Unit 1

Animal Nutrition and Digestion

Objectives

- Discuss the importance of nutrition and digestion for animal growth.
- Explore the basics of animal physiology.
- Determine how nutrients are used by various livestock species.
- Identify classes and sources of nutrients.
- Identify symptoms of nutrient deficiencies.
- Explain the role of feed additives in livestock nutrition.
- Formulate a feed ration using the Pearson square.
- Compare and contrast animal digestive systems.

Key Terms

- amino acids
- antibiotics
- anthelmintics
- balanced ration
- central nervous system
- colostrum
- concentrates
- crude protein
- digestible protein
- digestion
- digestive system
- energy
- feed additives
- free choice
- growth regulators
- lactation
- macrominerals
- maintenance
- microminerals
- monogastrics
- peripheral nervous system
- physiology
- ration
- roughages
- ruminants
In today’s society, one can’t turn on the TV or read a newspaper without seeing or reading information about health issues. What is the major factor discussed in these issues? Nutrition. Along with nutrition, genetics and environment are all factors that influence your health. Just like in humans, agricultural animals are influenced by these same factors. If animals don’t have proper nutrition, their growth rate, reproduction rate, immunity, and well-being are all affected. Just as proper nutrition is vital for your good health and proper function, it is just as vital for the health and function of agricultural animals.

Importance of Nutrition and Digestion

Nutrition is important for a variety of reasons. Animals need the proper nutrition for growth and maintenance, and to provide energy for work and vital functions. Maintenance is the nutrition required for an animal to maintain its current weight. Energy is the ability of the body to perform functions. Proper nutrition is also needed to maintain body temperature, produce milk, reproduce, and develop proper bone structures. Without proper nutrition, animals can develop health problems, which could result in treatment costs or even fatality. Good nutrition is essential for all of the systems of an animal to function and work together properly.

Animals that do not receive the proper nutrition are more likely to develop health and reproductive problems, and be less productive and marketable. Nutrition is important to have healthy animals, and, in turn, healthy animals help ensure profitability in agricultural operations.

Producers must understand not only what nutrition an animal needs but also how to supply that needed nutrition. Producers must know what ration is appropriate for a specific animal and how to provide a balanced ration. A ration is the feed an animal receives over a 24-hour period. A variety of feedstuffs, or basic ingredients, are used in rations, and producers must choose those that best suit their needs. A ration with all the nutrients an animal needs is a balanced ration.

Digestion is the process of breaking down feeds into simple substances that can be absorbed into the bloodstream and used by the body’s cells. It is important for producers to understand the digestive process because it helps in selecting the proper feed for the animal’s type of digestive system. The digestive system is the system in which food is acted upon through physical (chewing) and chemical (stomach acids) means. It includes all parts from the mouth to the anus.

Understanding the digestive system can help the producer become more efficient in feeding, resulting in a more cost-effective livestock enterprise. It also helps the producer have a better understanding of animal health and problems that may occur. Understanding the chemical and physical changes that take place after an animal eats is important in noticing health problems related to digestion.

Some animals need just enough nutrients to maintain current body weight.

Jupiter Images
Basics of Animal Physiology

Physiology refers to the systems and functions of the body. What are the systems in an animal’s body? The major ones include the skeletal, muscular, circulatory, respiratory, nervous, urinary, endocrine, digestive, reproductive, and mammary systems.

Skeletal System

The skeletal system consists of bones and cartilage that give the body shape. It protects internal organs and provides support for the body. Bone is the major component of the skeletal system, which consists partially of calcium and phosphate. The material inside bone is bone marrow, which produces blood cells. Cartilage provides support and serves as a cushioning effect for joints.

Circulatory System

The main components of the circulatory system are the heart, arteries, capillaries, and veins. The circulatory system delivers food and oxygen to the cells of the body and eliminates waste products. It contains blood, which consists of red blood cells, white blood cells, and platelets. Red blood cells carry oxygen while white blood cells help the body fight disease.

Urinary System

The urinary system, also known as the excretory system, consists of the kidneys, bladder, urethra, and ureters. The purpose of the urinary system is to remove waste products from the blood. The urinary system filters waste products and some water through the kidneys. The urine then goes through the ureters to the bladder where it is emptied through the urethra.
Muscular System
The muscular system allows movement and necessary functions such as circulation, digestion, and breathing. It is made up of muscles and connective tissue, such as tendons. The muscular system also helps provide support and shape. Muscles consist largely of protein and are the lean meat of an animal that is used as food for human consumption. Muscles can be voluntary or involuntary. Voluntary muscles are those that can be controlled. When an animal walks or chews it is using voluntary muscles. Involuntary muscles are automatic and operate without any thought on the part of an animal. Muscles that operate the heart, intestines, and lungs are involuntary.

Respiratory System
The major parts of the respiratory system are the nostrils, nasal cavity, pharynx, larynx, trachea, and lungs. When using the respiratory system, animals breathe in needed oxygen and breathe out carbon dioxide. Air first enters the respiratory system through the nostrils or mouth. Then the air passes through the nasal cavity to the pharynx. Finally, air goes through the trachea and enters the lungs. In the lungs, air is exchanged for carbon dioxide. When animals breathe out, this carbon dioxide is removed from the body.

Nervous System
The nervous system allows the body to communicate by sending, receiving, and interpreting signals. The nervous system is composed of the brain, spinal cord, and neurons. The nervous system can be divided into two parts: the central nervous system and the peripheral nervous system. The central nervous system includes the brain and spinal cord. It is responsible for receiving information from nerves that pass through the spinal cord and others that control the senses of hearing, sight, smell, touch and taste.

The peripheral nervous system connects the central nervous system to the rest of the body. The peripheral nervous system is the system that is responsible for voluntary muscle control. The autonomic nervous system is a part of the peripheral nervous system and controls automatic body activities, such as the heart muscle.
Endocrine System

The endocrine system consists of endocrine glands that release hormones into the body. Hormones are chemicals necessary for the regulation of many bodily functions. For example, hormones regulate growth and reproduction.

Digestive System

What happens to food after it is eaten? The digestive system breaks food down so that it can be used by the body. Digestive systems can vary depending on the species of animal. Some have very simple stomachs and others are more complex. The types of digestive systems are discussed later in this unit.

Reproductive and Mammary Systems

Have you ever seen a newborn foal or calf? The reproductive system is what enables reproduction to occur. The male and female reproductive systems differ in animals. The female reproductive system provides an environment for gestation. In female animals, the ovaries produce eggs, which are usually released on a regular cycle through ovulation. Eggs can become fertilized when mating occurs during a certain period of the ovulation cycle.
Unit 1 — Animal Nutrition and Digestion

The male reproductive system provides the sperm necessary for a female to become pregnant through fertilization. Animals must reach a certain age before they are able to reproduce safely.

Milk is produced through the mammary system of females. The process of producing milk is known as lactation and occurs after giving birth and stops when the offspring are weaned. In many mammals, the mammary system initially produces colostrum, a fluid that contains antibodies for the newborn. Also known as the first milk, colostrum aids young animals in fighting off infections due to the introduced antibodies.

How Nutrients are Used

Does a pregnant mare need the same nutrients as a horse that is ridden occasionally? No. The nutrient requirements of animals differ because of factors such as age and pregnancy. Animals that need nutrients to sustain the body condition they are in (no weight loss or gain) need nutrients for maintenance. Animals that require maintenance levels of nutrients are not pregnant, lactating, or producing products such as wool.

Young, growing animals require nutrients to meet the needs of the specific growth stages. Young animals need the proper nutrition for growth and development of bones, muscles, and organs. Some agricultural animals, such as chickens, grow rapidly. As animals grow, their nutrient needs change, and as they mature, their diets become closer to those of adult animals. Older animals may have health problems related to aging, which could require different nutritional needs such as vitamin and mineral supplements.

Animals that are pregnant or lactating have specific and increased nutritional needs. Pregnant animals need nutrition not only for themselves but also for the developing babies. Some agricultural animals commonly give birth to only one offspring (cattle and horses) while others give birth to multiple offspring (pigs, chickens, sheep and goats). Animals that are lactating or nursing their young also need specific nutrients to provide nourishing milk to their offspring.

Animals that exert large quantities of energy, known as working animals, need additional nutrients. Working animals are used for some type of work such as pulling heavy loads. Additionally, horses that are used for competitive events require different rations than horses that are ridden only for pleasure.

Have you ever worn a wool sweater? If so, the wool came from sheep that needed the proper nutrients to produce good quality wool. Many agricultural animals are raised for meat and products such as eggs, milk, or wool. In order to produce products or have the quality of meat consumers will purchase, proper nutrition is essential.

Knowledge Check

1. What could happen if animals do not receive the proper nutrition?
2. What does the digestive system do for an animal’s body?
3. Which animal system gives an animal’s body shape?
4. What is the purpose of the endocrine system?
5. What do male and female animals provide for reproduction to occur?
Classes and Sources of Nutrients

What nutrients do animals need? There are six major classes of nutrients: water, protein, carbohydrates, fats, minerals, and vitamins. Nutrients can be obtained from various sources. Common sources of nutrients for agricultural animals include roughages and concentrates. **Roughages** include feed that is high in fiber and low in energy, such as grasses, hays, and silages. **Concentrates** include feed that is high in energy and low in fiber, such as grains.

**Water**

How long can one survive without water? Not long. Water is vital for all animals and makes up more than one-half of most animals’ bodies! It forms the basis of fluids in the body and is essential for processes such as digestion, blood circulation, and waste elimination. Water helps dissolve nutrients and also regulates body temperature through perspiration and evaporation. Animals need a fresh, clean source of water. Most of the water an animal consumes comes from the water it drinks. Water also can be obtained from feed sources such as forage. Water is essential, especially for working animals or during hot weather. During hot weather or when working hard, horses can require 20 or more gallons of water per day.

**Protein**

Protein is made up of amino acids that are necessary for healthy animals. **Amino acids** are the building blocks of protein and are used for the formation of tissues and muscle production. Protein is needed for healthy growth, reproduction, and maintenance.

Protein can be obtained from both plant and animal sources. Plant proteins are more common in livestock feeds and include soybean, cottonseed, linseed, peanut, and sunflower seed meals. Protein also can be obtained from legume hays such as alfalfa or clover. Legumes are plants that produce or fix their own nitrogen. Sources of animal protein include tankage, fish meal, meat scraps, and milk products. Animals need different amounts of protein, depending on their needs. For example, young, growing animals need more protein than older animals. Protein is often the most expensive ingredient in feed. **Crude protein** refers to the total amount of protein in a feed while **digestible protein** is the protein that can be digested and used by an animal.

**Carbohydrates**

Carbohydrates are nutrients that provide the main source of energy for activities the body performs. Carbohydrates provide energy for growth, maintenance, and reproduction. They also help produce body heat for warmth. Carbohydrates come from plants and include sugars, starches, and cellulose. The main sources of carbohydrates in feed are grains such as corn, oats, wheat, barley, rye, and grain sorghum. Forages and hay are also sources of carbohydrates.
Fats
One may not think of fats as being essential, but they are. Although fats are needed in small amounts they are a necessary part of the diet. Fats provide energy and store excess energy. Fats help produce body heat and carry fat-soluble vitamins in the body. Many sources of proteins are also sources of fats. Fats are found in both plants and animals. Plant fats include oils that are within seeds, which are the main source of fats in agricultural feeds.

Minerals
Minerals provide material for growth of bones, teeth, and tissue and also help regulate many of the body’s chemical processes. Minerals also help in muscular activities, reproduction, tissue repair, and body heat. Although mineral intake may account for a small portion of the total diet, it is essential. Minerals can be categorized as macrominerals or microminerals. Macrominerals are needed in larger amounts by the body, and microminerals are needed in smaller amounts. Macrominerals include calcium, chlorine, magnesium, phosphorus, potassium, sodium, and sulfur. Microminerals include chromium, cobalt, copper, fluorine, iron, iodine, manganese, molybdenum, nickel, selenium, silicon, and zinc. Minerals are often added to animal feed or fed free choice, which means animals are able to access at any time. For example, salt and mineral blocks are fed free-choice where animals are able to lick them anytime they want.

Animals may be able to tolerate minerals in excess of recommended quantities; however, excess minerals in some species can cause toxicity, even leading to death. Producers should always ensure that minerals are given in the appropriate amount to animals. Sheep are susceptible to copper toxicity, which can lead to death. Symptoms of copper toxicity in sheep include lethargy, anemia, pale membranes, thirst, and jaundice. Excess of some minerals can cause weight loss and slower rates of gain in some animals. Hogs that are given excess minerals may have slower gains, and cattle that have an excess of sodium and chloride can have reduced milk production and weight loss. Selenium toxicity in horses can cause appetite loss, hair loss, paralysis, and eventual death. An excess of some minerals may also interfere with the metabolism of other minerals. For example, sulfur toxicity in cattle can interfere with the metabolism of selenium, copper, molybdenum, and thiamin.
Vitamins

Vitamins are essential for normal body functions such as digestion, cell metabolism, growth, and reproduction. Like minerals, they are also needed in relatively small quantities. Vitamins help in tooth and bone formation, assist the body in fighting stress, and prevent infection in the body. Vitamins can be obtained from many different sources such as forages, hay, and cereal grains. Just as in minerals, it is important for the producer to provide the appropriate vitamins.

Vitamins are fat soluble or water soluble. Water-soluble vitamins are dissolved in water, and fat-soluble vitamins are dissolved in fat. Fat-soluble vitamins include vitamins A, D, E, and K. Vitamin D is necessary for bone development, and it is produced in the animal’s body. In order to produce vitamin D, the animal must be in sunlight for a portion of the day. Some of the main benefits of the other fat-soluble vitamins include blood clotting (vitamin K), reproduction and muscle development (vitamin E), healthy eyes, and preventing infection (vitamin A).

Water-soluble vitamins include vitamin C and the B-complex. Vitamin C is needed for teeth and bone formation, and the prevention of infections. B-complex vitamins are necessary for growth and reproduction. The B-complex vitamins include thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, biotin, folic acid, benzoic acid, choline, and B-12. The B-complex vitamins help many body functions such as red blood cell maturation (vitamin B-12) and energy metabolism (riboflavin).

Symptoms of Nutrient Deficiencies

What happens when an animal doesn’t get enough of a specific nutrient? Symptoms of nutrient deficiencies range from a variety of diseases and health problems to fatality.

The symptoms of water deficiency include weakness, reduced feed intake, weight loss, eyes that appear sunken in, and lack of saliva production. Water deficiency can ultimately cause death if the animal does not receive adequate amounts of water.

Lack of energy is often a first symptom of carbohydrate deficiency. Other symptoms of carbohydrate deficiency include weight loss, poor growth rates, loss of fat, and an unthrifty appearance. Animals that lack carbohydrates for an extended time can face starvation and possibly death.
Fat deficiencies are not common in agricultural animals but may occur in poultry. Symptoms in poultry include reduced growth and reproductive performance.

Symptoms of protein deficiency include decreased growth and development, reduced feed intake, body tissue loss, poor hair coat, poor hoof growth, decreased physical endurance, infertility, and decreased milk and egg production.

Mineral deficiencies in animals can cause a wide range of problems from rickets and deformed bones (lack of calcium) to joint stiffness (lack of potassium). The mineral that is deficient determines the type of problem.

Like mineral deficiencies, vitamin deficiencies in animals can cause a wide range of problems, as well. They can result in vision problems (lack of vitamin A) to bone weakness (lack of vitamin D). The vitamin that is deficient determines the type of problem.

Mineral Deficiencies

- Abnormal bone growth
- Anemia
- Decreased growth
- Decreased milk or wool production
- Deformed bones
- Enlarged thyroid gland
- Heart failure
- Lameness
- Loss of hair
- Milk fever
- Paralysis
- Poor feed efficiency
- Poor hair coat
- Reduced feed intake
- Reproductive problems
- Rickets
- Skin disorders
- Stiffness in the joints
- Unthrifty appearance
- Weakening of the bones

Vitamin Deficiencies

- Abnormal bone growth
- Decreased milk production
- Decreased appetite
- Diarrhea
- Digestive disturbances
- Excessive watering of the eyes
- Impaired vision
- Increased susceptibility to infections
- Loss of hair
- Poor blood clotting
- Poor coordination
- Poor growth
- Poor hair coat
- Poor hoof growth
- Reproductive problems
- Respiratory illness
- Rickets
- Scurvy
- Unthrifty appearance
- Weakness

Knowledge Check

1. Which type of animal requires nutrients only for maintenance?
2. What makes up nearly half of an animal’s body?
3. Name and describe the six classes of nutrients.
4. What are some signs of carbohydrate deficiency?
Feed Additives

Agricultural producers must be efficient and produce a marketable product while maintaining costs. One method agricultural producers use to help them achieve these goals is the use of feed additives. Feed additives are added to an animal’s feed for growth acceleration, increased feed efficiency, increased production of animal products, or health maintenance improvement. Feed additives are not usually considered a nutrient source.

Two major categories of feed additives are growth regulators and antibiotics. Growth regulators are hormones that increase growth rates and feed efficiency. Antibiotics are used as a feed additive for the prevention and treatment of diseases and infections such as scours, coccidiosis, and foot rot. Antibiotics may be used at low levels to improve efficiency and growth.

Feed additives are also used for other purposes. Anthelmintics, also known as dewormers, are used to control various types of worms. Other uses of feed additives include bloat control in ruminant animals, stress reduction by adding tranquilizers, pH level regulation, and fly control.

Feed additives are regulated by the Food and Drug Administration (FDA) if they are medicated or by the Environmental Protection Agency (EPA) if they are pesticides. Feed additives only should be used according to label directions. Both the FDA and EPA are federal regulatory agencies.

Controversy surrounds the use of feed additives, and there is consumer concern about feed additives remaining in consumer products. In some cases, the feed additives are removed before the animals are marketed. Some agricultural producers market their products as not containing any feed additives.

“Which is better to feed cattle? Grass hay or alfalfa hay?”

The answer is, “It depends.” Cattle that eat alfalfa should gain more weight than ones that consume grass. Also, cattle will usually find alfalfa more palatable than grass hay. However, alfalfa hay will almost always contain more crude protein than grass hay. Thus, if you feed alfalfa exclusively to mature cows, you could theoretically feed them too much protein. Alfalfa is higher in digestible energy than is grass hay, but the fiber of grass hay is more digestible than is the fiber of most legumes. Good quality grass hay is usually much less expensive than good quality alfalfa hay. Therefore, if feeding young calves or mature beef cows that are in good body condition and don’t need the additional protein, grass hay will not only be more cost effective, it should provide adequate nutrition.
Producers must balance rations to be efficient and ensure an animal receives the proper nutrients. There are various methods of balancing rations such as using computer software or hand calculations. Regardless of the method used, one must know the animal’s nutritional needs and the nutrient analyses of the feed to determine a balanced ration. One of the most common methods of balancing rations is by using the Pearson Square. The Pearson Square method can be used to determine the portions of two feedstuffs required to obtain a desired nutrient composition for a ration. Only two components can be used in the Pearson Square, although the components can be a mixture.

### Pearson Square Steps

**Step 1.** Write the number in the middle of the square that represents the nutritional requirement of the animal. The nutritional requirement for the animal may be crude protein or TDN, amino acids, vitamins, or minerals. For this example, crude protein (CP) is being calculated.

**Step 2.** Write the two numbers on the left that represent the feedstuffs (ingredients) used to make the ration. The number in the middle of the square must fall between the numbers on the left.

**Step 3.** Subtract the nutrient value on the left from the nutritional requirement in the middle disregarding any negative.

**Step 4.** Add the feedstuff parts together.

**Step 5.** Divide the ingredient for which you want to know the ration by the total parts. Multiply by 100 to determine the percentage. Round if necessary.

**Step 6.** To determine the amount of each feed ingredient, multiply the percentage of each ingredient by the total amount of feed desired. In this example, 1 ton (2,000 lbs.) of feed is needed.
Animal Digestive Systems

The digestive systems of animals are divided into two main categories: ruminants and monogastrics. The digestive process of ruminants and monogastrics differs. **Ruminants** are animals that have stomachs with more than one compartment. The main components of the digestive system of ruminants are the rumen, reticulum, omasum, and abomasum. The large compartment is the rumen. Because the rumen can store large quantities of roughages, ruminants have a greater ability to process and utilize large quantities of bulky roughages. Examples of ruminants are cattle, sheep, and goats.

**Monogastrics**, also known as nonruminants, are animals with relatively small, simple, one-compartment stomachs containing limited microorganisms. Nonruminants are better adapted to processing and utilizing concentrated feeds such as grains. Examples of monogastrics are pigs, chickens, turkeys and horses.

**Ruminants**

The first step in the digestive process occurs when feed is taken into the mouth and chewed just enough to make swallowing possible. The feed then moves down the esophagus to the rumen, where it is acted on by millions of microorganisms. A portion of this feed, in the form of a bolus (cud), is forced from the rumen back into the mouth where it is rechewed and reswallowed. The feed then returns to the rumen and reticulum for further storage and action by microorganisms. The feed then moves to the omasum, where water is squeezed from the food and then on to the abomasum (true stomach) where it is mixed with digestive juices. From the abomasum, feed moves to the small intestine where the digestible portion of the feed is absorbed. The undigestible portion of the feed moves on to the large intestine and is formed into feces. The feces is stored in the rectum and expelled through the anus.

**Monogastrics**

The digestive system of monogastrics can be divided into several subdivisions. Some have a functional cecum which increases the animal’s ability to digest roughage in feeds. Examples of monogastrics with a functional cecum include horses, rabbits, guinea pigs, and hamsters. Others have a nonfunctional cecum in which the cecum is relatively small and has little function, limiting the animal’s ability to digest roughage in feeds. Examples of nonruminants with a nonfunctional cecum include pigs, dogs, and humans. Another subdivision of nonruminants is the avian digestive system. Avians have a digestive system where special organs (crop, gizzard) soften, crush, and grind feed. Examples of avians include chickens and turkeys (poultry).
of feed moves into the large intestine, where water is absorbed and the rest of the feed is formed into feces. The feces is stored in the rectum until it is expelled through the anus.

The digestive process of the avian system begins when feed is taken into the mouth. The feed immediately moves down the esophagus to the crop where it is stored and soaked. The feed then moves to the proventriculus (true stomach) where it is mixed with digestive juices. From the proventriculus the feed moves to the gizzard where it is crushed and ground. Then the feed moves through the small intestine, ceca, and large intestine where it is absorbed or formed into feces. The feces is expelled through the vent.

“Blister Beetles in Alfalfa”

Blister beetles are small bugs that can cause big problems for horses. Blister beetles are highly poisonous to livestock. If the beetles are present in a hay field at harvesting time, they can be trapped and crushed in the hay during baling.

Horses and other animals can become deathly ill if they consume the beetles in the hay. To be safe, buy hay from the season’s first cutting, because it is much less likely to be infested.

Knowledge Check

1. Describe the two major categories of feed additives.
2. Who regulates animal feed additives?
3. What is the Pearson Square?
4. Determine the amount of 45% CP soybean meal and 10% CP corn needed in a 100 lb. bag to obtain a total of 20% CP.
5. What is the first step to digestion for ruminants and monogastrics?
Unit Summary

Animal nutrition is important for the health and productivity of agricultural animals. Providing proper nutrition is much more than purchasing a bag of feed or putting animals on pasture. The producer should be knowledgeable about the basics of animal physiology. Just as the human body is made up of systems, animals have systems as well. Each of these systems plays a vital role in animal health.

Nutrients are important to animals so all systems function properly. Animals need varying nutrients according to factors such as age, pregnancy, and use. The six major classes of nutrients include water, protein, carbohydrates, fats, minerals, and vitamins. Nutrient deficiencies can cause health problems in animals, leading to death. In addition, an excess of nutrients, such as minerals, can also cause health problems. Feed additives are used to improve performance in an area and are generally not considered a nutrient source. The major types of feed additives are growth regulators and antibiotics.

Producers must provide animals with balanced rations. One method of balancing rations is the Pearson Square. The producer should also have an understanding of the digestive systems of animals. The digestive systems of animals are divided into two main categories: ruminants and monogastrics. The digestive process for each differs. Understanding the nutritional needs of an animal, as well as how the digestive system works, will enable the producer to provide a balanced ration that meets the animal’s needs.

REVIEW

1. Why is proper nutrition needed for animals?
2. Explain why it is important to study digestion.
3. Name the systems of the body.
4. What system pumps blood throughout the body?
5. Which system consists of the kidneys and bladder?
6. Describe how the nutrition of a pregnant animal and a young animal differs.
7. What are the six major classes of nutrients?
8. What do carbohydrates do for the body?
9. Explain the difference between macrominerals and microminerals?
10. Describe the symptoms of nutrient deficiency.
11. Why are feed additives used?
12. How are the two categories of feed additives different?
13. What method is used to balance feed rations?
14. Describe how the Pearson square is used.
15. Explain the differences between a ruminant and non-ruminant.
16. Name three ruminant and three non-ruminant animals.