

Investigating Oxidation of Fats and Oils

Background

Fats and oils are esters of triglycerols and fatty acids. The fatty acid consists of a long chain hydrocarbon and may contain carbon-carbon double bonds. If this is the case then the substance is classified as unsaturated. The carbon-carbon double bonds can be oxidised and this can lead to peroxides and carbonyl compounds being formed. This can result in unpleasant smells and flavours being produced and the fat or oil is said to have become rancid. The degree of oxidation of a fat or oil can be estimated by determining the “peroxide value” of the fat or oil.

Practical Techniques

You will need to find out about volumetric analysis (titrations) and how to make up accurate solutions.

Where to start

The oil of fat should be reacted potassium iodide. Any peroxides in the fat or oil will oxidise the iodide to iodine. The solution should then be titrated against sodium thiosulphate to measure the amount of iodine produced. The degree of oxidation of the fat or oil and therefore the peroxide value can be determined.

Possible Investigations

- Investigate the degree of oxidation of different fats and oils.
- Investigate the effect, on the oxidation, when the fat or oil is heated or when air is blown through it.
- Investigate the effect of adding antioxidants to a particular fat or oil (e.g. vitamin E).
- Investigate the effect of sunlight on the oxidation of different fats and oils.
- Investigate the degree of oxidation of fresh and well-used oils.
- Investigate the possibility of using a colorimeter to monitor the amount of iodine produced during the reaction.

Sources of Information

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Teachers' Notes

General

The Fats and Oils booklet by Unilever is an excellent source for this investigation and has **full details** of this experiment.

To test the effects of antioxidants air can be blown through the oil before and after the antioxidant is added.

Each titration experiment can take up to 30 minutes.

Chemical Principles

Fats and oils, alkenes, esters, redox, quantitative chemistry

Essential Equipment

Burettes, pipettes

Essential Chemicals

Starch, potassium iodide, sodium thiosulphate, glacial ethanoic acid, hexane

Safety

No risk assessment has been given. It is essential that students prepare a detailed risk assessment before they start. Teachers must be satisfied that this is suitable for the proposed investigation.

Starter Experiment Sheet – Investigating the oxidation of fats and oils

A basic procedure is given below.

Prepare the following solutions

- 3:2 (by volume) mixture of glacial ethanoic acid and hexane
- saturated potassium iodide solution
- 0.01 mol dm^{-3} sodium thiosulphate solution
- starch solution

You will need to think about how much of each solution to prepare. This will depend on how much of the solution is used in each experiment and how many experiments you do (including any repeats).

Weigh out about 5 grams of the fat or oil in a dry 250 cm^3 stoppered bottle or flask. Add 30 cm^3 of the ethanoic acid and hexane mixture and swirl the flask to dissolve the fat or oil. Add 0.5 cm^3 of the potassium iodide solution and allow to stand for one minute. Shake occasionally. Titrate the contents with sodium thiosulphate solution using starch solution close to the end point. Set up a blank mixture by omitting the fat or oil and repeat the procedure.