

The digestive system of the horse is different from that of the other farm animals. Although the horse has a single compartment stomach like man, the pig, and the dog, the horse can utilize roughages like the cow which is a ruminant. This is possible because the horse has a special type of intestine.

The digestive system is composed of the alimentary canal and its accessory organs. The alimentary canal is a hollow tube which extends from the mouth to the anus and has the following parts: mouth, pharynx, esophagus, stomach, small intestine, large intestine, and anus. Teeth, tongue, salivary glands, liver, and pancreas are the accessory organs.

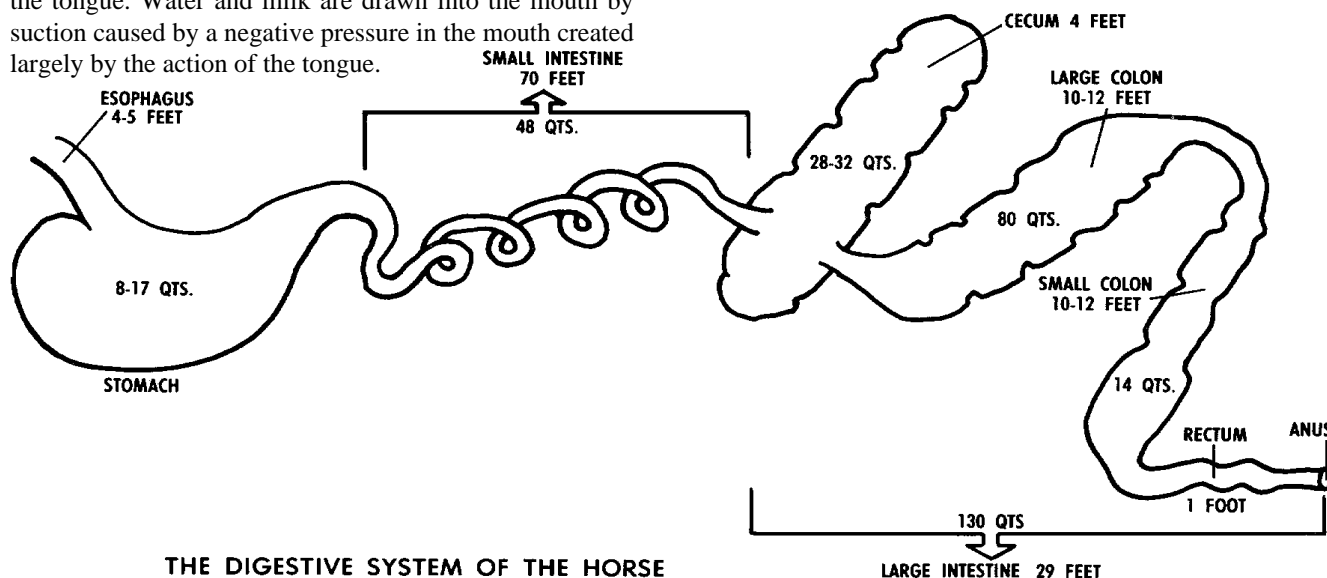
Digestion is the process of preparation of food for absorption from the alimentary canal into the blood stream and elimination of the unabsorbed residue from the body. The digestive process includes the combined effects of mechanical, secretory, chemical, and microbiological factors. The mechanical factors are chewing (mastication), swallowing (deglutition), movements of stomach and intestines, and elimination of residue (defecation). The digestive glands secrete digestive juices. Bacteria and possibly protozoa are the microbial influences. Understanding the structure (anatomy) and function (physiology) of the unusual digestive system of your horse helps you appreciate proper feeding of your horse.

## MOUTH

The mouth is the first part of the tract, and the first act of digestion is grasping of food (prehension) to convey it into the mouth. The horse's upper lip is the main structure in grasping food because it is sensitive, strong, and mobile. In grazing the action of the lip places the grass between the front (incisor) teeth which cut the grass off. In manger feeding, the loose food is collected by the lip with the aid of the tongue. Water and milk are drawn into the mouth by suction caused by a negative pressure in the mouth created largely by the action of the tongue.

Mastication (chewing) is the mechanical reduction of food into finely divided particles which provide a greater surface area for the action of digestive juices. Mastication also mixes the food with saliva which moistens the food thus facilitating chewing and swallowing. This is especially helpful with dry foods such as hays. Saliva is a secretion from 3 sets of paired glands (parotid, submaxillary, and sublingual) and other small glands found in the mouth. Water makes up 99% of the horse's saliva with the other 1% composed of inorganic salts (ions), and proteins. There are no enzymes in the saliva of the horse. The secretion of saliva in the horse is stimulated by the scratching (mechanical action) of food on the mucous membrane of the inner cheeks. It has been estimated that a horse will secrete about 10 gallons of saliva in 24 hours. Hay will absorb 4 times its weight of saliva while oats will absorb about its own weight: 6 lbs. hay + saliva = 30 lbs.; 6 lbs. oats + saliva = 12 lbs.

The horse is well equipped for chewing tough, coarse feeds with a set of 40 upper and lower teeth in the male: 12 incisors or front, 4 canines, and 24 premolars and molars or cheek teeth. Mares have 36 teeth since they usually do not have canine teeth which in the male are located in the space between the incisors and premolars. Jaw movement is vertical (up and down) and lateral (side to side). Because of this, the upper jaw is wider than the lower; therefore, mastication can occur on only one side of the mouth at a time. The cheek teeth wear sharp edges on the inside of the lower teeth and on the outside of the upper teeth because of the lateral movement. These sharp edges cause damage to the tongue and cheek resulting in the horse eating slowly and wasting feed. Floating the teeth will remove these sharp edges. An annual check-up will prevent this and other dental problems. The lower incisors serve another useful function - the detection of age. (see section 4)



THE DIGESTIVE SYSTEM OF THE HORSE

The horse is a relatively slow eater and chews food thoroughly requiring 15-20 minutes to eat a pound of hay and 5-10 minutes to eat a pound of grain.

Deglutition (swallowing) is the complex act, involving a number of muscles and nerves, of conveying food from the mouth through the pharynx and esophagus to the stomach.

## PHARYNX

The pharynx is a 6-inch muscular, funnel-shaped sac belonging to the digestive and respiratory tracts whose passages cross in this region. Food must move through the pharynx quickly so that it will not enter the larynx (windpipe) or be forced into the nasal passages. Once food and water enter the pharynx, it cannot return to the mouth due to the blocking action of the soft palate. Horses for this same reason cannot breathe through the mouth.

## ESOPHAGUS

The esophagus is a muscular tube about 50 to 60 inches in length which extends from the pharynx down the left side of the neck to the stomach. Solid and semisolid food moves down the esophagus by wave-like contractions (peristalsis), while liquids are squirted down. These movements can be seen by observing a horse eating and drinking. Choke can occur in horses when food, especially dry grain, and other materials become lodged in the esophagus. Food and water will be observed returning through the nostrils. Peristalsis is a one-way action in the horse from the pharynx to the stomach; because of this, it is very difficult for the horse to vomit. The act of vomiting usually results in the rupture of the stomach or pneumonia from the vomited material being forced into the larynx then to the lungs.

## STOMACH

The opening of the esophagus into the stomach, the cardia, is closed by a powerful involuntary ring-like muscle (sphincter). This also reduces the occurrence of vomiting since it is very difficult for material to pass from the stomach back into the esophagus. The horse has the smallest stomach compared with other farm animals. With only a capacity of 8 to 17 quarts, the horse should be fed portions of the daily ration 2 or 3 times daily rather than one large feeding.

Several types of glands and specialized cells are found in the stomach walls. Gastric juice and mucous secretions are produced by these specialized glands and cells. Gastric juice contains hydrochloric acid (HCl) and two enzymes, pepsin and gastric lipase. Pepsin is the enzyme which helps digest proteins. Gastric lipase helps digest fats into constituent fatty acids and glycerol; however, fat digestion is mainly by pancreatic lipase in the small intestine.

Hydrochloric acid (HCl) activates pepsin and cooperates with pepsin in the breakdown of protein. The rate of secretion of gastric juices is a continuous process with the rate increasing when food is eaten.

In the horse's stomach food has a tendency to arrange itself in layers. The first food passes into the bottom region of the stomach with subsequent food lying on or around the first food to form layers. The partially digested food does not leave the stomach until it has reached two-thirds of its capacity. Excess food consumed beyond the capacity of the stomach along with partially digested food pass on into the intestine. The emptying of the stomach is a continuous process during digestion. It requires a 24 hour fast to completely empty a horse's stomach. Stomach movement due to muscular contraction mixes the food with gastric juices and passes the ingesta into the duodenum.

When to water a horse has always been an important question. It has long been recommended never to water a horse during or immediately following eating because the water will wash food out of the stomach. This is not true. Drinking during or following a meal has no harmful effect on digestion since most of the water passes directly from the esophageal opening to the intestine opening which are located quite close together due to the U-shaped form of the stomach.

Horses are prone to digestive disorders originating in the stomach. Feeding ground grains which are easily packed into a doughy mass, sudden changes in feeding, failure to reduce the grain ration during idle periods, and ingestion of excessive amounts of water are a few causes of stomach disorders.

## SMALL INTESTINE

The small intestine is 70 feet in length and 3 to 4 inches in diameter; it extends from the stomach to the large intestine; it has three parts - the duodenum, jejunum, and ileum. The capacity of the small intestine is 48 quarts. The material leaving the stomach and entering the small intestine is known as chyme, and it is a fluid or semi-fluid. Two main types of factors influencing digestion in the small intestine are movements of the intestinal wall and secretions from the pancreas (pancreatic juice), the liver (bile), and the intestinal glands (intestinal juice).

The pancreatic juice is produced by the pancreas gland and contains several enzymes. Trypsin (activated trypsinogen) converts proteins and partly hydrolyzed proteins into peptides and amino acids. Pancreatic lipase hydrolyzes fats to fatty acids and glycerol, and pancreatic amylase which breaks down starch to maltose. Bile, a secretion from the liver, activates pancreatic lipase, assists in fat emulsification, and aids in absorption of fatty acids. The bile duct and pancreatic duct empty into the 3 to 4 feet long duodenum about 5 to 6 inch from the pylorus, the stomach opening into the intestine. In

other farm animals, bile is temporarily stored in a gallbladder. The horse does not have a gallbladder; there is a direct secretion of bile into the small intestine from the liver.

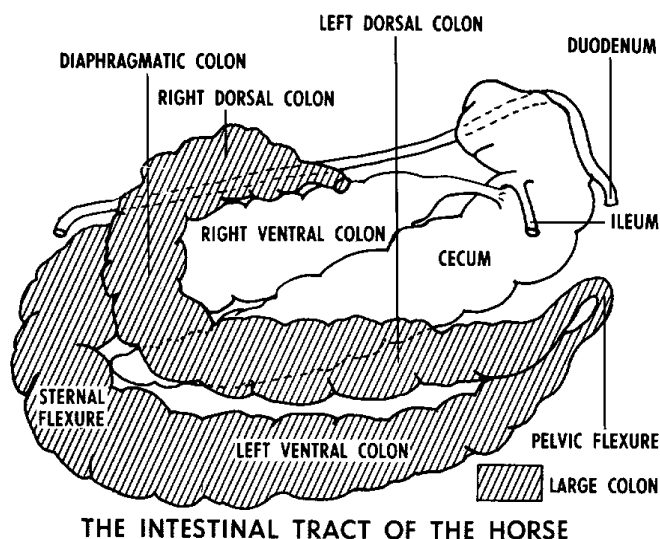
Simple tubular glands are found throughout the small and large intestine which secrete the sugar digesting enzymes - maltase, sucrase, and lactase. Each of these enzymes attacks the individual sugar with the name similar to its own (maltose, sucrose, and lactose). The enzyme breaks the sugar into glucose which can be absorbed. These simple tubular glands also secrete a lipase similar to pancreatic lipase.

Absorption of many nutrients (Amino acids, sugars, fatty acids, minerals, and vitamins) occurs in the small intestine which is well equipped with small projections called villi. Villi increase the surface area which enhances absorption. Intestinal movements mix the ingesta with the digestive secretions, enhance absorption, move the material through the intestines, expel the residues, and assist in the flow of blood and lymph through the vessels of the intestinal wall.

The great length of the small intestine leads to many problems such as twisted or telescoped intestine.

## LARGE INTESTINE

Material which is not or cannot be digested in the small intestine passes into the large intestine which is divided into the cecum, large colon, small colon, rectum, and terminates at the anus. The important digestive action of the cecum and colon is due to the presence of bacteria and possibly protozoa (one celled animals) which (1) digest cellulose, the fibrous part of roughages, and other carbohydrates such as starch and sugars to produce energy yielding volatile fatty acids; (2) synthesize B-vitamins; and (3) synthesize amino acids. Absorption of volatile fatty acids apparently occurs in the colon.



B vitamins are definitely synthesized by the bacteria of the large intestine; however, in certain situations the absorption of most of them may not be adequate to meet the need of the horse. On normal diets, B vitamin deficiency does not occur in the horse so adequate quantities of B vitamins are available either (1) in the feed (diet) or (2) by bacterial synthesis.

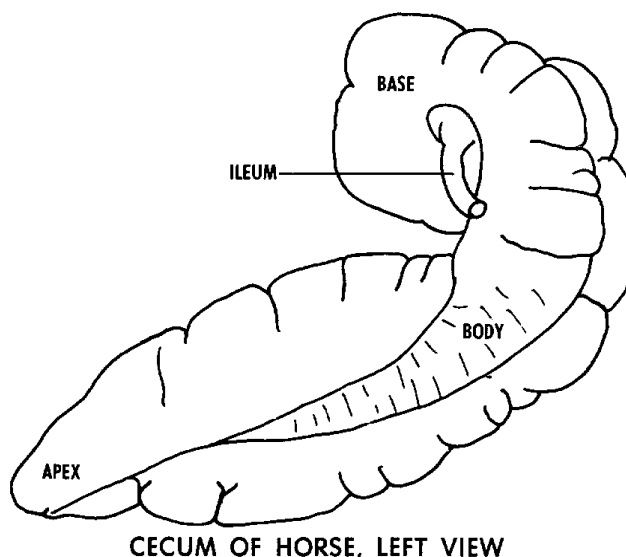
**CECUM.** The cecum, blind gut, lies between the small intestine and large colon. Its average length is 4 feet with a capacity of 28 to 32 quarts. It extends into the right flank. The presence of food in the stomach causes an emptying of the cecum into the large colon. Because of the microorganism digestive action in the cecum, it is a functional appendix.

**LARGE COLON.** The large colon with a diameter of 8 to 10 inches is 10 to 12 feet long and has a capacity of 80 quarts. The large colon extends from the cecum to the small colon where it terminates in a funnel shaped restriction. Because it is usually expanded with food, impactions may occur. Impactions occur also in the cecum and small colon.

**SMALL COLON.** The small colon extends from the large colon to the rectum. It is from 10 to 12 feet in length with a diameter of 3 to 4 inches. Water is reabsorbed from the contents of the small colon and the characteristic balls of feces are formed. Feces is the waste matter of digestion and contains water, indigestible and undigested food residues, cells sloughed off of the intestinal wall, and remains of digestive secretions.

**RECTUM.** The rectum extends 1 foot in length from the small colon to the terminal part of the digestive tract, the anus.

A horse normally voids 33 to 50 lbs. of feces per day. Vigorous horses defecate 5 to 12 times daily.



## NOTES

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## NOTES

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