**ACTIVITY: Salivary amylase and starch**

**Activity idea**

In this activity, students investigate the action of salivary amylase on starch present in cooked rice. Simple tests for starch and its digestion product, maltose, are applied.

By the end of this activity, students should be able to:

* use simple chemical tests to identify soluble starch and reducing sugars like glucose and maltose
* safely use their own salivary amylase
* explain in simple terms how the enzymatic digestion of starch occurs
* recognise the need for careful control of variables such as temperature and amount of reactant in activities of this type
* describe how high temperatures can inactivate enzymes like amylase.

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**Introduction/background**

When cooked rice is chewed and mixed with saliva in the mouth, chemical digestion of the starch present in the rice grains begins. On entry to the stomach, this digestion process is temporarily halted but begins again when the stomach contents are passed into the first section of the small intestine. Here, more of the enzyme amylase is made available, and the starch digestion process continues.

This activity attempts to mimic the starch digestion process that occurs in the mouth and small intestine. Students investigate the action of salivary amylase on starch present in cooked rice. The heat sensitivity of this enzyme will also be investigated. Simple tests for starch and its digestion product, glucose, will be applied.

Most people’s saliva contains the starch-digesting enzyme amylase. The activity of this enzyme can vary from one person to another, but most people have some degree of activity.

***Safety***

* Wear eye protection when handling chemicals and heating with a Bunsen burner.
* Observe good hygiene practice when working with saliva.

**What you need**

* Small disposable plastic cups
* 2 x 250mL glass beakers, 1 x 50mL glass beaker
* Thermometer
* Stirring rod
* Teat pipette
* White dimple spotting tile
* Bunsen burner, tripod and gauze
* Spatula or small spoon
* 3 x boiling tubes, 4 x test tubes in a test tube rack
* 1% starch solution
* 0.02 molL-1 iodine solution
* Boiled rice (enough to fill a boiling tube)
* Benedict’s solution
* 0.1 molL-1 glucose solution
* Copies of the student worksheet: [Testing saliva](#testing)

**What to do**

1. Give out copies of the student worksheet and assist students to gather the materials they need and complete the experiment. It is important that students work with their own saliva.
2. Discuss the findings:

* Amylase converts starch into maltose. Like glucose, it is a reducing sugar and gives a positive result when tested with Benedict’s solution. Maltose is a disaccharide with each molecule made up of 2 glucose molecules linked together.
* The activity of salivary amylase does vary from 1 individual to another.

**Testing saliva**

1. Using a clean teat pipette, place a drop of starch solution in 1 of the dimples in the spotting tile. Add a drop of iodine solution and note what happens.
2. Place 2cm of Benedict’s solution into 1 of the test tubes. Add an equal depth of glucose solution. Place the test tube in a 250mL beaker half full of hot water and leave for several minutes. Note what happens.
3. Half fill a disposable plastic cup with warm water. Take a mouthful of water, rinse around in your mouth for 10 seconds and carefully spit out to waste. Take another mouthful and rinse again but this time carefully spit it back into the cup. (This is your sample of salivary amylase.) Pour half of this sample into a 50mL glass beaker, place on a gauze mat on top of a tripod and heat gently to boiling over a Bunsen burner. Set aside to cool.
4. Clearly label the boiling tubes – 1 (control), 2 (saliva), 3 (boiled saliva). One-third fill each tube with pre-boiled and drained rice. Add 10mL of water to tube 1. From the disposable cup, pour the saliva into tube 2. From the 50mL beaker, pour the cooled boiled saliva into tube 3.
5. Place each tube in a 250mL beaker half full of warm water set at 37°C. (Use a thermometer to monitor the temperature. If heating is required, add small amounts of hot water to the beaker or place on a tripod and heat gently with a Bunsen burner.)
6. With a glass rod, gently stir the contents of each tube in turn making sure the rod is cleaned between tubes. Continue with this for 15 minutes.
7. After 15 minutes has elapsed, using a teat pipette, carefully remove a sample of liquid from tube 1 and place a drop in a dimple of the spotting tile. Repeat this for tubes 2 and 3, making sure the pipette is cleaned between samples.
8. To each loaded dimple, add a drop of iodine solution and note what happens in each case.
9. If no significant colour difference is observed between samples, set aside for a further 10 minutes and retest.
10. If a significant colour difference is observed between samples, extract samples of liquid from each tubes and place in each of 3 clean test tubes. To each tube, add 2mL of Benedict’s solution and place the tubes in a 250mL beaker one-third full of boiling water. Set aside for several minutes and note any colour change.

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| **Test with iodine** | **Tube #1** | **Tube #2** | **Tube #3** |
| After 15 minutes |  |  |  |
| After 25 minutes |  |  |  |
| Test with Benedict’s solution |  |  |  |

1. From the preliminary tests and your observations, describe the action salivary amylase has on boiled rice, a starch-rich food. What effect does heating have?