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LAB 39

Enzymatic Action

The alimentary canal consists of the mouth, esophagus, stomach, small intestine, large intestine, rectum, and anus. This system carries out a few processes such as ingestion of food, propulsion of food and wastes from the mouth to the anus, secretion of mucus water and enzymes , mechanical digestion of food, chemical digestion of food, and elimination of waste products by defecation.
This lab experiment will allow a closer look at the optimal conditions for chemical digestion of food.

Objective:

To understand the best environment for the breakdown of food in addition to the specific enzymes needed for breakdown of carbohydrates, proteins and fats. In this lab we will compare the temperature at which breakdown of these three foods sources is best and compare and contrast the optimal conditions for hydrolysis. After the completion of this lab when shoud have a better understanding of the chemical processes involved and relate it to common health issues.

Materials/Methods:
DI water, Tubes, Starch / Amylase, Trypsin/ BAPNA Litmus cream / lipase, bile salts Benedict solution , iodine solution

Carbohydrates

1A amylase and water
2A starch and water
3A maltose and water
4A amylase- boil water -then add starch
5A amylase and starch at 37 degrees C
6A amylase and starch at 0 degrees C

Interpretation:

In tube 1A the mixture did not turn blue after iodine solution was introduced, this is a negative finding for starch. Benedict's solution was added, no reaction, negative for maltose
In 2A the mixture turned green when iodine was added, positive for starch and negative for maltose after iodine was added. In tube 3A the mixture turned brown with iodine solution, negative for starch but positive with benedict's solution for maltose. In tube 4A amylase was denatured because it was boiled for four minutes. starch was added, the color was mildly blue indicating that amylase was not working at optimal capacity. 5A- solution was positive for maltose when adding benedict's solution and negative for starch when adding iodine. Tube 6A was positive for starch and mildly positive for maltose.

Interpretation :

We can observe that at 0 degrees celsius amylase is not as effective at digestion as It would be at 37 degrees celsius. At 0 degrees celsius it would take a longer time to fully hydrolyze whereas at 37 degrees celsius is the optimal temperature for the enzyme to work at peak performance. In addition, boiling the enzyme denatured its properties and in tube 4A there was incomplete digestion.

Protein

1T- 2mL trypsin and water.
2T- 2ml of BAPNA
3T- 2 ml trypsin Boil 5 minutes, add 3 drops of BAPNA
4T 2mL of trypsin with 3 drops of BAPNA
5T 2ml of trypsin with BAPNA

Interpretation:

We can observe that 1T was a control and remained clear in color because there was no substrate in the solution. 2T was also a control with no enzyme present so the solution remained clear. 3T was boiled with trypsin and then BAPNA was added. We can conclude that after boiling the tube for 5 minutes this affected how trypsin was able to digest BAPNA. When an enzyme is heated and denatured it will have less effect on the substrate. 4T was pigmented very yellow, showing that there was hydrolysis of BAPNA by trypsin. 5T tube was not placed in a hot bath and remained at 0 degrees celsius. The color of the tube was light yellow. There was some enzymatic action however, this is not the optimal temperature.

Lipids - lipid cream / bile salts / pancreatin

1L- water and pancreatin only
2L- water and litmus cream
3L pancreatin- boil in water- add litmus cream
4L litmus cream , pancreatin and bile salts
5L- pancreatin litmus, ice, litmus cream
5B- pancreatin litmus, ice, litmus cream, bile salts

Interpretation:

We can observe that 1L was a control with pancreatin only. There was no substrate to act on so the color remained clear. 2Lcontained only the litmus cream with no enzyme to act on the substrate. This was clear with no reaction. 3L had the enzyme in the tube and was boiled before litmus cream was added. Since pancreatin was denatured it coils not act on its substrate. 4L was a light pink color, we observed that there was moderate digestion of the litmus cream however, there was no bile salt to emulsify the fat. 4B was a rich red color. The fat in the tube was fully emulsified and had the optimal temperature for the enzyme to act on the substrate. Tube 5L and Tube 5B remained at 0 degrees celsius. 5L became a light blue/pink color which showed incomplete digestion at 0 degrees celsius in addition to the fact that there were no bile salt for emulsification. Lastly, 5B was a light blue color also demonstrating incomplete digestion at 0 degrees celsius.

Conclusion:

In order for digestion to happen, there are enzymes that break food down for proper absorption in the small intestine. Enzymes are large proteins that are catalysts for their substrate. Without these enzymes such as amylase, lipase, trypsin, and bile salts, we would not be able to process our food.

The small intestines is where most of the food is absorbed and is the main site of chemical digestion, specifically at the duodenum region. Bile salts are released by the gallbladder into this region, pancreatic juices are also released. In addition to brush border enzymes such as maltose which was used in this experiment. Once the food is broken down with the proper enzymes, PH and temperature, it is absorbed by the jejunum. It is here that amino acids, fatty acids, glycerol, and monosaccharides are absorbed into the intestinal mucosa and carried away by blood and lacteals.

Carbohydrates are polymers of sugar and must be broken down to monomers so that they can diffuse and be absorbed through the digestive tract. Salivary amylase initiates this process with the start of breaking down polysaccharides into disaccharides. Bile salts are needed to further emulsify fats. They are released from the gallbladder when chyme has enough fat content. The trigger for release of bile salts is cholecystokinin. The liver is responsible for producing bile and stores it in the gallbladder.

Some common health issues relating to the above experiment is lactose intolerance. This is a deficiency of the disaccharidase at the brush border of the small intestine. Lactase deficiency inhibits the breakdown of lactose into monosaccharides, glucose and galactose. The undigested lactose remains in the intestines, where bacterial fermentation causes gases to form. It also increases the osmotic gradient in the intestine which causes irritation and osmotic diarrhea. It is most common in blacks, hispanics and Native Americans. Clinical manifestation of bile salt deficiency can be related to poor intestinal absorption of fat soluble vitamins such as vitamin A, D, E, K, or the bile duct can be obstructed from gallstones. If the liver is damaged from cirrhosis, a person could experience difficulty processing a diet with fat.

Reference:
Huether, Mccance, Understanding Pathophysiology. Elsevier 2012