بسم الله الرحمن الرحيم

كلية آشور الجامعة – قسم تقنيات المختبرات الطبية Human Physiology-stage 2

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Chemical digestion:

Chemical digestion is the enzyme-mediated, hydrolysis process that breaks down large macronutrients into smaller molecules. **Chemical digestion** begins in the mouth when food mixes with saliva. Saliva contains an enzyme (amylase) that begins the breakdown of carbohydrates. Protein digestion occurs in the stomach and the duodenum through the action of three primary enzymes:

1. Pepsin, secreted by the stomach.
2. Trypsin, secreted by the pancreas.
3. Chymotrypsin, secreted by the pancreas.

These enzymes break down food proteins into polypeptides that are then broken down by various exopeptidases and dipeptidases into amino acids. Thus, trypsin is secreted by the pancreas in the form of trypsinogen, which is activated in the duodenum by enterokinase to form trypsin. Trypsin then cleaves proteins into smaller polypeptides.

In humans, dietary starches are composed of glucose units arranged in long chains of polysaccharide called amylose. During digestion, the bonds between glucose molecules are broken by salivary and pancreatic amylase, and result in smaller chains of glucose. This process produces the simple sugars glucose and maltose that can be absorbed by the small intestine.

Sucrase is an enzyme that breaks down disaccharide sucrose, commonly known as table sugar, cane sugar, or beet sugar. Sucrose digestion yields fructose and glucose, which are readily absorbed by the small intestine.

Lactase is an enzyme that breaks down the disaccharide lactose into its component parts, glucose and galactose that are absorbed by the small intestine. Approximately half the adult population produces only small amounts of lactase and is therefore unable to eat milk-based foods. This condition is commonly known as lactose intolerance.

The digestion of certain fats begins in the mouth, where lingual lipase breaks down short chain lipids into diglycerides. The presence of fat in the small intestine produces hormones that stimulate the release of pancreatic lipase from the pancreas, and bile from the liver, to enable the breakdown of fats into fatty acids. The complete digestion of one molecule of fat (a triglyceride) results in three fatty acid molecules and one glycerol molecule.

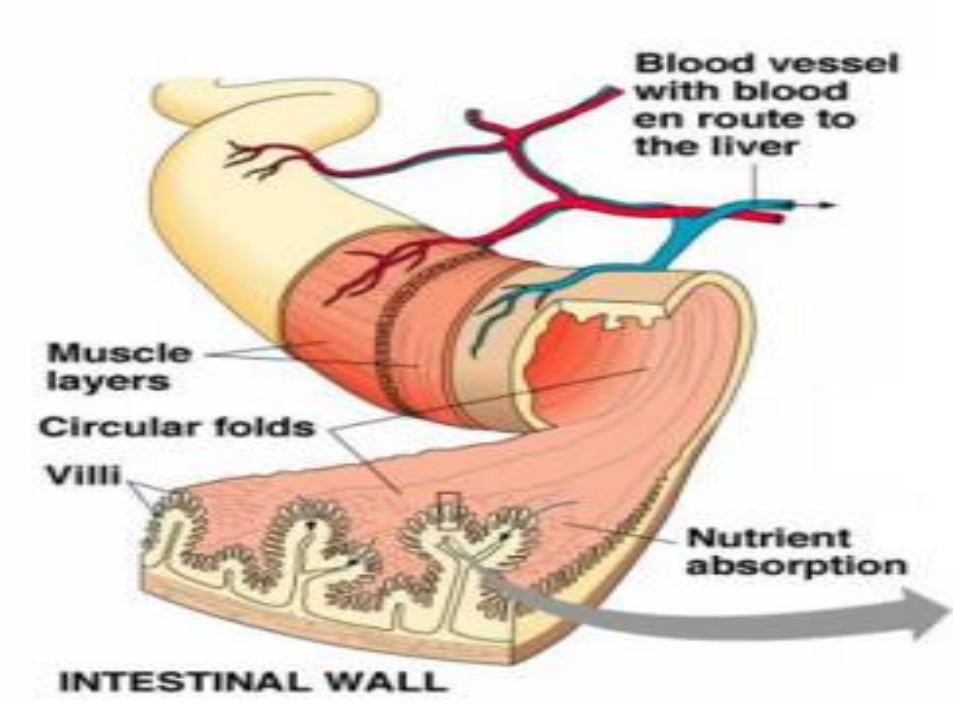
DNA and RNA are broken down into mononucleotides by the nucleases deoxyribonuclease and ribonuclease (DNase and RNase), which are released by the pancreas.

Absorption:

Although the small intestine is only 3 to 4 cm in diameter and approximately 7 metres in length. This enormous absorptive surface is provided by the unique structure of the mucosa, which is arranged in concentric folds. These folds, known as plicae circulares. The small intestine contains approximately 800 plicae circulares and that they increase the surface area of the

lining of the small bowel by five to eight times the outer surface area.

The villi usually vary from 0.5 to 1 mm in height. Their diameters vary from approximately one-eighth to one-third their height. At the base of the mucosal villi are depressions called intestinal glands .



The enterocytes are joined by a contact zone known as a “tight junction.” These junctions have pores that are closed in the resting state and dilated when absorption is required. The microvilli play an important role in the digestion and absorption of intestinal contents by enlarging the absorbing surface approximately 25 times. They also secrete the enzymes disaccharidase and peptidase that hydrolyze disaccharides to monosaccharides and dipeptides to amino acids. Molecular receptors for specific substances are found on the microvilli surfaces at different levels in the small intestine. Such receptors may explain the selective absorption of iron and calcium in the duodenum and upper jejunum. Furthermore, there are transport

proteins in the microvillus membrane associated with the passage of sodium ions, D-glucose, and amino acids.

Digestion Control:

The major hormones that control the functions of the digestive system are produced and released by cells in the mucosa of the stomach and small intestine. These hormones stimulate digestive juices and regulate appetite. The hormones that control digestion are gastrin, secretin, and cholecystokinin (CCK):

1- Gastrin causes the stomach to produce an acid for dissolving and digesting some foods. It is also necessary for the normal growth of the lining of the stomach, small intestine, and colon.

2-Secretin causes the pancreas to send out a digestive juice that is rich in bicarbonate. It stimulates the stomach to produce pepsin, an enzyme that digests protein, and it also stimulates the liver to produce bile.

3-CCK causes the pancreas to grow and to produce the enzymes of pancreatic juice.

Additional hormones in the digestive system regulate appetite:

1-Ghrelin is a hormone produced in the stomach and upper intestine in the absence of food in the digestive system and stimulates appetite.

2-Peptide YY is produced in the GI tract in response to a meal in the system and inhibits appetite.

Both of these hormones work on the brain to help regulate the intake of food for energy.

Nerve Regulators

Two types of nerves help to control the action of the digestive system. Extrinsic (outside) nerves come to the digestive organs from the unconscious part of the brain or from the spinal cord. They release a chemical called acetylcholine and another called adrenaline. Acetylcholine causes the muscle of the digestive organs to squeeze and increase the "push" of food and juice through the digestive tract. Acetylcholine also causes the stomach and pancreas to produce more digestive juice. Adrenaline relaxes the muscle of the stomach and intestine and decreases the flow of blood to these organs.

Defecation reflex:

When you eat, food moves from the mouth to the esophagus to the stomach. The food then passes through the small intestine to the large intestine to the rectum. The rectum is the final portion of the large intestine that connects to the anus, or the opening where the body releases stool.

The defecation reflex is triggered when:

1. When the muscles in the colon contract to move stool toward the rectum. This is known as a “mass movement.”
2. When enough stool moves to the rectum, the amount of stool causes to stretch the tissues in the rectum. Inside these tissues is special “stretch” receptors designed to signal the brain when they are stretched.
3. The defecation reflex triggers the two main sphincters around the anal canal. The first is the internal anal sphincter, which is a muscle that can’t be controlled voluntarily. The second is the external anal sphincter, which is skeletal muscle that you have some control.

4. The defecation reflex occurs when the internal anal sphincter relaxes and the external anal sphincter contracts.
5. After the defecation reflex is triggered, you can either delay or defecate. Delay occurs when a person doesn't go to the bathroom immediately. There are muscles in the anal sphincter that cause the stool to move backward slightly. This effect reduces the urge to defecate. If you choose to defecate, your brain activates voluntary and involuntary muscles to move stool forward and out of the body.