

## C2 Carbohydrates as providers of energy for metabolism – Starch and sugar

### 1 Potatoes contain starch

#### 1.1 Apparatus and materials

- 1 iodine tincture (iodine/potassium iodide solution), dropper bottle
- 1 knife (for all students)
- Newspaper or cardboard as surface to work on
- 1 potato, cassava, piece of white bread

**Attention:** After you have completed the experiment, return the materials or dispose of them properly as instructed by your teacher.

#### 1.2 Safety information

The materials may be used only as instructed by your teacher or as described in the experimentation instructions.

If the iodine tincture splashes onto your skin, immediately wash it off thoroughly with clear water.

#### 1.3 Conducting the experiment

- Cut a slice of vegetable (potato or cassava) and put a drop of iodine tincture on the cut surface.
- You can apply the iodine tincture directly onto the bread.
- What happens?



Fig. 1: Cut slice.

#### 1.4 Observation

Write down a summary of your observations.

#### 1.5 Analysis

- a) Formulate your assumption about which substance in the food could cause the color change.
- b) State one way in which this assumption could be tested (see also subexperiment 2).

## 2 Hydrolysis of starch

### 2.1 Apparatus and materials

- 1 iodine tincture (iodine/potassium iodide solution), dropper bottle
- 1 lighter or matches
- Newspaper or cardboard as surface to work on
- 1 plant clip (as test tube holder)
- 1 plastic cup, 100 ml
- 2 plastic cups, 500 ml, for the water or “waste water”
- Starch (“potato flour”)
- Tap water, or better, distilled water
- 1 tea light
- 1 teaspoon
- 2 test tubes, glass, 13 cm
- 1 test tube clamp
- 1 test tube stopper

**Attention:** After you have completed the experiment, return the materials or dispose of them properly as instructed by your teacher.

### 2.2 Safety information

The materials may be used only as instructed by your teacher or as described in the experimentation instructions.

For this experiment, be aware of the following risks:

- If the iodine tincture splashes onto your skin, immediately wash it off thoroughly with clear water.
- The starch is not suitable for consumption.
- Take care when working with a flame that you don't burn yourself or start a fire.

### 2.3 Conducting the experiment

#### 2.3.1 Making the starch solution

If your teacher provides a 0.1% starch solution, you can skip this step. Otherwise, you must first make the starch solution yourself.

- Add a small amount (less than fits on the tip of the teaspoon handle) of potato starch to a test tube and fill the test tube to approx. 10 cm with (distilled) water.
- Shake it thoroughly and pour off the water until only about 1 cm remains in the test tube.
- Now fill the test tube to approx. 5 cm with water.
- Heat the test tube over the tea light until the solution just starts to boil.
- Allow the test tube to cool to room temperature. The solution should now be completely clear and must no longer contain any visible starch grains. (Otherwise, you must pour off more of the solution and dilute it.)



Fig. 2: The starch solution should be completely clear.

### 2.3.2 Starch solution, once with and once without saliva

- Fill two test tubes each approx. 2.5 cm high with starch solution.  
(If you just prepared the starch solution yourself, pour half of the starch solution into the second test tube.
- Set one test tube aside.
- Then add saliva to the second test tube, close it with the stopper, and shake it thoroughly.
- Shake this test tube every 5 minutes for the next 15 minutes.

### 2.3.3 Adding iodine solution to both test tubes

- Now make a diluted iodine solution: To do so, fill the plastic cup approx. 1 cm high with water and add one drop of iodine tincture. Carefully swirl the cup to mix the water and the iodine tincture.
- Now add just enough of this diluted iodine solution drop by drop to the first test tube set aside until you notice an effect.
- Now add the same amount of the diluted iodine solution to the second test tube (the one with the saliva).

## 2.4 Observation

Write down a summary of the differences you observe when you add the diluted iodine tincture to the first and second test tubes.

## 2.5 Analysis

- a) Explain your observations and explain the effect of the saliva.
- b) What is the connection between the first subexperiment and subexperiment 2?
- c) Formulate a reaction equation for the observed phenomenon.

## 2.6 Questions

- a) What is the name of the group of substances that includes the substance in the food you investigated in subexperiment 1?
- b) What other foods contain similar substances?
- c) What other nutrients are important for us?
- d) What path does food take through the human body? Explain the path.
- e) Any nutritional guide will tell you that chewing your food well is important for digestion. How can this be explained from the biological and chemical perspectives?

For further study:

- f) Find out information about enzyme reactions. What are enzymes needed for in the body?
- g) How are nutrients broken down in the human body?
- h) Reverse reaction: If you have too much glucose in the blood, the liver can combine the excess molecules to form the storage substance glycogen. This corresponds formally to the reverse reaction of those you learned about in this experiment. Find out information about glycogen and formulate a reaction equation for its synthesis.