The Digestive System Processes

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The Digestive System involves breaking down large food molecules into water-soluble molecules that can be passed into the blood and transported to the body's organs. Those molecules are the nutrients that we need in order for our body to function properly. For this process to happen, food goes through two types of digestion. One is called mechanical. This is where food is broken down into smaller parts. The second type is chemical. This happens when food is broken down by acid and enzymes into their basic units.

This system is made up of the gastrointestinal tract (GI), also called the digestive tract. With accessory organs of the liver, pancreas, and gallbladder. The GI tract is made up of hollow organs, which are the mouth, esophagus, stomach, small and large intestine, and anus. The solid organs are the liver, pancreas, and gallbladder. (National Institute of Diabetes and Digestive and Kidney Diseases,2017).

Organs and functions

The mouth is the entry point for food. When we smell food, saliva is released by the salivary glands into our oral cavity. Once food is entered, a process called mastication occurs, teeth and tongue, and soft palate, aid in helping food move along to the pharynx and esophagus.

The pharynx is the area of transition from the mouth to the esophagus. There are 2 pathways where food, at this point called a food bolus, can take. The correct way where the bolus goes into the esophagus to the stomach, and the wrong way is down the windpipe and into the lungs. To prevent this from happening, swallowing, a mostly automatic reflex but is partially under our direct control, happens (Jerry, 2019). In the esophagus, a process called peristalsis happens, in a synchronized fashion. That moves the food towards the stomach.

To continue the breakdown process of food, glands in the stomach secrete acid and enzymes. Along with the stomach muscles mixing the food, and the enzymes and acid breaking down the food, a thick fluid called chyme is made. The chyme is then pushed into the first part of the small intestine, the duodenum. With the help from bile from the liver and enzymes from the pancreas, the process of further breaking down food occurs in the small intestines. The small intestine has 3 segments, duodenum, further breakdown of food happens here, jejunum and ileum, mostly takes care of the absorption of nutrients and water from the processed food into the bloodstream through the walls of the small intestine (National Institute of Diabetes and Digestive and Kidney Diseases,2017). The leftover wastes leave the upper GI tract (everything above the large intestine) and move into the large intestine. The lower GI tract, large intestine or colon, has the responsibility of solidifying waste product. Due to peristalsis, the waste product solidifies by the large intestine absorbing water from the waste. As the large intestine moves the waste product through the colon, stool is formed. It is then moved to the rectum, where the stool is stored and then expelled through the anus (Jerry, 2018).

For our body to absorb the necessary nutrients from food, we first need something to break them down. That something is called enzymes. There are many enzymes that help this process of food breakdown but the major ones that help are amylase, lipase, and pepsin. Amylase is responsible for breaking the bonds of starches, polysaccharides, and complex carbohydrates into simple sugars. In chemical digestion, salivary amylase is the first step to start breaking down food. As the starches, polysaccharides, and complex sugars continue in the digestive tract, they are further broken down from additional amylase released from the pancreas into the proximal small intestine (Christopher, 2018). Lipase is an enzyme that breaks down lipids. It is produced in the stomach as well as the pancreas. This enzyme allows our body to fully digest fats into their smallest components.

Pepsin is a powerful enzyme produced in gastric juice that digests proteins (meats, eggs, seeds, dairy products, etc). Glands that are in the stomach make and store pepsinogen, which aids in activating pepsin (Encyclopædia Britannica). Pepsin is an enzyme that needs to be activated. So, in order to make pepsin active, hormonal secretion of gastrin and secretin stimulates the release of pepsinogen into the stomach, where it is mixed with hydrochloric acid (HCL) and is then rapidly converted to the activation of the pepsin enzyme (Encyclopædia Britannica).

There are some health conditions that associate with some common malfunctions of the digestive system. One issue is Pancreatitis. Pancreatitis is the inflammation of the pancreas. This happens when digestive enzymes start digesting the pancreas itself (MedlinePlus). Another common malfunction is Malabsorption. This is a disorder that occurs when people are unable to absorb nutrients from their diets.

Objective

The objective of this lab activity is to observe the effects of digestive enzymes of amylase, lipase, and pepsin on their respective substances. As well as see the environmental effects that occur for each enzyme.

Materials and Methods

-Assessing Starch Digestion of Salivary Amylase

When testing for starch digestion, we conducted two experiments. One was for testing the digestion of starch by salivary amylase, and the second was testing for how different temperatures affect starch becoming salivary amylase at different amounts of time. For the first experiment, we took 2 test tubes and filled them with a starch solution using a dropper. Since we are testing for the presence of starch, an Iodine solution was used. We took the Iodine and added equal amounts to both test tubes. In test tube 2, amylase was added. Test tubes 1 and 2 were placed into a beaker filled with 150mL of water on top of a hot plate to warm up. After warming them up, both tubes were compared.

To see if starch in test tube 2 had been digested by the amylase into simple sugars, a Benedict's test was done. We took some of the digested solution from test tube

2 and put it into a test tube containing Benedict solution and then heated it.

For the second experiment, 5 beakers of water were heated at different temperatures, 20°C, 40°C, 50°C, 60°C, and 80°C. We labeled each test tube, S20, S40, S50, S60, and S80, and added 5mL of starch. Next, 5mL of amylase was added into 5 tubes labeled A20, A40, A50, A60, and A80. Then each test tube was placed into their corresponding bath temperatures. In order for each tube to equilibrate, a timer of 5 minutes was set. After equilibrating, each S and A tube was mixed with their corresponding number (S20-A20, S40-A40, etc). Lastly, we filled a well with iodine solution and added a drop of the new mixture from the combination of the test tubes until the reaction stopped and no color change was apparent.

-<u>Assessing Lipase Digestion of Fat</u>

The next test that we did was testing the activity of lipase on lipids. 4 test tubes were filled with a lipid cream. And a pink pH indicator (measures the activity of the lipase enzyme on the breakdown of lipids) was added to each tube. In test tube 1, we put water and bile salts, test tube 2 had lipase added, test tube 3 was given lipase enzymes and bile salts, test tube 4 had amylase added to it. Once we let a couple of minutes pass, we recorded our observations.

-<u>Assessing Pepsin Digestion of Proteins</u>

To test the digestion of proteins by pepsin, 5 cubes of egg whites were put into 5 test tubes. To compare results by the end of this test, only test tube 1 was given 2mL of water. Test tubes 2, 3, and 4 were given 2mL of pepsin solution. Test tube 2 and 4 were given an additional 2 drops of HCL. The only test tube to receive 2mL of amylase was test tube 5. Tubes 1, 3, 4, and 5 were incubated in warm water for 30 minutes. Tube 2 was kept at room temperature. After the 30minutes were done, we observed and recorded each test tube to see if there were any suspensions left from the egg whites.

Results/Data

Table 1: Salivary Amylase Digestion of Starch

Test tubes	Starch present	Iodine present	Amylase present	Mixed with Benedict	Color change
1	yes	yes	no	no	Dark purple-black color
2	no	no	yes	yes	Clear

Table 2: The Effect of temperature on Salivary Amylase Digestion of Starch

Test tube	**Contents**	**Temperature**	**Time until reaction ended**
1	Amylase and Starch	20°C	2 minutes
2	Amylase and Starch	40°C	1 min, 30 secs
3	Amylase and Starch	50°C	1 minute
4	Amylase and Starch	60°C	30 secs
5	Amylase and Starch	80°C	< 30 secs

Table 3:Lipid Digestion

Tube	Contents	Color change
1	Lipid cream, Water, Bile salts	no
2	LIpid cream, Lipase	Light pink (some lipids digested)
3	Lipid cream, Lipase, Bile salts	Light yellow (lipids digested)
4	Lipid cream, Amylase	no

Table 4: Protein Digestion

Tubes	Contents	Temperature	Observations (after 30 minutes)
1	Egg, Water	Warm	No visible suspensions
2	Egg, Pepsin, HCL	Cold	Some visible suspensions
3	Egg, Pepsin	Warm	Some visible suspensions
4	Egg, Pepsin, HCL	Warm	A greater amount of visible suspensions
5	Egg, Amylase	Warm	No visible

			suspensions

Discussion/Conclusion

When testing for the presence of starch, Iodine solution was used. It turns the solution to a dark purple-black color. Which we observed in test tube 1. But in test tube 2, there was no presence of starch because the amylase digested it. Hence the clear color. The enzyme amylase works to breakdown starch to its simplest form. By heating the solution, we have seen at the bottom of the test tube there was precipitation of the solution. This indicates that amylase did breakdown starch. As for the effect of temperature on amylase digesting starch, we observed that at different temperatures of the water, we get a quicker digestion process, as seen in Table 2.

In lipid digestion, a chemical reaction was shown through the change of pH. Due to the presence of lipase in test tubes 2 and 3, a color change happened. Even though as seen in test tube 1, bile salts (they aid in breaking down lipids) and water did not digest lipids. But since lipase was in test tube 3, along with bile salts and lipid cream, it changed. To a light yellow. Test tube 2 changed a little as well but not as much because bile salts were not present. Overall, test tube 3 was the prime example of enzyme lipase digestion because it had all the components of lipase digesting lipids.

For the pepsin digestion of proteins, as expected, amylase did not digest the egg whites. As seen in Table 4, test tubes 2, 3, and 4 showed digestion of proteins with pepsin present, compared to test tubes 1 and 5. But the key difference between 2, 3, and 4 is that since only test tube 2 was kept at room temperature, it only had some visible suspensions. But the prime example for pepsin digestion in this experiment is test tube 4. It was at a warmer temperature and had all the components necessary for protein digestion. By doing this digestive enzyme experiment, we can see how important our digestive system is and see the key role digestive enzymes play in order for us to sustain a functional body.

Works Cited

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