

B.Sc Second year Zoology (Honours)

Paper-4

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Digestive enzymes

Digestive enzymes are substances secreted by the salivary glands and cells lining the stomach, pancreas, and small intestine to aid in the digestion of food. They do this by splitting the large, complex molecules that make up proteins, carbohydrates, and fats (macronutrients) into smaller ones, allowing the nutrients from these foods to be easily absorbed into the bloodstream and carried throughout the body.

Digestive enzymes are released both in anticipation of eating, when we first smell and taste food, as well as throughout the digestive process. Some foods have naturally occurring digestive enzymes that contribute to the breakdown of certain specific nutrients.

Deficiencies in digestive enzymes are associated with a variety of health conditions, especially those that affect the pancreas as it secretes several key enzymes

Types

Each of the many different digestive enzymes targets a specific nutrient, splitting it up into a form that can eventually be absorbed. The most significant digestive enzymes are:

Amylase

Amylase is essential for the digestion of carbohydrates. It breaks down starches into sugars. Amylase is secreted by both the salivary glands and pancreas. The measurement of amylase levels in the blood is sometimes used as an aid in diagnosing various pancreas or other digestive tract diseases.

High levels of amylase in the blood may indicate a blocked or injured duct of the pancreas, pancreatic cancer, or acute pancreatitis, a sudden inflammation of the pancreas. Low levels may indicate chronic pancreatitis (ongoing inflammation of the pancreas) or liver disease.

Maltase

Maltase is secreted by the small intestine and is responsible for breaking down maltose (malt sugar) into glucose (simple sugar) that the body uses for energy. During digestion starch is partially transformed into maltose by amylases. The maltase then converts maltose into glucose that is either used immediately by the body or stored in the liver as glycogen for future use.

Lactase

Lactase (also called lactase-phlorizin hydrolase) is a type of enzyme that breaks down lactose, a sugar found in dairy products, into the simple sugars glucose and galactose. Lactase is produced by cells known as enterocytes that line the intestinal tract. Lactose that is not absorbed undergoes fermentation by bacteria and can result in gas and intestinal upset.

Lipase

Lipase is responsible for the breakdown of fats into fatty acids and glycerol (simple sugar alcohol). It's produced in small amounts by your mouth and stomach, and in larger amounts by your pancreas.

Proteases

Also called peptidases, proteolytic enzymes, or proteinases, these digestive enzymes break down proteins into amino acids. In addition, they play a role in numerous body processes, including cell division, blood clotting, and immune function.

Proteases are produced in the stomach and pancreas. The main ones are:

- **Pepsin:** Secreted by the stomach to break down proteins into peptides, or smaller groupings of amino acids, that are either absorbed or broken down further in the small intestine
- **Trypsin:** Forms when an enzyme secreted by the pancreas is activated by an enzyme in the small intestine. Trypsin then activates additional pancreatic enzymes, such as carboxypeptidase and chymotrypsin, to assist in breaking down peptides.
- **Chymotrypsin:** Breaks down peptides into free amino acids that can be absorbed by the intestinal wall
- **Carboxypeptidase A:** Secreted by the pancreas to split peptides into individual amino acids
- **Carboxypeptidase B:** Secreted by the pancreas, it breaks down basic amino acids

Sucrase

Sucrase is secreted by the small intestine where it breaks down sucrose into fructose and glucose, simpler sugars that the body can absorb. Sucrase is found along the intestinal villi, tiny hair-like projections that line the intestine and shuttle nutrients into the bloodstream.

Deficiencies

There are a variety of health conditions that can interfere with the secretion of sufficient amounts of digestive enzymes for full digestion of foods. Some are inherited genetic conditions while others develop over time.

Lactose Intolerance

Lactose intolerance is the inability to digest lactose due to insufficient production of lactase by the small intestine. It is characterized by symptoms such as bloating, diarrhea, abdominal pain, and gas that result from consuming milk and other dairy products.

There are several forms of lactose intolerance:

- **Congenital lactase deficiency** (also called congenital alactasia) is a rare inherited form of lactose intolerance in which infants are unable to break down lactose in breast milk or formula and have severe diarrhoea if they aren't given a lactose-free alternative. Congenital lactase deficiency is caused by mutations in the LCT gene that provides instructions for making the lactase enzyme.⁵
- **Lactase nonpersistence** is a common type of adult-onset lactose intolerance affecting around 65% of adults. It is caused by decreased expression (activity) of the LCT gene. Symptoms typically begin 30 minutes to 2 hours after ingesting dairy.³ Most people with lactase nonpersistence retain some lactase activity and can continue to include some lactose in their diets, such as in the form of cheese or yogurt that tend to be tolerated better than fresh milk.
- **Secondary lactose intolerance** develops when lactase production is reduced because of diseases that can cause damage the small intestine, such as celiac disease or Crohn's disease, or from other illnesses or injuries that impact the intestinal wall.