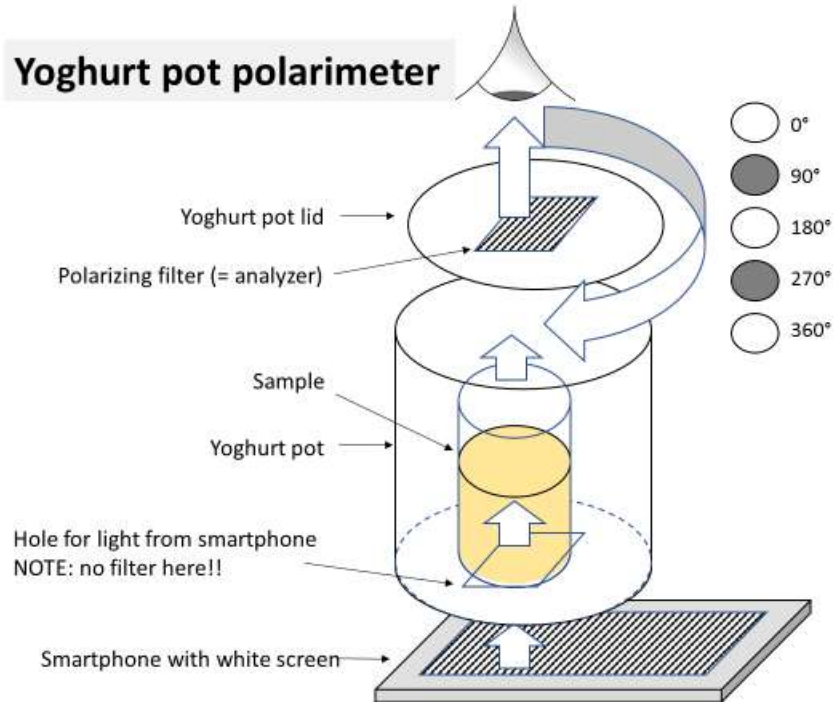
Construction of a simple yoghurt pot polarimeter

Aim: construct a functional polarimeter with which it is possible to study and measure the optical activity of solutions of chiral molecules such as sucrose from easily available materials.

Materials

- Polarizing filter e.g. from cheap 3D cinema glasses or similar (note: use plane polarizing sheet rather than circular polarizer used in photography)
- Large yoghurt pot with lid
- Scissors
- Black paper
- Sharp cutting knife (care!)
- Smartphone
- 360° protractor



Procedure

Find the centre of the bottom of the yoghurt and cut a small square around it.

Find the centre of the lid of the pot and cut a small square around it, then attach the polarizing filter. To check that the polarizer works, place the lid with the filter on the yoghurt pot and place the pot on a smartphone which has a white screen (for example use a word processing program with a blank page...) (note: this is not the torch function!). View the smartphone from the top and rotate the lid with the filter: as the filter is rotated, the light from the smartphone should darken and lighten.

Attach a protactor to the lid, being careful to centre it as accurately as possible.

Cut the black paper to fit inside the yoghurt pot to reduce effects of incident light. While not strictly necessary, this helps to greatly increase the contrast.

Use

A simple test of the polarimeter is to use a glass of water (a straight non-coloured glass works well) which fits inside the pot together with a similar glass filled to the same height with concentrated sucrose (sugar) solution. With the smartphone switched on, the polarimeter placed over the screen, the water sample in place and the lid on, carefully rotate the lid until the image seen in the filter in the lid is darkest. Make a note of the position of the lid. Replace the water sample with the sucrose solution and observe what happens. It should be necessary to rotate the lid in order to bring the image back to being as dark as possible. The amount of rotation needed can be used to calculate the specific rotation of the compound (see calculations).

Principle

This version works on the fact that the screens of smartphones (and electronic devices in general) typically emit plane polarized light. This avoids the need for a second filter found in traditional polarimeters which is place immediately after the light source and before the sample.

The use of the large yoghurt pot solves one of the main problems of home built polarimeters which is to have an accurate way for turning the analyzer filter because the large lid is clearly engineered to fit the body closely but not so close that it is impossible to rotate. Also, the rotation is quite positive with virtually no slippage.