

UNIT IV DIGESTIVE AND EXCRETORY SYSTEMS 9

Structure and functions of gastrointestinal system - secretory functions of the alimentary tract - digestion and absorption in the gastrointestinal tract - structure of nephron - mechanism of urine formation - skin and sweat gland - temperature regulation.

Structure and functions of gastrointestinal system

The digestive system is composed of the gastrointestinal (GI) tract or the alimentary canal, salivary glands, the liver, and the exocrine pancreas. The principal functions of the gastrointestinal tract are to digest and absorb ingested nutrients and to excrete waste products of digestion. Most nutrients are ingested in a form that is either too complex for absorption or insoluble and therefore indigestible or incapable of being digested. Within the GI tract, much of these substances are solubilized and further degraded enzymatically to simple molecules, sufficiently small in size and in a form that permits absorption across the mucosal epithelium. This chapter describes the normal biochemical processes of intestinal secretion, digestion, and absorption. Once these issues have been put in perspective, the chapter explores the pathogenesis of the important gastrointestinal diseases of domestic animals and the biochemical basis for their diagnosis and treatment.

Gastrointestinal Tract Anatomy

The gastrointestinal tract in humans begins at the mouth, continuing through the esophagus, stomach, and small and large intestines. The GI tract is about 9 meters in length.

There are many supporting organs, such as the liver, which helps by secreting enzymes that are necessary for the digestion of food.

The human GI tract can be divided into two halves, namely:

- Upper GI tract
- Lower GI tract

Upper Gastrointestinal Tract

The upper GI consists of the following organs:

Mouth

It includes the teeth, tongue, and buccal mucous membranes containing the ends of the salivary glands that continue with the soft palate, floor of the mouth, and underside of the tongue. Mouth functions by chewing the food, constantly by the muscular action of

the tongue, cheeks, and teeth through the lower jaw and upper jaw. The mouth is the beginning of the digestive tract. In fact, digestion starts before you even take a bite. Your salivary glands get active as you see and smell that pasta dish or warm bread. After you start eating, you chew your food into pieces that are more easily digested. Your saliva mixes with the food to begin to break it down into a form your body can absorb and use. When you swallow, your tongue passes the food into your throat and into your esophagus.

Pharynx

The pharynx is enclosed in the neck and functions as part of both the digestive system and the respiratory system. It protects the food from entering the trachea and lungs.

Oesophagus

A muscular tube-like structure that functions by carrying food to the stomach. Once the chewed food reaches the oesophagus from the mouth, the action of swallowing becomes involuntary and is controlled by the oesophagus.

Located in your throat near your trachea (windpipe), the esophagus receives food from your mouth when you swallow. The epiglottis is a small flap that folds over your windpipe as you swallow to prevent you from choking (when food goes into your windpipe). A series of muscular contractions within the esophagus called peristalsis delivers food to your stomach.

But first a ring-like muscle at the bottom of your esophagus called the lower esophageal sphincter has to relax to let the food in. The sphincter then contracts and prevents the contents of the stomach from flowing back into the esophagus. (When it doesn't and these contents flow back into the esophagus, you may experience acid reflux or heartburn.)

Stomach

This is where most of the digestion takes place. The stomach is a J-shaped bag-like organ that stores the food temporarily, breaks it down, mixes and churns it with enzymes and other digestive fluids and finally, passes it along to the small intestine.

The stomach is a hollow organ, or "container," that holds food while it is being mixed with stomach enzymes. These enzymes continue the process of breaking down food into a usable form. Cells in the lining of your stomach secrete a strong acid and powerful

enzymes that are responsible for the breakdown process. When the contents of the stomach are processed enough, they're released into the small intestine.

Lower Gastrointestinal Tract

The lower GI consists of the following organs:

Small Intestine

The small intestine is a coiled thin tube, about 6 meters in length, where most of the absorption of nutrients takes place. Food is mixed with enzymes from the liver and the pancreas in the small intestine. The surfaces of the small intestine function by absorbing the nutrients from the food into the bloodstream, which carries them to the rest of the body.

Made up of three segments — the duodenum, jejunum, and ileum — the small intestine is a 22-foot long muscular tube that breaks down food using enzymes released by the pancreas and bile from the liver. Peristalsis also works in this organ, moving food through and mixing it with digestive juices from the pancreas and liver.

The duodenum is the first segment of the small intestine. It's largely responsible for the continuous breaking-down process. The jejunum and ileum lower in the intestine are mainly responsible for the absorption of nutrients into the bloodstream.

Contents of the small intestine start out semi-solid and end in a liquid form after passing through the organ. Water, bile, enzymes and mucus contribute to the change in consistency. Once the nutrients have been absorbed and the leftover-food residue liquid has passed through the small intestine, it then moves on to the large intestine (colon).

Pancreas

The pancreas secretes digestive enzymes into the duodenum that break down protein, fats and carbohydrates. The pancreas also makes insulin, passing it directly into the bloodstream. Insulin is the chief hormone in your body for metabolizing sugar.

Liver

The liver has many functions, but its main job within the digestive system is to process the nutrients absorbed from the small intestine. Bile from the liver secreted into the small intestine also plays an important role in digesting fat and some vitamins.

The liver is your body's chemical "factory." It takes the raw materials absorbed by the intestine and makes all the various chemicals your body needs to function.

The liver also detoxifies potentially harmful chemicals. It breaks down and secretes many drugs that can be toxic to your body.

Gallbladder

The gallbladder stores and concentrates bile from the liver, and then releases it into the duodenum in the small intestine to help absorb and digest fats.

Large Intestine

The large intestine, also known as the Colon, is a thick tubular organ wrapped around the small intestine. Its primary function is to process the waste products and absorb any remaining nutrients and water back into the system. The remaining waste is then sent to the rectum and discharged from the body as stool.

Colon

The colon is responsible for processing waste so that emptying your bowels is easy and convenient. It's a 6-foot long muscular tube that connects the small intestine to the rectum.

The colon is made up of the cecum, the ascending (right) colon, the transverse (across) colon, the descending (left) colon, and the sigmoid colon, which connects to the rectum.

Stool, or waste left over from the digestive process, is passed through the colon by means of peristalsis, first in a liquid state and ultimately in a solid form. As stool passes through the colon, water is removed. Stool is stored in the sigmoid (S-shaped) colon until a "mass movement" empties it into the rectum once or twice a day.

It normally takes about 36 hours for stool to get through the colon. The stool itself is mostly food debris and bacteria. These "good" bacteria perform several useful functions, such as synthesizing various vitamins, processing waste products and food particles and protecting against harmful bacteria. When the descending colon becomes full of stool, or feces, it empties its contents into the rectum to begin the process of elimination (a bowel movement).

Rectum

The rectum is a straight, 8-inch chamber that connects the colon to the anus. The rectum's job is to receive stool from the colon, let you know that there is stool to be evacuated (pooped out) and to hold the stool until evacuation happens. When anything

(gas or stool) comes into the rectum, sensors send a message to the brain. The brain then decides if the rectal contents can be released or not.

If they can, the sphincters relax and the rectum contracts, disposing its contents. If the contents cannot be disposed, the sphincter contracts and the rectum accommodates so that the sensation temporarily goes away.

Anus

The anus is the last part of the digestive tract. It is a 2-inch long canal consisting of the pelvic floor muscles and the two anal sphincters (internal and external). The lining of the upper anus is able to detect rectal contents. It lets you know whether the contents are liquid, gas or solid.

The anus is surrounded by sphincter muscles that are important in allowing control of stool. The pelvic floor muscle creates an angle between the rectum and the anus that stops stool from coming out when it's not supposed to. The internal sphincter is always tight, except when stool enters the rectum. This keeps us continent (prevents us from pooping involuntarily) when we are asleep or otherwise unaware of the presence of stool.

Short-term or temporary conditions that affect the digestive system include:

- **Constipation:** Constipation generally happens when you go poop (have a bowel movement) less frequently than you normally do. When you're constipated, your poop is often dry and hard and it's difficult and painful for your poop to pass.
- **Diarrhea:** Diarrhea is when you have loose or watery poop. Diarrhea can be caused by many things, including bacteria, but sometimes the cause is unknown.
- **Heartburn:** Although it has "heart" in its name, heartburn is actually a digestive issue. Heartburn is an uncomfortable burning feeling in your chest that can move up your neck and throat. It happens when acidic digestive juices from your stomach go back up your esophagus.
- **Hemorrhoids:** Hemorrhoids are swollen, enlarged veins that form inside and outside of your anus and rectum. They can be painful, uncomfortable and cause rectal bleeding.
- **Stomach flu (gastroenteritis):** The stomach flu is an infection of the stomach and upper part of the small intestine usually caused by a virus. It usually lasts less than a week. Millions of people get the stomach flu every year.
- **Ulcers:** An ulcer is a sore that develops on the lining of the esophagus, stomach or small intestine. The most common causes of ulcers are infection with a

bacteria called *Helicobacter pylori* (*H. pylori*) and long-term use of anti-inflammatory drugs such as ibuprofen.

- **Gallstones:** Gallstones are small pieces of solid material formed from digestive fluid that form in your gallbladder, a small organ under your liver.

Common digestive system diseases (gastrointestinal diseases) and disorders include:

- **GERD (chronic acid reflux):** GERD (gastroesophageal reflux disease, or chronic acid reflux) is a condition in which acid-containing contents in your stomach frequently leak back up into your esophagus.
- **Irritable bowel syndrome (IBS):** IBS is a condition in which your colon muscle contracts more or less often than normal. People with IBS experience excessive gas, abdominal pain and cramps.
- **Lactose intolerance:** People with lactose intolerance are unable to digest lactose, the sugar primarily found in milk and dairy products.
- **Diverticulosis and diverticulitis:** Diverticulosis and diverticulitis are two conditions that occur in your large intestine (also called your colon). Both share the common feature of diverticula, which are pockets or bulges that form in the wall of your colon.
- **Cancer:** Cancers that affect tissues and organs in the digestive system are called gastrointestinal (GI) cancers. There are multiple kinds of GI cancers. The most common digestive system cancers include esophageal cancer, gastric (stomach) cancer, colon and rectal (colorectal) cancer, pancreatic cancer and liver cancer.
- **Crohn's disease:** Crohn's disease is a lifelong form of inflammatory bowel disease (IBD). The condition irritates the digestive tract.
- **Celiac disease:** Celiac disease is an autoimmune disorder that can damage your small intestine. The damage happens when a person with celiac disease consumes gluten, a protein found in wheat, barley and rye.