14–16 years

Measuring vitamin C in fruit using a microscale titration

ROYAL SOCIETY OF CHEMISTRY

Education
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Think, pair, share

Where do we get vitamin C from?

Why is vitamin C necessary?

What happens if you don't have enough vitamin C?

Introduction

Ascorbic acid, the compound we call vitamin C, dissolves in water. It is easy to take into our bodies via a solution of the compound, such as that found in fresh fruit juice.

It is a key nutrient required in the body for wound healing and iron absorption. It also acts as an antioxidant to protect cells and helps support the immune system to fight infection.

A deficiency in vitamin C can cause scurvy.

Think, pair, share

How much vitamin C do the fruits below contain?

Label them as ‘lots’, ‘some’ or ‘little vitamin C’

Introduction

In this practical activity, you will work in groups to analyse different samples of fresh fruits and juices, using a simple titration with iodine to determine the amount of vitamin C present.

When ascorbic acid reacts with iodine, dehydroascorbic acid and hydrogen iodide are formed:

ascorbic acid + iodine → dehydroascorbic acid + hydrogen iodide

Introduction

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Iodine and starch molecules combine to make a blue−black complex.

Therefore, by adding starch to the iodine we can observe when all the iodine has **fully reacted** with the acid as **there will be no blue-black coloured complex** left.

This is called the endpoint of the reaction.

Learning objectives

1. Safely carry out a simple microscale titration reaction.
2. Make inferences from experimental data and compare the amount of vitamin C levels present in different fruits.
3. Evaluate the results of the practical in terms of errors.
4. Plan an experiment to determine how vitamin C levels are affected by different conditions.

Method

1. Put 1 cm^3 of starch solution in a test tube.
2. Add 5 cm^3 of water and mix by gently shaking the tube.
3. Add 1 drop of iodine solution. A blue–black colour will appear.
4. Hold a white piece of paper behind the test tube. This will help you see the colour change.
5. Add the vitamin C solution drop by drop counting the number of drops added. Shake the mixture after every 5–10 drops.
6. Keep adding the vitamin C solution dropwise until the blue–black colour disappears. This will produce a grey–white colour in the tube.
7. Record the number of drops added in your results table.
8. Keep this tube to check for the same final colour in all the tests.
9. Take a clean dry test-tube and repeat steps 1, 2 and 3.
10. Add fruit juice drop by drop until the colour is the same as that in the first test tube, counting the drops added. Check the final colour is the same as the initial solution.
11. Repeat steps 9 and 10 with at least two different juices.

Results table – group

Fruit juice/vitamin tablet	Number of drops needed to react with all the iodine
100 mg vitamin C tablet in 100 cm^3 water	

Results table – whole class

Fruit juice/vitamin tablet	Number of drops needed to react with all the iodine
100 mg vitamin C tablet in 100 cm^3 water	

Follow-up questions

1. Identify the juice which has the most vitamin C of the ones you tested. Explain how you can tell.
2. Identify the juice which has the most vitamin C in the whole class.
3. Explain why the juice must be added drop by drop.
4. Describe any sources of error in this investigation.
5. Look at the labels on the juice packaging. Rank the juices from most to least vitamin C per volume.
6. Compare the results from your experiment to the information from the juice packaging (Q5).
7. Explain why there might be a difference between your results and those provided by the company on the packaging.
8. Give some factors that may affect the amount of vitamin C in the juices.

Investigating conditions affecting vitamin C levels

Plan an investigation to explore how vitamin C levels are affected by different conditions. Your teacher will give you a choice of research questions to investigate.

Here are some examples:

- How does temperature affect the amount of vitamin C?
- How does light affect the amount of vitamin C?
- How does packaging and storage conditions affect the amount of vitamin C?
- Do fruits of different varieties (e.g. mandarin oranges, navel oranges, clementines, satsumas, etc.) contain different amounts of vitamin C?
- Does frozen, concentrated orange juice contain as much vitamin C as fresh juice?
- Which fruit contains the most vitamin C per 100 g?

Investigating conditions affecting vitamin C levels

In your groups, plan an investigation and prepare a presentation to deliver your research idea to the rest of the class.

Consider the following:

- independent, dependent and control variables
- chemicals
- equipment
- method
- results
- analysis