Yeshi Wangchuk

New York City College of Technology

BIO 2312 :Human Anatomy and Physiology 2

(2:30-5:00) Tuesday

Niloufar Haque

11/09/2021

INTRODUCTION

In order for us to carry out our everyday tasks, grow, and repair our body we must be properly fueled with energy and nutrients.Here's where digestion comes into play. What exactly is digestion? Digestion is the process through which our bodies convert the food we ingest into energy. Digestion is divided into two stages: mechanical breakdown and chemical breakdown.

Mechanical digestion, the breakdown of food into small digestible parts starts with chewing in your mouth and progresses to stomach churning. Peristalsis the involuntary contractions and relaxations of the muscles of your esophagus, stomach, and intestines that help break down food and transport it through our digestive system is also a part of the mechanical digestion. Chemical digestion is the process by which chemicals with a high molecular weight in food are broken down into smaller ones that may be absorbed by our bodies. Without chemical digestion our bodies won't be able to absorb nutrients from the food for our daily activities and health.Chemical digestion begins in the mouth and progresses to the intestine, with the stomach serving as the primary site of chemical digestion(“Difference between mechanical and Chemical digestion) https://pediaa.com/difference-between-mechanical-and-chemical-digestion/

The mouth, pharynx, esophagus, stomach, small and large intestine, rectum, and anus are the seven major organs that assist our bodies break down the food we ingest. The digestive process begins in our mouths. Along with the mouth, our accessory organs such as the teeth, tongue, salivary glands, liver, gallbladder, and pancreas all

play an important role in the initial process in the mouth. In our mouth is where mastication (chewing) occurs. Our salivary glands produce saliva, a digestive liquid that moistens food and allows it to pass more easily past your esophagus and into your stomach.When you swallow, your tongue moves food down your throat and into your esophagus. After the esophagus receives the food from our mouth the epiglottis folds over our windpipe as we swallow to prevent us from choking as the food travels down our windpipe. A series of muscle contractions known as peristalsis transports food from the esophagus to the stomach. But before that, a ring-like muscle at the bottom of our esophagus, also known as the lower esophageal sphincter, must relax in order for food to pass through to the stomach. The sphincter then closes to prevent food from traveling back into the esophagus. After the food reaches the stomach the food is mixed with stomach enzymes that continue to break down the food, these enzymes are secreted by the stomach lining. After the stomach has processed the food, it travels into the small intestine. The small intestine runs from our stomach to the large intestine and is made up of three sections: the duodenum, jejunum and the ileum. The duodenum is the first part of the small intestine where food is still being processed. In the duodenum, the pancreas secretes enzymes to aid in the breakdown of proteins, carbs, and lipids. The jejunum and ileum are primarily in charge of absorbing all of the nutrients from the food we digested. The small intestine also has little finger-like extensions that aid in the absorption of food as it passes through the small intestine. The Liver secretes Bile into the small intestine which plays an important role in breaking down the fat and some vitamins, after the intestine absorbs the nutrients the liver then processes those nutrients into chemicals that our body needs, and is also helpful in detoxifying harmful

chemicals for our body. The waste from the digestive process then enters our large intestine, the waste from the digestive process is passed through the large intestine in a liquid state and slowly solidifies as the large intestine absorbs water from the waste. Then through peristalsis the stool travels into the colon, when the colon becomes full it then empties the stool into the rectum and anus for excretion through bowel movements (Digestive system process and regulation)https://guides.hostos.cuny.edu/bio140/5-16. In digestion there are three major enzymes: amylase,pepsin, and lipase. Amylase is an enzyme that is produced in our pancreas, and salivary gland. Amylase is an enzyme that operates on starch in food. Amylase breaks down starch molecules into simple sugars, which our bodies can absorb more easily. Pepsin is an enzyme found in our gastric juice that breaks down proteins into smaller peptides and amino acids, making them easier to absorb in the small intestine. Lipase is an enzyme produced by our pancrea and the small intestine, the function of lipase is to break down fats,oils into glycerol and fatty acids(why are enzymes important https://www.healthline.com/health/why-are-enzymes-important). “The digestive enzymes are also hydrolytic enzymes or hydrolases meaning their substrates on which they act are organic food molecules which break down by adding water to the molecular bonds, thus cleaving the bonds between the chemical building blocks,or monomers”(Marieb 2016)

The objective for this lab is to examine the effects of enzymes interacting with their substrate during the digestive process. In this lab the enzyme and substrate combinations that we will examine are: amylase to starch, Trypsin to proteins, and lipase to lipids.

MATERIALS/Methods

Activity 1 is to test for the presence of starch by using amylase. For this activity the materials needed are: test tube rack, test tubes, wax marking pencil, dropper bottle of distilled water, dropper bottle of maltose, amylase, and starch solutions, spot plate, boiling chips, and water baths. Tubes 1A to 3A are prepared as the controls while test tube 4A to 6A are prepared as the experimentals. Test tube 1A-3A was filled with 5gtt of water with 3gtt amylase solution in 1A, 3gtt starch solution in 2A, and 3gtt maltose solution in 3A. After being placed in 37 degree Celsius water each test tube was tested with lugol's iodine solution (IKI) and the benedict's solution " A blue black color indicates presence of starch and is referred to as positive starch test and if the starch is not present the mixture will not turn blue referring to as a negative starch test"(Marieb 2016). Then another 3 new test tubes were used 4A-6A test tube 4A was boiled with 3gtt of amylase for 4 minutes before adding starch, 5A had amylase and starch which were mixed in a 37 degree celsius and 6A at a temperature of 0 degree celsius.

Activity 2 involves using trypsin to test for protein digestion. For this activity the materials needed are: test tubes,test tube rack,dropper bottle of trypsin and one of BAPNA, and wax pencils. Test tube 1T and 2T are the controls for this experiment and test tubes 3T-5T are the experimental. Test tube 1t was filled with 5gtt of water along with 3gtt of trypsin, Test tube 2t was filled with 5gtt of water with 3gtt of BAPNA, test tube 3t-5t was filled with 5gtt of water along with 3gtt of trypsin. "Since BAPNA is a synthetic color producing substrate the presence of yellow color indicates a positive

hydrolysis test; the dye molecule has been cleaved from the amino acid, if a sample mixture remains clear a negative hydrolysis test has occurred”(Marieb 2016).

Activity 3 involves using lipase to test bile emulsification and lipid digestion.For this activity the materials needed are: test tubes, test tube rack, litmus cream,bile salt, pancreatic dropper bottle. In this activity 1L-2L are the control while 3l to 5l,4b and 5b are the experimental sample. In tube 1L 5gtt of water was added along with 3gtt of pancreatin, in test tube 2L 5gtt of water was added along with litmus cream, “ fresh cream provides the fat substrate for this assay; add litmus powder to it to make litmus cream The basis of this assay is a pH change that is detected by the litmus powder indicator. Alkaline or neutral solutions containing litmus are blue but will turn reddish in the presence of acid. If digestion occurs, the fatty acids produced will turn the litmus cream from blue to pink. Because of the effect of hydrolysis by lipase”(Marieb 2016). After in a new test tube (3L) 3 drops of pancreatin was added and then boiled for 4 minutes before adding 3 drops of litmus cream to identify if hydrolysis occurred at high temperatures. Then for the experimental tubes 3 drops of pancreatin and 3 drops of litmus cream were added to tubes 4l and 5l, tube 4L was tested at room temperature of 37 degree celsius while test tube 5l was tested at 0 degree celsius, Finally 3 drops of litmus cream and pancreatin were added in tubes 4B and 5B with bile salt to see if there is any lipid breakdown additionally 4b was tested in 37 degree celsius while 5b was tested in 0 degree celsius.

Results/Data

Activity 1: Salivary Amylase Digestion of Starch

Tube No.	**1A**	**2A**	**3A**	**4A**	**5A**	**6A**
Additives (3 gtt ea)	**Amylase, Water**	**Starch, Water**	**Maltose, Water**	**Amylase (4min boil then + starch)** **Boiled Amylase, Starch**	**Amylase, Starch**	**Amylase, Starch**
Incubation Condition	37°C	37°C	37°C	37°C	37°C	0°C
IKI Test (color change)	No color	Color	No color	Color	No color	Color
Result (+) or (-)	Negative	Positive	Negative	Positive	Negative	Positive
Benedict's Test (color change)	No color	No color	Color	No color	Color	Some color
Result (+) or (-)	Negative	Negative	Positive	Negative	Positive	Negative

Activity 2: Trypsin Digestion of Protein

Tube No.	**1T**	**2T**	**3T**	**4T**	**5T**
Additives (3 gtt ea)	**Trypsin, Water**	**BAPNA, Water**	**Trypsin (4min boil then +BAPNA)** **Boiled Trypsin, BAPNA**	**Trypsin, BAPNA**	**Trypsin, BAPNA**
Incubation Condition	37°C	37°C	37°C↑	37°C	0°C

Color change	No color	No color	No color	Color	Some color
Result (+) or (-)	Negative	Negative	Negative	Positive	Negative

Activity 3: Pancreatic Lipase Digestion oF Fats

Tube No.	**1L**	**2L**	**3L**	**4L**	**5L**	**4B**	**5B**
Additives (3 gtt ea)	**Pancreatin, Water**	**Litmus Cream, Water**	**Pancreatin (4min boil then + Litmus Cream)** **Boiled Pancreatin, Litmus Cream**	**Pancreatin, Litmus Cream,**	**Pancreatin, Litmus Cream,**	**Pancreatin, Litmus Cream, Bile Salts**	**Pancreatin, Litmus Cream, Bile Salts**
Incubation Condition	37°C	37°C	37°C ↑	37°C	0°C	37°C	0°C
Color Change	No color	No color	No color	Color	No color	Color	Some color
Result (+) or (-)	Negative	Negative	Negative	Positive	Negative	Positive	Negative

Discussion/Conclusion

activity 1 digestion of starch, test tubes 1A to 3A were prepared as the control variable. Tube 1A contained only amylase and water and because of this both the benedict's test and the IKI test came out negative, tube 2A contained starch and water and because of this the benedict's test came out negative but because of the starch present the IKI test came out positive resulting in a color change, tube 3A contained maltose and water

and because the tube contained maltose it tested positive for the benedict's test but negative for the IKI test. Tube 4a contained boiled amylase which was then introduced to starch because amylase was heated the enzyme denatured and was unable to digest starch resulting in positive for the IKI test but negative for the benedict's test,Tube 5a contained amylase and starch at 37 degree celsius which resulted in negative for the IKI test but positive for the benedict's test which shows that this is an ideal temperature for the enzyme to digest starch, Tube 6A containing amylase and starch at 0 degree celsius resulting in negative for the benedict's test but positive for the IKI test this shows that the enzyme wasn't able to digest starch at 0 degree celsius. This was caused by the cold temperature causing the enzyme to work at a very slow pace.

Activity 2 protein digestion, test tube 1T-2T were prepared as the control variable. Tube 1T contained trypsin and water and because there was no substrate for the enzyme the test came out negative and no color from the BAPNA, tube 2T contained BPNA and water and because BPNA had nothing to react to the test came back negative. Tube 3t the trypsin was boiled for 4 minutes before adding BAPNA and the result came back negative. This was caused because the enzyme was denatured by the extreme heat making it unable to digest. Tube 4t contained trypsin and BAPNA at 37 degree celsius which resulted in a positive result which shows that enzymes work best at 37 degrees. Lastly tube 5t contained trypsin and BAPNA at 0 degree celsius which resulted in some color meaning that the enzyme is digesting but at a very slow rate making it result in negative.

Activity 3 digestion of fats, test tube 1L-2L were prepared as the control variable. Tube 1L contained pancreatin and water because there was no substrate no digestion

occurred resulting in a negative result, Tube 2l contained litmus cream and water similar to tube 1l there was no substrate there was nothing to digest resulting in the test being negative, test tube 3l contained pancreatin which was boiled for 4 minutes then introduced to litmus cream which resulted in a negative result this was because the the pancreatin was boiled causing the enzyme to denature making it unable to digest the substrate. Tube 4L contains pancreatin and litmus cream at 37 degree celsius which resulted in the test being positive which shows that at 37 degrees the enzymes were able to work properly and digest the fat, tube 5l contained pancreatin and litmus cream at a 0 degree celsius which resulted in the test being negative which shows that the enzymes weren't able to work in the cold temperature. Tube 4B which contained pancreatin, litmus cream, and bile salt at 37 degrees which resulted in a positive result and cause the color to be reddish this is because the bile salt helped the enzyme digest and emulsify the fat more efficiently, Lastly in 5B which contains pancreatin, litmus cream, and bile salt at 0 degree celsius resulted in a negative result this was because even though the enzymes are digesting the substrate it is doing it at a much slower pace because of the temperature resulting in a negative outcome. Overall this lab was very useful, this lab taught me about the activities of enzymes and how different enzymes throughout our body help aid digestion so that our body can absorb the nutrients we gain from food and use it for our daily needs. It was very interesting going in depth about each part of digestion and what each does when we eat food.

References

https://guides.hostos.cuny.edu/bio140/5-16

https://pediaa.com/difference-between-mechanical-and-chemical-digestion/

https://my.clevelandclinic.org/health/articles/7041-the-structure-and-function-of-the-digestive-system

Marieb, E. N., Mitchell, S. J., & Zao, P. Z. (2016). Human Anatomy & Physiology Laboratory Manual: Fetal pig version. Pearson.