

# Digestion

*Shannon and Ian Jacobs*

A large white Chinese radish was peeled, cut into sections, and soaked for 24 hours in three solutions: tap-water, dilute HCl, and salt-water: with dye extracted in boiling water from red Bougainvillea.



The solutions affected the radish in different ways.



Radish after soaking in tap-water (left) and dilute HCl (right).

The radish in tap-water hardened and swelled as the cells took in water.



Very little dye, (mostly Anthocyanins), entered the cells with the water. Semi-permeable membranes inside the cell walls allowed water molecules to be exchanged but prevented the transfer of larger dye molecules.

The radish in salt-water shrank and went slightly floppy as water was exchanged out of the cells into the higher concentration of salt in the surrounding liquid. The effects are due to *osmosis* and are well known.

## Digestion

The radish in the acid reacted differently. An outer layer (5-8 mm thick) became soft (mushy) and red as shown in the image below. The acid broke down cell walls and allowed dye to penetrate.



Dye penetrated towards the core of the radish that was soaked in the dilute HCl solution for 24 hours at 30°C.

Food in the human stomach is *digested* (broken down into smaller molecules) that are then absorbed into the blood stream. The stomach contains 0.15 molar hydrochloric acid, with significant amounts of sodium and potassium chloride in solution with a number of enzymes.

The hydrochloric acid used here was at about one tenth of the strength of stomach-acid and the temperature was around 7 degrees lower than in the stomach, but the radish was soaked for a longer time (24 hours instead of 2-3 hours). There were no enzymes to break down starch to sugars and proteins into smaller units, there were no chloride ions and there was no agitation. Even so: the effect on the radish suggests digestion.

## Future work

The next step is to make solutions of HCl, NaCl and KCl in concentrations to mimic the solution in the stomach, add selected enzymes one at a time and study the effects on a range of foods at 37°C.