

Two pupil activity sheets A2 accompany this activity.

Requirements per group

- safety goggles
- 200 g plain flour
- <2 g finely ground sodium hydrogencarbonate (e.g. commercial baking powder)
- <2 g finely ground monocalcium phosphate* (acid calcium phosphate) (*supplied with book)
- 2 or more 1 dm³ beakers
- bunsen burner, heat resistant mat, gauze
- stopclock
- 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 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.

A2. Boiling dumplings

Pupils do practical activities investigating raising agents.

Hints for the teacher

- The first task is to get the water to boiling point in order to cook the dumplings. A kettle could be used to bring the water to the boil more quickly.
- The pupils will have to wait 15 minutes for the dumplings to cook and so can do other tasks during this time. The order of the tasks in this section could be altered to accommodate this.
- If the cut surfaces of the cooked dumplings are brushed over with an ink- soaked piece of sponge, a texture print can be made.

Typical results (see table)

pH

- The pH of the final dumplings shows that flour alone is acidic.
- Sodium hydrogencarbonate alone makes the dumpling alkaline (and would give it a soapy taste).
- The monocalcium phosphate alone makes the dumpling acidic.
- A combination of the two results in a typical acid-alkali (carbonate) reaction and results in the dumpling 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 dumpling rise.
- Sodium hydrogencarbonate alone will make the dumpling rise a

flour + water dumpling plus	volume	colour	texture/ colour	+ Universal indicator
nothing (Recipe A)	2/1	off white	closed	orange; pH 5 - 6
NaHCO ₃ (Recipe B)	3	yellow	medium	blue/green; pH 8 - 9
monocalcium phosphate (Recipe C)	2/1	off white	closed	red; pH 4 -5
NaHCO ₃ and monocalcium phosphate (Recipe D)	4	white	open	green; pH 7

Pupils may wonder why the acid and alkali are not present in equal amounts.

They could make a dumpling where this is the case (use 0.60 g of each). This will produce a slightly alkaline, pale yellow dumpling 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. Most usually the proportion of monocalcium phosphate to sodium hydrogencarbonate is 1.2 : 1.0.

Many foods, particularly those made from a dough, rise when they are cooked. There are a number of raising agents which are used in cooking and some of them involve the reaction between an acid and an alkali.

The following investigation considers the effect of components in some raising agents. To do this, you are going to make 4 dumplings using different recipes.

Recipe A

50 g plain flour only

Recipe B

50 g plain flour
0.60 g sodium hydrogencarbonate

Recipe C

50 g plain flour
0.72 g monocalcium phosphate (acid calcium phosphate)

Recipe D

50 g plain flour
0.60 g sodium hydrogencarbonate
0.72 g monocalcium phosphate (acid calcium phosphate)

Method

1. Put about 500 cm³ of water into two, 1 dm³ beakers and heat to boiling. This will be used to cook the dumplings.
2. Meanwhile, mix each of the dumpling mixtures with sufficient water to give a stiff ball of dough.
3. Place two of the dough balls into each of the beakers of boiling water for 15 minutes. Make sure you know which dumpling is which.
4. Remove the dumplings from the water and allow them to cool for a few minutes after cooking.
5. Cut each dumpling in half so that you can see inside. Compare the dumplings in the following ways:
 - Which has the greatest volume? Give the greatest one the value 4, the next 3, the next 2 and the smallest 1.
 - Describe the colour as white, off-white, pale yellow or yellow.
 - Describe the texture/structure as closed, medium or open.
 - Place three drops of universal indicator on a cut surface of each dumpling. Wait one minute. Describe what happens in terms of colour and pH number.
6. Put your results in a suitable table.

Try to explain the differences in the results.

What reaction is taking place in recipe D which makes the dumplings rise?