Ruminant Digestive System

The ruminant animal has the ability to digest feedstuffs, such as grain, grass, and hay, and produce consumable products (milk, meat, and fiber). The ruminant digestive system evolved so that feed such as grass could be eaten quickly and chewed later. The goat is just one example of a ruminant. Other domestic animals that are ruminants include cattle and sheep. White-tailed deer, elk, and big horned sheep are ruminants that live in the wild.

The ruminant’s digestive system is composed of four compartments: rumen, reticulum, omasum, and abomasum (see figure 5.1).

Rumen

The rumen is the first and largest compartment of the goat’s digestive system, making up about 80 percent of the stomach capacity. It acts as a large fermentation vat that mixes and stirs up the food. It can hold about 6 gallons of material.

Microorganisms, such as bacteria, fungi, and protozoa, live in the rumen and break down and convert feed and nutrients to products the animal can use. The microbes also grow and multiply, and the ruminant animal digests them. The protein from the microbes may provide up to approximately two-thirds of the protein required by the animal. These “rumen bugs” are the reason...
that ruminants are able to digest grasses and other forages that humans can’t digest. Rumen microbes have the ability to digest cellulose, a main component in forages. Humans and other nonruminants cannot digest cellulose.

The relationship between the rumen microbes and the ruminant animal is called a symbiotic relationship. Symbiosis is where each organism gains something; it is a win-win relationship. The goat’s food is broken down and obtains nutrients from the microorganisms, and the microorganisms have a place to live. These microorganisms require a warm, moist, and anaerobic (no oxygen) environment. The microorganisms produce gases such as methane, carbon dioxide, and ammonia. These are either used by the animal, or the other microbes, or are let off as gases during eructation (belching).

Volatile fatty acids (VFA) are also products of fermentation, which the animal uses as an energy source. The acids of highest concentration in the rumen are acetic, propionic, and butyric. These gases and acids affect the rumen pH. The pH is a measure of how acidic or alkaline the environment in the rumen is on a scale of 1.0 (acidic) to 11.0 (alkaline). A pH of 7.0 is neutral. The healthy rumen has a pH between 6.0 and 6.5.

What the animal eats and how much it chews affects the rumen environment and pH. The goat regurgitates a bolus of food, or cud, from the rumen for recrunching in a process called rumination, or “chewing its cud.” Rumination reduces particle size of the food for further digestion by the microbes and also adds saliva to the rumen. The sodium bicarbonate in the saliva acts as a buffer to help maintain a constant rumen pH. Low fiber/high concentrate diets that do not stimulate much chewing result in the production of a lot of gas and acid from the rumen microorganisms. There is also less saliva going into the rumen since the goat is not chewing as much. Low rumen pH can cause some health problems that are discussed in Chapter 6.

**Reticulum**

The reticulum is the compartment right next to the rumen. It acts together with the rumen to mix and store the food. The reticulum is also called the honeycomb because it has a honeycomb pattern (like that made by bees) on the inside. The reticulum catches large particles of feed so that they do not enter the omasum, allowing them to be further digested by rumen bacteria. Hardware, such as nails and wire, can get caught here. Although goats usually sort undesirable objects from feed, risks do exist from consumption of metal objects and their potential to irritate and infect tissue and to puncture the stomach, affecting the nearby heart.

**Omasum**

The omasum is the third compartment of the digestive system. It is also called “many plies,” which means “many leaves,” because it has many leaves or pages inside that are stacked like the pages of a book. Its main function is to squeeze and absorb water from the feed.

**Abomasum**

The fourth compartment is the abomasum. It is also called the true stomach and is very similar to the human stomach. It produces and secretes digestive enzymes and acids, such as hydrochloric acid and pepsin, to break down food into nutrients that are used by the body. The abomasum helps to
move food into the small intestine where the food is further digested and where many of the nutrients are absorbed. Digesta then goes into the large intestine, where much of the water is absorbed. The remaining undigested feed and waste is then excreted out the anus of the animal.

**Nutrients**

Different nutrients are required in different amounts to allow for proper animal growth, milk production, and bodily functions. There are six essential nutrients for goats: water, carbohydrates, fats, protein, minerals, and vitamins.

**Water**

Water is the most important nutrient needed to survive. Each cell in the body requires water, and depending on the age and amount of body fat, the goat’s body is composed of 50 to 80 percent water. Water helps with the body’s digestion of food and transportation of nutrients throughout the body. It also helps to rid the body of waste material and to regulate body temperature. A goat may consume up to 4 gallons of water per day, depending on its age and productive state, the environmental temperature, and the type of feed being consumed. A goat weighing about 100 pounds and not producing milk consumes about 1 gallon of water per day. **It is especially important to provide clean, fresh water at all times. For lactating goats, remember that milk is 87 percent water.**

**Carbohydrates**

Carbohydrates are a main source of energy for the goat. There are many different types of carbohydrates. All carbohydrates are made up of three elements: carbon, hydrogen, and oxygen. From these three elements, thousands of combinations are made.

In the rumen, carbohydrates are converted to volatile fatty acids (VFA). The goat absorbs these acids and uses them as the primary energy source for body functions, such as growth and milk production. Carbohydrates are separated into two groups: structural carbohydrates and nonstructural carbohydrates. Having a balance between structural and nonstructural carbohydrates is important in maintaining proper rumen health. Carbohydrates are also relatively inexpensive when it comes to the costs of feedstuffs.

Structural carbohydrates are those carbohydrates that are found in high concentrations in forages or fibrous by-products. They are the components of the plant cell walls that give “structure” to the plant. Neutral detergent fiber (NDF; includes hemicellulose, cellulose, and lignin) and acid detergent fiber (ADF; includes cellulose and lignin) are the technical references for these fiber sources. Lignin is neither digested by humans, animals, nor rumen microbes. Cellulose is a component that cannot be digested by humans and makes up a large part of the fiber in plants. Because of the rumen bacteria, goats are able to digest large amounts of cellulose. Structural carbohydrates lend to the production of more acetic acid than propionic and butyric acids. Acetic acid is a major precursor to the udder for the synthesis of milk fat. For that reason and other metabolic processes, low fiber diets may cause milk fat depression.

Nonstructural carbohydrates (NSC) are the starches and sugars found
in high concentrations in grains and some by-products that are fed to goats. Nonstructural carbohydrates are more digestible than structural carbohydrates and therefore, usually provide more energy to the animal. Nonstructural carbohydrates lend to the production of more propionic and butyric acids than acetic acid. Too many nonstructural carbohydrates can reduce rumen pH and lead to either an unhealthy rumen, sometimes causing metabolic disorders such as acidosis and laminitis, or milk fat depression.

Fats
Fats come in the form of oils or fatty acids and supply approximately 2.25 times the amount of energy per unit than carbohydrates. Diets for kids that include large quantities of milk or milk replacer may contain 10 to 35 percent fat in the dry matter (DM) consumed. Fat may be added to the diets of mature animals to increase energy density of the ration and to reduce dustiness of grain diets. Diets for nonmilk-fed animals usually contain around 3 to 4 percent fat. For animals with a developed rumen, additional fat, either in the form of a natural fat source or rumen inert fats (commercially prepared) can be added, but total dietary fat should not exceed 7 to 8 percent of the DM. In the rumen, fats are not changed very much by the microorganisms except that they undergo biohydrogenation, which is the addition of hydrogen to the unsaturated fatty acids. This process causes the unsaturated fatty acids to become saturated. Too much fat can decrease feed intake, depress fat and protein content in milk, and cause scouring. This occurs because too much fat can interfere with the microorganisms in the rumen. Commonly fed natural sources of fats are whole cottonseed, whole soybeans, and tallow. Several by-products sometimes fed to goats are higher in fat concentration than forages and cereal grains, such as hominy, distillers grains, and fishmeal. Calcium salts of fatty acids and saturated tallow are the most common sources of commercially available rumen inert fats.

Protein
Protein is needed for maintenance, growth, pregnancy, and lactation. Proteins have a complex structure and are made up of nitrogen, carbon, hydrogen, and oxygen. Some proteins also contain sulfur. Like carbohydrates, nitrogen can be combined with various chemical elements in different ways. The resulting combinations are many different structures called amino acids, which are the building blocks of protein. The goat’s protein requirements are actually met by amino acids. Metabolizable protein (MP) is used to describe the actual protein that is digested in the small intestine and absorbed as amino acids. Amino acids are supplied to the goat by feeding protein that escapes microbial breakdown and also by protein made by microorganisms. Approximately 65 percent of the crude protein (CP) in a typical goat’s diet may be broken down by microbial digestion to ammonia. The rumen microorganisms use this ammonia as a food source to grow and replicate. The goat then digests the microbial protein in the small intestine. If rumen ammonia concentrations are higher than what can be used by the microorganisms, the ammonia is absorbed into the bloodstream, converted to urea by the liver, and recycled or excreted as urea in the urine. All feed protein sources are not degraded in the rumen to the same extent.

Rumen degradable protein (RDP) describes protein sources that are degraded or broken down into amino acids and ammonia in the
rumen. The microorganisms in the rumen use these substrates for maintenance and growth. Non-protein-nitrogen (NPN) is an example of a rumen degradable nitrogen source and is converted into ammonia in the rumen. A common NPN source is feed grade urea. Urea should only be fed to goats and not to kids. It should be gradually introduced into the diet and not exceed 0.5 percent of the dietary DM or 1 percent of a concentrate mix, as toxicity can occur.

Rumen undegradable protein (RUP) describes protein that is not degraded or broken down in the rumen. Another name for this is “by-pass protein.” Most of the RUP is digested in the abomasum and small intestines. Blood meal, fishmeal, and some processed plant by-products are examples of RUP sources. Having a balance between RDP and RUP is important when formulating rations for goats.

### Minerals

Minerals are required to help build strong bones and teeth. They are also required for chemical reactions necessary for many of life’s processes. The major minerals, also called macro minerals, are so called because they are required in larger quantities and are usually denoted as a percentage of the daily diet. Micro minerals, or trace minerals, are required in lesser quantities than macro minerals, and are usually designated as parts per million (ppm). Calcium, magnesium, phosphorus, potassium, and salt are some of the important macro minerals. Copper, manganese, selenium, and zinc are just a few examples of trace minerals. See table 5.1 for a detailed list of minerals, their functions, signs of deficiency in the diet, and ways to provide the mineral in the diet.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Function</th>
<th>Deficiency Signs</th>
<th>Ways to Provide in Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Macro Minerals (Major Minerals)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>Proper skeletal structure, muscle contraction, and milk production</td>
<td>Rickets in growing animals; milk fever in lactating animals</td>
<td>Legume forages are high in calcium, calcium carbonate (limestone), dicalcium phosphate</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>Co-factor for major enzymatic reaction; normal nerve and muscle function; and bone formation</td>
<td>Grass tetany or Grass stagers; more commonly occurs with animals on pasture</td>
<td>Magnesium oxide, dolomitic limestone, magnesium chloride, magnesium carbonate, magnesium sulfate</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>Strong teeth and bones, energy reactions in cells, and milk production</td>
<td>Lack of appetite, unthrifty appearance, rickets in growing animals, signs of pica</td>
<td>Dicalcium phosphate, monosodium phosphate, defluorinated phosphate, nonruminant meat and bone meal, fish meal</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>Muscular activity; osmotic pressure of body fluid</td>
<td>Decreased feed and water intake; weight loss; reduced milk yield; pica; dull hair coat; forages are high in K, usually does not need to be supplemented except in hot weather</td>
<td>Potassium chloride, potassium sulfate, potassium carbonate</td>
</tr>
<tr>
<td>Mineral</td>
<td>Function</td>
<td>Deficiency Signs</td>
<td>Ways to Provide in Diet</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Macro Minerals (Major Minerals)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt (Sodium Chloride, NaCl)</td>
<td>Necessary for many bodily functions; helps to transport material across cell walls</td>
<td>Eating anything containing salt, signs of pica, lack of appetite, unthriftiness appearance</td>
<td>Mix in grain, total ration, or fed free choice.</td>
</tr>
<tr>
<td>Sulfur (S)</td>
<td>Component of some essential amino acids that make up proteins; required by rumen microbes for fiber digestion</td>
<td>Reduced animal performance and reduced fiber digestion; excessive sulfur can interfere with copper and selenium absorption</td>
<td>Calcium sulfate, magnesium sulfate, ammonium sulfate, potassium sulfate</td>
</tr>
<tr>
<td><strong>Micro Minerals (Trace Minerals)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>Component of many necessary enzymes that are involved in building strong bones and connective tissues; absorption and transport of iron for hemoglobin synthesis</td>
<td>Loss of hair pigmentation; loss of hair, scours, and anemia; high levels of molybdenum and sulfur can affect copper absorption</td>
<td>Copper sulfate, copper oxide, trace mineral salt</td>
</tr>
<tr>
<td>Iodine (I)</td>
<td>Needed for synthesis of thyroid hormones that control metabolism</td>
<td>Enlarged neck on adults; kids born with large necks; goiter; born weak, hairless, or dead</td>
<td>Potassium iodide, EDDI (ethylenediaminedi-hydroiodide), trace mineral salt</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>Needed for hemoglobin synthesis and for enzymatic reactions</td>
<td>Anemia; high levels of dietary iron can interfere with absorption of other minerals</td>
<td>Ferrous sulfate, ferrous oxide, trace mineral salt</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>Involved in enzyme reactions relating to the formation of cartilage and bone</td>
<td>Impaired growth; skeletal abnormalities; depressed reproduction; abnormalities of the newborn</td>
<td>Manganese sulfate, manganese oxide, trace mineral salt</td>
</tr>
<tr>
<td>Molybdenum (Mo)</td>
<td>Component in many enzymatic systems</td>
<td>Deficiencies are hard to produce and usually does not need to be supplemented; can be toxic due to binding of copper that results in copper deficiency</td>
<td></td>
</tr>
<tr>
<td>Selenium (Se)</td>
<td>Component of enzymatic systems; important in immune functions</td>
<td>White muscle disease—leg weakness, flexion of hock joints, muscle tremors, and heart failure. Reproductive problems—retained fetal membranes, cystic ovaries, and metritis; increase in prevalence or severity of mastitis; short-term deficiency can cause general unthriftiness.</td>
<td>Sodium selenite, sodium selenate, selenoysteate, trace mineral salt</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>Component is many enzymes that affect metabolism of carbohydrates, proteins, lipids</td>
<td>Reduced feed intake and growth rate; weak hoof horn and perakeratosis of the skin</td>
<td>Zinc sulfate, zinc oxide, zinc methionine, trace mineral salt</td>
</tr>
</tbody>
</table>
Vitamins

Vitamins are organic compounds that are needed in very small amounts and are required for growth, production of milk and fiber, and reproduction. There are two classes of vitamins: fat-soluble and water-soluble. The fat-soluble vitamins are A, D, E, and K. They are called fat-soluble because they can dissolve in fat solvents, such as ether or chloroform, and are usually stored in the fat tissues in the body. The water-soluble vitamins are B-complex vitamins and vitamin C. They are called water-soluble because they dissolve in water.

Vitamin A

Vitamin A is available to a goat through green, leafy forages. Vitamin A keeps the eye and body cell linings healthy and working. An animal with a deficiency in vitamin A may have night blindness, be weak, and have a greater chance of infections and reproductive problems. Carotene is the natural source for vitamin A, and synthetic vitamin A is normally added to goat rations.

Vitamin D

Vitamin D is necessary for strong bones and teeth. Animals with low concentration of vitamin D can have weak bones, swollen joints, and stiffness. They can develop a condition called “rickets” where they are weak and may drag their feet or, if they are growing, they may have crooked legs. Green, leafy, sun-cured feed and fish oils are excellent sources of Vitamin D. Animals can make their own vitamin D when the sun is shining on their skin. However, vitamin D supplementation is recommended.

Vitamin E

Vitamin E is an anti-oxidant, reducing off-flavors in milk and preventing white muscle disease in kids. Vitamin E is very important in stimulating and maintaining a good immune system. It also helps to reduce the incidence of and severity of mastitis and to improve reproductive performance. Vitamin E is found in green, leafy forages but also should be supplemented to animals.

Vitamin K

Vitamin K is necessary because it helps to clot the blood, which helps to stop bleeding. Most leafy feeds contain an adequate amount of vitamin K. It is also the only fat-soluble vitamin that is synthesized in the rumen and does not need to be supplemented.

B Vitamins

The B vitamins are water-soluble and are synthesized by the rumen microorganisms. Animals with a deficiency in a B vitamin may become paralyzed, lose hair, become weak, or have a poor appetite. Cereal grains and rumen bacteria are good sources of B vitamins. Usually, the B vitamins do not need to be supplemented; however, in some cases, supplementation is warranted, especially for biotin, niacin, or choline. It is possible that the microorganisms cannot make enough of the B vitamins in high-producing dairy goats. The B vitamins may also need to be supplemented to animals that are stressed or sick and to very young kids.

Vitamin C

Vitamin C, or ascorbic acid, is produced normally in the tissues of the animal, so adding it to the feed is not necessary. A deficiency of vitamin C results in loosening of teeth, brittle bones, slow growth, and a sore mouth; however, vitamin C deficiency usually does not occur in goats.
Feedstuffs

Classes of Feedstuffs

Feeds for goats are generally separated into two categories: forages and concentrates. The main purpose for feeding concentrates is to supply extra energy and nutrients (see table 5.2) required for growth and production above that which is obtained from forages. Feedstuffs commonly fed to goats are listed in table 5.11 at the end of this chapter, along with photographs of the most common.

Table 5.2. Classifying feed ingredients into primary nutrient groups.

<table>
<thead>
<tr>
<th>Carbohydrates</th>
<th>Minerals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>Calcium carbonate</td>
</tr>
<tr>
<td>Barley</td>
<td>(limestone)</td>
</tr>
<tr>
<td>Beet pulp</td>
<td>Dicalcium phosphate</td>
</tr>
<tr>
<td>Forages</td>
<td>Trace mineral salt</td>
</tr>
<tr>
<td>(hay, pasture, etc.)</td>
<td>White salt</td>
</tr>
<tr>
<td>Molasses</td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td></td>
</tr>
<tr>
<td>Rye</td>
<td></td>
</tr>
<tr>
<td>Sorghum (milo)</td>
<td></td>
</tr>
<tr>
<td>Soybean hulls</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
</tr>
<tr>
<td>Wheat middlings</td>
<td></td>
</tr>
<tr>
<td>Whey</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fats</th>
<th>Proteins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish oil</td>
<td>Alfalfa meal pellets</td>
</tr>
<tr>
<td>Tallow</td>
<td>Brewers grains</td>
</tr>
<tr>
<td>Rumen inert fats</td>
<td>Corn gluten feed</td>
</tr>
<tr>
<td>Vegetable oil</td>
<td>Corn gluten meal</td>
</tr>
<tr>
<td>Whole cottonseed</td>
<td>Cottonseed meal</td>
</tr>
<tr>
<td>Whole soybeans</td>
<td>Distillers grains</td>
</tr>
<tr>
<td></td>
<td>Fish meal</td>
</tr>
<tr>
<td></td>
<td>Soybean meal</td>
</tr>
<tr>
<td></td>
<td>Urea</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vitamins</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin premix</td>
<td></td>
</tr>
<tr>
<td>Vitamins A, D, and E</td>
<td></td>
</tr>
</tbody>
</table>

| Water               |                                 |

Forages

Forages are usually the foundation of the goat's diet. Forages are any feedstuffs that contains the leafy part of the plant such as leaves, stems, flowers, etc. Fibrous feedstuffs, such as alfalfa hay and corn silage, are good examples. These feeds are high in fiber (which the goat needs to maintain proper rumen health) and may be excellent sources of protein, energy, calcium, and other minerals and vitamins. Forages, if grown, harvested, and stored correctly, can be an inexpensive source of important nutrients. Of course, forages are often grazed by goats.

Forage quality is very important. High-quality forages supply a large portion of the energy, protein, and some minerals and vitamins in a ration. Forage quality largely depends on the maturity of the forage at the time of consumption or harvest, processing, and storage. The quality of grasses or legumes can be measured based on stage of growth, with the quality of the forage decreasing as the plant matures. As these forages mature, energy, protein, mineral, and vitamin contents decrease, while fiber content increases. The higher fiber content, in turn, causes a decrease in the digestibility of the forage. It is recommended that the majority of forages be harvested in early maturity. Grasses and legumes have different standard values for fiber, protein, and minerals. They can generally be harvested either wet or dry and can be stored in the form of silage or hay, respectively. Whole plants of several grains can also be ensiled as forage sources, including corn, rye, oats, wheat, and barley.

Because the quality of forages can vary greatly by cutting, fields, and even within the same field, forages should have a nutrient analysis test done periodically so that ration adjustments can be made according to changes in the forage analysis. High quality (sufficient for rapidly growing animals or high-yielding lactating does) for a legume is 20-30-40, meaning 20% CP,
30% ADF, and 40% NDF. For high-quality grasses, the 20-30-50 rule applies. Relative Feed Value (RFV) is used by some as an index of forage quality for legumes and grasses. The higher the RFV, the more valuable the forage. For example, an RFV of 100 relates to alfalfa that is in the full-bloom stage of maturity. An RFV of ≥ 150 is recommended for rapidly growing kids and high-yielding lactating does.

**Concentrates**

Concentrates consist of cereal grain concentrates, protein concentrates, vitamin/mineral mixtures, and processed feedstuffs. Corn, oats, barley, sorghum, and wheat are examples of high-energy cereal grains that are commonly used in goat rations. Processing the grain by rolling, crimping, cracking, grinding, or steam flaking to expose the inner kernel increases the digestibility of the grain. This makes the starch more available to the rumen microbes, providing more energy to the animal. However, steam-flaked corn and finely ground dry corn are rapidly fermented in the rumen, so exercise caution in balancing the intake of these feeds with adequate forage intake.

Protein concentrates are concentrates that are high in protein. Protein is usually either from a plant or an animal source. These two sources, though they are both protein, are very different in that they are made up of different amino acids. Examples of high plant-concentrate sources are the oilseed meals, such as soybean meal, cottonseed meal, linseed meal, and canola meal. Some animal-protein concentrates are feather meal, blood meal, nonruminant meat and bone meal, and fish meal. It is usually advantageous to mix plant and animal protein sources in a ration to provide for the desired balance of amino acids.

### Feed Additives

#### Buffers

Several feed additives, such as sodium bicarbonate and sodium sesquicarbonate, are added to diets to help maintain optimal rumen pH. Sodium bicarbonate is by far the most widely recognized and used rumen buffer. Some situations may necessitate adding buffers to diets:

1. Low forage/high concentrate diets
2. Diets high in fermentable carbohydrates (i.e., steam flaked corn)
3. Diets with small-particle-size forage that reduces the amount of time spent chewing
4. Diets where forage and concentrate are fed separately and at different times (i.e., feeding grain in the parlor)

#### Direct-Fed Microbials

Direct-fed microbials consist of live bacteria, yeast, or extracts of fermentation products of yeast or bacteria. The exact mechanism of how they work is not exactly known. There is evidence that fiber digestibility and milk production may be increased when microbial additives are used. They also may be useful in recovery of animals that have been on antibiotic therapy.

#### Ionophores

Ionophores are feed additives that are used to improve feed efficiency, control coccidiosis, and lower costs for growing animals. Ionophores work by changing the rumen bacterial environment and causing a shift in the production of the VFA to more propionate versus acetate. This provides more energy to the growing animal, causing the increase in feed efficiency. Because
of the shift in the microbial population, methane production is decreased by up to 30 percent when ionophores are fed. Ionophores also have an anti-coccidial activity and can help to reduce the incidence or severity of bloat.

An ionophore approved for the prevention of coccidiosis in goats is monensin (Rumensin®, ELANCO Animal Health, Greenfield, IN). Ionophores may be prohibited from being fed to certain animals and are toxic to horses and other nonruminant animals. Read feed tags carefully for warnings when feeding medicated feeds, and store these ingredients in a safe place away from other animals.

**Feed Tag Information**

Feed tags provide important information about the nutrients and ingredients and help you choose a feed that meets your animal’s needs and performance goals (see figure 5.2). Anyone selling feed commercially must supply a label or tag with each bag or bulk shipment of feed. Always read the tag to make sure you are getting what you want in the product and that you are not getting something that you do not want—such as the wrong medication or wrong feed ingredients. To provide your animals with the proper products, you must understand what is written on these tags.

Livestock feeds can be classified as either complete feeds or supplements. Complete feeds are those products containing all of the nutrients (except water and forages) required by the animals. Supplements are products that are added or mixed into other feed ingredients. They supply nutrients, such as additional protein, vitamins, minerals, or other additives, that may be lacking in the base feed. Supplements are usually added in small, specified amounts and are not to be fed as the total ration. The law requires that feed manufacturers provide the following labeling information on every bag or package of product:

1. **Product Name and Brand Name**
   A product name is always present with or without a brand name. A feed tag usually contains a unique name to identify the feed (Goat Starter, Kid Grower, Lactating Doe Supplement, Goat Mineral, etc.).

2. **Purpose of Feed**
   Each feed must have a purpose statement, specifying the species and animal class for which the feed is intended (Formulated for Lactating Does, Formulated for Growing Kids, Formulated for Kids, etc.).

3. **Purpose of Medication and Active Drug Ingredients**
   If a drug is used in the feed, the word MEDICATED must appear below the name with a statement and claim of medication, followed by a listing of the active drug ingredients and the amount of drug in the product. For example: “For prevention of coccidiosis caused by *Eimeria crandallis*, *Eimeria christensenii*, and *Eimeria ninakohlyakimovae*. Monensin ...... 20 g/ton.”
4. Guaranteed Analysis

Guaranteed analysis on the product gives information on various nutrients present in the feed. Legally, the feed company is obligated to have feed nutrients listed within the range stated on the feed tag. For example: Minimum Crude Protein, Maximum ADF (Acid Detergent Fiber), and Minimum and Maximum Calcium. The type of product and/or species class that is listed determines what nutrients are listed on the feed tag.

What does the guaranteed analysis not tell you? The guarantees do not reflect the quality or feeding value of a feed. There is a difference between qualities of various feed sources. For example, copper from copper sulfate is 80–90% available (digestible; absorbed), whereas copper from copper oxide is only 5–10% available.

5. Ingredient Statement

The list of ingredients on the feed tag starts with the ingredient present in the highest concentration, then lists the other ingredients in decreasing concentration. Actual ingredients may be listed collectively, for example corn, wheat, oats, and barley may all be listed individually or collectively as “grain products.” Collective terms represent a general classification of ingredients with a similar origin that perform a similar function but do not imply equal nutritional or digestibility values. The list of ingredients can be very useful or confusing. A collective term such as “Processed Grain By-Products” does not really tell you the specific
sources. Therefore, it may be difficult to determine the quality and digestibility of the product.

6. Feeding Instructions
Feeding instructions provide information on how the product should be fed.

7. Warnings and Cautions
Warnings and caution statements should be listed if medications are added to the feed. For example, any product containing monensin must carry the warning that it should not be fed to horses: “Do not allow horses or other equines access to feeds containing monensin. Ingestion of monensin by horses has been fatal.”

8. Name and Address of Distributor
The name and mailing address of the company responsible for making or distributing the feed must be listed on the tag.

9. Net Weight Statement
The net weight statement serves to tell the purchaser the weight of the feed in the bag or bulk shipment. This may be listed in pounds (lb) or kilograms (kg). A kilogram is equal to 2.2 pounds. Therefore, a 50-pound bag may be listed as 22.7 kilograms.

Feeding Systems

Pasture is a very common means of providing forage for goats, and many different legumes and grasses can be grazed. For the highest quality feed and most efficient forage growth, the land area should be fenced into different paddocks and the goats rotated among the paddocks. Goats should preferably be rotated among the paddocks every 3 to 7 days, but the frequency of the rotation depends on stoking density and forage growth. Goats also should be rotated among pasture areas as a control measure for internal parasites, allowing at least 3 weeks between rotations to break the growth cycle of the parasites. Growing kids and lactating does should be provided some concentrate mix daily to complement the forage consumed. For mature, nonlactating goats, plenty of pasture and a free-choice mineral supplement may be adequate. Plants in early stages of development and that are rapidly growing are low in magnesium (Mg) and high in potassium (high potassium intake reduces intestinal absorption of Mg), thus Mg supplementation of goats on pasture is advisable to reduce the risk of grass tetany.

Goats are more of a browser than are cattle and sheep, and goats eat grass much closer to the ground than cattle, so caution needs to be taken in avoiding damage to the established pasture with overstocking of animals. Goats have a narrow mouth, mobile upper lip, prehensile tongue, agile front legs, and extensible hind legs that aid in browsing and feed selection (Lu, 1989). Goats appear to tolerate bitterness in plants more than do other ruminant species (Lu, 1989). Goats may be less susceptible in general to toxic plants than cattle and sheep; however, their browsing nature increases the likelihood that they will consume potentially toxic plants.

Hay is the most common means of feeding stored forage to goats. For ease of handling and storage, small rectangular bales are most common, but large round or square bales can be used if properly stored and if the equipment for handling them is available. Balage (hay harvested at about
50% DM and stored in sealed plastic bags or wrapped) and silage can be used with goats, but it is difficult to feed sufficient quantity daily to preserve feed quality, and listeriosis is a risk with inadequately preserved wet forage. Grain and hay are usually fed separately (see figure 5.3), but if the forage and grain are mixed together prior to feeding, this mixture is commonly referred to as a total mixed ration (TMR). With a TMR, the forage and concentrate are fixed. When forage and grain are fed separately, grain is limited based on the animal’s needs and forage is fed free choice. Grain should never be fed free choice (unless it is in the case of creep feeding young kids) because the animal will eat too much. In a long-term situation, the animal may get too fat, but the highest risk is for acute illness (rumen acidosis) due to low rumen pH and associated health problems.

Feeding Kids

Digestive System of a Kid

The digestive system of a newborn kid functions like that of a nonruminant during the first few weeks of life. When a kid is born, the rumen, the reticulum, and the omasum are very small and undeveloped. The abomasum or true stomach is the primary stomach compartment that functions in a kid. In a newborn kid, liquid feed bypasses the rumen and goes directly into the abomasum by way of the esophageal or reticular groove. The reticular groove runs from the base of the esophagus, along the edge of the reticulum, and into the abomasum. During suckling, the groove’s edges contract to form a tube from the reticulum to the abomasum, allowing milk to bypass the rumen. As a
young kid increases its intake of grain, the rumen and the rumen papillae (projections from the rumen wall where absorption takes place) grow. As a kid continues to mature, the digestive system matures, and the esophageal groove ceases to close. The rumen of a kid gets larger and develops before weaning occurs. By the time a kid is weaned, the rumen is well developed.

At Birth
The first and most important feed for a newborn kid is colostrum. Colostrum is a newborn kid’s primary source of nutrients and antibodies. Colostrum is the milk that a kid’s mother produces immediately after the kid is born. This milk is yellow, thick, and very nutritious. True colostrum is obtained only from the very first milking. True colostrum is higher in energy, protein, vitamins, and minerals than regular milk (table 5.3).

Table 5.3. Composition of colostrum and normal milk from goats.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Colostrum</th>
<th>Normal Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total solids (percent not water)</td>
<td>32%</td>
<td>13.0%</td>
</tr>
<tr>
<td>Protein</td>
<td>16%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Fat</td>
<td>8%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Lactose</td>
<td>3%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Ash (minerals)</td>
<td>1%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

The most important element of colostrum is a large amount of immunoglobulins (antibodies) from the mother. Kids are born with little or no protection to disease or infection. The antibodies provide kids with some immunity and protection against diseases. The antibodies that a kid receives from its mother in the colostrum are very important for the kid’s survival. This is called passive immunity because antibodies are transferred passively from the mother to the kid, versus active immunity, where the kid’s immune system is working and is manufacturing its own antibodies. The types of antibodies that are in the mother’s colostrum represent the diseases to which the doe has been exposed or vaccinated. For this reason, an older doe’s colostrum is going to be of better quality (have a wider range of antibodies) than that of a young doe.

A kid’s resistance to disease is influenced by the quality of colostrum and also by when it receives the colostrum. Kids absorb the antibodies through their gut wall. In the hours after a kid is born, the gut becomes less able to absorb the antibodies, so that by the time the kid is 24 hours old, the gut is unable to absorb the large antibodies.

Kids should receive 1 ounce of colostrum for every pound of body weight (BW) at each of three feedings during the first 24 hours after birth. The first feeding should be within the first hour and the second feeding within the next 6 to 8 hours. Kids should only be fed colostrum of high quality (ample concentration of antibodies). The quality of colostrum can be measured using an instrument called a colostrometer. Kids should continue receiving does’ milk for at least the first three days after parturition. Although a kid is not able to absorb the antibodies after the first day, the milk may benefit the kid by keeping the intestinal tract healthy and because of the higher nutrient density.

Colostrum Storage
Some high-quality colostrum should always be kept frozen in the event a doe at kidding does not have any colostrum, has poor
quality colostrum, is sick, or dies during kidding. Colostrum should be thawed at room temperature or in a warm water bath. Heating colostrum in a conventional or microwave oven to thaw it can damage or destroy the antibodies. If a doe has poor quality colostrum at kidding and you don't have any frozen colostrum at your home, contact another goat owner to determine if they have some colostrum that you can use. If this is not available, contact a goats farmer to inquire about obtaining frozen doe colostrum from their farm. It is always best to provide high-quality colostrum from does at your farm, but if such colostrum is not available, other sources are much better than not feeding colostrum at all.

After 3 Days
After 3 days of age, you must decide if you want to continue to let a kid nurse or if you want to put it on milk replacer; of course, this decision may be based on whether you have meat or dairy goats. If you have dairy goats, excess colostrum (dilute 50% with warm water because it is more concentrated than normal milk) and waste milk (milk that cannot be used for human consumption) are the cheapest feeds for kids. If these are not available, consider whole milk from the does or milk replacer. Whole milk contains the appropriate amounts of protein, energy, vitamins, and minerals for kids. However, the cheapest option for milk feeding depends on milk prices and the price of milk replacers.

Kids should be fed milk daily at about 30% of their BW (7 lb * 0.3 = 2.1 lb or 34 oz/day of milk). It is best to feed this amount of milk over 3 to 4 feedings per day during the first 4 to 6 weeks of age, and then the stated amount of milk can be provided at 2 feedings per day. If you have meat goats, it is best to cross-foster a kid onto another doe rather than to hand-feed. Although goat milk replacer is preferred, kids can be raised on milk replacer for calves. However, the kids are susceptible to bloating from milk replacers that contain a high amount of lactose (for example, milk replacers for calves). A good milk replacer should meet recommended standards and be fed according to the label instructions. The milk replacer should contain a coccidiostat (for example, decoquinate; Deccox®, Alpharma Animal Health, Fort Lee, NJ; or an approved ionophore) to help prevent scours. The coccidiostat can be included in the grain starter, but kids do not eat enough, especially during the first couple of weeks, to provide adequate intake of the medication to prevent coccidiosis.

By the second week of life, start to offer kids a high-quality grain starter. If a grain starter specifically developed for kids is not available, a kid starter can be used. This helps with the development of the rumen and growth of the rumen microbes. It is not recommended to feed hay until after weaning. Feeding hay prior to weaning reduces starter intake, causing kids to develop a "pot-bellied" appearance. Additionally, hay is not needed for the rumen at this time. Of course, nursing kids may nibble on the pasture or hay fed to the does. Creep feeding the kids is convenient and allows the kids access to ample amounts of grain. Creep feeding also takes place before kids are weaned. By building a pen with an entrance large enough for only kids (approximately 5 inches wide X 12 inches high), you can make grain (usually at least 16% CP on an as-fed basis) available to kids at all times. Always have fresh water available for the kids. During the kid's first few weeks of life, one or two injections of selenium may be
advisable to prevent against white muscle disease. Consult your veterinarian for recommendations in your area.

**Weaning**

A kid can be weaned when it is consuming about 1% of its BW per day of starter (2–3 oz per day) for three consecutive days. This usually occurs when the kid is 2.5 times its birth weight and is 6 to 8 weeks old. For kids that nurse the doe, especially with meat goat breeds, weaning should occur at about 12 weeks of age. If you are purchasing milk replacer, it is more economical to wean kids as early as possible because milk and milk replacer are more expensive than dry feed. The milk should be reduced to half the full feeding rate for 1 week before removing all of the milk from the diet. Keep fresh grain starter available to kids at all times to stimulate eating, and add hay to the diet after weaning to promote rumen growth. Always make feeding changes gradually — this helps reduce digestive problems and the risk for enterotoxemia.

**After Weaning**

The nutrient requirements of kids vary, especially depending on their BW and average daily gain (ADG) (see table 5.4). After weaning, kids should be fed a good starter/grower feed (commercial mix or one similar to those shown in table 5.5) and high-quality forage ad libitum (free choice). The amount of feed consumed also depends on the kid’s BW and its ADG (usually between 120 and 300 g/day). Even if kids have access to all the pasture they want, some supplemental grain should be provided to complement the pasture, making sure mineral and vitamin intakes are adequate (see table 5.6). Depending on BW, growth, and forage quality, kids will generally be fed 0.5 to 1.0 lb/day of grain. The growth rate of dairy goat kids is slower than that for meat goat kids (see figure 5.5). The grain supplement should contain an approved ionophore (for example, monensin) to help reduce the risk of coccidiosis and improve feed efficiency. In general, the growth rate of kids should allow them to reach market weight at 6 to 7 months of age, and replacement does should be of breeding size (> 70 lb for most dairy and meat breeds) by 7 to 10 months of age. Overfeeding energy and underfeeding protein, especially before puberty, can result in overweight kids that lack adequate frame. As kids mature, their nutritional requirements change. Younger kids lack the rumen capacity to maintain satisfactory weight gains if they are fed only forage. Older kids, however, have sufficient rumen capacity for adequate growth if fed only high-quality forage rations, with some mineral supplementation. Abundant pasture may be adequate for older kids, but grain supplementation may be needed as pasture growth slows in the summer months. Growth and body condition (relative degree of body fat) of kids should be routinely monitored.

Typically, meat goats are not put on a finishing ration prior to harvest like some other meat animals because the consumer does not prefer “fat” goats, goats are not very efficient in converting feed into fat tissue, and this practice increases costs without adequate return. If a finishing period is used, it is usually for 30 to 60 days, and the kids are fed a ration of about 15% hay and 85% grain. The grain mixture can be a blend of shelled corn and protein concentrate pellet (for example, corn and 16% CP concentrate in a ratio of 1:1) or a grain mixture similar to the one in table 5.5 for legume hay with 15% CP.
### Table 5.4. Dry matter intake and nutrient requirements for growing kids.\(^1\)

<table>
<thead>
<tr>
<th>BW (lb)</th>
<th>ADG (lb/day)</th>
<th>DM Intake (lb/day)</th>
<th>NE (Mcal/day)</th>
<th>CP (g/day)</th>
<th>Ca (g/day)</th>
<th>P (g/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.3</td>
<td>1.5</td>
<td>0.7</td>
<td>66</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>0.6</td>
<td>2.6</td>
<td>0.7</td>
<td>104</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>40</td>
<td>0.3</td>
<td>2.0</td>
<td>1.2</td>
<td>84</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>40</td>
<td>0.6</td>
<td>3.1</td>
<td>1.3</td>
<td>123</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>60</td>
<td>0.3</td>
<td>2.4</td>
<td>1.7</td>
<td>100</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>60</td>
<td>0.6</td>
<td>3.5</td>
<td>1.7</td>
<td>139</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>80</td>
<td>0.3</td>
<td>2.8</td>
<td>2.1</td>
<td>115</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>80</td>
<td>0.6</td>
<td>3.9</td>
<td>2.1</td>
<td>154</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>100</td>
<td>0.3</td>
<td>3.3</td>
<td>2.4</td>
<td>129</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>100</td>
<td>0.6</td>
<td>4.3</td>
<td>2.5</td>
<td>168</td>
<td>10</td>
<td>6</td>
</tr>
</tbody>
</table>

\(^1\)BW = body weight, ADG = average daily gain, DM = dry matter, NE = net energy, and CP = crude protein.


### Table 5.5. Example concentrate mix (as-fed basis) for a growing kid consuming either alfalfa or grass hay free choice.\(^1\)

<table>
<thead>
<tr>
<th>Grain Ingredient</th>
<th>Legume Hay (20% CP)</th>
<th>Legume Hay (15% CP)</th>
<th>Grass Hay (15% CP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn, cracked or rolled</td>
<td>70.0</td>
<td>55.0</td>
<td>54.0</td>
</tr>
<tr>
<td>Oats, whole or crimped</td>
<td>21.0</td>
<td>22.0</td>
<td>21.0</td>
</tr>
<tr>
<td>Soybean meal, 48% CP</td>
<td>---</td>
<td>11.0</td>
<td>10.5</td>
</tr>
<tr>
<td>Molasses</td>
<td>8.0</td>
<td>11.0</td>
<td>10.5</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>---</td>
<td>---</td>
<td>3.0</td>
</tr>
<tr>
<td>Trace mineralized salt</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

\(^1\)CP = Crude protein.
Table 5.6. General guidelines for dietary mineral concentrations for goats (DM basis).

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Lactating Does</th>
<th>Dry Does</th>
<th>Kids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium, %</td>
<td>0.70</td>
<td>0.42</td>
<td>0.55</td>
</tr>
<tr>
<td>Phosphorus, %</td>
<td>0.36</td>
<td>0.24</td>
<td>0.30</td>
</tr>
<tr>
<td>Magnesium, %</td>
<td>0.25</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>Potassium, %</td>
<td>1.00</td>
<td>0.65</td>
<td>0.65</td>
</tr>
<tr>
<td>Sulfur, %</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
</tr>
<tr>
<td>Iron, ppm</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Manganese, ppm</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Copper, ppm</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Zinc, ppm</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Selenium, ppm</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Vitamin A, IU/lb</td>
<td>1800</td>
<td>1800</td>
<td>1000</td>
</tr>
<tr>
<td>Vitamin D, IU/lb</td>
<td>450</td>
<td>450</td>
<td>140</td>
</tr>
<tr>
<td>Vitamin E, IU/lb</td>
<td>10</td>
<td>40</td>
<td>11</td>
</tr>
</tbody>
</table>

Feeding Mature Goats

Maintenance

The nutrient requirements for goats that are not growing or lactating are relatively low. They usually eat 2.5 to 3.5% of their BW as DM, 11 to 12% of which should be CP. Be cautious about letting the animals get too fat. Except for some mineral supplementation, most of their nutritional needs can usually be met by stored forages or pasture.

Feeding Bucks

Mature bucks can obtain most of their nutrients from forages. Bucks must be in good condition prior to the breeding season, as they will likely lose weight during the breeding season because of increased activity. To improve body condition prior to breeding, bucks can be fed 0.25 to 0.5%
of their BW as grain. To reduce the risk of urinary calculi, calcium intake by bucks should be limited; therefore, legume forage consumption by bucks should be limited. Whole cottonseed or cottonseed products should not be fed to breeding bucks because cottonseed can contain gossypol that may decrease male fertility.

Feeding Does Prior to Breeding

Does should not be overconditioned going into the breeding season, so their energy intake needs to be constantly managed. Overconditioned does are at higher risk for health problems at kidding, especially for pregnancy toxemia and dystocia. About 2 weeks prior to breeding, it may be advantageous to increase the energy intake of does—this is called “flushing.” This management practice may increase the number of ovulations, thus potentially increasing the number of multiple births. Flushing is usually accomplished by feeding about 0.5 lb/day of shelled or cracked corn. If the does have been on low-quality forage, turning them to lush pasture may have the same effect.

Feeding Does Prior to Parturition

Feeding the dry does separately from the lactating does is very important in making a smooth transition from the dry to lactating states. During the later 2 to 3 weeks of gestation, the grain feeding to the dry doe should be increased to meet the increased requirements for fetal development, to allow the rumen and its microorganisms to adjust to more dietary starch, and to accommodate for some of the drop in DM intake during the last few days before parturition. About 1% of BW as grain should be fed daily during this time. The increased energy intake also is important to reducing the risk of pregnancy toxemia (acetonemia; ketosis); does with multiple fetuses are especially at risk. Intake of calcium should be limited (for example, limit feeding of legume hay) to reduce the risk of parturient paresis (milk fever) after kidding. To prevent white muscle disease in the kids after birth, it may be advisable to inject the does with selenium at 2 to 3 weeks prior to kidding. Consult your veterinarian for advice.

Feeding the Lactating Doe

Nutrient requirements for lactating does are higher than for most any other life stage for goats; therefore, they need to eat a lot of feed. Nutrient requirements (see table 5.6) and DM intake (see table 5.7) will vary primarily by BW, age, milk yield, and milk composition. The yield of milk and milk composition vary by breed of dairy goats (see table 5.8). You can split the lactation period into different stages: early lactation, mid-lactation, and late lactation. It is important to feed does appropriately for each stage. Overfeeding can result in lost income and overconditioned or fat does. Underfeeding can result in animals not reaching their genetic potential and lost growth in does during their first lactation. Energy is usually the nutrient that is most limiting in diets for lactating does. This can be a challenge with high-producing does and does in early lactation. For dairy does, your goal should be to feed the does for maximum milk production, while maintaining good health. For nondairy breeds of goats, the goal is to feed the does for adequate milk for the kids that are nursing and to maintain good health of the doe. Commercial grain mixtures for goats are often available. If such concentrate mixtures are not available in your area, grain mixtures for goats can be used (grain mixtures for sheep are not
advised because the copper requirement for goats is higher than for sheep). You can also prepare your own grain mixture. Some example concentrate mixtures for lactating does are provided in table 5.9, and suggested feeding rates are provided in table 5.10 based on milk yield, milk composition, and quality of forage.

The majority of dairy rations have forage to concentrate ratios of 40:60, 50:50, and 60:40. This is to try to maintain enough forage in the diet for good rumen health and to maintain enough energy for maximum milk production. Forage quality influences what that ratio should be depending on the nutrient requirements for a group of animals.

The decline in milk production after peak milk is known as “persistency.” The downward slope on the lactation curve is a measure of persistency. The gentler the slope, the more persistent the animal. First lactation does generally have lower peak milk but are more persistent than older does, which have higher peak milk. This makes the lactation curves of the young does much flatter. After peak milk yield, milk production should be approximately 90 to 95 percent of the previous month’s milk yield, meaning that milk production for the current month should be 90 to 95 percent of the milk production achieved in the previous month. The length of lactation varies, but for most dairy breeds, the length of lactation is about 10 percent shorter than for goats.

Examining your animal’s lactation curve can be helpful in locating feed and management problems in the herd. High-producing does require a high peak and good persistency. Does that are not peaking well may indicate problems in the transition feeding from the dry period to the lactation ration (change may be too abrupt), and does lacking persistency may indicate a nutrient or energy deficiency in the ration.

**Early Lactation**

Following kidding, the doe’s body is going through many changes, with the main event being the onset of lactation. Making milk requires large amounts of energy. Does lose BW during early lactation because milk production peaks earlier than DM intake. In other words, the doe cannot eat enough feed to keep up with the nutrient needs for maintenance and milk production. This puts her in a state of negative energy balance. She compensates some by using her own body fat reserves. This is why does always lose weight after kidding and why it is important for them to have high-quality feed and adequate body reserves (body condition). A goal is to minimize the length of time and the extent that the negative energy balance occurs by using good feeding practices.

The main challenge for early lactation does is providing a diet that has enough energy density, but also enough fiber to maintain a healthy rumen. This makes it very important to feed high-quality forages that provide a minimum of 26 to 28% of NDF in the dietary DM. To avoid digestive upsets, feedstuffs should not be ground too fine or chopped too small. Feed and fresh water should be available at all times.

**Mid-lactation**

Does at this stage are doing many things that require their bodies to be healthy. They are producing milk, getting pregnant, maintaining pregnancy, and regaining body condition lost in early lactation. Energy is still the most limiting nutrient, and good quality forages are very important.
Late Lactation

Does in late lactation are still an important group to be managed nutritionally. At this point, milk production is decreasing and body reserves are being replenished. It is important in this time period to avoid letting does become too fat. Nutritionally, energy and protein requirements are less during this stage than for does in early and mid-lactation. Balancing rations for late lactation does can prevent overfeeding, which can lead to fat does, lost income from feed costs that are higher than necessary, and health problems at the next parturition.

Table 5.7. Dry matter intake (% of body weight) for lactating dairy goats.

<table>
<thead>
<tr>
<th>FCM (lb/day)</th>
<th>50</th>
<th>75</th>
<th>100</th>
<th>125</th>
<th>150</th>
<th>175</th>
<th>200</th>
<th>225</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4.1</td>
<td>3.5</td>
<td>3.2</td>
<td>3.0</td>
<td>2.8</td>
<td>2.7</td>
<td>2.6</td>
<td>2.5</td>
</tr>
<tr>
<td>4</td>
<td>5.5</td>
<td>4.4</td>
<td>3.8</td>
<td>3.5</td>
<td>3.3</td>
<td>3.1</td>
<td>3.0</td>
<td>2.8</td>
</tr>
<tr>
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<td>5.3</td>
<td>4.5</td>
<td>4.0</td>
<td>3.7</td>
<td>3.5</td>
<td>3.3</td>
<td>3.1</td>
<td>3.1</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>5.2</td>
<td>4.6</td>
<td>4.2</td>
<td>3.9</td>
<td>3.6</td>
<td>3.4</td>
<td>3.4</td>
</tr>
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<td>10</td>
<td></td>
<td></td>
<td>5.1</td>
<td>4.6</td>
<td>4.2</td>
<td>4.0</td>
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<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>5.1</td>
<td>4.6</td>
<td>4.3</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.0</td>
<td>4.6</td>
<td>4.3</td>
<td>4.3</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.0</td>
<td>4.6</td>
<td>4.6</td>
</tr>
</tbody>
</table>

¹% Fat-corrected milk (FCM) = (0.4 * lb milk) + (15 * lb fat)

Table 5.8. Milk yield and composition for some of the most common goat breeds based on individual doe lactations during 2005 (ADGA, 2005).

<table>
<thead>
<tr>
<th>Breed</th>
<th>Number of does</th>
<th>Age at Start of Lactation</th>
<th>Milk Yield (lb/lactation)¹</th>
<th>Milk Fat (%)</th>
<th>Milk Protein (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpine</td>
<td>493</td>
<td>3 yr, 6 mo</td>
<td>2334</td>
<td>3.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Lamancha</td>
<td>234</td>
<td>2 yr, 6 mo</td>
<td>2050</td>
<td>3.9</td>
<td>3.1</td>
</tr>
<tr>
<td>Nubian</td>
<td>457</td>
<td>2 yr, 6 mo</td>
<td>1754</td>
<td>4.8</td>
<td>3.7</td>
</tr>
<tr>
<td>Oberhasli</td>
<td>63</td>
<td>2 yr, 6 mo</td>
<td>2137</td>
<td>3.4</td>
<td>2.8</td>
</tr>
<tr>
<td>Saanen</td>
<td>381</td>
<td>2 yr, 6 mo</td>
<td>2537</td>
<td>3.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Toggenburg</td>
<td>192</td>
<td>3 yr, 6 mo</td>
<td>2101</td>
<td>3.3</td>
<td>2.8</td>
</tr>
</tbody>
</table>

¹Based on Dairy Herd Improvement Registry. Individual doe records not corrected for age.

Table 5.9. Example concentrate mix for lactating does consuming either alfalfa or grass hay free choice.¹

<table>
<thead>
<tr>
<th>Grain Ingredient</th>
<th>Legume Hay (20% CP)</th>
<th>Legume Hay (15% CP)</th>
<th>Grass Hay (15% CP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn, cracked or rolled</td>
<td>61.7</td>
<td>69.0</td>
<td>68.3</td>
</tr>
<tr>
<td>Oats, whole or crimped</td>
<td>32.2</td>
<td>14.1</td>
<td>13.7</td>
</tr>
<tr>
<td>Soybean meal, 48% CP</td>
<td>4.0</td>
<td>15.5</td>
<td>15.0</td>
</tr>
<tr>
<td>Limestone</td>
<td>0.8</td>
<td>—</td>
<td>1.6</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>0.5</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Trace mineralized salt</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
</tr>
</tbody>
</table>

¹CP = Crude protein.

Table 5.10. Suggestions for amount of grain (lb/day; as-fed basis) to feed to lactating does based on milk yield, milk fat concentration, and quality of forage.¹

<table>
<thead>
<tr>
<th>Milk yield (lb/day)</th>
<th>3.5% Milk fat</th>
<th>4.5% Milk fat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15% CP Forage</td>
<td>20% CP Forage</td>
</tr>
<tr>
<td>2</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>4</td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>6</td>
<td>2.5</td>
<td>2.0</td>
</tr>
<tr>
<td>8</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>10</td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>12</td>
<td>4.0</td>
<td>3.5</td>
</tr>
</tbody>
</table>

¹CP = Crude protein.
Balancing Rations

A balanced ration is one that provides all the necessary nutrients that the animal needs during one day. To balance a ration, you need to list the animal’s requirements and determine which feeds and the amounts of those feeds that are necessary to meet those requirements and keep the animal healthy.

As-Fed Versus Dry Matter

Some feeds commonly fed to goats contain large amounts of water (for example, high moisture corn, corn silage, and molasses) and all feeds have some variability in water content, so rations are formulated on a dry matter (DM) basis. How do you convert the nutrient content to a DM basis? Let’s examine alfalfa hay that is 88% DM and 12% water (as-fed). This means that for every 100 lbs of hay, as-fed, 12 lb is water and 88 lb is actual hay.

To convert the amount of feed from an as-fed to a DM basis, you need to know either the percentage DM or the percentage of water in the feed. This can be determined by a nutrient analysis from a lab. There are also several simple on-farm methods for determining DM. Use the equation below to convert the amount of feed from as-fed to DM basis.

\[
Pounds \ of \ Feed = \frac{Pounds \ of \ Feed \ As-Fed \times \% \ DM}{100}
\]

**Example:** You have 5 lb of hay at 88% DM that you are feeding your doe each day. How many lbs of hay DM is she eating per day?

\[X = 5 \times (88/100), \ where \ x = lb \ of \ DM\]
\[= 4.4 \ lb \ of \ DM\]

There aren’t very many computer programs designed to formulate and/or evaluate rations for goats, but spreadsheets can be designed to be quite helpful with some of these calculations. However, if forage DM changes or a protein value changes, it is helpful to know how to change your ration easily, especially if the computer is not available.

Some simple guidelines for formulating rations are as follows:

- Always formulate rations on a DM basis.
- The percentage of a nutrient in a feed on a DM basis is always higher than it is on an as-fed basis.
- The amount of DM consumed or required is always less than the feed consumed on an as-fed basis.

Remember: DM is the amount fed minus water, and as-fed is with water.

Once DM is known, there is an easy way to make mixtures with a desired concentration of a nutrient. It is called a Pearson’s Square.

![Pearson’s Square Diagram]

**Example:** You would like to mix corn and soybean meal to make a 16% crude protein mixture on a DM basis.

1. Draw a square.
2. Place an E for the concentration of the mixture that you would like in the middle of the square.
3. Place at A and B the concentration of the nutrient in the feeds (DM basis) you are using.
   
   Corn – 10% CP and Soybean Meal – 54% CP

4. Subtract diagonally: \( A - E = D \) and \( B - E = C \) and put the results on the right side of the square and disregard the sign of the result.

5. The C is the number of parts of feed A, and D is the number of parts of feed B. Do not get confused because that is not how the numbers were determined.

6. Add \( C + D \) to determine \( F \), divide \( C \) by \( F \) and multiply by 100 to get the percentage of \( C \):
   
   \[
   \left( \frac{C}{F} \right) \times 100 = \% C
   \]

   \[
   (38 \div 44) \times 100 = 86\%
   \]
   
   and now do the same for D.

You can check your answer by:

- 86% corn \( \times 0.10 \) (proportion of protein) = 8.6%
- 14% soybean meal \( \times 0.54 \) = 7.6%
- 8.6% + 7.6% = 16.2% (does not exactly equal 16% because of rounding)

This can be done for any nutrient as long as you know the composition of your feed ingredients. Also, the exercise can be done on an as-fed basis. Use the desired concentration of the nutrient on an as-fed basis and the nutrient concentration in feeds on an as-fed basis (A and B). Then C and D will be the proportion of feeds to use on an as-fed basis.

Another item that is important is determining DM of forages, especially if a lot of wet forage, such as silage, is used in the ration. If your silage DM changes from 35% to 45%, how does the amount of silage in the ration need to change?

For this, you need to know how DM is determined. For example, there is 80 lb of corn silage in your mix on a DM basis. That is 228.6 lb as-fed with the corn silage at 35% DM.

Here is the equation:

\[
\text{DM (lb)} = \text{As-fed (lb)} \times (\% \text{ DM} \div 100)
\]

\[
= 80 \text{ lb} = X \times 0.35
\]

\[
(80 \div 0.35) = X \text{ (as-fed)} = 228.6 \text{ lb as-fed}
\]

So, if the DM changes suddenly for the corn silage from 35% to 45%, how much corn silage should be in your mix on an as-fed basis to maintain the 80 lb DM of corn silage?

\[
80 = X \times 0.45
\]

\[
80 \div 0.45 = X = 177.8 \text{ lb as-fed}
\]

So the amount of corn silage changed from 228.5 to 177.8 lb in the ration. This is something that you can easily check on the farm and change without having to consult your nutritionist or feed salesperson for a new ration.

Example diets for different stages of production are found earlier in the chapter. Examine the chart below for examples of feedstuffs fed to goats.
Table 5.11. Feedstuffs fed to goats. These feedstuffs are used throughout the livestock industries.

<table>
<thead>
<tr>
<th>Name of Feed</th>
<th>Color</th>
<th>Texture</th>
<th>Other Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa meal pellets</td>
<td>Green</td>
<td>Smooth</td>
<td>Tubular shaped particles that may be of varying lengths because of breakage of the pellets.</td>
</tr>
<tr>
<td>dehydrated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley, steam-rolled</td>
<td>Brown</td>
<td>Flaky</td>
<td>Whole barley that has been steamed and rolled; look for creases in the kernel caused by the roller; darker color and shorter in length than rolled oats.</td>
</tr>
<tr>
<td>Barley, whole-grain</td>
<td>Brown</td>
<td>Slightly rough</td>
<td>Particles are shorter than for oats.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>with irregular</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>edges</td>
<td></td>
</tr>
<tr>
<td>Brewers grain</td>
<td>Brown</td>
<td>Flaky</td>
<td>By-product from making beer from grains; particles more oblong than for soybean hulls.</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>Brown to light</td>
<td>Smooth with</td>
<td>Grain grown in limited quantities.</td>
</tr>
<tr>
<td></td>
<td>black</td>
<td>sharp edges</td>
<td></td>
</tr>
<tr>
<td>Complete pelleted feed</td>
<td>Light brown with</td>
<td>Smooth</td>
<td>Tubular shaped particles that may be of varying length because of breakage of the pellets.</td>
</tr>
<tr>
<td></td>
<td>yellow spots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn, cracked</td>
<td>Yellow/White</td>
<td>Rough</td>
<td>Whole corn kernels that have been broken; starch may stick to fingers.</td>
</tr>
<tr>
<td>Corn gluten feed</td>
<td>Light brown</td>
<td>Flaky</td>
<td>By-product from removing starch, oil, germ, and gluten from corn.</td>
</tr>
<tr>
<td>Corn gluten meal</td>
<td>Yellow</td>
<td>Granular to</td>
<td>By-products from removing starch, oil, and germ from corn.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>powdery</td>
<td></td>
</tr>
<tr>
<td>Corn, ground</td>
<td>Yellow</td>
<td>Powdery</td>
<td>Whole corn ground very fine.</td>
</tr>
<tr>
<td>Corn, whole kernel</td>
<td>Yellow</td>
<td>Smooth</td>
<td>Most common cereal grain in Ohio.</td>
</tr>
<tr>
<td>Cottonseed meal</td>
<td>Brown</td>
<td>Granular to</td>
<td>By-product from removing oil from cottonseeds.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>powdery</td>
<td></td>
</tr>
<tr>
<td>Cottonseed, whole</td>
<td>White</td>
<td>Fuzzy</td>
<td>By-product from removing cotton lint from seeds.</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>Gray</td>
<td>Granular</td>
<td>Looks like small rocks of uniform sizes.</td>
</tr>
<tr>
<td>Distillers grains</td>
<td>Brown</td>
<td>Flaky to powder</td>
<td>Sweet smell; by-product from making alcohol for liquor or fuel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish meal</td>
<td>Brown</td>
<td>Powdery</td>
<td>Smells like fish; look for tiny bone chips; by-product from fisheries or removal of oil from fish.</td>
</tr>
<tr>
<td>Hay cube</td>
<td>Green</td>
<td>Rough</td>
<td>Large cube with noticeable hay particles pressed together.</td>
</tr>
<tr>
<td>Limestone, ground</td>
<td>Light gray</td>
<td>Granular</td>
<td>Looks like small rocks of various sizes.</td>
</tr>
<tr>
<td>Linseed meal</td>
<td>Varies from light</td>
<td>Granular</td>
<td>By-product from removing oil from flax-seed; not commonly used in most areas of the United States.</td>
</tr>
<tr>
<td></td>
<td>to dark brown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milo (whole-grain sorghum)</td>
<td>Reddish-brown</td>
<td>Smooth</td>
<td>Round, bead-like grain.</td>
</tr>
<tr>
<td>Molasses, dry</td>
<td>Dark brown</td>
<td>Flaky and/or</td>
<td>Sweet smell; high in sugar; made from sugar beets (most common source) or sugar cane.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Granular</td>
<td></td>
</tr>
<tr>
<td>Name of Feed</td>
<td>Color</td>
<td>Texture</td>
<td>Other Characteristics</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------</td>
<td>--------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Oats, steam-rolled</td>
<td>Light brown</td>
<td>Flaky</td>
<td>Whole oats that have been steamed and rolled; look for creases in the kernel caused by the roller</td>
</tr>
<tr>
<td>Oats, whole-grain</td>
<td>Brown</td>
<td>Slightly rough with irregular edges</td>
<td>Common cereal grain fed for its fiber.</td>
</tr>
<tr>
<td>Rye, whole-grain</td>
<td>Brownish-gray</td>
<td>Smooth with round edges</td>
<td>Particles are longer than for wheat.</td>
</tr>
<tr>
<td>Salt, trace mineral</td>
<td>Bronze</td>
<td>Granular, grainy</td>
<td>Looks like tiny, uniform crystals.</td>
</tr>
<tr>
<td>Salt, white</td>
<td>White</td>
<td>Granular</td>
<td>Looks like tiny, uniform grainy crystals.</td>
</tr>
<tr>
<td>Soybean hulls</td>
<td>Light brown</td>
<td>Flaky</td>
<td>Look for dark specks from the outer coat of soybeans; by-products of removing oil from soybeans.</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>Light brown</td>
<td>Granular to flaky</td>
<td>By-product after removing oil from oil-seeds; 44% crude protein (CP) soybean meal = soybean meal plus soybean hulls; 48% CP = soybean meal without hulls.</td>
</tr>
<tr>
<td>Sugar beet pulp, dried</td>
<td>Grayish-brown</td>
<td>Rough</td>
<td>Looks like a dried root; by-product from removing sugar from beets.</td>
</tr>
<tr>
<td>Urea</td>
<td>White</td>
<td>Granular</td>
<td>Small bead-like particles; used as a source of nonprotein nitrogen for ruminant animals.</td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>Brown with white spots</td>
<td>Flaky</td>
<td>By-product from removing starch from wheat; looks like crumbled bran cereal.</td>
</tr>
<tr>
<td>Wheat, whole-grain</td>
<td>Brown</td>
<td>Smooth with round edges</td>
<td>Look for crease along the middle of one side.</td>
</tr>
<tr>
<td>Whey, dried</td>
<td>Light brown</td>
<td>Powdery</td>
<td>Smells sweet like milk replacer; by-product from making cheese.</td>
</tr>
</tbody>
</table>

Prepared by Dr. Maurice L. Eastridge, Department of Animal Sciences, The Ohio State University.
Feedstuffs

Whole-Grain Oats

Dry Molasses

Cracked Corn

Whole-Kernel Corn

Complete Pelleted Feed

Steam-Rolled Oats

Department of Animal Sciences, The Ohio State University.
Trace Mineral Salt

Steam-Rolled Barley

Ground Limestone

Hay Cube

Dried Sugar Beet Pulp

Wheat Middlings
Cottonseed Meal

Whole-Grain Barley

Soybean Meal
Chapter 13
Caring for Animals

Goals and Objectives

- Increase the awareness of the issues of animal well-being, quality assurance, and show animal ethics.
- Encourage you to reflect on your values concerning these issues.

Privileges, Responsibilities, and Rewards

Everyone associated with livestock, either on the farm or in the show ring, is responsible for the well-being of his or her animals. As a 4-H member, you need to learn to care properly for your projects and develop acceptable livestock husbandry skills.

Your duty as a 4-H member is to properly care for your animals. As a 4-H animal owner, you need to understand the privileges, responsibilities, and rewards that you can expect from the 4-H program.

Privileges

- To know as much about your project as possible.
- To receive information to raise the project.
- To be given a variety of experiences relating to project work.
- To be given sound guidance and direction.
- To ask questions and share concerns.
- To be recognized.

Responsibilities

- To treat all livestock projects in your possession humanely.
- To be sincere and believe in the value of a job well done.
- To be loyal to the values and ideals of the 4-H program.
- To accept the guidance and decisions of the program coordinators.
- To be willing to learn and participate in training programs and meetings.
- To continue learning throughout your years of 4-H membership.
- To follow good practices ensuring a safe, wholesome product of the highest quality.

Rewards

- To enjoy satisfaction from a job well done.
- To receive both public and personal recognition.
- To learn new skills, receive special training, and experience personal growth.
- To make new friends and have fun.
- To feel good about producing a wholesome, consumable product.
- To know you are special and you can make a difference.

Animal Well-Being

As a 4-H member, you need to be aware of the things you can do with your own animal to promote animal well-being. You need to set goals and develop a plan that positively
impacts your animal’s well-being, either on the farm, in your backyard, or at the fair.

You can complete some tasks before you even obtain your animal. First, think about the size your animal will be as it grows to maturity. Are your facilities large enough for the animal to exercise in? Are there hazards where you are going to keep your animal, such as protruding nails, broken boards, or wire? Can the animal reach any potentially dangerous objects? (For example, an electrical box or a poisonous plant.)

Think about the type of bedding you will be using and the quantity it will take to keep your animal dry and warm or cool. You should have an ample supply of fresh water available to your animals at all times. A designated feeding area should be kept free of manure, urine, and bedding. If you have dairy goats, think about your milking facilities. Is the equipment clean and operating properly? Is the equipment adjusted in a manner that prevents teat and udder damage to the doe?

Once your animal arrives and is in your care, providing it with a balanced ration is an important first step. Many processed feeds, supplements, and pre-mixes are available. Be sure your animal is receiving the nutrition it needs in relation to its age, growth cycle, and purpose. Your animal also needs special consideration if it is pregnant or lactating.

Animal Health

Know Your Vet

When questions or concerns arise, involve your veterinarian. Develop a veterinarian-client-patient relationship (VCPR). This relationship requires that the veterinarian has seen and has knowledge of the animal (patient) and has discussed a health plan or any treatments with the owner (client). Your veterinarian can be very helpful in developing a health-care program for your animal. Your plan should include an appropriate schedule for vaccinating, dehorning, internal/external parasite control, etc.

Using Medicine

You should check with your veterinarian before administering medication, especially if there is any question about the diagnosis and the medication you are planning to use. If injections are necessary, give them in the proper location using good technique.

It is important that you follow withdrawal time directions as given by the label or as prescribed by your veterinarian. This is the period of time that must pass between the last treatment and the time milk from the animal may be sold to the processor or the animal may be slaughtered. For example, if a medication with a 14-day meat withdrawal period was last given on August 1 at 2:00 p.m., the meat withdrawal would be completed on August 15 at 2:00 p.m. and that would be the earliest the animal could be sent to market or slaughtered to be processed for meat for human consumption.

Unlike meat products, which are safe for use immediately following completion of the withdrawal time, milk from treated lactating does presents a slightly different situation. When considering lactating does, it is important to remember that does continuously produce milk. The milk is stored in the doe’s udder until the milk is harvested during milking. Therefore, when a lactating doe is treated with a drug that has a milk withdrawal time, all milk produced by the doe during the withdrawal
time must be discarded. (It is not safe for human consumption and should not be sold to the processor.)

But what if the withdrawal time is complete at 4:00 p.m. and you do not milk the doe out until 6:00 p.m.? Do you have to discard the milk from the 6:00 p.m. milking since you milked out the doe two hours after the withdrawal was complete?

Yes. Keep in mind that the milk stored in the udder between milkings is collected in large holding areas called gland cisterns. In these holding areas there is no way to separate the milk that was produced during the withdrawal time (prior to 4:00 p.m.) and the milk that was produced during the two hours following completion of the withdrawal time. Therefore, the entire 6:00 p.m. milking is not safe for human consumption and must be discarded.

Use the following rule of thumb when in doubt: **All milk produced by the doe during the withdrawal period and harvested during the first milking following completion of the withdrawal time must be discarded.**

In addition to the withdrawal time, the label of a drug lists the animal species for which the drug is approved, the dosage to be administered, how it is to be given, and for what diseases/conditions it can be used as a treatment. Any use, other than that printed on the label, can only be directed or prescribed by your veterinarian.

For example, a neighbor’s animal is sick and a veterinarian has treated it using twice the dose listed on the label of an OTC (over-the-counter) product. Your animal becomes ill and is showing the same symptoms as your neighbor’s. You may not use the neighbor’s double dose for your animal without a veterinarian examining your animal and prescribing the specific treatment. Any deviation from the label directions when using a drug is referred to as **extra-label drug use** (ELDU). Unless directed by a veterinarian with whom you have established a VCPR, **extra-label drug use is illegal.**

**Animal Identification**

Each animal in your care should be permanently identified. Individual animal identification enables good record keeping. If your animal becomes lost, stolen, or needs medical attention when you are not available, the only way to know the animal’s identity and health history is by permanent identification. This is most commonly done by tattooing or ear tagging. For specific information about tattooing and ear tagging, see Herd Management and Diseases.

If your animal is registered with a breed association, identification may consist of recording identifying marks of the animal with a drawing or photograph. Other breed associations use tattooing for identification. Your Junior Fair program may identify all 4-H animals through county-wide tagging or tattooing. If not, you are responsible for permanently identifying all of your animals.

**Know Your Animal**

Training animals and acquainting yourself with them needs to begin at an early age or as soon as you acquire your animal. If at all possible, you should spend time with your animal daily. As you walk, stand, and set-up your animal, you develop trust in each other and become accustomed to each others’ movements. You also become aware of what sounds or sights bother your animal and in which direction it tends to jump or shy away from.
Handling your animal daily also helps you to recognize abnormal behavior in your animal that could signal illness, stress, or pain. The longer you avoid working with your animal, the more difficult training and preparation for show becomes. The two Ps—practice and patience—usually pay off.

From the day you acquire your animal until the day it leaves your care, you should maintain feed and treatment records. This is important for the day-to-day care of your animal and for whoever might later purchase your animal. This is also the best way to keep track of the kinds and amounts of expenses you have incurred with your project.

Finally, if you plan to exhibit your animal, continue the same quality care program throughout the exhibition as you did at home. This starts by loading and hauling your animal safely and with concern for its well-being. The exhibition facilities should be prepared and checked ahead of time, just as you prepared your facilities at home when you first acquired your animal. Continually watch your animal for signs of stress, pain, or illness. Exercise your animal daily. Clean, feed, and water your animal regularly.

Above all, enjoy your animal project experience. You should feel good about the knowledge you gain and the quality care program you develop and implement with your animal project.

Think back to some time when you bought a toy or other product and were disappointed in it. Would you buy it again? Consumers will choose to buy or not to buy a product from their perception of the value of that product. What would happen to a business if no one purchased its products?

Many businesses have quality assurance departments to make sure that their products are of the highest quality. Businesses pay attention to quality assurance because that helps to build consumer satisfaction. When quality is high, consumers will buy again. Livestock products must be safe, wholesome, and produced in a manner that meets consumer approval.

Who is in charge of quality assurance in the livestock industry? When you sell the milk your does have produced or sell a cull doe to market, who is responsible for assuring that the milk and meat eaten by the consumer is a high-quality and safe product? The retailer? The processor? The packer? You?

**Everyone involved in the livestock industry is obligated to do his or her**

![Image of a dog]

### Topics Important to Quality Assurance

**Nutrition**
- Essential nutrients, feed and forage analysis, ration balancing.

**Environmental Design**
- Space requirements, ventilation, freedom from hazards and injury, feeding systems, handling and loading, housing comfort, milking facilities, feeding facilities, manure handling, image.

**Genetics**
- Suitability to livestock production systems, processor needs, consumer preferences, producer needs.

**Veterinary Health**
- Disease prevention, proper drug usage, drug residues and withdrawal times, injection technique, records.
part to provide a safe, wholesome product to the consumer.

Quality assurance in the livestock industry begins with providing the right genetics and continues with the proper husbandry of the live animal, a good processing plant or packing house, and good retailing. Every action you take as a livestock producer will reflect on the quality of the livestock industry as a whole. The image of the agricultural industry and the 4-H program is affected by the decisions you make and the actions you take in the care of your animal.

Quality assurance in raising livestock involves providing for the animal's needs to produce a healthy animal and a wholesome product. Basic animal needs include water, food, shelter, and care. Proper attention to animal husbandry helps assure a high-quality marketable product.

Good animal husbandry requires an understanding of many different sciences, including nutrition, environmental design, genetics, veterinary health, production, and economics. These topics all contribute to a quality livestock product. To learn more, consult your project book, a 4-H advisor, an Extension educator, a veterinarian, or a livestock production expert.

Evaluating quality assurance of your project is something like looking into a mirror. Reflect on your project for a moment. Do you like what you see? More important, will the consumer like it?

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**Good Production Practices**

Ten Good Production Practices (GPP) that relate to quality assurance and food production are listed below:

**GPP 1:** Identify and track all treated animals.

**GPP 2:** Maintain medication and treatment records.

**GPP 3:** Properly store, label, and account for all animal health and medicated feeds.

**GPP 4:** Use veterinary prescription drugs (or FDA-approved drugs in an extra-label manner) only when there is a valid veterinary/client/patient relationship.

**GPP 5:** Educate all employees and family members on proper administration techniques.

**GPP 6:** Use drug residue tests when appropriate.

**GPP 7:** Establish an efficient and effective animal health management plan.

**GPP 8:** Provide proper animal handling and care.

**GPP 9:** Follow appropriate feed processor procedures and feed tag recommendations.

**GPP 10:** Review and update quality assurance program at least once a year.

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**The dairy double.** Dairy producers have product responsibilities that are two-fold. The obvious product is milk. The less obvious but no less important product is meat. Many dairy producers often forget that the majority of cull does go to slaughter for meat. Therefore, the dairy producer needs to be aware of both milk and meat quality assurance.
Important Treatment Record Information

Veterinarian-Client-Patient Relationship (VCPR) is established when a veterinarian, who knows about an animal's health by having seen it or other animals in the same herd, takes charge of the medical decisions about the animal's treatment. The veterinarian has to be available for follow-up in case the animal does not respond as expected, and the caretaker of the animal has to agree to follow the veterinarian's instructions regarding the treatment program.

Withdrawal Time is the time needed to allow drug residues to diminish to a safe level. It is the period that must elapse after the last treatment and before harvest of the animal (slaughter) or use of its products (milk, meat, and eggs) for human consumption.

Extra-Label Drug Use is using a medication in a way other than that stated on the label by the manufacturer. For instance, using a medication as a treatment for a disease not listed on the label for that type of animal is extra-label use. Extra-label use, if not directed by a veterinarian with an established VCPR, is illegal.

Veterinary drugs are available in two categories, over the counter (OTC) and prescription (Rx). To be an OTC product, the medication must meet certain criteria for safety to both the animal and the person handling the product. If simple directions can adequately be written on the label by the manufacturer, a product can be classed as an OTC. The OTC medications may be sold through retail outlets such as farm supply stores in the same manner as aspirin is sold at a grocery store.

When human and animal safety, proper diagnosis, and special directions are concerns, medications are classed as prescription (Rx) products. A prescription product can be identified because the exact following statement will appear on the container: Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian. Just as veterinarians are not allowed to authorize extra-label drug use without a valid VCPR, neither are they permitted to prescribe Rx medications for animals where a valid VCPR has not been established. The Rx medications are available only from or on the order of a veterinarian much as prescription drugs for people are only available from physicians and from a pharmacist by prescription.
Proper Administration of Animal Drugs

Follow these general guidelines when administering drugs to your animal.

1. Read label directions carefully and determine how the drug is administered. Medications must be given to your animal according to label instructions, which should indicate one of these methods:

   - **Oral (O or PO).** Giving drugs through the mouth. Tablets, pills, capsules, and liquid medications are easily administered orally. A drenching tube, balling gun, or oral dosage syringe is usually used to place the liquid or pill at the base of the tongue at the back of the mouth. Make sure the medication goes down the throat and the animal swallows it. Take care the animal is not choked by the medication going down the trachea (windpipe). You might also be able to administer medication in the animal’s feed or water.

   - **Topical route.** Applying the medication to the skin or to the mucous membranes of the eyes, ears, or nasal passages. Such medications are available as ointments, aqueous solution, powders, and sprays. Do not allow these products to come in contact with the animal’s eyes, nose, reproductive tract, or mouth unless they are specifically formulated for that use.

   - **Injectable route.** Administering the drug directly into the animal’s body with a syringe and needle. Injections are the most common method of administering medications to individual animals. The label specifies which specific injection method to use:
      - **Subcutaneous (SQ)** injections are accomplished by inserting the needle just under the skin and not into the muscle. This is important because SQ injectables are designed for a slower rate of absorption or are highly irritating to muscle tissue.
      - **Intramuscular (IM)** injections are the most commonly used. This is accomplished by inserting the needle straight into the skin and deep into the muscle.
      - **Intravenous (IV)** injections are given directly into the bloodstream and are used when the medication is a strong irritant to muscle tissue and may cause damage. IV injections get the medication into the system of a sick animal and eliminate the chance of tissue damage.

2. Use sterilized needles and syringes and keep bottles and bottle caps clean.

3. Restrain the animal in a safe manner. You may need someone to hold your animal.
4. Give injections at clean, dry sites on the animal.

5. Do not transfer needles back and forth from animal to bottle. You may carry bacteria from the animal's skin. Needles are used just once and then discarded; do not use the same syringe needle multiple times.

6. Products with low dosage rates are preferred.

7. When making multiple injections, space injections at least six inches apart.

**Injection Reminders**
All products labeled SQ are administered behind the elbow joint or in front of the shoulder. Without exception and regardless of age of the animal, all products labeled IM are administered in the neck region. Whenever possible, IM injections are to be avoided. Products labeled for SQ, IV, or O administration are recommended.
Intramammary Infusion Procedures

- All products labeled for intramammary infusion shall be given directly into the udder through the teat canal.
- To administer intramammary infusion, use the following procedure:
  1. Clean and dry the teats.
  2. Dip teats in an effective germicidal product (teat dip). Allow at least 30 seconds of contact time before wiping the teats with an individual disposable towel.
  3. Clean and disinfect each teat end thoroughly by scrubbing with cotton soaked in 70% alcohol. Use a separate piece of cotton for each teat.
  4. Prepare teats on the far side of the udder first, if more than one quarter is to be treated, followed by teats on the near side. Treat quarters in reverse order—near side first, far side last.
  5. Insert only the tip of the cannula into the teat canal. Do not allow the sterile cannula to touch anything prior to infusion. This avoids damage to the teat canal and avoids the introduction of new bacteria into the udder.
  7. Identify treated does with plastic or velcro leg bands, hock markers, neck straps, paint sticks, etc. If you group lactating does, move treated does to the sick doe group to prevent drugs from entering the milk supply.

- Infusing a drug into one or more quarters affects the milk produced in all four quarters. Therefore, all milk produced during the withdrawal period and harvested during the first milking following completion of the withdrawal period must be discarded.

courtesy of the national mastitis council (nmc), dry doe therapy. used with permission.

what is hot milk? hot milk is milk that contains antibiotic residues. there is a zero tolerance policy for antibiotic residues in milk. milk that tests positive for antibiotic residues may subject the producer to stiff fines, or the producer may be forced to pay for an entire truckload of milk. where there are several violations, the license to sell milk may be revoked.

such violations can be avoided by carefully observing and following milk withdrawal times for medications and medicated feeds. some dairy producers use on-farm drug residue screening tests to determine the presence of antibiotic residues in their bulk tank. there are a wide variety of on-farm drug screening tests available. keep in mind, however, that there are no fda-validated screening tests for milk from individual does. it is extremely important that you work with your veterinarian or milk processor to determine the best way to make sure that the milk you produce is safe to sell.

drug storage

producers are subject to strict drug storage guidelines. these guidelines are enforced by state and federal agencies and, in the case of dairy, by milk processors. producers who violate drug storage guidelines may be subject to fines and may not be allowed to sell their products for specified periods of time.
Federal and state laws specify that drugs for lactating does and drugs for other animals, including non-lactating does, kids, replacement does, wethers, etc., must be stored separately. This can be done by labeling shelves in your medication cabinet or refrigerator “Drugs for Lactating Animals” and “Drugs for Non-Lactating Animals.”

All medications must be stored so that they do not come in contact with feed, milk, or milking equipment. If you are a dairy producer, check your state guidelines to learn about specific drug storage regulations.

Guide to Reading the Medication Label

Name of drug. Brand or generic name of drug being prescribed.

Active ingredients. Chemical name(s) of what is in the drug.

Withholding/Withdrawal times. The time period that must elapse after the last treatment and before harvest of the animal (slaughter) or use of its products (meat, milk, and eggs) for human consumption.

Medication Label

**Name of Drug**

OMNIBIOTIC

(Hydrocillin)

**Active Ingredient**

Directions for use: See package insert.

Cautions and Warnings

**Warning:** The use of this drug must be discontinued for 30 days before treated animals are slaughtered for food. Exceeding the highest recommended dosage level may result in antibiotic residues in meat or milk beyond the withdrawal time.

**Storage**

Store between 2° and 8°C (36° and 46°F) Keep dry and away from light.

**Quantity of Contents**

Net Contents: 100 mL Distributed by USA Animal Health, Inc.

**Name of Distributor**

**Lot Number**

EQ771-3

**Expiration Date**

2/11/20XX

This activity was adapted from information found in the Quality Assurance and Animal Care Youth Education Program. Based upon work supported by the Extension Service, United States Department of Agriculture, under special project number 93-EFSQ-4096.
Cautions and warnings. Tells of items to be cautious about when using the product. Examples: (a) Do not give to certain kinds of animals; (b) do not give too much; (c) pay attention to withholding times (see above).

Storage. Tells how the medication should be kept while not in actual use. Many medications may lose their potency when exposed to moisture, direct light, warm and/or freezing temperatures. Most also lose effectiveness with time. The label will indicate how the product should be stored to retain maximum strength.

Quantity of contents. Tells how much is in the container. Usually in metric units. Liquid measure: 1 fluid ounce = 29.6 milliliters (ml); dry measure: 1 pint = 551 milliliters (ml); 1 cubic centimeter (cc) = 1 milliliter (ml).

Name of distributor. This will tell you who distributed the medication.

Expiration date. Tells when to discard the drug. Most drugs lose effectiveness with time. Do not use medication after the expiration date listed.

Lot number. A manufacturer’s reference number that indicates the day or batch in which this product was made. These numbers are needed if the product is recalled. The Lot Number can also be referred to as the Serial Number.

Approved uses (indications). The situation for which the drug is to be used. Indicates the particular type of animal, stage of lactation, condition, illness, etc.

Dosage. How much to give and how often/how many times to give.

Route of administration. How is the product given to the animal? Basically, there are four routes of administering medications (see descriptions in Proper Administration of Animal Drugs):

1. Oral route
2. Topical route
3. Injectable route
   - Subcutaneous (SQ)
   - Intramuscular (IM)
   - Intravenous (IV)
4. Intramammary infusions

Cautions and warnings. Tells of items to be cautious about when using the product. Examples: Do not give to certain kinds of animals; do not give too much; pay attention to withdrawal times.

Storage requirements. Tells at what temperature the medication should be stored. For example: Do not freeze.

Withholding/withdrawal times. The time period that must elapse after the last treatment and before harvest of the animal (slaughter) or use of its products (meat, milk, eggs) for human consumption.

Sizes available. Tells how the medication is supplied and sizes available.
**Medication Insert**

**Name of Drug**  OMNIBIOTIC  
(Hydrocillin in Aqueous Suspension)  **Active Ingredient(s)**

For use in Meat Cattle, Lactating and Non-Lactating Goats, Swine, and Sheep

*Read Entire Brochure Carefully Before Using This Product.*

**Active Ingredients:** Omnibiotic is an effective antimicrobial preparation containing hydrocillin hydrochloride. Each ml of this suspension contains 200,000 units of hydrocillin hydrochloride in an aqueous base.

**Indications:** Cattle — bronchitis, foot rot, leptospirosis, mastitis, metritis, pneumonia, wound infections. Swine — erysipelas, pneumonia. Sheep and goats — foot rot, pneumonia, mastitis, and other infections in these species caused by or associated with hydrocillin-susceptible organisms.

**Recommended Daily Dosage**
The usual dose is 2 ml per 100 lb. of body weight given once daily. Maximum dose is 10 ml/day.

<table>
<thead>
<tr>
<th><strong>Dosages</strong></th>
<th><strong>Body Weight</strong></th>
<th><strong>Dosage</strong></th>
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<tbody>
<tr>
<td></td>
<td>50 lb.</td>
<td>1 ml</td>
</tr>
<tr>
<td></td>
<td>100 lb.</td>
<td>2 ml</td>
</tr>
<tr>
<td></td>
<td>300 lb.</td>
<td>6 ml</td>
</tr>
<tr>
<td></td>
<td>500 lb. or more</td>
<td>10 ml</td>
</tr>
</tbody>
</table>

Continue treatment for 1 to 2 days after symptoms disappear.

**Cautions and Warnings**
- **Caution:** 1. Omnibiotic should be injected deep within the fleshy muscle of the neck. Do not inject this material in the hip or rump, subcutaneously, into a blood vessel, or near a major nerve because it may cause tissue damage. 2. If improvement does not occur within 48 hours, the diagnosis should be reconsidered and appropriate treatment initiated. 3. Treated animals should be closely observed for at least 30 minutes. Should a reaction occur, discontinue treatment and immediately administer epinephrine and antihistamines. 4. Omnibiotic must be stored between 2° and 8°C (36° and 46°F). Warm to room temperature and shake well before using. Keep refrigerated when not in use.

**Sizes Available**
- **Warning:** Milk that has been taken from animals during treatment and for 48 hours after the last treatment must not be used for food. The use of this drug must be discontinued for 30 days before treated animals are slaughtered for food.

**How Supplied:** Omnibiotic is available in vials of 100 ml.

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This activity was adapted from information found in the **Quality Assurance and Animal Care Youth Education Program.** Based upon work supported by the Extension Service, United States Department of Agriculture, under special project number 93-EFSQ-4096.
Ohio Livestock Coalition

This statement from the Ohio Farm Animal Commission, now known as the Ohio Livestock Coalition, summarizes many of the topics discussed in this chapter. Be sure to read the statement, understand the purpose of the coalition, and follow the Code of Practices.

Policy Statement

The Ohio Farm Animal Care Commission (OFACC) was organized in 1990 to provide leadership on matters related to farm animal care. In 1997 the organization changed its name to the Ohio Livestock Coalition (OLC) to provide leadership and lend support to the recommendations by the Ohio Livestock Industry Task Force, which released its report in 1996. The Commission was then designated a vital part of the OLC.

The Commission has dedicated itself to the promotion of sound animal husbandry practices in the care and efficient production of animals used for food and fiber. The use of proper animal husbandry practices minimizes stress, improves animal efficiency and profitability for the farmer and insures a safe, healthy and wholesome product to the consumer at a reasonable price.

The Commission believes animals are vital to human existence and therefore deserve our protection and compassion. Humans have had an inseparable relationship with animals and nature, as man has served as their sole caretaker for centuries. Yet, humanity is answerable to another set of laws and concepts that is uniquely a product of human society. Animals cannot be made subject to the laws that we as human beings are governed by and therefore do not have the rights of humans.

The Commission firmly believes that all animals use other animals for their existence. Thus, the responsible use of animals by humans is natural and appropriate.

The Commission believes that farmers take pride in their responsibility to provide proper care for their animals and endorses the following "Code of Practices."

Code of Practices

The following describes general responsibilities of the farmer and all persons in their authority, in the proper care and handling of animals raised for food and fiber:

- To provide food, water and care necessary to protect the health and welfare of my animals.
- To provide a safe and healthy environment for my animals that is clean, well ventilated and provides ample space.
- To provide a well-planned disease prevention program to protect the health of my herd or flock. This includes a strong veterinarian/client relationship.
- To use humane and sanitary methods when it becomes necessary to dispose of my animals.
- To make timely inspections of all animals to evaluate the health and ensure that all basic requirements are being met.
- To ensure proper handling techniques are used to eliminate any undue stress or injury when manual manipulation is necessary.
- To provide transportation for my animals that avoids undue stress or injury caused by overcrowding, excessive time in transit or improper handling when loading or unloading.
- The willful mistreatment of my animals or the mistreatment of any animal will not be tolerated. In cases of mistreatment, I will notify the proper authorities.
- To make management decisions based on scientific fact and to consider the welfare of my animals.
- We encourage livestock producers to complete species-specific quality assurance programs.