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Basic Meat Goat Nutrition

Introduction

The meat goat sector is currently the largest of the goat industry in the United States. The increased demand for goat meat is a result of a rise in immigrant and ethnic group populations. Primarily located in the Southwest and Southeast regions, the meat goat sector has shown promise of expansion over the past decade, and it continues to emerge as an alternative animal production system for small and limited-resource farmers.

Because no market exists for grain-finished goats, producers in the United States take advantage of several unwanted plants and brush species to provide a product in high demand. In fact, one of the advantages of goat meat production is that farmers can produce goats without intensive feeding strategies or systems because of the goats' unique ability to digest large quantities of fiber or roughage (see Figure 1).

Structure and Function of the Digestive System

Mature goats are herbivorous ruminant animals. Their digestive tracts, which are similar to those of cattle, sheep, deer, elk, bison, and giraffes, consist of the mouth, esophagus, four stomach compartments, small intestine, cecum, and large intestine.

A brief description of the anatomy and physiology of the mouth and the stomach compartments of goats follows.

Figure 1: Goat eating browse plants. Photo courtesy of the ARS, USDA.

Mouth

Like other ruminant animals, goats have no upper incisor or canine teeth. They depend on the rigid dental pad in front of the hard palate, the lower incisor teeth, the lips, and the tongue to take food into their mouths.

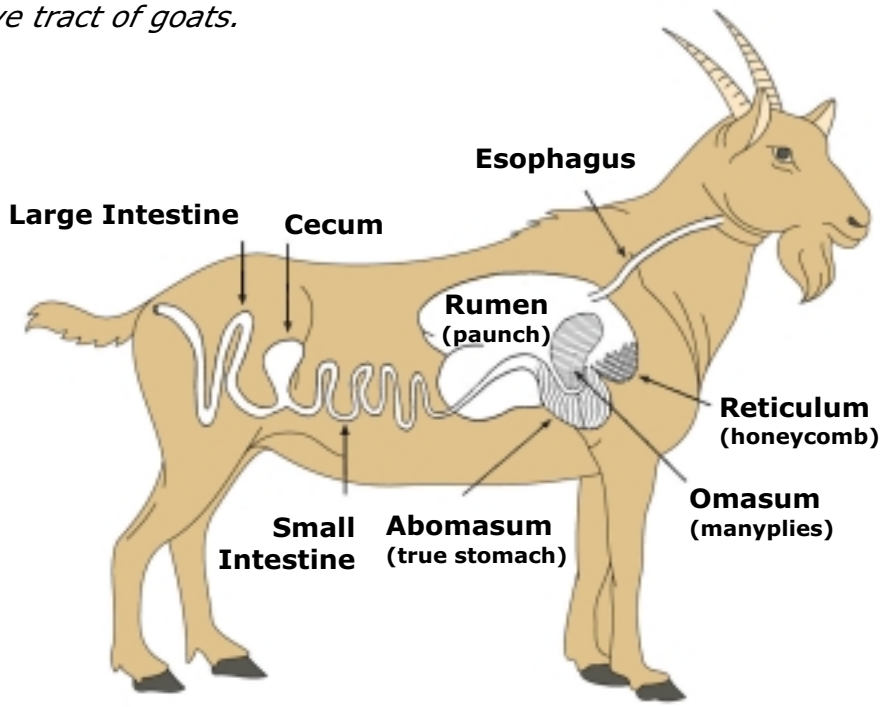
Esophagus

This is a tube-like passage from the mouth to the stomach (see Figure 2). The esophagus, which opens into the stomach at the junction of the rumen and reticulum, helps transport both gases and cud.

Rumen

This is the largest of the four stomach compartments of ruminant animals (see Figure 3). The capacity of the rumen of goats ranges from 3 to 6 gallons, depending on the type of feed. It is lined with small fingerlike projections called papillae that increase the absorptive surface of the rumen. This compartment, also known as the paunch, contains many

Figure 2: The digestive tract of goats.



microorganisms such as bacteria and protozoa that supply enzymes to break down fiber and other feed parts.

Microbiological activities in the rumen result in the conversion of the fiber and starch of feeds to the volatile fatty acids (VFAs) acetic, propionic, and butyric acids. The molar proportion of the VFAs is primarily influenced by the roughage-to-concentrate ratio of the diet. On a high-roughage diet, the molar percentage of acetic, propionic, and butyric acids is approximately 70, 20, and 10 percent, respectively. These VFAs are absorbed through the rumen wall and provide as much as 80 percent of the animal's total energy requirements. Microbial digestion in the rumen is the reason that ruminant animals effectively use fibrous feeds and are maintained primarily on roughages.

Rumen microorganisms also convert components of the feed to useful products such as essential amino acids, B-complex vitamins, and vitamin K. Afterward, the microorganisms themselves are digested in the small intestine to free up these nutrients for the ruminant animal's use.

In the process of digesting feeds, rumen microorganisms also produce large amounts of gases, primarily methane and carbon dioxide. The animal normally eliminates these gases by eructation (belching). When the gases are produced faster than the animal can eliminate them, a potentially lethal condition known as bloat can result. This condition is often associated with the rapid consumption of large amounts of leguminous vegetation.

During resting, rumen ingesta are regurgitated, rechewed, and reswallowed (rumination). Animals with four stomach compartments regurgitate ball-like masses of fibrous and coarse feeds called bolus or cud. The regurgitated cud is chewed thoroughly for about a minute then swallowed again. Ruminant animals may spend up to 8 hours per day in rumination, depending on the type of feed. This phenomenon affects the amount of feed the goat can eat. Reducing the particle size of the feed through rechewing allows the material to be easily accessible to the microorganisms and to pass out of the rumen.

Reticulum

This compartment, also known as the honeycomb or hardware stomach, is located just below the entrance of the esophagus into the stomach (see Figure 3). When goats swallow foreign objects such as wire, nails, and screws, these objects can become lodged in the reticulum, potentially causing serious injury. The reticulum is part of the rumen separated only by an overflow connection, the rumino-reticular fold. Therefore, microbial action also takes place in this compartment. The capacity of the reticulum of goats ranges from 1/4 to 1/2 gallon.

Omasum

This compartment, also known as the manyplies, consists of many folds or layers of tissue that grind up feed ingesta and squeeze some of the water from the feed (see Figure 3). The capacity of the omasum of goats is approximately 1/4 gallon.

Abomasum

This compartment is often considered the true stomach of ruminant animals (see Figure 3). It functions similarly to human stomachs. The mucosa of the fundus contains parietal cells that secrete hydrochloric acid, and chief cells that secrete the enzyme pepsin. This enzyme is secreted in an inactive form (pepsinogen), which is then activated by hydrochloric acid. Pepsin is responsible for breaking down feed proteins before they enter the small intestine. The pylorus, which is the terminal portion of the abomasum, is characterized by secretions that are largely mucous. The capacity of the abomasum of goats is approximately 1 gallon.

Development of the four stomach compartments

When a goat kid is born, the abomasum is the largest of the four stomach compartments. The abomasum of a goat kid is about 70 percent of the total stomach area, while the rumen is about 30 percent. Hence, digestion in the goat kid is like that of a monogastric animal. In the suckling goat kid, closure of the esophageal groove ensures that milk is channeled directly to the abomasum instead of going through the rumen, reticulum, and omasum. Peptic cells in the abomasum of young milk-fed ruminants secrete, in addition to pepsin, the enzyme rennin. This enzyme is responsible for forming milk curdles and digesting milk protein.

When the suckling goat kid starts to eat vegetation during the first or second week after birth, the rumen, reticulum, and omasum gradually develop in size and function. After approximately 2 months, the four stomach compartments reach their relative adult proportions.

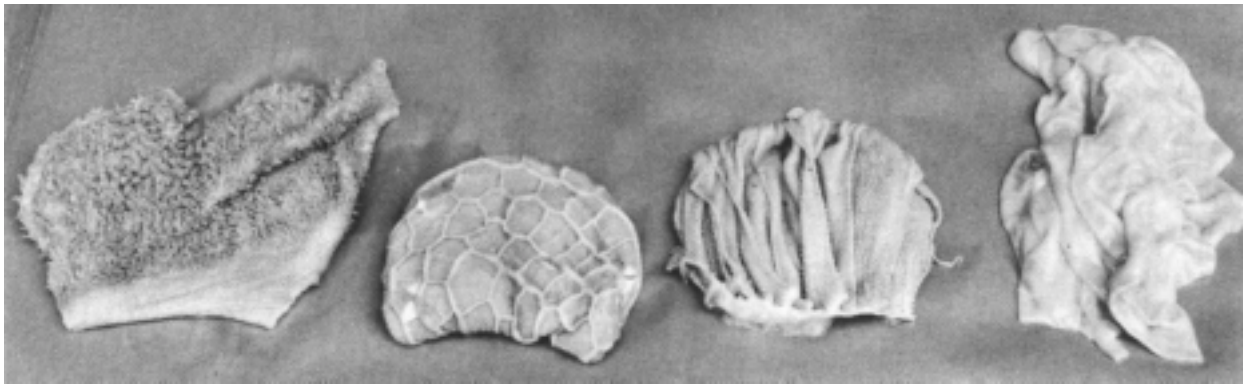


Figure 3: Inside structures of rumen, reticulum, omasum, and abomasum of goats. Photo courtesy of G. F. W. Haenlein, University of Delaware.

Small Intestine

As partially digested feed enters the duodenum, the first part of the small intestine, the enzymes produced and secreted by the pancreas and the Brunner's glands of the duodenum further break down feed nutrients into simple compounds (end products).

To digest starch, fat, and protein, the pancreas of ruminant animals secrete amylolytic, lipolytic, and proteolytic enzymes. Postruminal digestion of starch is partially dependent upon secretion of pancreatic amylase. Brunner's glands lining the proximal duodenum also secrete amylase. In addition to these amylases, intestinal disaccharidases such as lactase and maltase, and pancreatic proteases such as trypsin, chymotrypsin, and carboxypeptidases, are present throughout the small intestine.

The end products of enzymatic digestion of nutrients are absorbed into the bloodstream or lymph by an active process carried on largely in the jejunum and ileum (second and third part of the small intestine, respectively). The small intestinal wall is lined with many small fingerlike projections called villi that increase the absorption area of the small intestine. The capacity of the small intestine of goats is approximately 2 1/2 gallons.

Cecum

This simple tubular structure, also known as the blind gut, is located at the junction of the small and large intestines. Feed materials entering this compartment are digested by inhabiting microorganisms. The capacity of the cecum of goats is approximately 1/4 gallon.

Large Intestine

Undigested feed and unabsorbed nutrients leaving the small intestine pass into this compartment. The functions of the large intestine include water absorption and further digestion of feed materials by microorganisms. The large intestine is comprised of the colon and rectum. Fecal pellets are formed in the end portion of the spiral colon. The capacity of the large intestine of goats ranges from 1 1/4 to 1 1/2 gallons.

Accessory Glands

The salivary glands, liver, and pancreas contribute to digestion. Saliva secreted by the salivary glands is important in chewing the cud and maintaining the ruminal pH in the optimal range for growth of rumen microorganisms (6.2 to 6.8). Bile produced by the liver, and stored and secreted by the gall bladder, helps emulsify fat in preparation for digestion. Enzymes secreted by the pancreas are important in the small intestinal digestion of carbohydrates, proteins, and fats.

Nutrients

Energy

Age, body size, growth, level of activity, pregnancy, lactation, and environment all affect the energy requirements of goats. Carbohydrates and fats supply most of the energy requirements of the animal body. Much of the goat's energy comes from the breakdown of cellulose in roughages and the breakdown of starch and fat in concentrates. Energy deficiency in goats results in reduced growth or weight loss, reduced reproductive performance, reduced milk production, and reduced resistance to infectious diseases and internal parasites.

Protein

Protein consists of amino acids that are the basic units of all body cells. The goat's body requires protein for growth, reproduction, milk production, disease resistance, and general maintenance. Mature goats, like other ruminant animals, rely on rumen microorganisms to synthesize essential amino acids. Rumen microbes can utilize either nitrogen (N) of feed origin or nonprotein nitrogen (NPN) to synthesize amino acids and protein to meet

the requirements of the host animal. Microbial protein and undigested feed protein reaching the small intestine are broken down to amino acids that are absorbed and utilized by goats. Protein deficiencies in the diet of goats result in depleted stores in muscles, retarded fetal development, low birth weights, reduced growth, and depressed milk production.

Vitamins

Vitamins are organic compounds required in small amounts by the goat's body. Because all B vitamins and vitamin K are synthesized by microorganisms in the rumen and vitamin C is synthesized in body tissues, mature goats require only dietary sources of the fat-soluble vitamins A, D, and E. During the grazing season, goats can obtain sufficient fat-soluble vitamins from green pastures and plenty of sunlight. Goats can also store an adequate supply of these vitamins to maintain production for 3 to 4 months.

Symptoms of vitamin A deficiency are associated with abnormal bone development, low resistance to infections, night blindness, and birth of abnormal kids. Vitamin D deficiency results in bone abnormalities such as rickets, in kids. Vitamin E, a biological antioxidant, is added to the diet of young nursing kids to prevent nutritional muscular dystrophy. Selenium, which has a sparing effect on the vitamin E requirement, is also effective in preventing nutritional muscular dystrophy in young kids.

Minerals

Many minerals (inorganic elements) are required by the goat. The major or macrominerals of concern are common salt (NaCl), calcium (Ca), phosphorus (P), magnesium (Mg), potassium (K), and sulfur (S). The trace or microminerals involved in goat nutrition are cobalt (Co), copper (Cu), molybdenum (Mo), fluorine (F), iodine (I), iron (Fe), manganese (Mn), selenium (Se), and zinc (Zn). In goat feeding, most minerals are usually added to mixed feeds. It is also recommended that the calcium-phosphorus ratio be kept at approximately 2:1.

Specific information on the symptoms of mineral deficiencies and toxicities in goats is scarce. However, these symptoms appear to be similar to those in sheep. Some symptoms of mineral deficiencies in goats include reduced feed intake, depressed milk production, and retarded growth and abnormal bone development in young kids.

Water

Water is the least expensive nutrient and the largest component of live plant and animal tissue. Environmental factors, age, growth, pregnancy, lactation, and level of activity affect the water requirements of goats. Goats obtain water from their feed, as well as from drinking water, snow, and dew. Because water carries out important body functions, an adequate supply of fresh, clean water is critical to goats during their entire life cycle.

Nutrient Requirements

Each of the six nutrients described above has a specific function and is required by the goat in varied amounts during various stages of the life cycle. This means that producers must supply animals with feed that satisfies their body functions for maintenance and production (growth, reproduction, and lactation).

Maintenance requires those nutrients necessary for normal functioning of vital organs, control of body temperature, and repair of body tissues. Because the maintenance requirements are related to body size, a large goat requires more nutrients than a small one. This requirement must be met first before using nutrients for other body functions.

Nutrients that are not used for maintenance may be used to accomplish a specific production body function such as growth, reproduction, or lactation. The kind and

amount of nutrients required depend on the type and amount of production desired.

Producers who feed their goats based on the nutrients required by animals are better able to produce healthy goats and increase profits.For more information on the recommended dietary nutrient allowances, procure the National Research Council (NRC) report titled *"Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids"*, Publication ISBN 0-309-10213-8, 2007. This NRC report can be acquired from the National Academy Press, 2101 Constitution Avenue NW, Washington, DC, 20418.

Feedstuffs

Goats prefer to eat brushy plants and can efficiently digest coarse, fibrous feeds. Hence, goats will consume and effectively utilize a wide variety of woody and weedy plant species (table 1) mostly found on ranges.

Table 1.
Several browse plants consumed by goats

Common Name	Scientific Name
Blackberry	*Rubus fruticosus*
Black locust	*Robinia pseudoacacia*
Greenbrier	*Smilax rotundifolia*
Hackberry	*Celtis occidentalis*
Honeysuckle	*Lonicera japonica*
Multiflora rose	*Rosa multiflora*
Post oak	*Quercus stellata*
Shining sumac	*Rhus copallinum*

Meat goats are raised primarily on unimproved pastures and rangelands. Meat goats do not need extra feed if they are grazing on land areas with a variety of brush, weeds, and grass. Additional feed, however, may be needed in periods of drought or in winter. The types and amounts of supplemental feed are also dictated by the functions of the goats.

Aside from pasture and brushlands, dry roughages and forages are the most economical feeds for meat goats. The use of good-quality hays as supplemental feed for grazing meat goats can compensate for extremely poor pasture or range conditions, while supporting the profit margins. Legume hays such as alfalfa, clover, and lespedeza are preferred to grass hays such as bahiagrass, bermudagrass, orchardgrass, and bromegrass because they are much higher in protein and a variety of minerals. Good-quality legume hay or a mixed legume and grass hay provide an excellent source of highly digestible nutrients.

The cutting date is the single most important factor affecting hay quality. As the stage of maturity of forage crop increases, the protein content decreases and the fiber content increases. Good-quality hays are those that have been cut earlier and have more leaves and tender stems. If pasture or range conditions become adverse and supplemental hay is of poor quality, provide supplemental concentrates for maximum performance. Cereal grains such as corn, oats, barley, and wheat are the common energy ingredients of concentrate mixtures for goats. Oil meals such as cottonseed meal and soybean meal are probably the most widely used sources of protein for goats. Commercial supplements containing other nutrients such as minerals in addition to protein may be preferable to one of the oil meals.

Because the cost of grain and meal mixtures is usually high, feeding supplemental concentrates to meat goats is advised only during critical periods of their life cycle. The profit margins do not support intensive feeding strategies using expensive feeds.

Grazing Management Systems

Ruminants such as cattle, sheep, and goats can digest cellulosic substances and can convert plants to products such as milk, meat, wool, and mohair. Pastureland, therefore, is critical to the production of these ruminants and the products they provide. In order to obtain maximum profits from pasture grazing, producers must manage the land for high production per acre and must manage the animals to minimize forage waste and to ensure that they are growing sufficiently.

Mature goats will consume 3 to 5 percent of their body weight in dry matter daily. A general rule of thumb is that six to eight goats consume about the same amount of feed as one cow on good-to-excellent pasture. However, the optimum stocking rate will depend mainly on forage availability and quality.

Grazing systems provide high-quality forage and reduce feed and veterinary costs, while avoiding manure buildup. Feed costs are reduced because farmers and ranchers do not have to grow or purchase forage and grain year round, and veterinary costs are reduced because animals on pasture have fewer health problems than those that feed in the barnyard. In addition, pastures require few or no pesticides and allow natural recycling of manure. They also provide a continuous soil cover, thus protecting wildlife habitats and important ecosystems.

The three most widely used grazing systems are continuous grazing, rotational grazing, and multispecies grazing.

Continuous Grazing

The primary grazing system used in many states across the country is continuous grazing. In this grazing system, animals graze a specific pasture area freely and uninterruptedly throughout the year or grazing season. Because continuous grazing allows animals to graze selectively, individual animal performance is usually maximal. However, due to the selective grazing nature of animals, some forages are overgrazed, while less desirable plants are undergrazed, which damages or wastes pastureland.

Rotational Grazing

The grazing system that most effectively uses pastureland is the rotational grazing system, which includes short-duration grazing, rapid grazing, cell grazing, and strip grazing. In a rotational grazing system, the pasture is fenced off into subdivisions or paddocks, and animals are rotated according to the forage available and the forage growth rate. Short grazing periods are beneficial because they can increase the carrying capacity of the pasture without plants being damaged. However, research indicates that individual animal weight gains are higher under a continuous grazing system than under a rotational grazing system. Rotational grazing focuses more on animal production per acre than on individual animal performance.

Additional advantages of rotational grazing are that animals can be examined more easily and frequently and that surplus forage can be harvested as hay. Under a rotational grazing system, the advantages of hay production become an economic consideration when deciding which grazing system to use.

One other aspect that must be considered when choosing a grazing system is the fact that a rotational grazing system requires much more fencing than other systems. Rotational grazing is more labor intensive and often more expensive than traditional continuous grazing; however, electric-powered fences that are easy and quick to build make subdividing pastures easier and more economical. Electrical fences became popular as a way to exclude both domestic and predatory animals and are also commonly used to prevent livestock from grazing certain areas, such as pastures sprayed with herbicides.

Portable electric net fences may make it easier and more economical for goat producers to establish and improve rotational grazing. Prefabricated electric nets for goats are 34 and 42 inches tall, have 4x6-inch mesh openings, and come in 165-foot rolls with all the posts already built into the net at the proper spacing. The energizer used depends on the amount of flexible netting to be electrified, source of power, species of animal to be contained, and amount of vegetation around the fence. Poor grounding is the leading cause of electric fence failures. Therefore, it is critical to follow the manufacturer's instructions for grounding electric fences.

Properly managed, constructed, and serviced electrical fences can increase the efficiency and profitability of goat enterprises through better management of animals and forage resources. Since an electrical fence serves as both a psychological and physical barrier, much less material is needed to build it than is needed to build a conventional fence. Therefore, electrical fences can usually be erected for about half the cost of conventional fences.

Multispecies Grazing

Multispecies grazing is a grazing system in which cattle, sheep, and goats graze together. Research shows that cattle, sheep, and goats do well together on shared range because they have different grazing behaviors. Cattle mainly eat grasses; sheep prefer broad-leafed plants such as forbs; and goats have a preference for browse plants such as small shrubs and trees. Some species of animals also graze differently because of their mouth size, lip anatomy, and method of prehension. Sheep and goats have a partially lifted upper lip that is very mobile and permits closer defoliation. Cattle have a fixed upper lip that is relatively immobile.

Multispecies grazing offers producers the opportunity for complementary pasture use since what one species will not eat, the other will. This significantly maximizes forage utilization, which translates into higher animal production rates per acre, lower costs of production, and better returns for farmers and ranchers. In addition, the cattle's presence protects the sheep and goats from coyotes and wild dogs.

Although rotational and multispecies grazing systems offer many benefits, animals within these systems, especially sheep and goats, are very vulnerable to internal parasite infestation. Of most concern is the barber pole worm, the *Haemonchus contortus* that feeds on the host animal's blood with a voracious appetite. This parasitic nematode is among the world's most widespread stomach parasite of cattle, sheep, and goats. Producers must, therefore, develop preventive treatments and control programs to combat this parasite and others.

Feeding Management

Kids

Newborn kids should be allowed to nurse their dams to obtain colostrum (first milk). Colostrum contains antibodies that protect young kids against diseases. At birth, kids are able to absorb these antibodies effectively. However, the ability to absorb colostral antibodies decreases within the first 36 to 48 hours of life. To greatly increase the chances of survival, kids should receive colostrum immediately after birth.

Early forage consumption will lead to early rumen development. Fine hay can be offered to encourage young kids to consume solid feed at about 2 to 3 weeks of age. Young kids receiving adequate amounts of milk from their dams do well on good pasture or range. If pasture or range conditions are poor, however, kids should have access to good-quality hay plus about 3/4 pounds of a grain mixture daily.

Kids weaned at about 3 to 4 months should be suitable for slaughter off grass. With the increased population of immigrant and ethnic groups, particularly Latinos, the cabrito, or weaned kid, has become very popular.

Replacements

After 4 to 6 months of age, replacement does and bucks can do well on good pasture (see Figure 4) or good-quality hay alone. A daily allotment of 1/2 pound of a concentrate mixture should lead to ample growth. If the pasture or hay is of poor quality, however, replacement animals may require 1 to 1 1/2 pounds of concentrate per day. If properly fed, replacement goats will be large enough to breed as yearlings.

Figure 4: Replacement does can do well on good forage alone. Photo courtesy of Robert Spencer, Urban Regional Extension Specialist.

Does

Feeding does during a dry period is important for development of the unborn kids and for obtaining proper body condition of the does for adequate nutrition of the newborn kids. The unborn kid develops 70 percent of its birth weight during the dry period (last 6 weeks of pregnancy). During this period, does can be maintained on good range or pasture, with only mineral supplementation needed, particularly salt and phosphorus. However, if grass is short, a good-quality mixed legume and grass hay is good for feeding. If pasture and hay are poor quality, provide supplemental feeds such as goat range cubes at the rate of 1/2 to 3/4 pounds per head per day. A doe should be in good flesh but not fat at time of kidding.

Lactating does on good-quality range or pasture may require daily supplementation of 1/2 to 3/4 pounds of grain mixture or range cubes that contain approximately 20 percent protein. If the quality of range feed is poor, a higher protein supplement may be needed at the rate of 1/4 pound per head per day.

Bucks

Young bucks should be fed in the same manner as replacement does, but they will require more feed because of their size. Bucks that are not breeding can do well on good pasture or good-quality hay alone. Supplemental grain or concentrates should be fed according to the condition of the pasture and the bucks. During the breeding season, however, grain or supplement should be provided at the rate of 1/4 to 1/2 pound per head per day. If the bucks become too fat or inactive, grain can be withdrawn.

It is worth mentioning that moldy feeds should be discarded and any changes in the diet should be made gradually. Goats should not be fed large amounts of grain, particularly finely ground grains, in a short period of time. Consumption of large quantities of cereal grains or other sources of readily fermentable starch will increase lactic acid production in the rumen that could lead to acidosis.

Nutritional-Related Diseases

Enterotoxemia

This condition, also known as overeating disease, is a toxic reaction to *Clostridium perfringens* types C and D. Enterotoxemia is caused by excessive feeding of concentrates to animals not accustomed to such feeds and sudden access or change to highly palatable feed. All kids should be given a toxoid vaccination at about 1 month of age, followed by a second dose 2 weeks later and

booster doses every year. All does should be given a yearly booster toxoid about 3 to 4 weeks before kidding.

Urolithiasis

This condition, also known as *urinary calculi*, is characterized by the formation of inorganic masses, known as calculi, in any part of the urinary tract. When a high phosphorus level develops in the blood and urine, magnesium and ammonium phosphate precipitate to form a calculus. This calculus can pass easily through the urethra of does but not so easily through the urethra of bucks. Obstruction to the outflow of urine often results in rupture of the urethra or bladder. Keep the calcium-phosphorus ratio at approximately 2:1.

Ketosis

This condition, also known as *pregnancy disease*, is characterized by an increased concentration of ketone bodies in the body tissues and fluids. Ketosis occurs when the energy requirements are met by way of lipid metabolism within the liver, resulting in an increased production of ketones (acetoacetic acid and β-hydroxybutyric acid). The condition, which usually appears in the last 30 days of pregnancy, is caused by a decreased blood glucose level due to increasing fetal demand and undernourishment. Ketosis rarely occurs in meat goats. Nevertheless, as a form of prevention, make certain that goats have clean, fresh water at all times.

References

Anderson, D. M., & Havstad, K. M. (1991, December 1). Cattle and sheep together: Partners in grazing. *Agricultural Research, 39*(12),14.

Church, D. C. (1993). *The ruminant animal: Digestive physiology and nutrition.* Illinois: Waveland Press, Incorporated.

Ensminger, M. E. (2002). *Sheep and goat science.* (6th ed.). Illinois: Interstate Publishers, Incorporated.

Gillespie, J. R. (1998). *Animal science.* New York: Delmar Publishers.

Jurgens, M. H. (1993). *Animal feeding and nutrition.* (7th ed.). Iowa: Kendall/Hunt Publishing Company.

Matches, A. G. (1992). Plant response to grazing: A review. *Journal of Production Agriculture, 1*(1), 1–7.

Randall, D., Burggren, W., & French, K. (2002). *Eckert animal physiology: Mechanisms and adaptations.* (5th ed.). New York: W. H. Freeman and Company.

Shapiro, L. S. (2001). *Introduction to animal science.* New Jersey: Prentice-Hall, Incorporated.

Taylor, R. E., & Field, T. G. (2001). *Scientific farm animal production: An introduction to animal science.* (7th ed.). New Jersey: Prentice-Hall, Incorporated.

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