

A4. Baking scones

Pupils investigate raising agents used in baking scones.

Flour - acid or alkali?

Pupils test small quantities of plain flour, and self raising flour in suitable dishes, with the Universal indicator.

Results

mixture	colour	pH	comment
self raising flour	uniform orange with red specks red specks appear; this goes greener with time	red specks 4 - 5	the red specks are picking out the acid part of the raising agent present in the flour
plain flour	even orange	5 - 6	plain flour is an acidic substance on its own

What makes scones rise?

Hints for the teacher

- To save time it might be more convenient to have the flour plus the raising agent mixtures already weighed out and prepared.
- It is important to roll the scones out to the same thickness. The use of roller guides would help this process.
- If the cut surfaces of the cooked scones are brushed over with an ink-soaked piece of sponge, a texture print can then be made. Alternatively, the cut surface of the scones can be photocopied.

Results for scones

scone mixture plus	volume	colour	texture/structure	Universal indicator
nothing (recipe A)	2/1	off white	closed	orange; pH 5 - 6
sodium hydrogen carbonate (recipe B)	3	yellow	medium	blue/green; pH 8 - 9
monocalcium phosphate (recipe C)	2/1	off white	closed	red; pH 4 - 5
sodium hydrogen carbonate and monocalcium phosphate (recipe D)	4	white	open	green; pH 7

KS3/4

food technology

Timing - 50 - 60 minutes.

Two pupil activity sheets A4 accompany this activity.

Requirements for baking scones activity plain flour

self-raising flour

Universal indicator & chart

Apparatus (per batch)

- 300 g plain flour
- 62.5 g margarine
- 62.5 g sugar; (it is possible to make the scones without sugar in order to save money)
- 120 cm³ milk
- balance accurate to 0.1 g
- <10 g commercial bicarbonate of soda
- <10 g monocalcium phosphate* (acid calcium phosphate) - supplied with this resource
- various mixing bowls, knives, etc.
- pastry cutters
- greased baking trays
- oven at 230°C
- Universal indicator & chart
- ink and sponge (optional)

* Further supplies are available from the Chemical Industry Education Centre, University of York, Heslington, York, YO10 5DD, (tel 01904 432523)

The pupils' sheet does not specifically ask pupils to smell or taste the scones but this is permissible. The scones with just the sodium hydrogencarbonate may smell and taste 'soapy'. Obviously, the fourth batch of scones should be the most acceptable.

The taste of sodium hydrogencarbonate used as the sole raising agent is soapy and thus its use is limited to baked products which have strong flavours, such as gingerbread and parkin so that the unpleasant taste is masked.

Discussion of results:

pH

- The pH of the final scones shows that flour alone is acidic.
- Sodium hydrogencarbonate alone makes the scones alkaline (and would give them a soapy taste).
- The monocalcium phosphate alone makes the scones acidic.
- A combination of the two results in a typical acid-alkali (carbonate) reaction and results in the scones being approximately neutral.

raising properties

- A combination of an acid and alkali is needed to produce an acceptably risen product as this reaction produces carbon dioxide which is responsible for making the scones rise.
- The sodium hydrogencarbonate alone will make the scones rise a little as the compound decomposes thermally to produce carbon dioxide.

colour

- The use of sodium hydrogencarbonate alone produces a yellow colour. This is desirable in some industrially produced cakes such as some chocolate cakes.

Pupils may wonder why the acid and alkali are not present in equal amounts. They could make scones where this is the case (use 3.61g of each). This will produce a slightly alkaline, pale yellow scone which has a softer texture. In commercial situations the proportions of acid (and acid type) to alkali vary according to the product taking into account factors such as added flavours, waiting time between mixing and baking and others. Most usually the proportion of monocalcium phosphate to sodium hydrogencarbonate is 1.2 : 1.0.

Tests on the unbaked flours

mixture	colour	pH	comment
plain flour	even orange	~ 5	plain flour is an acidic substance on its own
plain flour + sodium hydrogen carbonate	even yellow/green the colour becomes darker with time even	6 - 7.5	sodium hydrogen carbonate is an alkali
plain flour + monocalcium phosphate	orange/red	4 - 5	monocalcium phosphate is an acidic substance
plain flour, sodium hydrogen carbonate + monocalcium phosphate	even orange with red specks; goes greener with time	4 - 5	similar to self raising flour

Before being eaten, any product which contains flour must be cooked. This alters the starch in the flour so that it becomes digestible. Flour is used in many savoury and sweet dishes, particularly in foods that consist of a dough.

Cakes, bread and other similar dishes often contain a raising agent. A raising agent consists of an acid and an alkali. The acid present can vary but the alkali used is usually sodium hydrogencarbonate. Raising agents are classed as food additives; the two most important ones being E341 - the acid calcium phosphates and E500 - sodium carbonate.

You are going to investigate what makes scones rise.

Flour - acid or alkali?

1. Place a small sample of ordinary self raising flour into a suitable dish.
2. Add some Universal indicator solution. Leave for two minutes. Describe and explain what happens.
3. Repeat this using ordinary plain flour. Describe and explain what happens.

What makes scones rise?

You are going to produce and compare four different batches of scones. It may be better to work in 4 groups and share results.

Recipe A

1. Sift 250 g of plain flour into a mixing bowl.
2. Rub 62.5 g of margarine into the flour.
3. Add 62.5 g of sugar into the mixture.
4. Gradually add approximately 120 cm³ of milk and mix to give a good dough. The amount of milk you will need to add may vary.
5. Roll out the dough on a lightly floured surface or board. It must be 1cm thick.
6. Cut the dough into scones using a pastry cutter.
7. Place the scones onto a lightly greased baking tray and bake for 12 to 15 minutes in an oven at 230 °C.

Recipe B

1. Weigh out 300 g of plain flour.
2. Add to this 3.61 g of sodium hydrogencarbonate.
3. Mix these dry ingredients very thoroughly.
4. Take 250 g of this mixture and sift it into a mixing bowl. Keep the rest of the mixture for a later test.

Carry out steps 2-7 of recipe A.

Recipe C

1. Weigh out 300 g of plain flour.
2. Add to this 4.33 g of monocalcium phosphate (acid calcium phosphate).
3. Mix these dry ingredients very thoroughly.
4. Take 250 g of this mixture and sift it into a mixing bowl. Keep the rest of the mixture for a later test.

Carry out steps 2-7 of recipe A.

Recipe D

1. Weigh out 300 g of plain flour.
2. Add to this 3.61 g of sodium hydrogencarbonate and 4.33 g of monocalcium phosphate (acid calcium phosphate).
3. Mix these dry ingredients very thoroughly.
4. Take 250 g of this mixture and sift it into a mixing bowl. Keep the rest of the mixture for a later test.

Carry out steps 2 - 7 of recipe A.

When the scones are ready and cool, cut each of the scones in half so that you can see inside. Compare them in the following ways:

- Describe the colour; white, off-white, pale yellow or yellow.
- Which scone has risen the most? Give 4 to the highest score, 3 to the next, 2 to the next and 1 to the smallest.
- Describe the texture/structure; closed, medium or open.
- Add three drops of Universal indicator to each cut surface. Wait for one minute. Describe what happens in terms of colour and pH number.

You should have samples of unused mixtures from recipes B, C and D and some plain flour as used in recipe A. Add 3 drops of Universal indicator to each of these mixtures and comment on what you observe.

Present your results in tables similar to those below. Try to explain the differences in the results.

Comparison of scones from the four recipes

scone mixture plus	volume	colour	texture/ structure	Universal indicator
nothing (Recipe A)				
sodium hydrogen carbonate (Recipe B)				
monocalcium phosphate (Recipe C)				
sodium hydrogen carbonate and monocalcium phosphate (Recipe D)				

Comparison of flour mixtures prior to baking

flour mixture sample	colour/pH	comments
from recipe A		
from recipe B		
from recipe C		
from recipe D		