

Pancreatic Enzymes

Digestion enzymes are enzymes that break down polymeric macromolecules into their smaller building blocks. Digestive enzymes are found in the digestive tract of animals (including humans) where they aid in the digestion of food as well as inside cells, especially in their lysosomes. Enzymes are also found in the saliva, which is produced from within the salivary glands.

Digestion enzymes are classified by their substrates: proteases and peptidases split proteins into amino acids, lipases split fat into three fatty acids and glycerol, carbohydrases split carbohydrates such as starch into sugars, and nucleases split nucleic acids into nucleotides.

In the human digestive system, the main sites of digestion are the oral cavity, the stomach, the duodenum, and the jejunum and digestive enzymes are secreted by different glands: the salivary glands, the glands in the stomach, the pancreas, and the glands in the small intestine.

Oral cavity

Complex food substances taken by animals and humans must be broken down into simple, soluble and diffusible substances before they can be absorbed into the body. In the oral cavity, salivary glands secrete (or create) ptyalin. It is a type of α -amylase, which digests starch into small segments of multiple sugars and into the individual soluble sugars secreted by small and large salivary glands.

Salivary glands also secrete lysozyme, which kills bacteria but is not classified as a digestive enzyme.

Summary of the actions of digestive enzymes:

- Bromelain tenderizes meat and acts as an anti-inflammatory agent.
- Betaine effects cell fluid balance as osmolytes

- Salivary Amylase (also known as ptyalin) (Mouth) produced by salivary glands breaks down starch into sugar.

Stomach

The enzymes that get secreted in the stomach are called *gastric enzymes*. These are the following:

- Pepsin is the main gastric enzyme. It breaks proteins into smaller peptide fragments.
- Gelatinase degrades type I and type V gelatin and type IV and V collagen, which are proteoglycans in meat.
- Gastric amylase degrades starch, but is of minor significance.
- Gastric lipase is a tributyrase by its biochemical activity, as it acts almost exclusively on tributyrin, a butter fat enzyme.
- Pepsin enzyme is secreted by gastric glands
- Rennin enzyme change the liquid milk to solid

Small intestine

The pancreas is the main digestive gland in our body. It secretes the enzymes:

- Trypsin is a protease that cleaves proteins at the basic amino acids.
- Chymotrypsin is a protease that cleaves proteins at the aromatic amino acids.
- Steapsin degrades triglycerides into fatty acids and glycerol.
- Carboxypeptidase, is a protease that takes off the terminal acid group from a protein
- Several elastases that degrade the protein elastin and some other proteins.
- Several nucleases that degrade nucleic acids, like DNAase and RNAase
- Pancreatic amylase that, besides starch, and glycogen, degrades most other carbohydrates. Humans lack the enzyme to digest the carbohydrate cellulose.

- Pancreatic Secretion: Bile from the liver, which emulsifies fat, allowing more efficient use of lipase in the duodenum in converting lipids to smaller more manageable sizes. Bile is not considered an enzyme, but aids macronutrient degradation.

Proper small intestine enzymes

- Several peptidases.
- The jejunum and ileum secretes a juice called succus entericus which contains the following:

Four types of enzymes degrade disaccharides into monosaccharides:

- Sucrase, which breaks down sucrose into glucose and fructose
- Maltase, which breaks down maltose into glucose.
- Isomaltase, which breaks down maltose and isomaltose
- Lactase, which breaks down lactose into glucose and galactose

The intestinal lipase breaks down fatty acids.

The small intestine receives lipase, trypsin and amylase from the pancreas. They are transported from the pancreas to the duodenum through the pancreatic duct. Protein, fats and starch are broken down into smaller molecules. However, they are not fully broken down yet. This causes the enzymes of the small intestine to act upon them. These enzymes include peptidase, which breaks down peptides into amino acids and the enzyme maltase acts upon maltose which produces glucose. These molecules are absorbed by the villi in the small intestine and according to the molecule they are either absorbed by the lacteal or blood capillaries.