

# Lecture 1

## INTRODUCTION

### The Ruminant Animal

Ruminants are characterized by their four stomach chamber and "cud-chewing" behaviour. The cud is a food bolus that has been regurgitated. There are about 150 different ruminant species including cows, goats, deer, buffalo, bison, giraffe, moose, and elk. Ruminant species can further be classified as grazers, browsers, or intermediates. Grazers, such as sheep, cattle, and buffalo consume mostly lower quality grasses while browsers such as moose and mule deer stay in the woods and eat highly nutritious twigs and shrubs. Intermediates, such as goats and white-tailed deer have nutritional requirements midway between grazers and browsers.

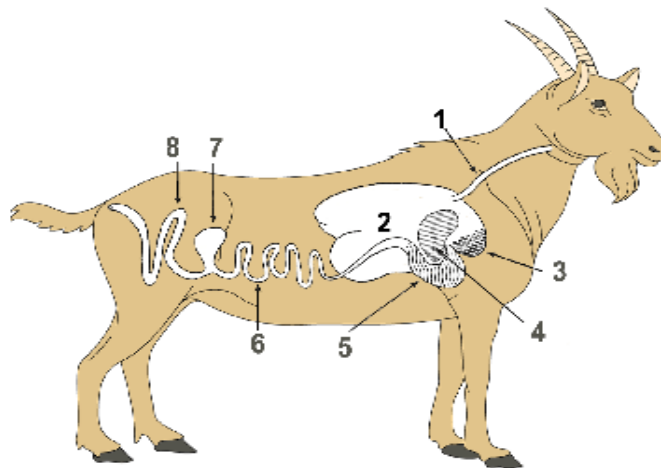
The primary difference between ruminants and simple-stomached animals, like dogs or pigs, is the presence of a four-compartment stomach that includes the rumen, reticulum, omasum, and abomasum. Llamas and alpacas are "pseudo-ruminants" because they have a three-compartment stomach instead of four like ruminants. Horses are also not ruminants; however they have a "caecum" that performs a similar function as the cow or sheep's rumen.

### The Ruminant Digestive System

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

The digestive tract of goats.

1. Oesophagus
2. Rumen
3. Reticulum
4. Omasum
5. Abomasum
6. Small Intestine
7. Cecum
8. Large Intestine



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

The **rumen** also called the paunch occupies a large percentage of the abdominal cavity of the ruminant animal. It is a large storage space for food that is quickly consumed, then later regurgitated, re-chewed, and re-swallowed in a process called cud-chewing. Rumination or cud-chewing occurs predominantly when the animal is resting and not eating. Microbial digestion in the rumen is the basic reason why ruminant animals effectively utilize fibrous feeds and are maintained primarily on roughages. Rumen microorganisms also convert components of the feed to useful products such as the essential amino acids, the B complex vitamins, and vitamin K. Finally, the microorganisms themselves are digested farther in the digestive tract. Healthy mature sheep will chew their cud for several hours each day. The capacity of the rumen of sheep and goats ranges from 12-24 litres depending on the type of feed.

The rumen is also a large fermentation vat. It contains billions of micro-organisms, including bacteria and protozoa, which allow ruminants to digest fibrous feeds such as grass, hay, and silage that other animals cannot efficiently utilize. Fermentation in the rumen produces enormous quantities of gas that ruminants must get rid of by belching. Anything that interferes with belching is life threatening to the ruminant and may result in a condition called "bloat." Mild cases of bloat can be treated with an antacid.

The **reticulum** also referred to as the honeycomb is closely associated with the rumen. Contents mix continually between both sections. It looks like a "honey comb. This compartment is located just below the entrance of the esophagus into the stomach. The reticulum is part of the rumen separated only by an overflow connection, the rumino-reticular fold. The capacity of the reticulum ranges from 1-2 litres.

The **omasum** also called many-piles consists of many folds or layers of tissue that grind up feed ingesta and remove some of the water from the feed. The capacity of the omasum of goats is approximately 1 litre.

The **abomasum** is the "true stomach" of the ruminant. It is similar in function to the stomach of a non-ruminant: secretion of enzymes and acids to breakdown nutrients before they enter the small intestine. The capacity of the abomasum of goats and sheep is approximately 4 litres.

As partially digested feed enters the **small intestine**, enzymes produced and secreted by the pancreas and small intestinal mucosa further breakdown feed nutrients into simple compounds that are absorbed into the bloodstream. Undigested feed and unabsorbed nutrients leaving the small intestine pass into the large intestine.

The functions of the **large intestine** include absorption of water and further digestion of feed materials by the microorganisms present in this area. The 100-foot-long intestinal canal of sheep has a capacity to hold 12 litres.

When a goat lamb is born, the rumen is small and the abomasum is the largest of the four stomach compartments. The rumen of a goat kid represents about 30 percent of the total stomach area, while the abomasum represents about 70 percent. Hence, digestion in the lamb is like that of a monogastric animal. In the suckling lamb, closure of the esophageal groove ensures that milk is channeled directly to the abomasum, instead of entering the rumen, reticulum, and omasum. When the suckling goat kid starts to eat vegetation (first or second week of life), the rumen, reticulum, and omasum gradually develop in size and function. The lamb's rumen and reticulum are usually functional by the time it is 50 to 60 days old.