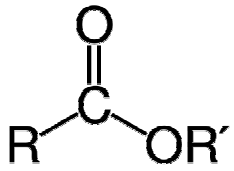
Esters

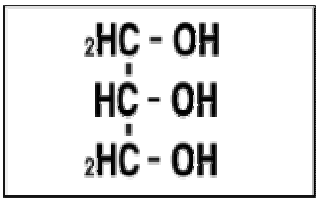
Esters are compounds formed from the reaction between alcohols and acids.



Esters are usually derived from carboxylic acids
A carboxylic acid contains the –COOH group, and in an ester, the hydrogen in this group is replaced by a hydrocarbon group of some kind . This could be an alkyl group like methyl or ethyl, or one containing a benzene ring like phenyl.
Example of esters: ATP, it is a phosphate ester.

Fats and oils.

Fats and oils are tri-esters of glycerol, propane 1, 2, 3 triol, with carboxylic acids



Glycerol

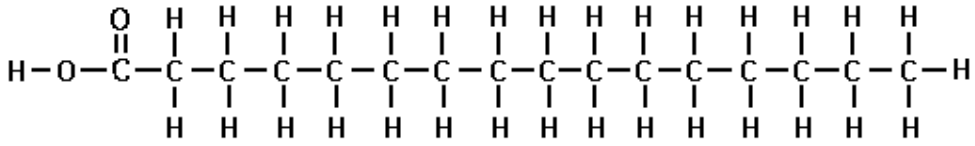
Fats usually come from land animals e.g. butter. Oils usually come from marine animals and from the vegetable kingdom e .g. sunflower oil.

The difference between a fat and oil is simply in the melting points of the mixture of esters they contain.
If the melting points are below room temperature, it will be a liquid – oil.
If the melting points are above room temperature, it will be a solid – a fat.

The lower melting temperature oils tend to replace fats in marine animals e.g. whales, because fats would be too viscous or solid at sea temperatures.

Fats contain mainly saturated acids such as:

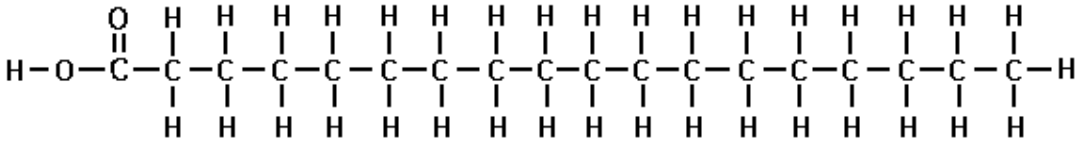
- Hexadecanoic acid: C15H3CO2H, which is commonly known as palmitic acid.



Palmitic Acid

$CH_3 (CH_2)_{14} COH$

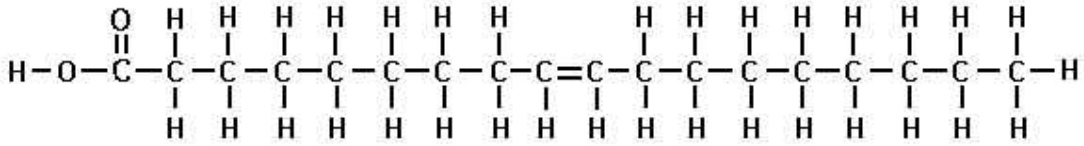
- And octadecanoic acid: C17H35CO2H, which is commonly known as stearic acid.



Stearic Acid

$CH_3 (CH_2)_{16} CO_2H$

While oil contains a high proportion of unsaturated acids such as oleic acid, C17H33CO2H.



Oleic Acid- Monounsaturated Fatty Acid

Cis – $CH_3 (CH_2)_7 CH=CH (CH_2)_7 CO_2H$

Oleic acid is mono – unsaturated acid since it only has one carbon – carbon double bond.
Fats have higher melting temperature than oils…

This is caused by the relative ease with which saturated chains can pack together, maximizing intermolecular attraction and melting temperature.
The saturated chains allow more effective vender Waals dispersion forces between the molecules. That means you need more energy to separate them, and so increases the melting points.

The greater the extents of the unsaturation in the molecules, the lower the melting points tend to be because the Vander Waals dispersion forces are less effective.

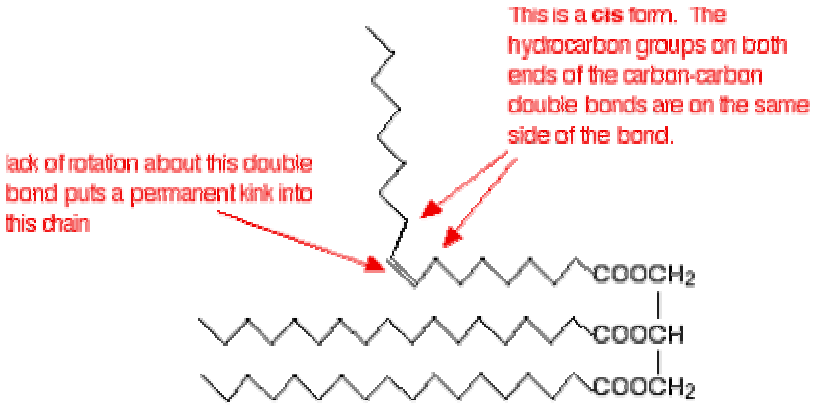
Vander Waals dispersion forces need the molecules to be able to pack closely together to be really effective. The presence of carbon – carbon double bonds in the chains gets in the way of tidy p acking.

Saturated fat

The hydrocarbon chains are, of course in constant motion in the liquid, but it is possible for them to lie tidily when the su bstance solidifies. If the chains in one molecule can lie tidily, that means that neighboring molecules can get close. This increases the attractions between one molecule and its neighbors and so increases the melting point.

The problem of packing of molecules in unsaturated fats which makes them have a low malting temperature

There isn't any rotation about a carbon – carbon double bond and so that locks a permanent kink into the chain.
That makes packing molecules close together more difficult. If the y don't pack so well, the wander Waals forces won't work as well.
This effect is much worse for molecules where the hydrocarbon chains either end where the hydrocarbon chains are arranged Cis to each other, which means, both of them on the same side of th e double bond.



In Trans form, the two hydrocarbon groups are on opposite sides of the carbon – carbon double bond. This doesn't cause so much distortion. Therefore, we can say that Trans fats and oils have higher melting points than Cis ones, because the packing is not affected as much.

Naturally occurring unsaturated fats and oils tend to be the Cis form.

Margarine.

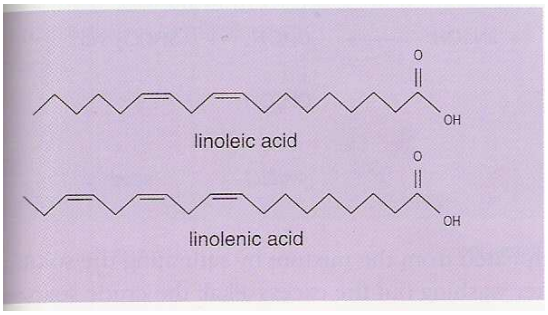
Margarine is a cheap substitute for butter with better keeping qualities. The first margarine was obtained from animal fats by separating the unsaturated esters which were then ripened with little milk.

During the 20th century, it has been manufactured by partial catalytic hydrogenation of oils using nickel as a catalyst.

- Removing the unsaturation raises the melting temperature.
- Emulsifiers, yellow coloring, butter odors, common salt and antioxidants are then added.
- The mixture is ripened with skimmed milk

In the early century, cheap margarine caused some dietary deficiency because of the lack of natural vitamins.
Vitamins A and D are then added to the mixture by law

The polyunsaturates (unsaturated compounds) present in the mixture (linoleic acid and linolenic acid) do not have conjugated double bonds. They are said to be Cis.



At high temperatures, these might change to Trans and conjugation might occur.
To avoid this problem, it's better to complete hydrogenation using monounsaturates and then blend in the oils which are richer in the polyunsaturates.

Lubricating oils and essential oils

Lubricating oils are based on the products of vacuum distillation of the higher boiling fractions from petroleum. They are not esters.

Essential oils strongly smell and volatile oils derived from plants.

- They are derived from the molecule C10H16, limonene, which is an essential oil derived from lemon grass
- They are called terpenes due to their relationship with limonene.
- They can be aldehydes, alcohols, or ketones.
- Most of them are now synthetic.

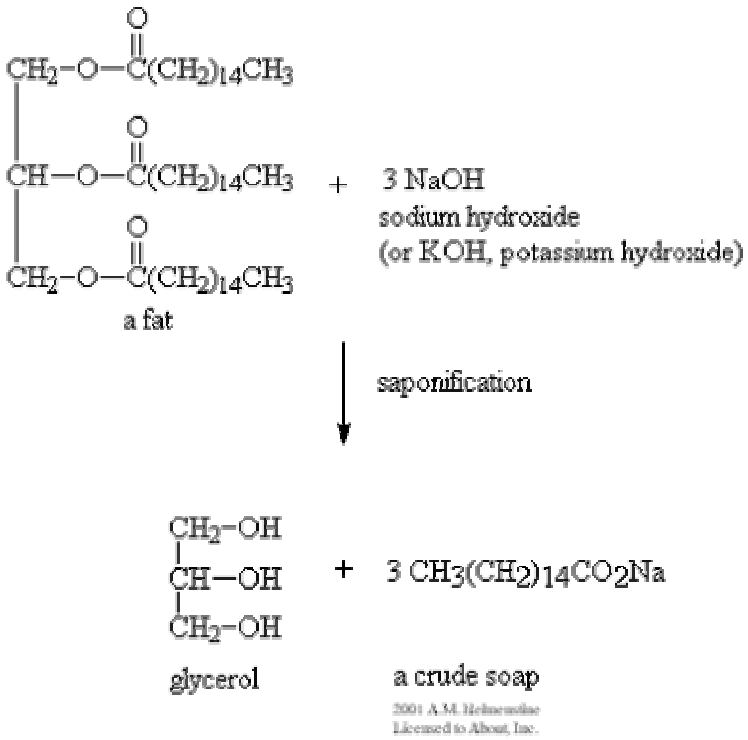
You should realize that the volatility and odor of alcohols can be varied by esterification often with ethanoic acid

Soaps

Saponification: making of soaps by the alkaline hydrolysis of fats and oils the alkali usually used is sodium hydroxide.

Other alkali's like:

- Potassium hydroxide: is used in making toilet soaps
- Lithium hydroxide: is not suitable
- Other lithium salts: are used in greases for automobiles.



1- The soap is precipitated from the mixture by saturating the solution with common salt.
2- After washing out excess alkali, crude soap is mixed with glycerol to soften it
3- It is then colored and perfumed.

Thank you ☺