

Ruminant Digestion

Ruminants eat rapidly, swallowing much of their feedstuffs without chewing it sufficiently (< 1.5 inches). The esophagus functions bi-directionally in ruminants, allowing them to regurgitate their cud for further chewing, if necessary. The process of rumination or “chewing the cud” is where forage and other feedstuffs are forced back to the mouth for further chewing and mixing with saliva. This cud is then swallowed again and passed into the reticulum. Then the solid portion slowly moves into the rumen for fermentation, while most of the liquid portion rapidly moves from the reticulorumen into the omasum and then abomasum. The solid portion left behind in the rumen typically remains for up to 48 hours and forms a dense mat in the rumen, where microbes can use the fibrous feedstuffs to make precursors for energy.

True ruminants, such as cattle, sheep, goats, deer, and antelope, have one stomach with four compartments: the rumen, reticulum, omasum, and abomasums. The ruminant stomach occupies almost 75 percent of the abdominal cavity, filling nearly all of the left side and extending significantly into the right side. The relative size of the four compartments is as follows: the rumen and reticulum comprise 84 percent of the volume of the total stomach, the omasum 12 percent, and the abomasum 4 percent. The rumen is the largest stomach compartment, holding up to 40 gallons in a mature cow.

The reticulum holds approximately 5 gallons in the mature cow. Typically, the rumen and reticulum are considered one organ because they have similar functions and are separated only by a small muscular fold of tissue. They are collectively referred to as the reticulorumen. The omasum and abomasum hold up to 15 and 7 gallons, respectively, in the mature cow.

The reticulorumen is home to a population of microorganisms (microbes or “rumen bugs”) that include bacteria, protozoa, and fungi. These microbes ferment and break down plant cell walls into their carbohydrate fractions and produce volatile fatty acids (VFAs), such as acetate (used for fat synthesis), propionate (used for glucose synthesis), and butyrate from these carbohydrates. The animal later uses these VFAs for energy.

The reticulum is called the “honeycomb” because of the honeycomb appearance of its lining. It sits underneath and toward the front of the rumen, lying against the diaphragm. Ingesta flow freely between the reticulum and rumen. The main function of the reticulum is to collect smaller digesta particles and move them into the omasum, while the larger particles remain in the rumen for further digestion.

The reticulum also traps and collects heavy/dense objects the animal consumes. When a ruminant consumes a nail, wire, or other sharp heavy object, it is very likely the object will be caught in the reticulum. During normal digestive tract contractions, this object can penetrate the reticulum wall and make its way to the heart, where it can lead to hardware disease. The reticulum is sometimes referred to as the “hardware stomach.” Hardware disease is discussed in detail in Mississippi State University Extension Service Publication 2519, “Beef Cattle Nutritional Disorders.”

The rumen is sometimes called the “paunch.” It is lined with papillae for nutrient absorption and divided by muscular pillars into the dorsal, ventral, caudodorsal, and caudoventral sacs. The rumen acts as a fermentation vat by hosting microbial fermentation. About 50 to 65 percent of starch and soluble sugar consumed is digested in the rumen. Rumen microorganisms (primarily bacteria) digest cellulose from plant cell walls, digest complex starch, synthesize protein from nonprotein nitrogen, and synthesize B

vitamins and vitamin K. Rumen pH typically ranges from 6.5 to 6.8. The rumen environment is anaerobic (without oxygen). Gases produced in the rumen include carbon dioxide, methane, and hydrogen sulfide. The gas fraction rises to the top of the rumen above the liquid fraction.

The omasum is spherical and connected to the reticulum by a short tunnel. It is called the “many piles” or the “butcher’s bible” in reference to the many folds or leaves that resemble pages of a book. These folds increase the surface area, which increases the area that absorbs nutrients from feed and water. Water absorption occurs in the omasum. Cattle have a highly developed, large omasum.

The abomasum is the “true stomach” of a ruminant. It is the compartment that is most similar to a stomach in a nonruminant. The abomasum produces hydrochloric acid and digestive enzymes, such as pepsin (breaks down proteins), and receives digestive enzymes secreted from the pancreas, such as pancreatic lipase (breaks down fats). These secretions help prepare proteins for absorption in the intestines. The pH in the abomasum generally ranges from 3.5 to 4.0. The chief cells in the abomasum secrete mucous to protect the abomasal wall from acid damage.

<http://www.thebeefsite.com/articles/2095/understanding-the-ruminant-animals-digestive-system>