot bear to sell or cull is often a costly practice. Low producers who fail to put milk on the table or extra does who produce more milk than is needed for the table or for sale should be moved out of the herd.

Sell Kids

Sell kids not needed for herd replacements or for sale as breeding stock. If this decision can be made at 1 to 3 days following birth, the extra colostrum can be fed to kids being raised, you have more herd milk for the table or for sale plus fewer growing costs, vet bills and less labor. A day old kid may sell for $30 at the local market. You may feed it milk, grain and hay until 90 days old and sell it at that same market for $60. Costs far exceed the extra sale income.

Low Mortality

Keep kid mortality low. A good sanitation program, feeding regime and clean, dry housing is usually all that is required. High mortality reduces animals available for sale and often necessitates the purchase of mature animals to keep milking herd numbers at a desired level.

Use Extra Milk

Try selling extra goat milk during flush production periods rather than feeding it to a pig or veal calf. An option is to learn to make cheese that can be stored and aged to provide food during those "dry" months. Try freezing some of the extra milk. Wasting precious milk is a fairly common practice.

Correct Feeding

Avoid overfeeding and underfeeding of grain. Underfeeding especially during periods of high production, greatly reduces milk production potential for the lactation. Overfeeding can cause excess fat to be laid down in the udder and reproductive tract thus reducing breeding performance and milk production potential. Both extremes are obviously costly practices. Buy a grain mix formulated for a ruminant.

Prevent Feed Waste

Build hay mangers that prevent wasting of hay, especially the precious leaves from clovers and alfalfa. Goats are notorious forage wasters.

Year-round Milk

A milk market is better served if breeding practices in the herd encourage freshening the does over as wide a time span as possible. This is especially valuable during base building periods and as an aid to providing the customer with a year-round source of milk.

Keep Records

The selling price of does and their offspring is enhanced if those animals are registered and parentage is documented, and if high milk records are documented through a DHIA testing program.

Use a Processor

If a commercial processor is available it is usually more economical to sell the milk to the plant or to employ that service to process and package under your label. Quality control in milk and milk products for the novice is a difficult art and science to master and cost of processing equipment is beyond imagination.

Those points are not listed in priority order; neither are they the sole factors to consider. However, if the goat enthusiast is to have a chance at a profitable economical enterprise, his or her management abilities must be positively accounted for in addition to the cost of brick, mortar, concrete and stainless steel, feed and animals.

Budget

In the foreseeable future a small herd of 5 to 10 high-producing registered does will produce an adequate quantity of nutritious milk to supply several neighborhood families. The income from sale of milk will pay for the out-of-pocket costs to feed and care for the animals and extra income can be realized from sale of breeding stock to other dairy goat enthusiasts.

Those who plan to produce goat milk for sale off the farmstead should make as accurate a budget of cost and income as is possible. Overestimate the costs and underestimate income on your first attempt and refine it later. Have a realistic plan at the time you approach the lending agency. At the same time be working with the milk regulatory agency and, if applicable, the milk plant where the milk will be received. It's better to answer their questions before any concrete is poured or nail driven. If marketing is to be done by the owner-producer, be sure you have more than a verbal contract with the prospective buyer (hospital, health food store, etc.) and knowledge of the specific quantity they will purchase. If stock must be purchased make every effort to assure that it is disease-free. Work with the Cooperative Extension Service in your county to set up an adequate record keeping system both for milk and cash flow and discuss production and management details. If it's a farm you are purchasing, check soil maps, drainage and crop production potential. Finally, be a lover of animals with an appreciation for working 365 days a year. Goats are lovable, affectionate creatures, easily handled and intelligent but they depend on the owner-caretaker for constant and complete care every day in the year.

An understanding of the economics of goat dairying demands a mixture of personal goals, philosophical outlook, cash income and expense, a labor of love, a willingness to learn and change, enthusiasm and decision making abilities. To consider goat dairying from purely an economical viewpoint is to miss the essence of life. To embark on the project with no consideration of cash flow will lead eventually to disillusion. The successful dairyman of tomorrow will be the person who can combine many talents into a functional management program that will enhance a standard of living.

Reviewed by G. F. W. Haenlein, U. of Delaware, Newark.

Goat dairying is a mixture of economics and personal goals. Photo courtesy of D. L. Ace, Pennsylvania State University.

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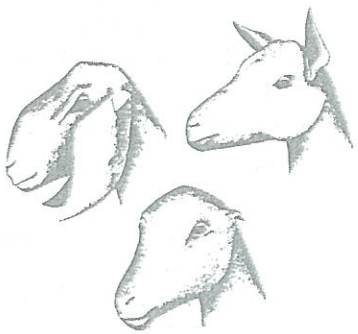

GOAT MILK VERSUS COW MILK

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To most people today, especially in the more developed countries, the term milk is synonomous with cow milk, as if cows alone possess a singular ability to produce mammary secretions. Perhaps nowhere has the feeling been more prevalent than in the US, where over 10 million cows are maintained to provide an abundant, clean source of nourishment and refreshment to our country, producing more than 125 billion pounds of milk annually. Yet on a world wide basis, there are more people who drink the milk of goats than from any other single animal. Over 440 million goats (world wide) produce an estimated 4.8 million tons of milk that is predominantly consumed locally, or processed into various types of cheeses.

Here in the US, which historically has been one of the staunchest denigrators of the "stinking" goat, there are approximately a million dairy goats actively producing milk. Most of the upsurge in goat popularity has been the result of a growing trend towards attaining some measure of self-sufficiency on the part of many people, for both economic and aesthetic purposes. A goat will eat little, occupy a small area and produce enough milk for the average family (a good milker will produce about a gallon a day); whereas the prospect of maintaining a cow in a surburban backyard is usually more than the homeowner is willing or able to cope with. Hence the growing popularity of the "poor man's cow".

As the interest in dairy goats and their products continues to rise, it is apparent that many misconceptions, discrepancies and exaggerated claims are being perpetuated. A comparison of cow and goat milk seems to be in order, so that some prejudices against goat milk may be erased. Also, while goat milk is somewhat unique, it is certainly not a magical elixir.

One of the primary misconceptions concerning goat milk is that it has a peculiar "goaty" odor or taste to it. This effect is produced by the presence of the buck, whose scent glands are rather odoriferous and may indeed cause the "goaty" type of milk people object to if he is present among the herd, especially at milking time. Does, however, do not have the powerful odor of the buck and milk produced in the absence of a buck should bear no objectionable odor.

Diet also plays a large role in the palatability of goat milk, as well as cow milk. While cows are usually rather closely regulated as to what they may eat and when, goats are often allowed to consume a great variety of materials at any time, including browsing. This kind of feeding may allow a certain "off" taste or smell to be transferred to the milk, just as cows may produce a "garlicky" milk from some spring pastures. What holds true for the cow also holds for the goat; i.e. what comes out is based on what goes in! If goats and cows are similarly managed, the smell and taste of both milks are quite comparable.

Goat milk is similar to cow milk, in its basic composition. In average, cow milk contains about 12.2% dry matter (3.2% protein, 3.6% fat, 4.7% lactose and 0.7% mineral matter). Goat milk contains about 12.1 dry matter (3.4% protein, 3.8% fat, 4.1% lactose and 0.8% mineral matter). These figures are only averages of course, as there are considerable differences between breeds, and among individuals of a breed. There are 6 breeds of dairy cows in the US, and 6 breeds of dairy goats producing milk.

The Saanen is best known as the Holstein of the goat world, producing a high quantity of milk with somewhat low fat levels. At the other extreme is the Jersey of the goat world, the Nubian. This breed produces a lesser amount of milk with a high fat content. The Toggenburg, LaMancha, Oberhasli and Alpine fall somewhere in between.

However, there are also differences that give goat's milk a place for special purposes. In summary:

1. Goat milk has a more easily digestible fat and protein content than cow milk.

2. The increased digestibility of protein is of importance to infant diets (both human and animal), as well as to invalid and convalescent diets.
3. Goat milk tends to have a better buffering quality, which is good for the treatment of ulcers.
4. In under-developed countries, where meat consumption is low, goat milk is an important daily food source of protein, phosphate and calcium not available otherwise because of a lack of cow milk.
5. Goat milk can successfully replace cow milk in diets of those who are allergic to cow milk.

Allergies appear to be more common than formerly thought, especially in very young children. In an allergic type reaction, the symptoms are produced by histamines, which are stored in body cells. Histamines are released when triggered by a local stimulus. Antibody-antigen type reactions that manage to find an anchorage on cell walls trigger a release of histamine and produce the allergic symptoms. Such a release brings on a congestion of the capillaries and a flooding of the intracellular spaces by the lymphatic glands. The stimulation of local nerve endings also occurs. People who display an allergic reaction are usually more sensitive to the release of a given amount of histamine and also tend to produce greater numbers of antibodies to certain proteins.

Some of the so called "sudden deaths" of infants seem to be related to allergic type responses, resulting in anaphylactic shock. About 6% of the infants in the US suffer allergic responses to cow's milk. Of this number, however about only 14% (of the 6%) react to bovine serum present in cow milk. Most infants are allergic to various constituents of cow milk which may also be present in goat milk. Individuals who are allergic to bovine serum in cow milk will undergo also an allergic reaction to a variety of dairy products that are made with cow milk.

Other types of digestive upsets can result from milk due to a lack of the lactose digesting enzyme. While the presence of lactase is universal in infants (up to 3 years), the presence of this enzyme in adults is somewhat irregular and genetically determined.

Fat

One of the more significant differences from cow milk is found in the composition and structure of fat in goat milk. The average size of goat milk fat globules is about 2 micrometers, as compared to 2½ - 3½ micrometers for cow milk fat. These smaller sized fat globules provide a better dispersion, and a more homogeneous mixture of fat in the milk. Research indicates that there is more involved to the creaming ability of milk than merely physical size of the fat globules. It appears that their clustering is favored by the presence of an agglutinin in milk which is lacking in goat milk, therefore creating a poor creaming ability, especially at lower temperatures.

The natural homogenization of goat milk is, from a human health standpoint, much better than the mechanically homogenized cow milk product. It appears that when fat globules are forcibly broken up by mechanical means, it allows an enzyme associated with milk fat, known as xanthine oxidase to become free and penetrate the intestinal wall. Once xanthine oxidase gets through the intestinal wall and into the bloodstream, it is capable of creating scar damage to the heart and arteries, which in turn may stimulate the body to release cholestrol into the blood in an attempt to lay a protective fatty material on the scarred areas. This can lead to arteriosclerosis. It should be noted that this effect is not a problem with natural (unhomogenized) cow milk. In unhomogenized milk this enzyme is normally excreted from the body without much absorption.

Another significant difference from cow milk is the higher amount of shorter-chain fatty acids in the milk fat of goats.

Furthermore, glycerol ethers are much higher in goat then in cow milk which appears to be important for the nutrition of the nursing newborn. Goat milk also has lower contents of orotic acid which can be significant in the prevention of fatty liver syndrome. However, the membranes around fat globules in goat milk are more fragile which may be related to their greater susceptibility to develop off-flavors than cow milk.

Protein

The protein composition of cow and goat milk is fairly similar, although the typical major alpha-s-1-casein in cow milk is absent in goat milk and the formation of casein curd under rennin action is different. The quality of curd is judged on two criteria:

1. Curd tension - a measure of the hardness or softness of the curd. The softer the material, the more easily digestible it is. This tension is largely a breed characteristic. Holsteins generally have the softest curd in the bovine family. Cow range = 15-200 g, avg = 70 g. Goats range = 10-70 g, avg = 36 g.
2. Relative size of flakes - formed by the addition of strong acid to milk, causing curd flakes to precipitate. It can be seen that goat milk forms finer flakes more rapidly than cow milk, which tends to form large lumps and

more slowly. This test tends to duplicate reactions that occurs in the stomach, and demonstrates why goat milk is more easily and rapidly digested.

Vitamins

Goat milk has greater amounts of vitamin A than cow milk. Also, goats convert all carotenes into vitamine A, creating a white type of milk.

Vitamin B levels are a result of rumen synthesis in goats and cows, and are somewhat independent of diet. Goat milk is higher in B levels especially riboflavin, but vitamin B_6 and B_{12} are higher in cow milk. Niacin levels are also higher in goat milk.

The milk levels of vitamin C and D are low and roughly the same for cows and goats.

Lactose

Cow milk is higher in lactose levels, although the difference is minor.

Ash (Minerals) and Buffering

Goat milk is higher in minerals, calcium, potassium, magnesium, phosphorus, chlorine and maganese; but it is lower in sodium, iron, sulphur, zinc and molybdenum.

Cow and goat milk is slightly on the acid side, with a pH range of 6.4-6.7. The principal buffering components of milk are proteins and phosphates. The good buffering capability of goat milk appears to make it ideal for treatment of gastric ulcers.

Goat milk has also less of certain enzymes, ribonuclease, alkaline phosphatase, lipase and xanthine oxidase. Thus, some differences exist but their nutritional significances in human nutrition have yet to be researched and documented. The goat probably will never replace the cow for commercial production of milk, but there seems to be a great potential for diligent efforts in practice and research to improve production and marketing of goat milk and its products. The value of goat milk as an alternative food for children and sick people, because it is easier digested, extends also to feeding animals, young dogs, foals, even calves. Experience in the field indicates that calves can consume large quantities of goat milk while similar amounts of cow milk may result in scouring calves. Goat milk can, therefore, have a value not only for growing veal but also for raising valuable dairy replacement heifers, which will benefit from the high milk intake and show superior growth.

Reviewed by D. L. Ace, Pennsylvania State U., University Park.

Table 1. Comparative Average Composition of Milks

Item	Goat	Cow	Human
Fat, %	3.8	3.6	4.0
Solids-not-fat, %	8.9	9.0	8.9
Lactose, %	4.1	4.7	6.9
Nitrogen x 6.38, %	3.4	3.2	1.2
Protein, %	3.0	3.0	1.1
Casein, %	2.4	2.6	0.4
Albumin, globulin, %	0.6	0.6	0.7
Non-prot. nitr. x 6.38, %	0.4	0.2	0.1
Ash, %	0.8	0.7	0.3
Calcium, (Ca0), %	0.19	0.18	0.04
Phosphorus, (P_20_5), %	0.27	0.23	0.06
P_20_5/Ca0	1.4	1.3	1.4
Chloride, %	0.15	0.10	0.06
Iron (P/100,000)	0.07	0.08	0.2
Copper (P/1000,000)	0.05	0.06	0.06
Vitamin A (i.u./g fat)	39	21	32
Vitamin B (ug/100 ml)	68	45	17
Riboflavin (ug/100 ml)	210	159	26
Vitamin C (mg asc. a./100 ml	2	2	3
Vitamin D (i.u./g fat)	0.7	0.7	0.3
Calories/100 ml	70	69	68

Various powdered, evaporated, pasteurized, raw milk, yogurt and goat cheese products are found in stores and direct farm sales. Photo courtesy of G. F. W. Haenlein, University of Delaware.