

## DOES HEATING OR FREEZING AFFECT THE SETTING OF PINEAPPLE JELLY?

What steps can you take to make sure this experiment is fair?

Do you find the same results with vegetarian jelly?

Does adding chilli make a difference?

Do you find the same results with kiwi, papaya, apple?



### Equipment required

A packet of jelly

Measuring jug

Pineapple chunks

Microwave

Freezer

4 x small bowls

### To be used by an adult:

Knife

Kettle

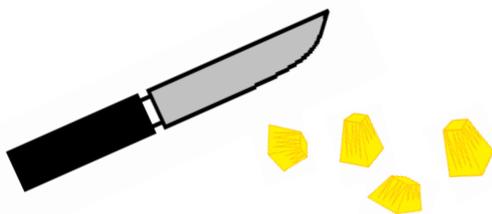
Can you explain your findings?

# Kitchen Chemistry: Enzymes in Pineapple

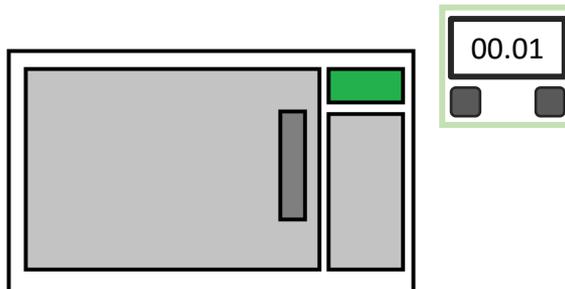
DEPARTMENT OF CHEMISTRY



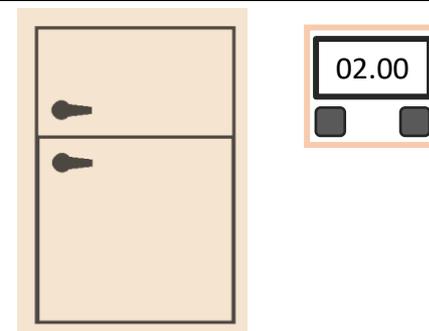
**1** Ask an adult to chop a portion of pineapple into small chunks.



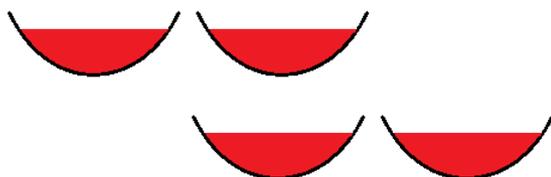
**2** Microwave a handful of chunks for 1 minute.



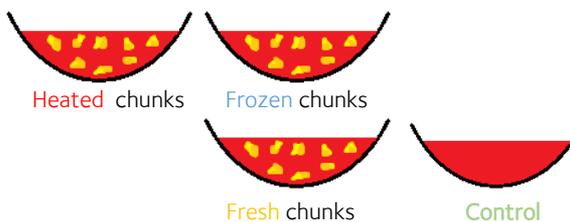
**3** Freeze a handful of chunks for 2 hours.



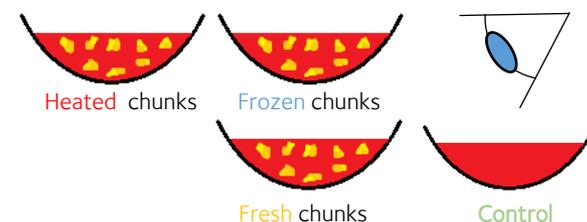
**4** Ask an adult to prepare the jelly in 4 separate small bowls.



**5** Add the **heated**, **frozen** and **fresh** pineapple chunks into each bowl, leaving the 4<sup>th</sup> as a **control**.



**6** Place the bowls into the fridge. Once the jelly in the **control** bowl has set, observe the results.

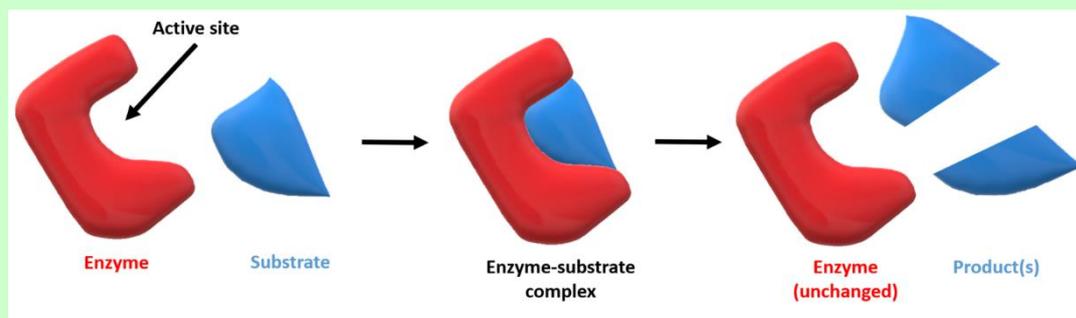


*This set of resources are adapted from the RSC Kitchen Chemistry resource, written by Ted Lister in collaboration with Heston Blumenthal. The integrated instructions are inspired by the work of David Paterson.*

## Kitchen Chemistry: Enzymes in Pineapple

### Scientific explanation

Enzymes are biological molecules that speed up important reactions that occur in nature. For example, the enzymes in our digestive system are able to break down different types of food quickly so that we can absorb the nutrients. Enzymes are made up of proteins that are folded to produce a shape that is specific to the enzyme's function. The shape provides a specific space where the reactions take place. This is called the active site.



Jelly contains gelatine which sets the jelly when added to hot water. Gelatine is derived from the protein collagen. The enzyme in fresh\* pineapple, bromelin, breaks down collagen and this prevents the jelly from setting. If the shape of the active site is distorted, the enzyme can no longer function and is described as being denatured. The aim of this experiment is to investigate if heating or freezing can affect the shape, and, therefore, the function of the enzymes in pineapple.

\*frozen pineapple can be used as the freezing process does not denature the enzymes.

### Practical investigation:

#### Equipment:

- |   |  |  |
|---|--|--|
| <input type="checkbox"/> Packet of Jelly        | <input type="checkbox"/> Fridge Freezer  | <input type="checkbox"/> Papaya (optional)           |
| <input type="checkbox"/> Fresh/frozen pineapple | <input type="checkbox"/> 4 x small bowls | <input type="checkbox"/> Kiwi (optional)             |
| <input type="checkbox"/> Measuring jug          | <input type="checkbox"/> Knife*          | <input type="checkbox"/> Chillies (optional)         |
| <input type="checkbox"/> Microwave              | <input type="checkbox"/> Kettle*         | <input type="checkbox"/> Vegetarian jelly (optional) |
|   | * Adult use only                         |  |

### Method

1. Prepare the pineapple chunks by chopping into small (approx. 1 cm<sup>3</sup>) pieces, trying to keep the sizes of the chunks relatively consistent. You will need enough to place roughly a handful into each of three small bowls (one bowl will act as the control with no pineapple chunks in it).
2. Microwave one portion of pineapple chunks for one minute.
3. Place one portion of pineapple chunks in the freezer for two hours.
4. Once the heated and frozen pineapple is ready, follow the instructions on the packet of jelly to make enough jelly to dispense into four even portions into four separate bowls, boiling water will have to be poured by yourself as the adult in order to make the jelly.
5. Once you have poured the jelly mixture into four separate bowls, add the pineapple chunks into the bowls as follows: 1. heated chunks, 2. frozen chunks, 3. fresh chunks, 4. *no* pineapple chunks.
6. Place all four bowls into the fridge.
7. Allow enough time for the jelly in bowl 4 (the control) to set for 2-4 hours before observing the results.

### Questions:

- a) What steps can you take to make sure that this experiment is fair? [Make sure pineapple chunks are a relatively consistent size/ keep quantities of jelly and pineapple consistent/ use the same batch of jelly for each bowl]
- b) Do you find the same results with vegetarian jelly? [vegetarian jelly usually contains carrageenan (found in seaweed) which is not affected by the enzymes in pineapple]
- c) Does adding chilli make a difference? [Chilli peppers allow the jelly to set by interfering with the enzyme activity in the fruit. However, results are not always consistent, so it may be interesting to investigate different masses of chilli, different types of chillies, or even different forms of chilli (fresh vs. powder)]
- d) Do you find the same results with kiwi, papaya, apple? [kiwi contains the enzyme actinidin, papaya contains the enzyme papain, both act in the same way as bromelin, and prevent jelly setting.]



Professor Nicholas Kurti was a physicist at the University of Oxford. He would experiment with a variety of fascinating scientific cooking techniques such as using pineapple juice as a meat tenderiser.

You can learn about the Vincent Group at the University of Oxford's Department of Chemistry and how they specialise in utilising enzymes in new and efficient ways:

[What can Chemists learn from nature?](#)