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# UNDERSTANDING DAIRY GOAT PRODUCTION

**By**
**Harlan H. D. Attfield**

**With Contributions From**
**George F.W. Haenlein**
**Jane Williams**
**Earl M. Moore**

**Technical Reviewers**
**Morrison Lowenstein**
**Pam Adolphus**

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**VITA**
**1600 Wilson Boulevard, Suite 500**
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**Tel: 703/276-1800 . Fax:703/243-1865**
**Internet: pr-info@vita.org**

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## PREFACE

**This paper is one of a series published by Volunteers in Technical Assistance to provide an introduction to specific state-of-the-art technologies of interest to people in developing countries. The papers are intended to be used as guidelines to help people choose technologies that are suitable to their situations. They are not intended to provide construction or implementation details. People are urged to contact VITA or a similar organization for further information and technical assistance if they find that a particular technology seems to meet their needs.**

**The papers in the series were written, reviewed, and illustrated almost entirely by VITA Volunteer technical experts on a purely voluntary basis. Some 500 volunteers were involved in the production of the first 100 titles issued, contributing approximately 5,000 hours of their time. VITA staff included Patrice Matthews and Suzanne Brooks handling typesetting and layout, and Margaret Crouch as senior editor and project manager. VITA Volunteer Dr. R. R. Ronkin, retired from the National Science Foundation, lent his invaluable perspective, as a volunteer, to the compilation of technical reviews, conversations with contributing writers, editing, and in a variety of other ways.**

**Long-time VITA Volunteer Harlan H.D. Attfield, the author of Raising Rabbits, Raising Chickens and Ducks, and other VITA publications, has spent many years working in agriculture projects in developing countries. In putting this paper together he drew from the work of Dr. George F.W. Haenlin, a professor and dairy specialist in the Department of Animal Science at the University of Delaware; Jane Williams, a former animal husbandry adviser for the Peace Corps; and Dr. Earl Moore, a former poultry and livestock consultant for the Ford Foundation. Reviewer Dr. Morrison Lowenstein is retired from the University of Georgia, where he was a goat milk products specialist. Pam**

**Adolphus is a self-employed dairy goat farmer. Both are long-time VITA Volunteers. Harlan Attfield's father. Harry E. Attfield, a retired San Francisco lithographer, provided the funds for the word processing of the initial drafts of the paper.**

**VITA is a private, nonprofit organization that supports people working on technical problems in developing countries. VITA offers information and assistance aimed at helping individuals and groups to select and implement technologies appropriate to their situations. VITA maintains an international inquiry Service, a specialized documentation center, and a computerized roster of volunteer technical consultants; manages long-term field project; and publishes a variety of technical manuals and papers.**

**UNDERSTANDING DAIRY GOAT PRODUCTION**

**By VITA Volunteer Harlan H. D. Attfield**

## 1. THE DAIRY GOAT

**Goats are among the smallest domesticated ruminants and have served mankind longer than cattle or sheep. They thrive in arid, semitropical, or mountainous countries. More than 460 million goats**

**in the world produce over 4.5 million tons of milk and 1.2 million tons of meat annually, besides mohair, cashmere, leather, and dung for fuel and fertilizer. Goats are friendly animals; with proper attention they maintain good health and can be managed easily even by children.**

**More people consume dairy products from goats than from any other animal. Goat's milk greatly improves the diet of many rural families. It is traditionally valued for the elderly, the sick, babies, children who are allergic to cow's milk, and patients with ulcers. It is even preferred for raising orphan foals and other young domestic animals. Goat milk is richer than cow's milk in some important nutrients: vitamin A, niacin, choline, and inositol; it is poorer in folic acid.**

**Goats are browsers, preferring the new growth of shrubs and the seed heads of grasses to the lower quality older growth in a pasture. They are able to select the most nutritious parts of plants, even from thornbushes and higher tree branches not reached by sheep, and can use a wide range of forage. For this reason, they are able to survive in areas where other livestock do not.**

**As browsers, they are useful for clearing brush in small areas. However, because they strip the leaves and bark of young trees, they should be used in settled areas only if**

**good fences can be provided. One or two animals can usually be controlled with a tether, but they must be watched carefully lest they get tangled in brush or wind their tethers around small trees.**

**Most efforts to improve dairy goat management have been designed to provide more and better milk. These efforts include:**

**1. Breeding and selecting to produce more and better milk.**

**2. Better feeding and pasturing practices.**

**3. Better housing for extremes of weather and climate.**

**4. Improved sanitation of milk and milk products.**

**5. Control of internal parasitic diseases that often lead to poor health and decreased milk production.**

**6. Improved marketing of dairy goat products.**

**7. Development of information and research services.**

**All goats, even those selected for milk production, eventually are used for meat unless they die or are destroyed for other reasons. Many people prefer goat meat to mutton, beef, or pork; it is the**

**principal source of animal protein in many North African and West Asian nations. It is also important in the Caribbean area and in Southeast Asia, and relatively more so in developing tropical countries than in the temperate regions. The world production of edible meat from cattle, buffaloes, sheep, goats, swine, and horses is estimated at 17.9 million tons, 5.7% of which comes from goats.**

## 2. BREEDS

**The major breeds of dairy goats are listed below:**

**Saanen, originally from Switzerland, where they were bred for odor-free**

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**milk, are totally white. Like other Swiss breeds, they may or may not have horns. They are usually short haired. Saanen goats are used around the world as leading milk producers.**

**Toggenburg, brown with white stripes on the face, ears and legs, are mostly**

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**short haired, erect eared goats. They too are of Swiss origin and are 10 cm shorter and 9 kg lighter than the Saanen. Pure bred for over 300 years, they are reliable milk producers summer and winter, in temperate and tropical zones.**

**Alpine (including French, Rock and British), another Swiss breed, are short**

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**haired and as tall and strong as the Saanen. They are colored white on black, and produce less milk than Saanen or Toggenburg.**

**Anglo-Nubian is a breed developed in England from native and from Indian**

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**and Nubian goats. They have heavy arched noses and long, pendulous ears, spiral horns (when horns are present), and short hair. Anglo-Nubian goats are as tall as Saanen, but give milk that is less in amount and higher in fat content. They are less tolerant of cold but do well in hot climates. They "talk" a lot, and are in numbers the most popular breed in the United States, Canada, and many parts of Asia. They often produce triplets and quadruplets. Goats of this breed show many colors and are often spotted.**

**Oberhasli (also called Swiss Alpine. Chamoisie, or Brienz) goats, of Swiss**

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**origin, are usually solid red or black, have erect ears, and are not as tall as Saanen. They are very well adapted for high-altitude mountain grazing and long hours of marching. Milk production is variable.**

**Before selecting a breed consult local agricultural extension authorities for advice. Regardless of
the breed selected for milk production, individual animals should have body characteristics as
shown in Figure 1.**

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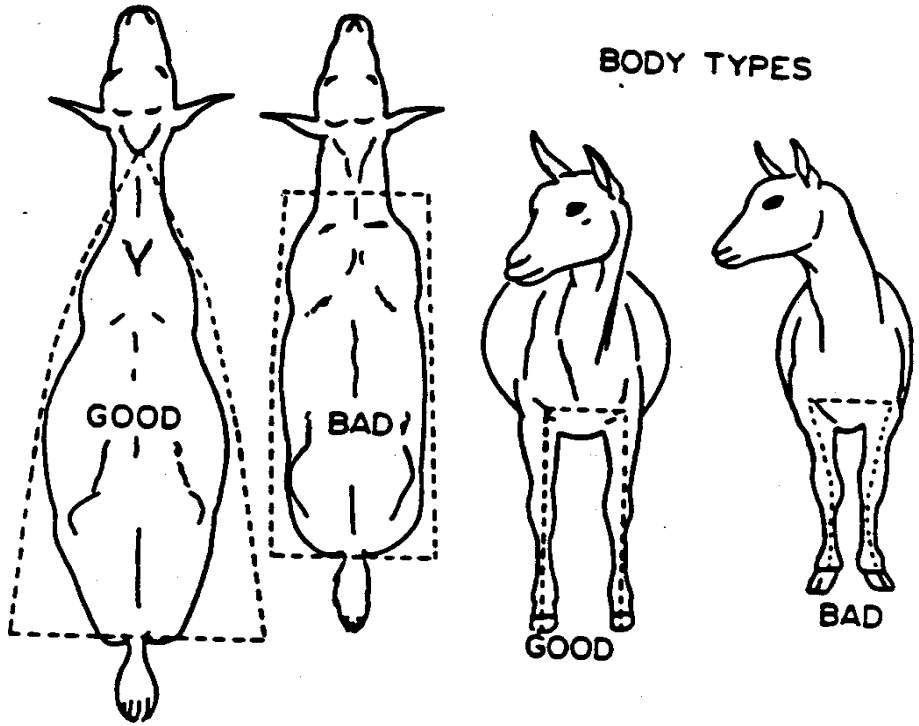


GOOD AND BAD UDDERS

BAD - PENDULOUS BAD - UNBALANCED GOOD - ROUND, FIRM, WELL BALANCED

**Figure 1: Choosing a Dairy Goat**

## 3. REPRODUCTION

**Goats may breed at any month of the year, but in temperate climates they breed seasonally, generally showing estrus in the autumn as the days become shorter and producing young about five months later. Seasonal breeding is much less marked in the tropics. Most breeds reach sexual maturity at about five months; dwarf or pygmy goats as early as three months. In the tropics female goats often produce first young by 12 to 15 months even if poorly fed and not well developed.**
**The usual birth interval is about a year in the United States and Europe; in the tropics under good management the interval varies from 260 to 290 days.**

**A female goat is called a doe, males are bucks, and the young are kids. Mature does of most breeds produce more twins than single kids; triplets and quadruplets are common and are success-reared.**
**The usual litter size varies from 1.4 to 2.2 kids and in the tropics the kidding interval is about 280 days. A female should produce young three times in two years, or 2.1 to 3.3 kids per year.**

**Swiss goat breeds are the world's leaders in milk production. Indian and Nubian goat breeds are dual-purpose meat and milk animals. Spanish and South African Boer goats are best known for meat producing ability. The Turkish Angora, Asian Cashmere, and the Russian Don**

goats are kept
for mohair and cashmere wool production. In addition, Pygmy goats from Western Africa are of
increasing interest as laboratory and pet animals, and as successful meat and milk producers in
areas infested by tsetse flies.

## 4. FEEDING DAIRY GOATS

The goat is a ruminant, having a four-part stomach like the cow and sheep. The first part, called
the rumen, is the largest; it receives food that has been swallowed without much chewing and
stores it until it is regurgitated and chewed again. The food eventually goes to the third and fourth
stomachs, where it is more completely digested. The rumen contains bacteria that break down
plant fibers to soluble sugar and manufacture certain essential nutrients that may be absent from
the diet. Digestion is completed in the small intestine.

Although the goat has a great capacity for consuming fibrous feed (roughage), it needs to be given
forage or good quality, such as legume hay. In India this often consists of berseem (Egyptian clover,
Trifolium alexandrinum), alfalfa (lucerne), groundnut hay, acacia beans or leaves from legumes
(pulses). It is economical to give goats all the good quality hay they will consume, because

**this is often the cheapest source of nutrients for ruminants. Dry hay should be stored for use when green fodder is unavailable. Goats also like vegetable leaves and peelings; for example, cabbage, cauliflower, carrot tops, and turnip tops (potato peelings can be toxic). These should be fed with the regular forage, not in place of it.**

**The forage diet of dairy goats is often supplemented with a mixture of seeds and other materials, called "concentrate." Farm by-products are sometimes fed to goats. Among traditional by-products used in Africa are cassava waste, cottonseed meal, and rice bran. Nonconventional sources include bagasse, poultry litter, and sawdust.**

**The main nutritional requirements are as follows:**

**Energy sources, Most of the goat's energy comes from the breakdown of the plant fiber. The rest comes from the oxidation within the body of starches and fats from concentrate. The energy content of the diet is studied in the laboratory by burning a sample and measuring the heat that is generated. The results need to be refined, because some of the energy in food is lost to the animal in the feces, urine, and gases. Moreover, the body uses some of the energy just to do the work of digestion itself. In recent years energy measurements have been refined to**

**account for the special
needs of body maintenance, weight gain, or milk production.**

**A continued shortage of dietary energy sources will lower milk production. Goats at the very early
stages of lactation (milk production) need more energy.**

**Protein - Protein is the main source of dietary nitrogen, makes up the basic cell and tissue structures
of the body, and is vital for growth, milk production, disease resistance, reproduction, and
general maintenance. Protein quality, a term nutritionists use when referring to the amino-acid
content of food, has no significance in ruminant nutrition except at exceptionally high levels of
milk production. This is so because rumen microorganisms manufacture all the amino acids needed
by the host animal. Excess protein, if any, is oxidized in the body for its chemical energy and
the nitrogen is eliminated by the kidneys. Since protein is generally the most expensive part of the
ration, it is unwise to feed more than is needed. Protein requirements vary from 12 to 16 percent
of the ration dry matter the larger figure represents the need during high milk production.**

**Urea and other nonprotein nitrogen products can be used by the microorganisms of the rumen for
the production of protein. However, they are not generally recommended for goats**

**because the animals adapt slowly to foods containing them.**

**Minerals - Most of the minerals needed by goats are obtained from forage and concentrate. The major minerals are calcium, phosphorus, and sodium (as salt). These may be added to the concentrate or made freely available. The ratio of calcium to phosphorus should be kept around 1.5 to 1. Equal parts of salt and dicalcium phosphate are recommended for free-choice feeding. Selenium is essential in very small amounts; in some areas of the world it must be added to the diet.**

**Vitamins - The only important vitamins in ruminant nutrition are A, D, and E. Generally, goats on green pastures with plenty of sunshine require no vitamin supplements. When goats are confined indoors, vitamin mix, which is not very expensive, should be added to the diet. Stored forages are poor vitamin sources.**

**Fats - Fats are of little importance in the ruminant diet. Practically all feeds contain small amounts of fat, and added levels are not practical. Levels beyond 5 percent in the grain mixture are not recommended.**

**Water - This may be the least expensive feed ingredient, but a deficiency will**

affect milk production
more quickly than the lack of any other nutrient. Water is not only the largest single constituent
of nearly all living plant and animal tissue, but it also performs exceedingly important
functions during digestion, assimilation of nutrients, excretion of waste products, control of body
temperature, and production of milk. Ready access to fresh water is important. Goats with free
access to water produce more milk than those watered twice daily.

Although goats can sustain themselves in dry climates better than cows and sheep, their milk production
also is considerably less.

## Feed Formulation in India

Researchers at Ludhiana in North India suggest a diet of high-quality roughage (fiber) and concentrate
(grains). The concentrate provides sufficient protein, minerals, and vitamins. The relationship
of concentrate to the quality of roughage is shown in Table 1.

Table 1

Quality of Roughage and Protein Level Needed in the Concentrate

| Quality | Description | Protein needed, % |
|---|---|---|

**Poor Dry wild grasses, maize fodder, millet, 24
wheat or rice straw.**

**Fair Late cuttings of legume hay (without leaves) 20
mixed hay, silage from grass or maize.
Good Alfalfa, berseem, groundnut hay, good pasture 16**

**Excellent Extra leafy fine-stemmed alfalfa hay, berseem, 14
or excellent fertilized pasture containing
some legumes.**

**A typical concentrate contains the following ingredients, in percent by weight: maize 40, molasses
8, wheat bran 20, rice polishings 13, groundnut cake 15, salt 2, and mineral mix 2. Another formula
contains: maize whole kernels or sorghum or other cereal 60; soybeans raw or (better) roasted,
other legume or whole cottonseed 36, dicalcium phosphate 2, salt and trace minerals 2.**

**Feed materials were classified according to their protein content as low, medium, high, or very
high. Examples are listed below:**

*** Low protein: maize, maize and cob meal, wheat, oats, barley, millet.
* Medium protein: wheat bran, rice polishings.
* High protein: copra meal, brewers dry grains, legumes.
* Very high protein: cottonseed meal, linseed meal, groundnut oil cake, soybean**

**oil meal, dried
milk, meat meal, blood meal.**

**It was found that, in making up a diet, any item could be substituted for another in the same class.
A suitable mineral mix contained the following ingredients, in percent by weight: sterilized bone
meal 35, finely ground high-grade limestone or oyster shell 45, iodized salt 20, and trace
amounts of copper sulfate, cobalt sulfate, zinc sulfate, and iron chloride. This formula can be
made commercially or mixed at home.**

**Free-Choice Feeding Experiment in Germany**

**German scientists studied the diets that were freely chosen by five Saanen goats over a 24-month
period. Such long-term studies are important, but infrequently performed because of their high
cost.**

**The feeds offered were mixed grass and legume hay, a concentrate mixture, fodder beets in season,
or chopped grass, dried beet pulp, water, and--for three weeks--alfalfa leaf meal. The low
protein content of the hay was supplemented by a concentrate made of ground oats, wheat bran,
seed meals, leaf meals, and dry yeast.**

**Milk production in the first year was good and in the second year was well above average. The results showed clearly that free-choice feeding of dairy goats leads neither to their eating too much concentrate nor to unprofitable production costs. Furthermore, it was shown that goats require liberal amounts of water and lush feeds for high milk production. Free-choice feeding can result in good milk production, although yields may vary among animals. Moreover, high milk production is cheaper than lower milk production under free-choice feeding.**

**Common Feeding Systems**

**Feeding systems for goats are linked to local methods of growing feed crops and are classified as follows:**

**Village systems - It is traditional in tropical countries to maintain goats in small areas (1 to 2 ha) of land. They are tethered for limited grazing or are fed kitchen wastes, usually by women and children. Concentrates are rarely used.**

**Primitive extensive systems - These allow limited grazing or browsing on larger areas of land of low crop productivity. Herds of up to 15 animals are usually made up of smaller herds and are controlled and kept together by a goatherd. The goats eat what is immediately**

**available. There are usually one to four animals per hectare. Often the goats migrate from area to area in a pattern that uses the sparse vegetation without continuous grazing. The seasonal movements, inadequate feed supplies, and infection by parasites seriously affect live weight and cause high mortality. Very extensive systems of this type are found in Africa and parts of West Asia.**

**Semi-intensive to intensive forage systems - The goats graze on cultivated grasses and sometimes on legumes. However, intensive grazing of pasture is not very common, mainly because the land is valuable for other purposes. Goats can efficiently use cultivated pastures for either meat or milk production. A hectare can support 16 to 60 goats depending on the type of pasture, the amount of fertilizer applied, and the presence of legumes. Available farm by-products are sometimes used to supplement the intake from pasture.**

**Very intensive system (stall feeding) - Requiring higher labor and capital investment, this system is not commonly practiced in the tropics, but has commercial potential. It assumes continuous management of goats and is justified by the presence of abundant supplies of farm by-product feeds. The system also enables greater control over the goats. It is common in**

**many countries of Latin America and parts of West Asia.**

**Integration with cropping systems - The nature and the extent of integration depend on the types of crops (annuals or perennials) and on the relative importance of goats in the local economy. Usually the integration of goats is more common with such perennial or tree crops as coconuts, oil palm or rubber. It efficiently uses herbage undergrowth, including mainly grasses, weeds and legumes. The dry matter production of the undergrowth is variable (400 to 1,200 kg/ha). An advantage is that the land becomes more fertile due to return of feces and urine, reduced fertilizer used, control of waste herbage growth, and easier management of the main crop. Success of the system may depend on the amount of dry feed produced from herbage.**

**Feeding tree leaves - Tree leaves are fed to goats throughout the tropics. The amounts fed vary according to availability of material and the time needed to harvest it, as well as the duration of grazing. Leaves provide variety in the diet as well as meeting part of the requirements for energy, protein and minerals. Many tree leaves are important sources of dietary nitrogen. In Africa, these include acacia (Acacia spp.), leucaena (Leucaena leucocephala), and cassava (Manihot esculenta).**

**These and other tree leaves are an important and underused resource.**

**The use of farm by-products - Farm by-products can be used effectively for feeding goats. These materials are often abundant and are not suited for human consumption. Some examples are listed above, in this section.**

**5. SHELTER AND SPACE**

**Although goats have adapted to diverse and adverse climates without the aid of man-made shelters and support, maintenance of good health and dairy productivity require minimizing the stresses associated with excessive heat, cold, humidity, and wind.**

**Protection from Cold and Moisture**

**Shelters are needed where temperatures remain below 5[degrees]C, especially if there are kids. Wooden walls and roofs are better than stone or metal constructions, which tend to accumulate condensation water, thus adding to respiratory and other health problems because of increased humidity.**
**Open buildings or sheds are satisfactory as long as their length and depth exceed the height and the location of exits and open windows does not cause excessive drafts.**

**The build-up of ammonia in the shelter from the bedding, urine, and feces is**

**easily avoided with small roof vents or rafter louvers that can be opened and shut. Roof insulation is necessary only when condensation cannot be controlled in this way. But the greatest need for insulation is on the floor, where the goats tend to lie against the cold, wet ground. Slatted false floors made of treated 5 cm x 10 cm lumber 2 cm apart on 10 cm x 10 cm cross pieces will reduce the risk of infection.**
**Wooden slatted floors reduce the costs of bedding. Concrete floors must be avoided, even when poured upon plastic insulation sheets. A sleeping platform helps to keep the goats clean and dry.**

**In parts of India, dairy goats are kept in small sheds, often with a portion of the structure closed off to store feed and equipment. Bedding material is usually provided to keep the goats clean and healthy. Available bedding materials vary in their capacity to absorb urine. Spaced wood boards (as described above) make excellent bedding. Sawdust or shavings, bagasse, paddy husk, groundnut hulls, wheat straw, crushed maize cobs, and dry grass are all good, cheap, and available in many tropical countries. If nothing else is available, coarse sand can be used. To increase the effectiveness of the litter rake the droppings into it.**
**The depth of the litter will partially depend on the price and availability of suitable materials. If**

**they are cheap and available, use 7 to 10 cm. If less than 2.5 cm is used it will not absorb all the urine and the floor may become wet. Used bedding can be spread in fields and vegetable gardens to increase plant growth.**

**Protection from Heat**

**Goats, especially dehorned goats or those originally from temperate zones, begin to seek relief when the temperature reaches 32[degrees] C by reducing feeding activity, sharply increasing respiration and open-mouth ventilation, seeking shade, and resting on the north sides of stone walls or buildings, and inside ground-depressions, ditches, and open dirt pits. Goats with horns or coming from hot and arid zones suffer less, use the rumen as a water reservoir, and adapt with more concentrated urine, wool cover insulation and variable body temperature. Shelters in hot climates need to provide shade and plenty of air circulation through open walls. Trees can serve these functions very cheaply. Straw or hay stacks on the upper story of a shelter provide excellent insulated shade below.**

**Metal roofs should be painted with white sun-reflecting paint. Tropical thatched roofs are excellent if they shed rain and don't harbor too many flies and other bothersome insects.**

**Soil covered roofs, used in some countries, are excellent insulators, but they require strong supports and may grow grass, which invites undesirable grazing of goats on the roof.**

**Stilted or elevated housing is popular in hot and humid climates. Slatted board walls and flooring provide good ventilation. They also allow for clean maintenance, with easy automatic separation of feces and urine from the goats. This, in turn provides some control of internal parasites and clean udders for low bacterial counts in the milk. Overhanging roofs keep out driving rains. The feeding trough is usually placed on an outside wall and is also covered with an overhanging roof.**

**In the tropics, a typical elevated shelter for 20 or more goats measures 20 to 80 sq m. The shelter is supported 60 to 90 cm above the ground. The roof is 150 to 200 cm above the slatted floor, sloped at about 28[degrees] (53 cm rise for each 100 cm level measure). Roof materials may include clay tiles and palm leaves. Treated floor boards or bamboo pieces are secured a finger-width apart.**

**Space and Fencing**

**Goats need and enjoy exercise. The herd manager will have fewer fence problems if space allotments are liberal and daily fresh, palatable feeds are provided generously. The**

**minimal interior space, 2.5 sq m per adult animal, is commonly provided in tropical countries. Ten square meters is considered ideal.**

**A fenced area that allows 40 sq m per animal with a fence 1.5 to 1.8 m high per animal is common in most tropical countries. Fencing should allow maximum air circulation for hot weather, but should offer some winter protection against cold winds. Posts should be placed not more than 1.5 m apart, and the bottom strand of wire needs to be close to the ground to stop kids from crawling underneath. High-tensile fence, barbed wire, turkey wire, timber bamboo and sticks all have pros and cons. Some sizes of wire mesh fence may be hazardous if they allow kids with horns to insert their heads and become trapped. Vertical wood or bamboo pieces also invite trapped heads. Horizontal wire on fencing invites climbing; vertical-only stockade-type fences may be too expensive or keep out cooling winds in hot weather.**

**A sheltered container filled with clean water should always be available. Outside hayracks should be sheltered against sun and rain, with a bottom trough to reduce waste. The same applies to outside feed troughs, best placed below hayracks and along fences to reduce hay wastage, keep out**

**feces, and facilitate filling and cleaning.**

**Extensive goat management systems based upon pasture feeding and migration sometimes use only night-time shelters. Goats may travel far during day-time grazing; night shelters are traditionally provided in many countries for safety and comfort.**

## 6. MILK AND MILKING

**The world's dairy goat production has grown partly because of a trend toward increasing self sufficiency by people in many countries. A goat eats little, occupies a small are, and produces enough milk for the average unitary family (an average doe will give about 2 L a day); whereas the prospect of maintaining a cow at home is often more than the homeowner can cope with. Hence the growing popularity of goat as the "poor-person's cow."**

**As the interest in dairy goats continues to rise, it is important to address many misconceptions and exaggerated claims. A comparison of cow and goat milk will erase some prejudices against goat milk. And while goat milk is somewhat unique, it is certainly not a magical elixir.**

**A persistent objection to goat milk is that it has a peculiar "goaty" odor or taste. The presence of a**

**buck among does at milking time can result in this objectionable feature. Another major cause of off-flavored milk is low-grade udder infection (subclinical mastitis).**

**Diet affects the taste and odor of both goat and cow milk. Although the diet of cows is usually closely watched. goats are often allowed to consume a great variety of materials at any time. Such unmonitored feeding may allow objectionable tastes or odors to be transferred to the milk, if it occurs within two hours of milking. If goats and cows are similarly managed, the smell and taste of both milks are sweet and neutral.**

**Goat milk is similar to cow milk in its basic composition (see Table 2).**

**Table 2**
**Average Composition of Goat and Cow Milk**

| | Dry matter, Percent of | Percent Protein | Fat | Lactose | Mineral matter |
|---|---|---|---|---|---|
| Goat | 12.1 | 3.4 | 3.8 | 4.1 | 0.8 |
| Cow | 12.2 | 3.2 | 3.6 | 4.7 | 0.7 |

**However, there are also differences that give goat's milk a special place in human diets. For example, in Third World 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. Calves can consume large quantities of goat milk while similar amounts of cow milk may cause dysentery. Goat milk can, therefore, be used 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.**

**The Saanen breed is best known as the Holstein (a very productive dairy cow) of the goat world, producing a large 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, Oberhasli, and Alpine give milk with intermediate values, as does the La Mancha, a breed not listed above.**

**Milking**

**Whether goats are milked by hand or by machine, care must be taken to produce a clean, wholesome product and to prevent injury to or infection of the udder.**

**Non-commercial herds use mostly hand-milking, which requires few facilities and little equipment. There is no minimum number of goats required for machine milking, because the**

**convenience
and reduced discomfort to the person's hands, wrists and arms may outweigh considerations
of efficiency or economics. Portable single or double milking machines are easily assembled,
washed, and maintained. Although machine milking is not covered in this paper, a brief description
of hand milking follows for the goat herder who wants to produce a quality product.**

**In contrast to cows, the milking of goats is routinely done in different ways and schedules, depending
on tradition, convenience, and budget. In most countries goats are milked twice a day, 12
hours apart. Routine, once-daily milking is not recommended. The doe's udder produces milk
throughout the day and night, but production is slowed as milk accumulates. During the height of
lactation heavy producers can be milked three times a day at eight-hour intervals to relieve pressure
in the udder. This procedure often yields more milk.**

**Milking equipment should include a strip cup, a seamless milking pail, and a milk strainer with a
filter that is thrown away after each milking. Goats should be milked in an environment free of
dust, odors, dogs, and disturbing noises.**

**To produce clean milk it is necessary to have clean equipment, a clean area for**

**milking, healthy goats, clean clothes, and clean hands. The milker's hands (short fingernails) should be washed with hot water and soap before starting, and before moving from one animal to another. Hands should be washed after cleaning feces from the udder. The udder can be washed with a clean cloth, but both the udder and hands should be dried before milking.**

**The first stream or two of milk should directed through a fine wire mesh, such as a tea strainer, into a separate strip cup so that the presence of flaky milk, which is often an indication of mastitis (discussed later) can be detected.**

**Dairy goats should be milked dry at each milking. When some experienced milkers think they have milked the goat thoroughly they will often push the udder gently a few times and run the index finger and thumb down each teat until they have "stripped" out the last drop of milk. The advantages of this procedure are not entirely clear.**

**As soon as the milk has been collected from the doe, it should be poured through a single-use filter. The milk should be cooled promptly and rapidly (to as near 0[degree]C as possible) to ensure good flavor and retard the growth of bacteria. Air cooling is not recommended; the closed container**

**may be cooled by immersing it in ice water with frequent stirring. After cooling, the container of milk should be taken promptly to the consumer, stored in a refrigerator, or immersed in ice water. Unnecessary temperature changes can cause bad flavor.**

**All milking equipment should be rinsed in warm water immediately after use and then washed in hot water to which a mild chlorine solution and detergent are added. Finally the utensils should be rinsed in clean, preferably boiling, water and kept in a dust-free place to dry.**

## 7. PREVENTION AND CONTROL OF DISEASE

**Although often considered one of the healthiest of all domesticated animals, goats are susceptible to the same diseases that affect cattle and sheep. If infected cattle or sheep are nearby try to prevent contact with them. The occurrence of disease may be affected by locality, amount of space given to each goat, the feeding program, and housing, as well as the general health of the individual goats and the amount of exposure to infected animals or parasites.**

**In many parts of the tropics vaccinations against goat pox, rinderpest, and foot-and-mouth disease are generally advised. In addition, goats are usually tested routinely for brucellosis (Malta Fever, Bang's Disease), tuberculosis, and mastitis. Diarrhea, caused by**

**bacterial infections,
viruses, or coccidia, can also be troublesome. In addition to infectious diseases, goats sometimes
suffer from such noncontagious ailments as pneumonia, wound infections, milk fever (parturient
paresis), bloat (tympanites), external and internal parasites, and plant poisoning.**

**Ideally, the diagnosis and treatment of goat diseases should be left to a veterinarian. The importance
of an accurate diagnosis cannot be over-emphasized because the treatment is determined by
the cause of the ailment. However, veterinary services are often too costly for people who keep
goats, except in the most urgent cases. Fortunately, most goatkeepers can acquire enough basic
knowledge to cope with basic problems.**

**No doubt, it is always better to prevent disease than to have to treat infected animals! Some precautions
needed to maintain the health of a goat herd are listed below:**

**1. Avoid involvement in goat trading or trafficking.**

**2. Buy young kids preferably from healthy goat farms where diseases are under control and
the animals look healthy.**

**3. Separate kids from adults immediately at birth and feed them pasteurized**

**milk.**

**4. Isolate a goat that becomes sick.**

**5. Do not allow equipment to be brought to the goat farm from locations where the goats are unhealthy.**

**6. Keep visitors from walking around in the goat house or corral.**

**7. If possible, get an accurate and early diagnosis from a qualified veterinarian if evidence of a disease appears.**

**8. Use medications only when necessary.**

**9. Consider goat droppings as a potential source of disease.**

**10. Eliminate ticks, lice, and mites, and control predatory animals.**

**11. Keep the goat herd separated from sheep and cattle.**

**12. Use good business ethics and do not sell diseased goats to an unsuspecting buyer.**

**13. Keep the goat house clean and dry.**

**14. Trim hooves at least four times yearly. Brush goats when needed to remove loose hair and**

**dirt that might contaminate the milk.**

**15. Keep feces out of the feed and water: keep goats' feet out of hay racks and keep feed and water containers above tail level.**

**16. Keep fresh water available and uncontaminated.**

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