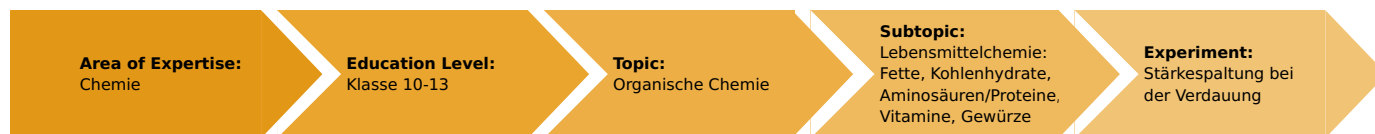


Cleavage of starch during digestion (Item No.: P7187700)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



20 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

starch, digestion, cleavage of starch

Task and equipment

Information for teachers

Additional Information

Most foods contain carbohydrates in the form of starch.

The digestive process begins with the chewing action, during which starch is decomposed to maltose.

Notes on content and learning objectives

- Maltose (= malt sugar) can be detected with Fehling's solution and so be differentiated from starch.
- Foods containing starch supply malt sugar on digestion.
- Maltose consists of two glucose molecules.

Notes on the method

The terms grape sugar - glucose, or malt sugar - maltose, should be discussed and their molecular structure worked out. Further detection methods for glucose are given in the experiment "Reducing properties of glucose".

Fundamentals and remarks

The most important monosaccharides, glucose and fructose, act reducingly in alkaline media. Similarly, the disaccharides lactose (milk sugar) and maltose (malt sugar) have reducing properties. All are present in alkaline media in the open-chain aldehyd- or keto-form. They react with Fehling's solution by reducing the copper(II) ions to copper(I) oxide. Sucrose does not react with Fehling's solution, as this disaccharide from fructose and glucose (2,1 glycosidic linkage) has no free aldehyd- or keto-groups.

Hints on going deeper

- During the making of Westfalian (Westfalia, region in Germany) "pumpernickel" (slightly sweet rye bread with coarsely ground rye), starch from barley is converted enzymatically to maltose by means of a special baking method.
- In beer brewing, the "wort" is first prepared. Barley is brought to germination. During this process, enzymes convert starch to malt sugar. Yeast fungi convert the malt sugar to alcohol in the "fermentation" process.

Notes on the set-up and procedure

Preparation:

The reducing properties of other sugars can also be shown in this experiment. Malt beer is also suitable for use.

Notes on the students experiment:

Ensure that the same amounts of Fehling's solution I and II are pipetted into the test tube.

**Hazard and Precautionary statements**

Fehling's solution

I:

H411: Toxic to aquatic life with long lasting effects.

P273: Avoid release to the environment.

Fehling's solution

II:

H314: Causes severe skin burns and eye damage.

P280: Wear protective gloves/protective clothing/eye protection/face protection.

P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do - continue rinsing.

P309 + P311: IF exposed or you feel unwell: Call a POISON CENTER or doctor/physician.

Hazards

- Fehling's solution is corrosive.
- Wear protective gloves and protective glasses!

Waste disposal

Pour the filtrate into the container for heavy metal solutions.

Cleavage of starch during digestion (Item No.: P7187700)

Task and equipment

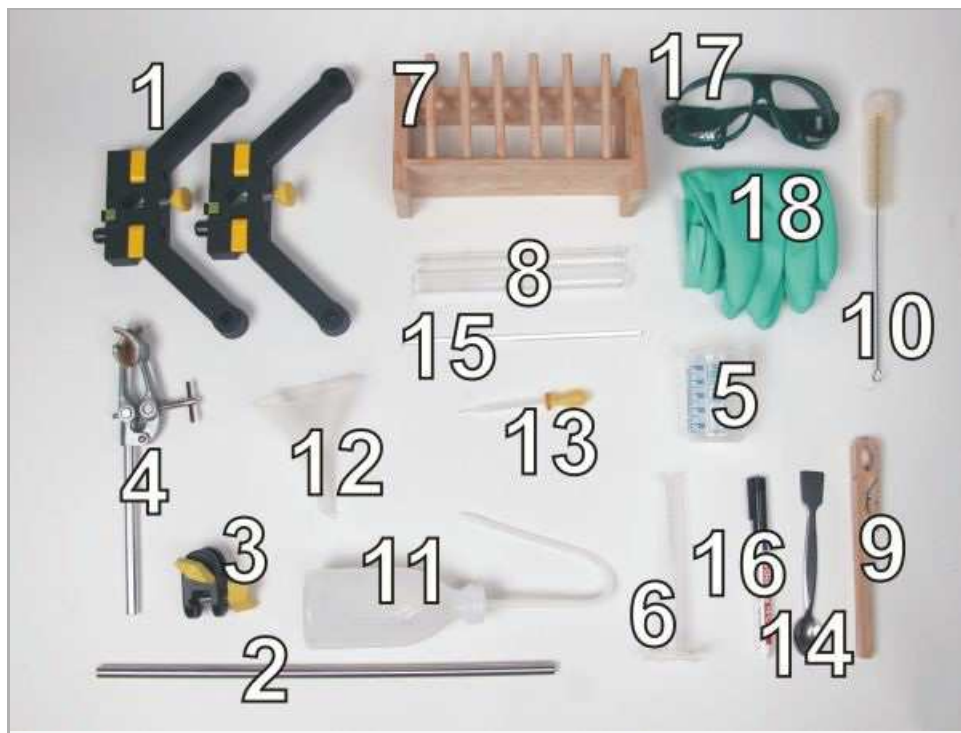
Task

How is starch cleaved during digestion?

Prove that starch is decomposed by the digestive enzyme ptyalin to malt sugar.



Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Boss head	02043-00	1
4	Universal clamp	37715-00	1
5	Beaker, 100 ml, low form, stackable, plastic	36081-00	1
6	Graduated cylinder, 10 ml, plastic	36636-00	1
7	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
8	Test tube, 180x18 mm,100pcs	37658-10	(2)
9	Test tube holder, up to d 22mm	38823-00	1
10	Test tube brush w. wool tip,d25mm	38762-00	1
11	Wash bottle, 250 ml, plastic	33930-00	1
12	Filter funnel, d = 75 mm, PP	46895-00	1
13	Pipette with rubber bulb	64701-00	1
14	Spoon, special steel	33398-00	1
15	Glass rod, boro 3.3, l=200mm, d=6mm	40485-04	1
16	Labor pencil, waterproof	38711-00	1
17	Protecting glasses, clear glass	39316-00	1
18	Rubber gloves, size S (7)	39325-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane cartridge CV 300 Plus, 240 g	47538-01	1
	Fehling's solution I 1000 ml	30079-70	1
	Fehling's solution II 500 ml	30080-50	1
	Water, distilled 5 l	31246-81	1
	folded filter,qual.,150 mm,100pcs	47580-04	1
Additional material			
	White bread		

Set-up and procedure

Set-up

Hazards

- Fehling's solution is damaging to health when swallowed and can corrode skin on contact.
- Wear protective glasses and protective gloves!



Setup

Number four test tubes from 1 to 2 and stand them next to each other in the test tube rack (Fig. 1).

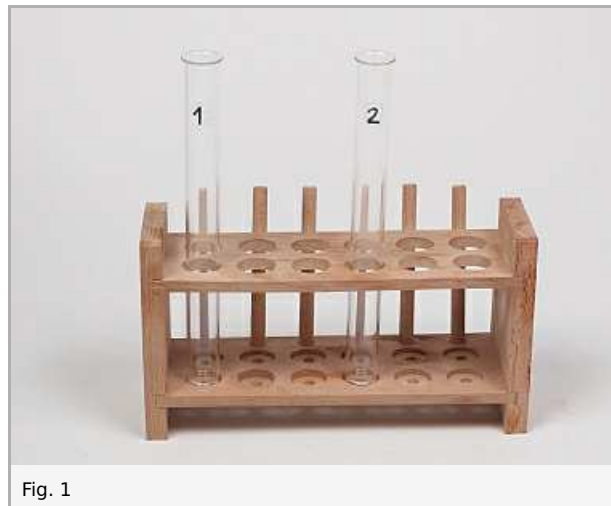


Fig. 1

Assemble the stand as shown in figures 2 to 5.



Fig. 2



Fig. 3



Fig. 4



Fig. 5

Adjust the funnel so that it hangs upright above test tube 1 (Fig. 6).



Fig. 6

Procedure

Chew a piece of white bread for about 3 minutes. Note the change in taste.



Spit the paste in a 100 ml lab beaker, add about 10 ml of distilled water, mix with a glass rod (Fig. 8) and filter into test tube 1 as can be seen in Figure 9.



Mix 2 ml of Fehling's solution I and 2 ml of Fehling's solution II in test tube 2.

Add 2 ml of the prepared filtrate to the mixture of Fehling's solutions in test tube 2 (Fig. 10). Fix the test tube in the test tube holder and heat carefully, under continuous shaking (Fig. 11).



After boiling for a short time, place the test tube back in the test tube rack and extinguish the bunsen burner flame.

Waste disposal

Pour the filtrate into the container for heavy metal solutions.

Report: Cleavage of starch during digestion

Result - Observations

Note your observations in the following succession:

- a) Taste on chewing
- b) Reaction with Fehling's solution

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Evaluation - Question 1

Draw conclusions form your observations.

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Evaluation - Question 2

Draw conclusions from the change in colour of the precipitate.

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Evaluation - Question 3

Complete the following statements:

1. Malt sugar forms a with Fehling's solution.
2. Saliva contains the digestive enzyme
3. Starch is split by ptyalin to