

1 | CHAPTER 17: THE DIGESTION AND ABSORPTION OF FOOD

Overview: Functions of the Gastrointestinal Organs

Figure 17–3 presents an overview of the secretions and functions of the gastrointestinal organs. The gastrointestinal tract begins with the **mouth**, and digestion starts there with chewing, which breaks up

5 large pieces of food into smaller particles that can be swallowed. **Saliva**, secreted by three pairs of **salivary glands** (see Figure 17–1) located in the head, drains into the mouth through a series of short ducts. Saliva, which contains mucus, moistens and lubricates the food particles before swallowing. It also contains the enzyme **amylase**, which partially digests polysaccharides. A third function of saliva is to dissolve some of the food molecules. Only in the dissolved state can these molecules react with chemoreceptors in the
10 mouth, giving rise to the sensation of taste (Chapter 9).

The next segments of the tract, the **pharynx** and **esophagus**, contribute nothing to digestion but provide the pathway by which ingested materials reach the stomach. The muscles in the walls of these segments control swallowing.

The **stomach** is a saclike organ, located between the esophagus and the small intestine. Its functions are
15 to store, dissolve, and partially digest the macromolecules in food and to regulate the rate at which the stomach's contents empty into the small intestine. The glands lining the stomach wall secrete a strong acid, **hydrochloric acid**, and several protein-digesting enzymes collectively known as **pepsin** (actually a precursor of pepsin known as pepsinogen is secreted and converted to pepsin in the lumen of the stomach).

20 The primary function of hydrochloric acid is to dissolve the particulate matter in food. The acid environment in the **gastric** (adjective for "stomach") lumen alters the ionization of polar molecules, especially proteins, disrupting the extracellular network of connective tissue proteins that form the structural framework of the tissues in food. The proteins and polysaccharides released by hydrochloric acid's dissolving action are partially digested in the stomach by pepsin and amylase, the latter contributed
25 by the salivary glands. A major food component that is not dissolved by acid is fat.

Hydrochloric acid also kills most of the bacteria that enter along with food. This process is not 100 percent effective, and some bacteria survive to take up residence and multiply in the gastrointestinal tract, particularly the large intestine. The digestive actions of the stomach reduce food particles to a solution known as **chyme**, which contains molecular fragments of proteins and polysaccharides, droplets of fat,
30 and salt, water, and various other small molecules ingested in the food. Virtually none of these molecules, except water, can cross the epithelium of the gastric wall, and thus little absorption of organic nutrients occurs in the stomach.

Digestion's final stages and most absorption occur in the next section of the tract, the **small intestine**, a tube about 1.5 inches in diameter and 9 ft in length that leads from the stomach to the large intestine.
35 Here molecules of intact or partially digested carbohydrates, fats, and proteins are broken down by

hydrolytic enzymes into monosaccharides, fatty acids, and amino acids. Some of these enzymes are on the luminal surface of the intestinal lining cells, while others are secreted by the pancreas and enter the intestinal lumen. The products of digestion are absorbed across the epithelial cells and enter the blood and/or lymph. Vitamins, minerals, and water, which do not require enzymatic digestion, are also absorbed in the small intestine.

The small intestine is divided into three segments: an initial short segment, the **duodenum**, is followed by the **jejunum** and then by the longest segment, the **ileum**. Normally, most of the chyme entering from the stomach is digested and absorbed in the first quarter of the small intestine, in the duodenum and jejunum.

Two major glands—the pancreas and liver—secrete substances that flow via ducts into the duodenum. The **pancreas**, an elongated gland located behind the stomach, has both endocrine and exocrine functions, but only the latter are directly involved in gastrointestinal function and are described in this chapter. The exocrine portion of the pancreas secretes (1) digestive enzymes and (2) a fluid rich in bicarbonate ions. The high acidity of the chyme coming from the stomach would inactivate the pancreatic enzymes in the small intestine if the acid were not neutralized by the bicarbonate ions in the pancreatic fluid.

From: Widmaier, E. P., Raff, H., & Strang, K. T. (2001). *"Vander et al's human physiology: the mechanisms of body function"*. New York: McGraw-Hill Companies.