Using Food as Natural Indicators

What is an acid and what is a base?

Does the solution's identity affect the colour of the indicator solution created?

Do the red cabbage and the turmeric indicators produce the same effects?

Equipment required:

Pan
Stove
Red cabbage
Turmeric
Glasses
Water
Straw
Various cupboard and household ingredients to test

Can you explain the findings?

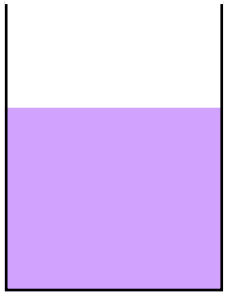
Kitchen Chemistry: Food indicators

DEPARTMENT OF CHEMISTRY

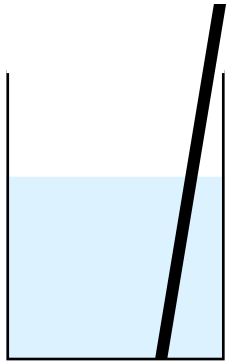
UNIVERSITY OF OXFORD

1 Ask an adult to boil red cabbage for 10 mins.

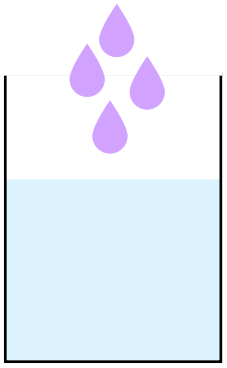
2 Once cooled, drain and keep the liquid. This is the indicator!



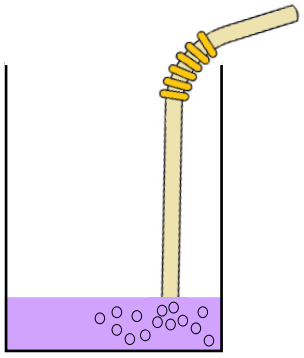
3 Make up solutions in water of various substances.



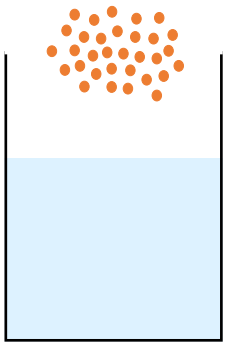
4 Add a few drops of the indicator liquid to each solution.



5 Use a straw to carefully blow into leftover unused liquid indicator.



6 Add turmeric powder to fresh solutions as tested before.



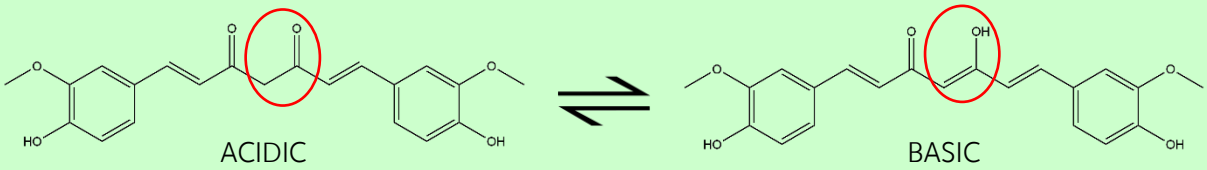
The science behind the scenes...

We can classify different solutions depending on their acidic and basic properties. We define a **pH scale** to do this, ranging from value of 0 to 14. Solutions are **acidic** if they have a pH below 7, and **basic** if their pH is above 7. pH 7 is a neutral solution.

Indicators are really useful tools to tell whether a solution we have is acidic or basic. They have excellent properties in which they change colour depending on the pH of the solution they are in. They achieve this by subtle **changes** to the molecule that gives rise to their colour when exposed to the different acidic/basic environments.

Red cabbage and turmeric are just two examples many useful natural indicators.

Turmeric displays two colours depending on whether it is exposed to an acidic or basic solution. The molecule responsible for the colourful properties of turmeric is **curcumin**:



The subtle change in the structure of the molecule gives rise to the colour change from **yellow** to **red** when in acidic and basic solutions. Therefore, turmeric lends itself as a really useful, natural indicator!

Red cabbage indicator is even more useful, as it displays a **range** of colours which can be compared to a colour chart to determine not only if the solution is acidic or basic, but the rough pH of the solution.

Practical Investigation:

Equipment:

- ☐ Various cupboard and household ingredients to test: e.g. soap, baking soda, vinegar, milk, lemon juice
- ☐ Turmeric
- ☐ Glasses
- ☐ Water
- ☐ Straw
- ☐ Pan
- ☐ Stove
- ☐ Red cabbage

Method:

1. Chop the red cabbage and boil in water on a stove for 10 minutes. The water should have turned purple after boiling.
2. Leave the pan to cool slightly before draining the liquid into a container. This is the red cabbage indicator. Leave to fully cool for around 30 minutes before use.
3. Whilst the red cabbage indicator is cooling, different solutions to test can be made up. Dissolve various household substances in water, i.e. baking soda, lemon juice, vinegar, hand soap, milk. Water can be used as a control.
   Note: ensure any substances used are safe to handle.
4. Pour half of each solution into a separate glass- these will be used to test using turmeric later.
5. Add a few drops of the red cabbage indicator to each solution. Observe what happens. Compare the colour of the solution against the pH scale.
6. Using the remainder of the red cabbage indicator solution, use a straw to blow through the solution. Observe what happens to the colour of the solution.
   Note: Be careful to not suck the liquid up the straw.
7. Add a small amount of turmeric to each of the solutions. Observe what happens.

Questions:

(a) What is a control in an experiment?
[A control test is the baseline for comparison in your test. In this example, water is neural, so neither acidic or basic.]

(b) Did you find the same results for acid/base with the turmeric and red cabbage indicators?
[The acidic/basic properties of a substance are properties of the solution itself, hence the results should be the same for both indicators, as they are merely a tool to reveal to us the properties. The colours produced by the indicators will be different depending on the indicator, which is why each indicator has its own pH colour scale.]

(c) Does the amount of indicator added affect the observation?
[The amount of indicator added will only change the intensity of the colour produced by the indicator.]

(d) Look at the solutions which you identified as acidic and as basic- do they have any similar properties?
[Acidic foods like lemon juice tend to be sour, whereas basic foods like baking soda are very bitter in taste.]

Below is pH scale for the red cabbage indicator:

(Source: Compound Chem)

One key part of being a thorough scientist is recording our observations in a clear and logical way to make sure we can read and use the data we have collected at a later date. This could be a great opportunity to practice recording your observations!

A good format for a table to record data is below:

Solution	Red Cabbage Indicator			Turmeric Indicator	
	Observation	Acid or Base?	pH	Observation	Acid or Base?

Science isn't just useful in the labs...

pH is an important property that needs to be carefully **monitored** and **adjusted** as appropriate in certain everyday applications.

The pH of **swimming pools** needs to monitored to keep it neutral (pH 7) to avoid uncomfortable problems for swimmers such as burning eyes or mouths, cloudy water and to ensure the chlorine in the water can effectively disinfect the water. Indicators can be used in the form of pH strips to regularly check the pH of a swimming pool is a suitable level.

Also, indicators are really useful for gardeners to test the pH of their **soil**. Some plants grow best in slightly acidic soil, whereas others grow best in slightly basic soil. Therefore, gardeners want to be able to test the pH of the soil they are planting in to adjust it to the optimum environment for their plant.

Photo citations:

http://clipart-library.com/clipart/551218.htm
https://www.compoundchem.com/tag/red-cabbage/
https://www.vectorstock.com/royalty-free-vectors/spice-rack-vectors
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