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Digestive System

Activity-4: Assessing Fat Digestion by Pancreatic Lipase and the Action of Bile

Objective:

The human digestive system is a complex combination of mechanical and chemical processes of digestion. It consists primarily of the gastrointestinal tract, a series of organs and glands that help break down food into smaller molecules for the body to absorb and use for energy. There are six essential activities in the digestion process: ingestion, propulsion, mechanical digestion, chemical digestion, absorption, and defecation. During chemical digestion, enzymes (large protein molecules) and digestive enzymes (hydrolytic) take actions in the catabolic breakdown of food, generally begin in the mouth and conclude within the small intestine. Because digestive enzymes are highly specific and require precise environment conditions for enzyme to function optimally, their hydrolytic activity can also be studied in a test tube. The specific purpose of this lab (activity 4) was to investigate fat digestion by pancreatic lipase and the action of bile, and to recognize whether fat digestion is ongoing or completed (2).

Methods:

The experiment was carried out by placing 6 test tubes, labeled 1 to 6, on the test tube holders in the incubation unit. Each test tube holds different solutions: test tube 1 contains lipase, vegetable oil, bile salts, and pH 7.0 buffer; test tube 2 contains lipase, vegetable oil, deionized water, and pH 7.0 buffer; test tube 3 contains lipase, deionized water, bile salts, and pH 9.0 buffer; test tube 4 contains deionized water, vegetable oil, bile salts, and pH 7.0 buffer; test tube 5 contains lipase, vegetable oil, bile salts, and pH

2.0 buffer; test tube 6 contains lipase, vegetable oil, bile salts, and pH 9.0 buffer. The test tubes were then incubated for 60 minutes at 37°C. After incubation, pH was measured for each test solutions using a pH meter, and the data was recorded. Measurements of pH were used to determine whether fat digestion occurred or not. A solution containing fatty acids liberated from fat will exhibit a lower pH than one without fatty acids (2).

Results:

Pancreatic Lipase Digestion of Fats and the Action of Bile

Tube no.	1	2	3	4	5	6
Additives	Lipase Vegetable oil Bile salts pH 7.0 buffer	Lipase Vegetable oil D.I. water pH 7.0 buffer	Lipase D.I. water Bile salts pH 9.0 buffer	D.I. water Vegetable oil Bile salts pH 7.0 buffer	Lipase Vegetable oil Bile salts pH 2.0 buffer	Lipase Vegetable oil Bile salts pH 9.0 buffer
Incubation condition	37°C 60 min.	37°C 60 min.	37°C 60 min.	37°C 60 min.	37°C 60 min.	37°C 60 min.
pH	6.21	6.72	9.0	7.0	2.0	8.97

The results showed that after 60 minutes of incubation, the pH for test tube 1 decreased from 7.0 to 6.21, the pH for test tube 2 (no bile salts) decreased from 7.0 to 6.72, there were no changes in pH for test tubes 3 (no vegetable oil), 4 (no lipase), and 5, and a slight decreased in pH for test tube 6.

Discussion:

It was the purpose of this lab to examine fat digestion by pancreatic lipase and the action of bile. Fat digestion is able to occur because of the action of bile. Bile is a substance produced by the liver and stored and released from the gall bladder. Bile salts are responsible for emulsification, preventing fat droplets from reforming into globules.

As for the pancreatic lipase, it acts on triglycerides (TG) to break the bonds that link the fatty acid chains to the glycerol backbone of the TG, resulting 3 fatty acid chains and a glycerol. Bile enhances fat digestion by lipase (1). From test tube 1, bile salts and lipase together boost the activity of fat digestion (pH decrease from 7.0 to 6.21). From test tube 2, lipase activity examined without bile salts, the activity of fat digestion occurred (pH decrease from 7.0 to 6.72) but not as enhancive. In test tube 5, even with the presence of bile salts and lipase, fat digestion does not occur because the buffer (pH of 2.0) is already quite acidic. In test tube 6, a small amount of fat digestion occurred because the pH decreased from 9.0 to 8.97.

Comparing test tubes 2 and 4, fat digestion occurs with the presence of pancreatic lipase but not with the presence of bile salts. Both test tubes have most substances similar, only that test tube 2 has lipase but not bile salts and test tube 4 has bile salts but not lipase. As a result, the pH in test tube 4 does not change, but the pH in test tube 2 decrease, indicating that fat digestion has occurred. Such incidents occur because the optimum pH for lipase activity is pH 7.0.

Fat digestion is essential because fat is the most concentrated source of food energy. When you ingest fewer calories than your body needs, your body turns to fat for energy. However, having free fatty acids is not bad because they are necessary to absorb vitamins and a major energy fuel of liver cells and skeletal muscle, which is important for body functioning.

Reference:

1. Marieb, E., & Hoehn, K. (2007). *Human Anatomy & Physiology* (7th ed.), p.884-947. San Francisco: Pearson Education Inc.

2. Zao P., Stabler T., Smith L., Gibson M., Zanetti N., and Lokuta A. (2006). PhysioEx 6.0 for A&P:Laboratory Simulations in Physiology. San Francisco: Pearson Education, Inc.