ICRGU STEM ACADEMY

ROBERT GORDON UNIVERSITY ABERDEEN

School of Pharmacy & Life Sciences

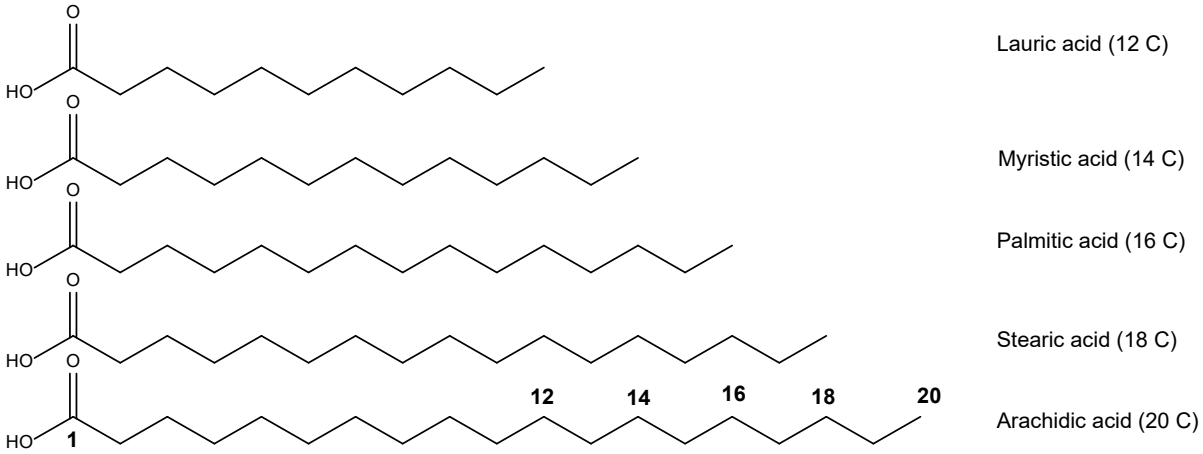
Worksheet: Fat characterisation – composition and quality

Background

Fats are substances that we find in many aspects of our lives. Fats can make up around 20% of the human body and are critical to our successful existence. Outside the body we find fats in many of the foods we eat. We often use fats in cooking as they help to transfer heat, help to enhance other flavour compounds, and add flavour themselves. However, as you have probably observed, not all cooking fats are the same, and this is true of all fats.

Fats molecules are made by combining 2 other molecules, fatty acids, and glycerol. While the glycerol part of a fat molecules is the same in all fats, the type of fatty acid can vary. Fatty acids themselves are made up of the elements carbon, hydrogen and oxygen. Carbons join together to form a long chain and hydrogens join onto this chain. Oxygen is found at either end of the chain. The length of the chain varies and so does the number of hydrogens that join to the carbons. Some examples of fatty acid structures are shown in the diagram below. The overall result of this is that the fatty acid molecules can vary in size and shape, and this impacts their properties such as melting point. If a carbon chain has lots of hydrogens attached then it is more likely to be solid at room temperature. These are often fats from animal sources and many are classed as saturated. Where there are fewer hydrogens on the chain then these are usually classed as unsaturated. These are often from plant sources. However, like all good science rules there will be exceptions!

Examples of fatty acids that have different lengths of carbon chains



The fatty acids don't just impact melting point, they can make a fat more or less susceptible to oxidation. Despite the name oxidation does not have to involve oxygen. Chemically it is a process where electrons are lost during a chemical reaction. In food substances, such as fats, this process occurs when fats are exposed to oxygen from the air (or other sources). The oxidation reaction is disrupting the composition of the fatty acid molecule i.e. it has been oxidised. In cooking terms this is often referred to as fats going 'rancid' and causes them to have a very bitter taste. It is not just air that can break down the fat molecules as light and heat can also have a similar effect. It therefore becomes important that cooking fats are stored correctly, as per any instructions on the bottle or container to minimise their exposure to air, heat, and light.

Oxidation of oil would reduce its quality. In the food industry tests are carried out to check the quality of oil before it is sold to customers. The quality is related to the composition of the fatty acids as the quality changes as these break down. There are many tests available that use different principles.

The experiment

In the video you are shown 3 different tests used to look at the quality and composition of typical vegetable-based oils used in UK cooking. The 3 tests are

- Saponification
- Peroxide value
- Free fatty acid value

Watch the video and then think about the sections asked in the comprehension section.

Comprehension

1. Thinking about fats used in a typical household kitchen can you identify some that are liquid at room temperature and some that are solid?
2. What are these oils made from? Is it animal or fat sources?
3. Can you find out what kind of fatty acids might be in these products?
4. For one of these fatty acids try to find out how long the carbon chain is and how many hydrogens it has attached to them.
5. In the tests demonstrated in the video the oils had been open for some time. How do you think this might have impacted the results of the different tests?
6. All the tests are based on the principles of titration and use a colour change indicator to show a reaction has taken place. What is a titration experiment and why do you think it is useful to scientific experiments?

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