

Method 4 (carbon dioxide)

Aim

Making a batch of scones, and investigating the most effective raising agent in terms of external and internal appearance, texture, degree of rise and flavour.

Equipment

You will need for each variation:





- Digital scales
- Mixing bowl
- Sieve
- Small knife
- Flour dredger
- Rolling pin
- Scone cutter
- Scone rolling guides (if available)
- Palette knife
- Measuring jug
- Pastry brush
- Baking tray lined with greaseproof paper
- Oven gloves
- Cooling rack
- Ruler
- Digital timer / stopwatch / clock with a second hand
- Serrated knife

Method

- Preheat oven to 230°C (210°C if using a fan oven)
- Control – 115g plain flour, pinch of salt, 5g baking powder, 15g butter, 70ml fresh milk.
- Repeat the above experiment with the following variations:
- Variation 1 – 115g self-raising flour, pinch of salt, 15g butter, 70ml fresh milk.
- Variation 2 – 115g plain flour, pinch of salt, 15g butter, 2.5g bicarbonate of soda, 5g cream of tartar, 70ml fresh milk.
- Variation 3 – 115g plain flour, pinch of salt, 15g butter, 5g bicarbonate of soda, 70ml fresh milk.
- Sift the flour, salt and raising agent/s into the mixing bowl.
- Cut the butter into small pieces, then use your fingertips to rub it into the flour until the mix resembles fine breadcrumbs.
- Add the milk all at once and mix quickly to form a soft dough. Knead gently for a few seconds until the dough becomes smooth, and then roll out onto a lightly floured surface to a 2cm height. Cut into rounds using a scone cutter, making sure that you use the same size cutter for each variation and that each scone is rolled out to the same thickness.
- Glaze the tops, not the sides, with milk. Bake at 230°C (210°C if using a fan oven) for 10 minutes.
- Remove from oven and transfer to a cooling rack. Make sure that the scones are clearly labelled so that they do not become muddled up.
- Use a serrated knife to cut one scone from the Control and each Variation in half, so that you have 2 half-moon shapes.
- Measure the height of each one with a ruler. Examine the texture and appearance (including the colour), and then taste the scones.

Results

Compare your findings in the table below:

Comments	Control	Variation 1	Variation 2	Variation 3
External appearance	Golden brown surface appearance on top. Paler sides.	Similar to Control.	Dark golden brown surface appearance on top and on sides. Much darker than Control.	Very dark golden brown surface appearance on top and on sides. Darker than Variation 2.
Internal appearance/ texture	Close crumb, small visible air bubbles. Creamy white colour.	Close crumb, slightly closer than Control, small visible air bubbles. Creamy white colour.	Dense crumb, not as attractive as Control or Variation 1. Creamy yellow colour.	Dense crumb, not as attractive as Control or Variation 1 and Variation 2. Creamy yellow colour – more yellow than Variation 2.
				
Degree of rise	Well risen.	Well risen.	Well risen.	Well risen.
Flavour	As you would expect, quite bland, no overpowering flavour.	As you would expect, quite bland, no overpowering flavour.	As you would expect, quite bland, no overpowering flavour.	Unpleasant – a definite soapy and bitter flavour.

Task 3 – Conclusions

Summarise your findings here. You should consider the following:

Rank samples in order of preferred rise.

- 1st – Control
- 2nd – Variation 1
- 3rd – Variation 2
- 4th – Variation 3

Rank samples in order of preferred appearance.

- Joint 1st – Control and Variation 1
- 2nd – Variation 2
- 3rd – Variation 3

Rank samples in order of preferred texture.

- 1st – Control
- 2nd – Variation 1
- 3rd – Variation 2
- 4th – Variation 3

Rank samples in order of preferred flavour.

- 1st – Control
- 2nd – Variation 1
- 3rd – Variation 2
- 4th – Variation 3

In your opinion, which is the most successful sample? Explain your answer.

Control – it has a good external appearance both in terms of the texture and the way it has risen. The internal texture is light and crumbly, there are no after tastes and it is well risen. It's soft on the inside and crisp on the outside. This is the way I would expect a scone to look and taste.

Write a paragraph explaining the action of the raising agents when scones are baked.

After the scones are made and placed in the pre-heated oven for baking, the following happens:

The air introduced by rubbing butter into flour expands, and causes the scone mix to rise.

The steam produced from the milk expands, and causes the scone mix to rise. This steam evaporates and is then replaced by air.

The carbon dioxide produced from the chemical raising agent (baking powder/bicarbonate of soda) expands due to the heat from the oven, and causes the scone mix to rise. Once the chemical raising agent (baking powder/bicarbonate of soda) has depleted the carbon dioxide supply, the scones will set due to starch gelatinisation and dextrinisation and the coagulation of proteins.

The structure and shape of the scone should be formed by this stage.

Extension task

Write a list of experiments that could be conducted with scones. For each experiment, make sure that you specify the aim of the experiment, and list the variations that you will use.

Examples include:

- **Variation suggestion** – 115g plain flour, pinch of salt, 2.5g bicarbonate of soda, 2.5g cream of tartar, 70ml sour milk, 15g butter.
- **Variation suggestion** – add a total of 100ml milk to Control recipe. What happens? Explain this.
- **Variation suggestion** – leave the samples out of the oven for 30 minutes before baking. Compare the finished scones with those that are baked immediately.

Find out the difference between Single and Double acting baking powders.

Question:

Why do scone recipes include cream of tartar with bicarbonate of soda? Why not include bicarbonate of soda only, and leave out cream of tartar?

Without the cream of tartar a bitter taste will be left. When sodium bicarbonate (bicarbonate of soda) is heated, it gives off carbon dioxide and sodium carbonate. It is the sodium carbonate that has the bitter taste. It has a soapy flavour.

When cream of tartar (tartaric acid) is combined with sodium bicarbonate (bicarbonate of soda), the soapy flavour is neutralised. This makes the scones pleasant to eat. This is because bicarbonate of soda is an alkali, and cream of tartar is an acid.

Write down the chemical equation for the reaction of sodium bicarbonate (bicarbonate of soda) as a raising agent.

Sodium hydrogen carbonate	With moisture and heat →	Carbon dioxide	+	Water	+	Sodium Carbonate
2NaHCO_3	With moisture and heat →	CO_2	+	H_2O	+	Na_2CO_3

Write down the chemical equation for the reaction of sodium bicarbonate (bicarbonate of soda) with cream of tartar (potassium hydrogen tartrate) as a raising agent.

Sodium hydrogen carbonate	+	Cream of tartar (potassium hydrogen tartrate)	With moisture and heat →	Carbon dioxide	+	Water	+	Sodium potassium tartrate
NaHCO_3	+	$\text{KHC}_4\text{H}_4\text{O}_6$	With moisture and heat →	CO_2	+	H_2O	+	$\text{NaKC}_4\text{H}_4\text{O}_6$

What happens to your scones if too much raising agent is added?

The internal texture of the scone is coarse and open, and the external sides of the scone are likely to be cracked.

What happens to your scones if too little raising agent is added?

The scone does not rise well, and the internal texture of the scone is close and heavy.