

# Digestive System Physiology

**U**NDERSTANDING the chemical and physical changes that occur during the digestive process leads to more efficient livestock feeding. Although there are four types of digestive systems, the digestive systems of most livestock are very similar in terms of the organs they contain.



## Objective:



Describe the functions of the major parts of the digestive system.

## Key Terms:



amylase

anus

bile

cecum

chyme

duodenum

enzymes

feces

ileum

jejunum

lactase

large intestine

lipase

maltase

mastication

peristalsis

pepsin

salivary glands

stomach

sucrase

trypsin

## Major Parts of the Digestive System

Digestion includes physical and chemical action that breaks food down into simple substances that can be absorbed by the body. The digestive system is made up of a number of organs. The system begins at the mouth, where food enters the body, and ends at the anus, where undigested material exits the body. The basic digestive system consists of the following: mouth, salivary glands, esophagus, stomach, small intestine, liver, pancreas, cecum, large intestine, and anus.

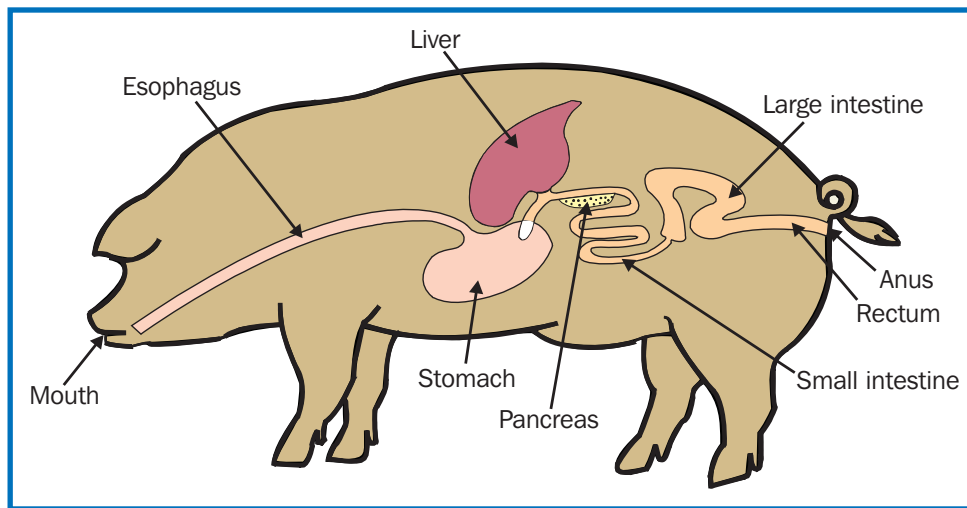


FIGURE 1. Some of the basic components of a hog's digestive system.

## MOUTH, SALIVARY GLANDS, AND ESOPHAGUS

Food enters the digestive system through the mouth, where partial digestion occurs. The mouth is the place of **mastication**, or chewing. The chewing action of the mouth and teeth breaks, cuts, and tears up the feed. This reduces food particle size and increases the surface area of food particles, aiding in swallowing and the remaining digestive process.

The **salivary glands** secrete saliva to moisten feed so that it can be swallowed. Saliva also begins the breakdown of simple carbohydrates. Saliva contains the salivary amylase and salivary maltase enzymes. **Enzymes** are organic catalysts that speed up chemical reactions in the body without being altered by the reactions. Salivary amylase changes starch to maltose, or malt sugar. Salivary maltase changes maltose to glucose. Food moves from the mouth to the stomach via the esophagus. Food moves through the esophagus by involuntary smooth muscle contractions called **peristalsis**.

## STOMACH

The **stomach** is a muscular organ that stores food and moves it to the small intestine. Its primary function is to advance the breakdown of food by mixing it with hydrochloric acid (HCl) and other enzymes. When feed enters the stomach of a monogastric animal or the abomasum of a ruminant, gastric juices begin to flow.

The fluid comes from glands in the wall of the stomach. The juices contain from 0.2 to 0.5 percent hydrochloric acid and the enzymes pepsin, rennin, and gastric lipase. Hydrochloric acid breaks proteins down into shorter chains of amino acids. To prevent infections of the lower digestive tract, the HCl creates a low pH in the stomach, which kills any bacteria ingested with the feed. **Pepsin** breaks the proteins in the feed into polypeptides.

The actions that occur in the stomach result in a partially digested material called **chyme**. The muscular walls of the stomach churn and squeeze the stomach's contents, and the chyme

is pushed into the small intestine. The chyme is an acidic, semifluid, gray, pulpy mass. The gastric juices then act on the solids that remain in the stomach.

## SMALL INTESTINE, LIVER, AND PANCREAS

The small intestine is composed of three parts: the duodenum, the jejunum, and the ileum. The **duodenum** is the first segment of the small intestine and is where most digestion occurs in a monogastric animal. The **jejunum** is the second segment of the small intestine and is where nutrient absorption begins. The **ileum** is the third segment of the small intestine and is where most nutrient absorption occurs.

In the small intestine, the chyme is mixed with three digestive juices: pancreatic juice, bile, and intestinal juice.

The pancreatic juice is produced by the pancreas and is secreted into the duodenum. The pancreatic juice includes the enzymes trypsin, amylase, and lipase. **Trypsin** breaks down proteins and polypeptides to reduce them to small peptides. The peptides are then broken down by chymotrypsin to produce amino acids. **Amylase** changes starch into disaccharides. The disaccharides are maltose, lactose, and sucrose. **Lipase**, along with bile, breaks up fat molecules into a form that can be absorbed. Lipase changes fat molecules into fatty acids and glycerol.

**Bile** is a yellowish-green, alkaline, bitter liquid produced in the liver. Bile is stored in the gall bladder in every animal except the horse and is secreted as necessary into the duodenum.

Glands in the walls of the small intestine produce intestinal juice. This fluid contains peptidase, maltase, lactase, and sucrase, which are all enzymes used in digestion. Peptidase breaks down peptides into amino acids. Maltase, lactase, and sucrase break down disaccharides into monosaccharides, or simple sugars. The monosaccharides are glucose, galactose, and fructose. **Maltase** converts maltose into two molecules of glucose. **Lactase** converts lactose into one molecule of glucose and one molecule of galactose. **Sucrase** converts sucrose into one molecule of glucose and one molecule of fructose.



### FURTHER EXPLORATION...

#### ONLINE CONNECTION: Colic in Horses

The cecum in a horse is odd in design because its entrance and exit are both at the top of the organ. Feed enters and exits at the top of the cecum. This could cause problems if an animal eats a lot of dry feeds without adequate water or if a rapid change of diet occurs. Either may cause a compaction in the lower end of the cecum, in turn producing pain or colic. Colic is a serious condition in horses. In fact, it is the number one killer of horses.

Visit the links below to understand the causes of colic, to learn how to prevent colic, to recognize the signs of colic, and to learn how to treat colic.

[http://www.yourhorseshealth.com/health\\_care/colic.html](http://www.yourhorseshealth.com/health_care/colic.html)

[http://equestrian.com/horses\\_care/health/illnesses\\_injuries/colic905/](http://equestrian.com/horses_care/health/illnesses_injuries/colic905/)

## CECUM

The **cecum**, or “blind gut,” is found where the small intestine joins the large intestine. It is a small organ and has little function in some animals. In the horse, the cecum can be 4 feet long and 1 foot in diameter and can hold 25 to 30 liters. In a pseudo-ruminant, feed is fermented and digested by bacterial action in the cecum. Nutrient absorption also occurs in the cecum. In a nonruminant animal, the cecum and the colon are extremely large and provide areas for microbial digestion of fiber.

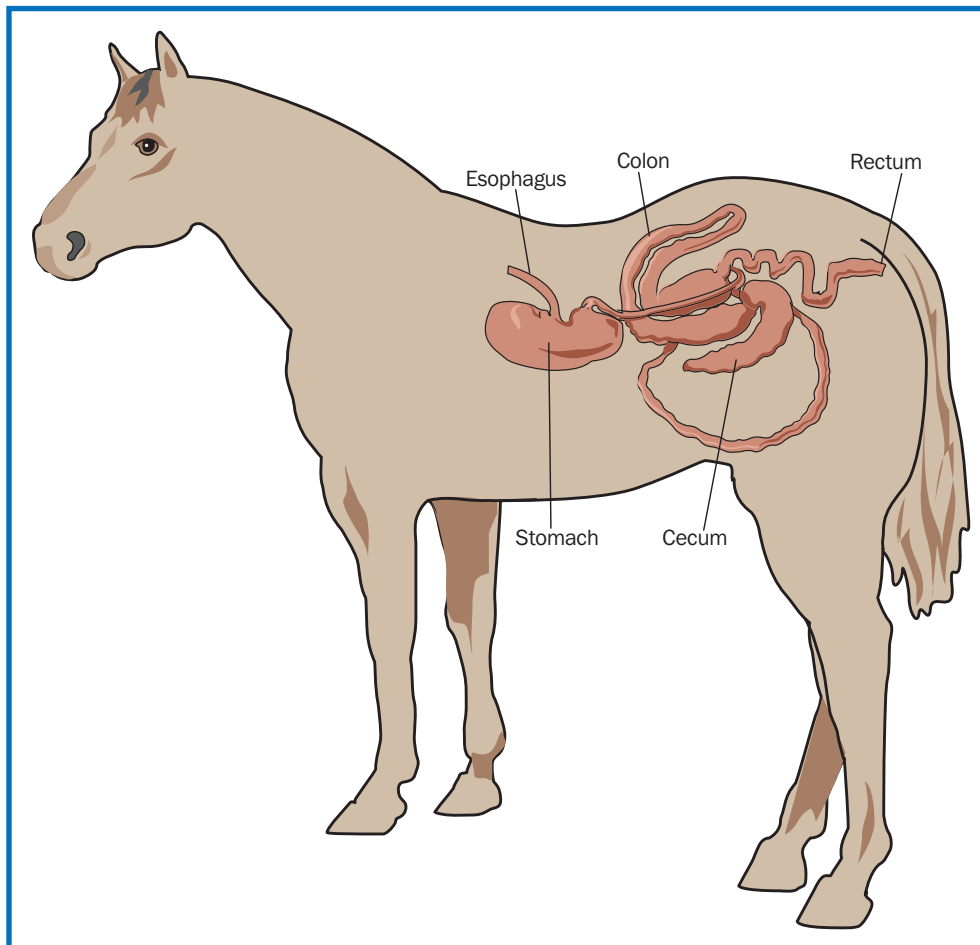


FIGURE 2. In a horse's digestive system, the cecum can hold up to 30 liters.

## LARGE INTESTINE AND ANUS

Feed not digested in the small intestine moves to the large intestine. The **large intestine** stores indigestible feed, forms feces, and absorbs water. The main function of this organ is to absorb water. Feed materials not digested or absorbed are called **feces**. These materials are moved through the large intestine by muscles in the intestinal walls. Feces are passed through the rectum and out the body through the **anus**, the opening at the end of the large intestine.

## Summary:



The basic digestive system consists of the following: mouth, salivary glands, esophagus, stomach, small intestine, liver, pancreas, cecum, large intestine, and anus. The mouth is the place of mastication and is where food particle size decreases. Food moves from the mouth to the stomach via the esophagus. The stomach stores and breaks down food material and moves it to the small intestine. The small intestine is composed of the duodenum, the jejunum, and the ileum. The small intestine is where most digestion occurs. Feed then moves to the cecum or large intestine. The cecum is very important to pseudo-ruminants, as it is the location for microbial digestion of fiber. The large intestine stores indigestible feed, forms feces, and absorbs water.

## Checking Your Knowledge:



1. Define *peristalsis*.
2. What are the two functions of hydrochloric acid in the stomach?
3. List the three parts of the small intestine.
4. Name the three disaccharides.
5. What is the function of lipase?
6. What is the role of the pancreas in the digestive process?
7. Name the three monosaccharides.
8. Name two functions of saliva.
9. What role does the liver have in the digestive process?
10. What is the function of peptidase?

## Expanding Your Knowledge:



Interview a local horse owner or veterinarian and discuss the function of the cecum in the digestive system of a horse. Discuss colic and determine the causes, preventive measures, signs, and treatment.

## Web Links:



### ***The Merck Veterinary Manual***

<http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/20100.htm>

### **The Horse's Digestive System**

[http://ohioline.osu.edu/b762/b762\\_5.html](http://ohioline.osu.edu/b762/b762_5.html)

### **Agricultural Career Profiles**

<http://www.myaert.com/career-profiles>