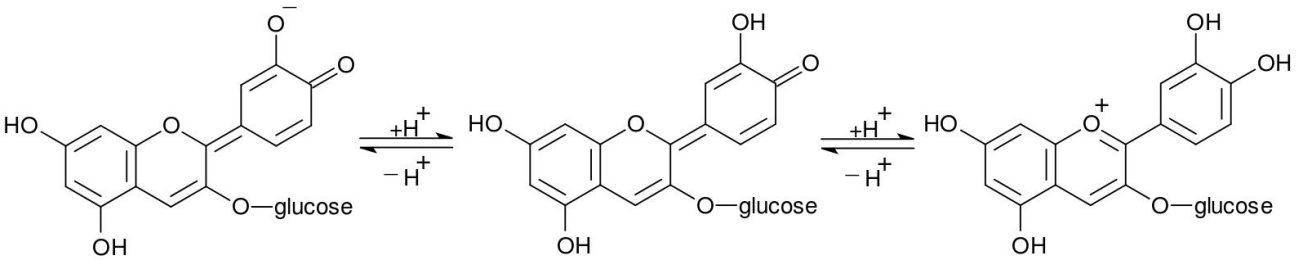
Red Cabbage as a pH Indicator

We can make a safe pH indicator chemical from a steep of red cabbage. Boil chopped red cabbage for about an hour and strain off the colored liquid produced.

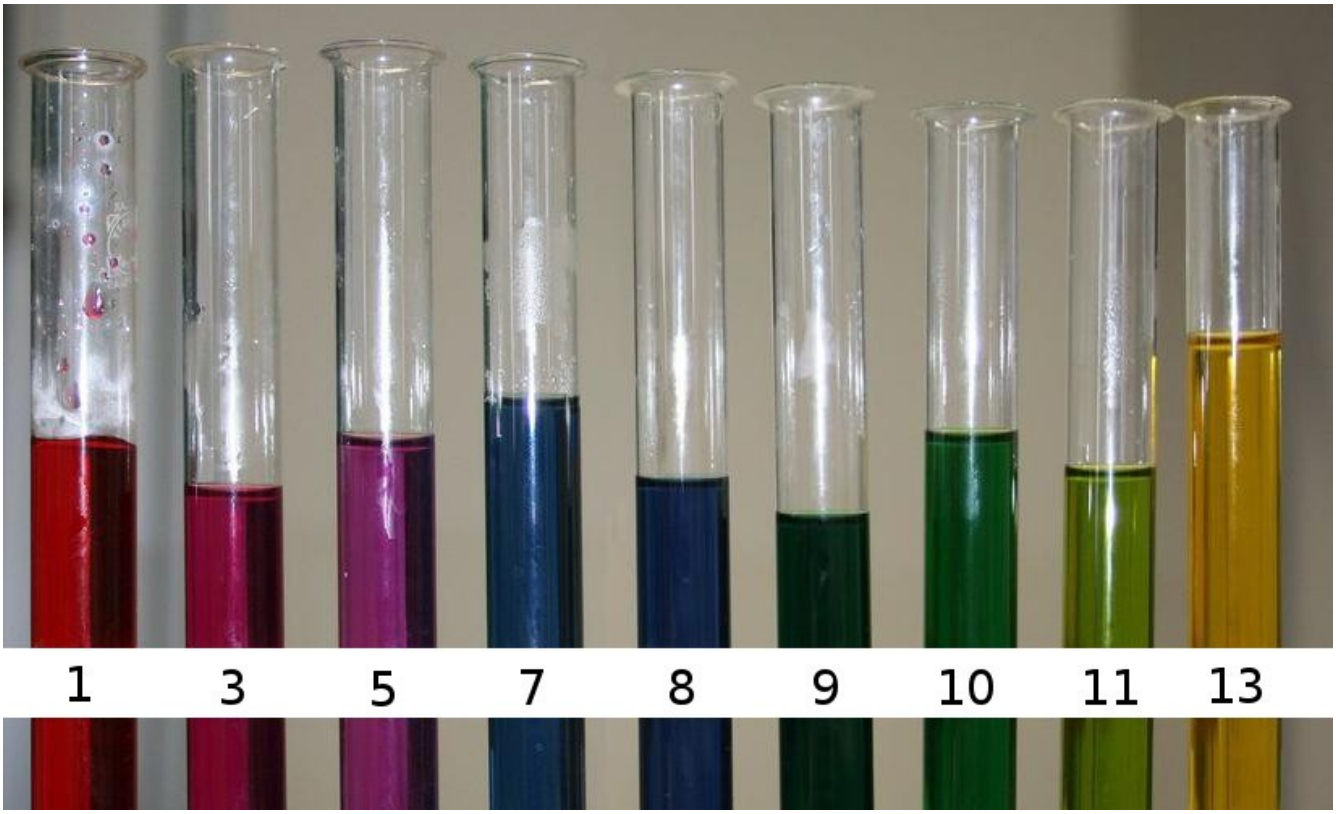
A chemical in red cabbage (and in other red vegetables and flowers like hydrangeas and pansies) is chrysanthemin which changes color depending on the acidity of the solvent in which it is placed. The addition or removal of protons causes the string of alternating double and single bonds to react to visible light colors differently as shown below.

Chrysanthemin (cyanidin-3-glucoside)



pH > 11 | 7 < pH < 8 | pH < 3

The colors corresponding to different pH values are shown below. Water, household vinegar, household ammonia, and washing soda should give different colors.



Additional Notes about pH

Only about 0.3 cc of 5% acetic acid is needed to neutralize about 4 cc of 2.5 % ammonium hydroxide. The ammonia with cabbage indicator rather abruptly turns purple when a sufficient amount of acetic acid is added.

Electrodes with 25 V across them separated by 12 cm immersed in our well water with red cabbage indicator produces pink color at the positive electrode and green at the negative electrode showing that the positive electrode has become acidic (OH^- depleted as O_2 is produced) and the negative electrode has become basic (H^+ depleted as H_2 is produced).

Once disconnected from a 12 V source, this ion separation still produces about 0.6 V and can deliver 1.5 mA as it discharges.