FE 271 FOOD CHEMISTRY LABORATORY EXPERIMENT 3

DETERMINATION OF STARCH USING POLARIMETRY

Objective of the experiment

To determine the starch content with the help of optical activity by using Polarimetry
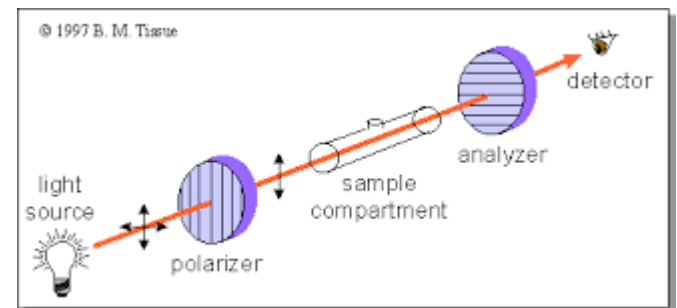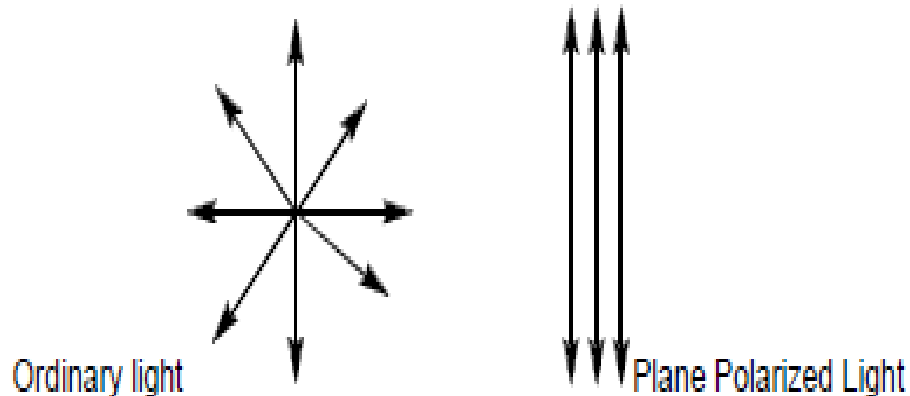

Wheat Flour

Rice Flour

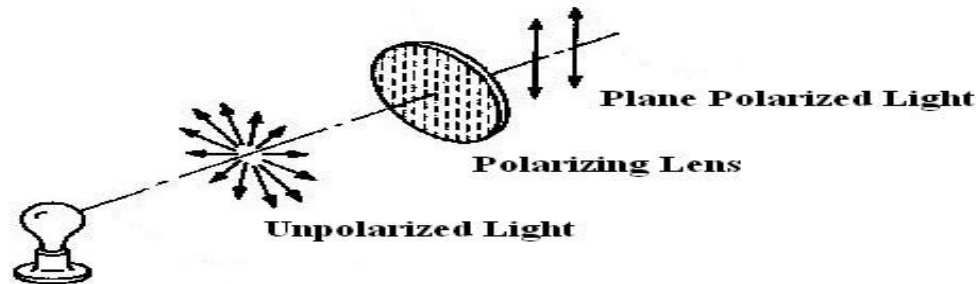Corn Starch

Polarimetry Diagram

Polarimetry

can be define as the technique for measuring the optical activity.

Optically active substances

can rotate the plane polarized light.

Ordinary light   Plane Polarized Light

- An ordinary light usually vibrates in all directions ⟶ UNPOLARIZED LIGHT

Plane Polarized Light
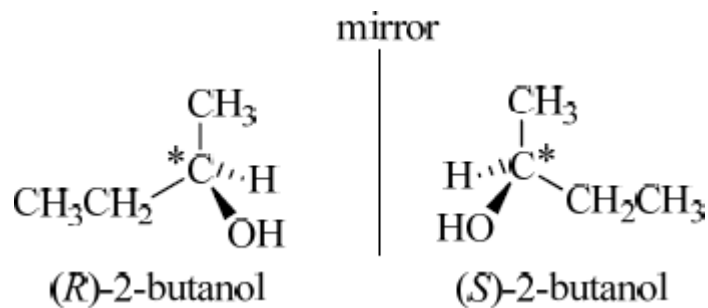
Polarizing Lens

Unpolarized Light

- The vibrations may all be restricted to one direction only, in the perpendicular plate ⟶ PLANE POLARIZED LIGHT

Optical Rotatory power is useful for:

- ✓ Qualitative analysis
- ✓ Quantitative analysis
- ✓ Elucidation of chemical structures

# Chiral (asymmetric) compound

Molecules that have two enantiomeric forms are called *chiral* and they generally contain at least one atom that is bonded to four different groups. This atom is called a *stereogenic centre*.

mirror

(R)-2-butanol   (S)-2-butanol

If the sample is chiral, the rotation will be observed in polarimeter

Polarimeter

Device consist of - light source
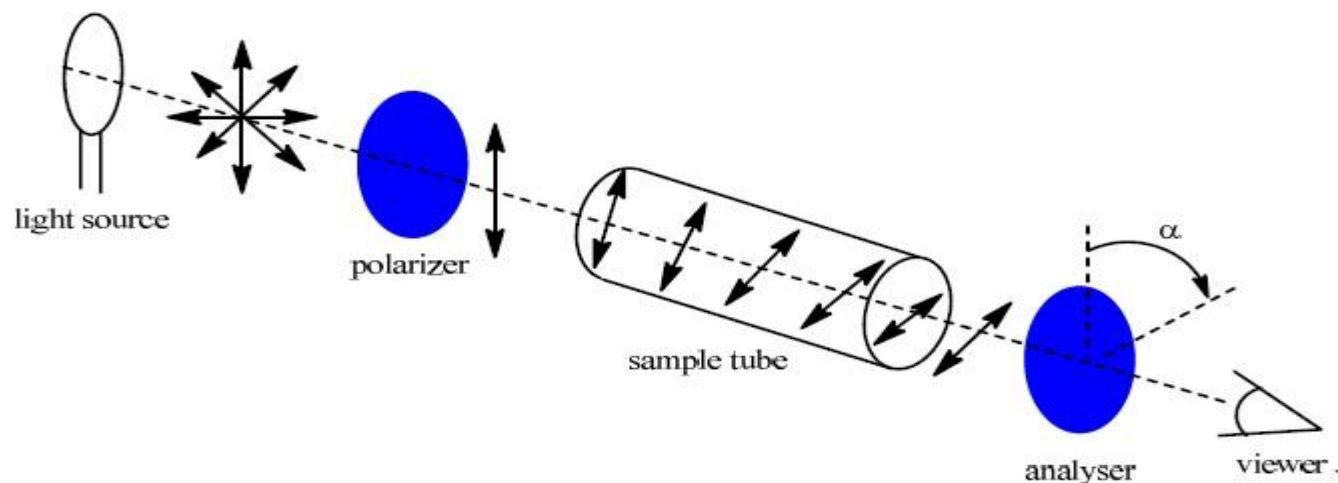
- polarising lens

- sample tube

- analysing lens
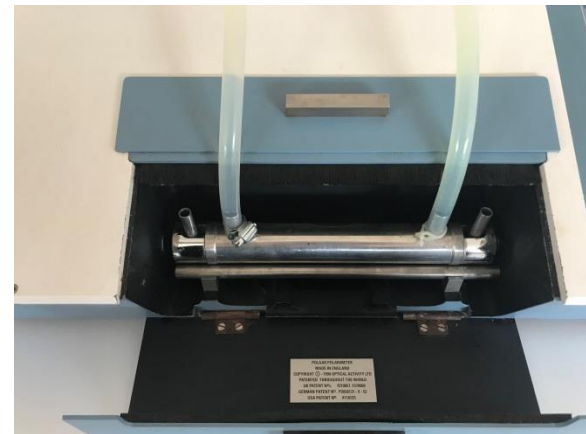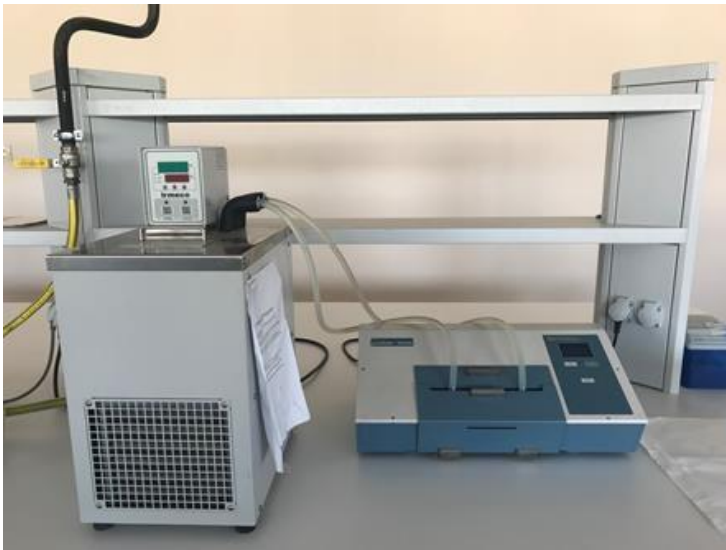
Figure 1: A diagram of a polarimeter.

- The angle of "α" is called observed rotation of the compound
- If observed rotation is;
  right (dexter in Latin) designated by "ɖ"
  left (leavus in Latin) designatd by "l"

Magnitution of the rotation depends upon;

➢ Nature of substances

➢ Length of sample tube

➢ Concentration of the solution

➢ Nature of the solvent

➢ Temperature of the solution

➢ Wavelength of the light used

- **The specific rotation** of a compound is the angle of rotation given by a sample solution with a content of 1 g of active substance per mL with a light path of 1 dm length.

- Specific Rotation $\quad [\alpha]_{\lambda}^{T} = \dfrac{\alpha}{l \times c} = \dfrac{\text{observed rotation (degrees)}}{\text{path length (dm)} \times \text{concentration (g/mL)}}$

- T is the temperature, λ is the wavelength of light

Procedure

1) Weigh 2,5g sample into 100ml flask

2) Add 25ml HCI and shake

3) Add another 25ml HCI

4) Immerse the flask in a boiling water bath and shake 3 minute

5) Wait 12 minute more in water bath before remove

6) Add nearly 20ml cold water

7) Cool to 20°C (under the tap water)

8) Add 10ml of Carez I and shake 1 minute

9) Add 10ml of Carez II and shake 1 minute

10) Make up the volume to 100ml with water

11) Filter

12) Measure the optical rotation at 589nm at 25°C

a) Adjust the base is zero

b) Fill the sample into the tube

c) Check there is no air bubble

d) Read the angle in the screen

e) Note that temperature and wavelength values

Calculation

Starch content (%) = $\dfrac{2000\left(P - P^{'}\right)}{[\alpha]_{\lambda}^{20°}}$

- P = total optical rotation in angle degrees

- P' = optical rotation in angle degrees of the substances soluble in 40 % ethanol

- $[\alpha]_{\lambda}^{20°}$ = specific optical rotation of pure starch

- The numerical values conventionally accepted for factor are the following:

➢ + 185.9°: rice starch
➢ + 185.4°: potato starch
➢ + 184.6°: maize starch
➢ + 182.7°: wheat starch
➢ + 181.5°: barley starch
➢ + 181.3°: oat starch
➢ + 184.0°: other types of starch

Discussion

your discussion must be answer these questions;

❖ What is your numerical result

❖ What is the predicted numerical result for your sample

❖ What is the gap between these two results and why it can be occur

❖ What is the meaning of P' and why we are assume that its 0 in our experiment

❖ What is the importance of Carez solutions

❖ What is the role of the HCl

❖ Which steps are critical, can be caused wrong result

❖ What is the importance of this experiment in food industry

POST LAB QUESTIONS

1. What are the most common methods for determination of starch in food products? Explain each methods briefly.

2. What are the limitations of polarimetric method over the other methods? Indicate advantages and disadvantages of the polarimetric method.

3. What are the application areas of the polarimeter in food industry (except from starch determination).