**ACTIVITY: Enzyme action**

**Activity idea**

In this activity, students investigate the effect that fruit purees (pineapple, kiwifruit, peach) have on the setting of party jellies.

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

* describe the action of proteolytic enzymes found in some fresh fruit purees on gelatine
* name the proteolytic enzymes found in pineapple (bromelin) and kiwifruit (actinidin)
* explain the temperature sensitivity of these enzymes
* extrapolate the findings of this activity to the effect raw sliced kiwifruit has on pavlova
* understand why a fresh pineapple piece held in the mouth for a minute or so can lead to a feeling of discomfort.

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**Introduction/background**

Children’s birthday parties often include flavoured jellies as one of the party foods. The wobbling of the jelly, its fruity flavour and its ice cream partner makes it a popular treat. Sometimes, slices of fresh fruit, such as peaches, are added to the party jelly to improve its appeal.

These jellies are based on gelatine, which is derived from a structural protein called collagen. This protein is present in animal tissues such as muscle and bone.

In this activity, students will investigate the effect that some fresh fruit purees, such as pineapple and kiwifruit, have on freshly made-up jelly as well on the setting process when making jelly.

The effect of heating the fruit puree before adding it to the jelly will also be investigated.

Fresh fruit purees made from pineapple and kiwifruit contain enzymes capable of breaking down the proteins present in gelatine.

By placing small drops of puree on ice-block size party jelly pieces and leaving aside for 20 minutes or so, small indentations in the blocks are formed, indicating enzyme action on the gelatine.

The setting of the jelly is also investigated. Fresh puree is added to the cooled gelatine solution prior to setting and the effects of these additions on the setting time compared.

**What you need**

* Fresh pineapple puree and kiwifruit puree
* Pack of party jelly crystals
* Dishes in which to set the jelly – ice cube tray or small Petri dishes
* Stirring rod and teaspoon
* 100mL beaker
* 2 x 50mL beakers
* Bunsen burner, tripod, gauze and heat-proof mat or other heating means
* Access to a fridge/freezer
* Copies of the student worksheet: [Adding fruit puree to jelly](#adding)

**What to do**

1. Give out copies of the student worksheet [Adding fruit puree to jelly](#adding) and assist students to gather the materials they need and complete the experiment.
2. Discuss the findings:

* The surface of the jelly overlaid with the unheated purees should show indentation and pitting. Some of the surface will have been dissolved away.
* The surface of the jelly overlaid with the heated purees and the control jelly surface should be unaffected.
* The jelly solutions containing the unheated purees should not have set satisfactorily.
* The jelly solutions containing the heated purees and the control should have set.

***Explanation***

Fresh pineapple puree contains an enzyme called bromelin. It is a protease enzyme that is capable of breaking down the protein chains present in the gelatine. As a result, the gelatine solution, used to make party jelly, fails to set.

Fresh kiwifruit puree contains an enzyme called actinidin. Like bromelin, it too is a protease and interferes with the setting of party jelly.

Fresh pineapple juice can be used to tenderise tough cuts of meat. The bromelin enzyme softens the tough collagen fibres present in the connective tissue in the meat.

If a small piece of fresh pineapple is placed between your teeth and lips and held there for about 30 seconds, a feeling of discomfort is experienced. This is caused by the bromelin breaking down parts of the tissue lining the mouth, initiating a pain response.

When foods are canned, they have to be heated to a high temperature. Any enzymes present are inactivated as a result. Canned pineapple can be used in party jellies but not fresh pineapple.

Actinidin present in kiwifruit can also act on milk proteins. Slices of kiwifruit placed atop the thick layer of cream on pavlova slowly hydrolyse some of the milk proteins, and after a while, the cream liquefies.

**Adding fruit puree to jelly**

***Puree on the jelly***

1. Add 50mL of water to the 100mL beaker and heat to boiling.

1. Add sufficient jelly crystals as per the instructions on the pack and stir to dissolve. Allow the solution to cool.
2. Half fill each of 3 small Petri dishes with the cooled solution and allow it to set. (Placing in a fridge or freezer will speed up this process.)
3. Place a teaspoon of the pineapple puree into a 50mL beaker and heat gently over a Bunsen burner for several minutes.
4. Repeat this process with the kiwifruit puree in the second 50mL beaker.
5. When the jelly has set, carefully place half a teaspoon of the unheated pineapple puree to the right of centre of one of the ‘jellied’ Petri dishes and the heated puree to the left of centre. Keep them separate.
6. Repeat with another ‘jellied’ Petri dish but, this time, add half a teaspoon of pureed kiwifruit.
7. The remaining ‘jellied’ Petri dish has nothing added to it as it will serve as the control.
8. Set the dishes aside in the same place and at room temperature and leave for 20 minutes.
9. After 20 minutes, carefully inspect each of the dishes in particular around the area of the fruit puree. Compare with the control dish. Note your observations.
10. Leave for another 20 minutes and inspect each of the dishes again. Note your observations on the results and interpretation sheet provided.

***Puree in the jelly***

1. Half fill each of 5 small Petri dishes with the remaining jelly solution.
2. To one of the dishes, add half a teaspoon of unheated pureed pineapple, mix thoroughly with the solution and set it aside.
3. Repeat with another Petri dish, but add half a teaspoon of the heated pureed pineapple, mix thoroughly with the solution and set it aside.
4. Repeat using the unheated and heated kiwifruit pulp instead of pineapple.
5. The remaining ‘jellied’ Petri dish has nothing added to it as it will serve as the control.
6. To speed up the setting process, the dishes can be placed in a fridge or freezer.
7. Inspect each dish at regular intervals. Note your observations.

**Results and interpretation sheet**

***Puree on the jelly***

|  |  |
| --- | --- |
| Pureed pineapple |  |
| Pureed heated pineapple |  |
| Pureed kiwifruit |  |
| Pureed heated kiwifruit |  |
| Control |  |

***Puree in the jelly***

|  |  |
| --- | --- |
| Pureed pineapple |  |
| Pureed heated pineapple |  |
| Pureed kiwifruit |  |
| Pureed heated kiwifruit |  |
| Control |  |

***Interpretation***

Fresh pineapple puree contains an enzyme called bromelin. It is a heat-sensitive protease enzyme that is capable of breaking down the protein chains present in the gelatine – the main constituent of party jelly crystals.

Fresh kiwifruit puree contains an enzyme called actinidin. It is also a heat-sensitive protease.

Use this information to explain your observations.