B.Sc Part III Paper ORGANIC

TOPIC: - FATS AND OILS

COLLEGE: - PATNA SCIENCE COLLEGE, PATNA

DEPARTMENT OF CHEMISTRY

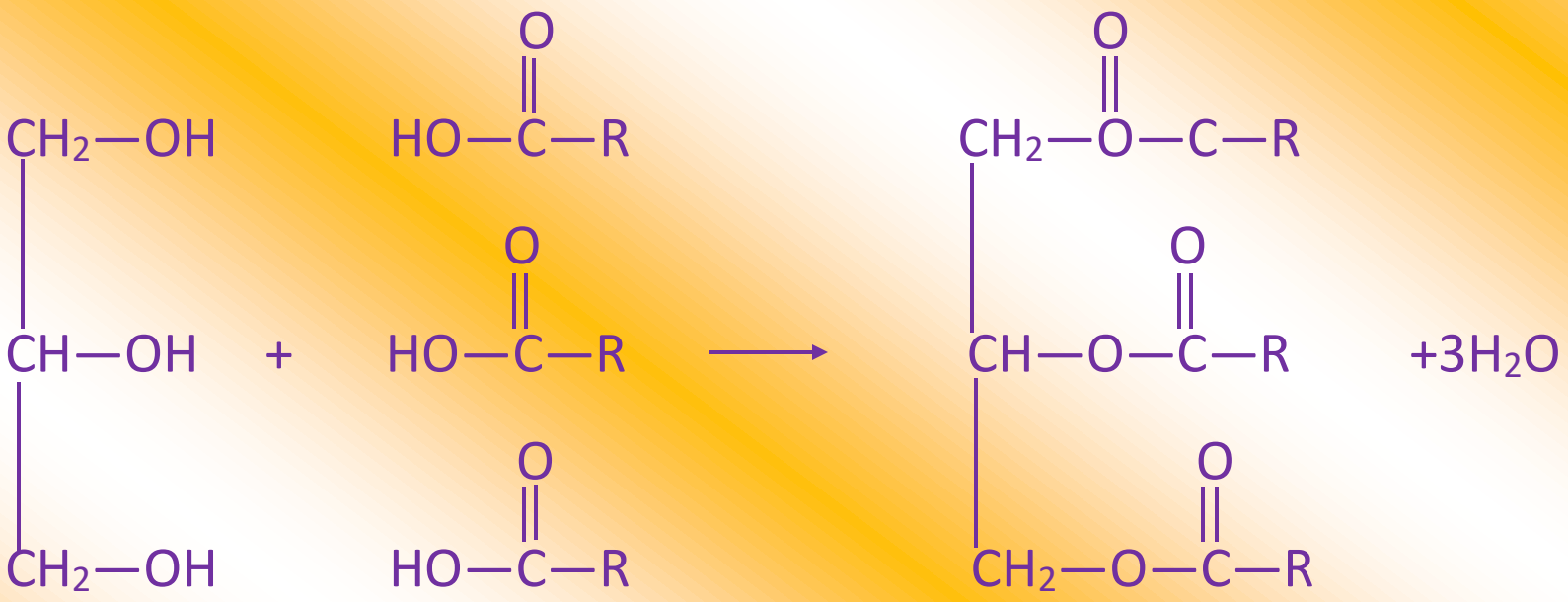
BY: - DR. PANKAJ KUMAR (GUEST FACULTY)

EMAIL ID: - pank9097@gmail.com

MOB NO: - 9097705750

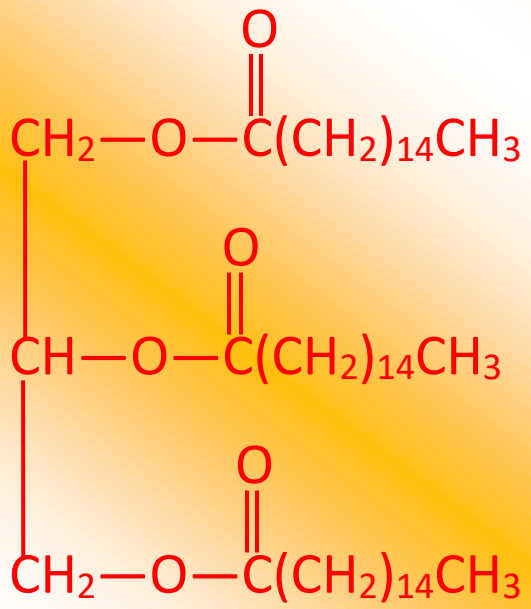
WHAT AE FATS AND OILS ?

Natural fats and oils are the trimesters of glycerol with long-chain carboxylic acids (12 to 20 carbons). These are known as **Triglycerides.**



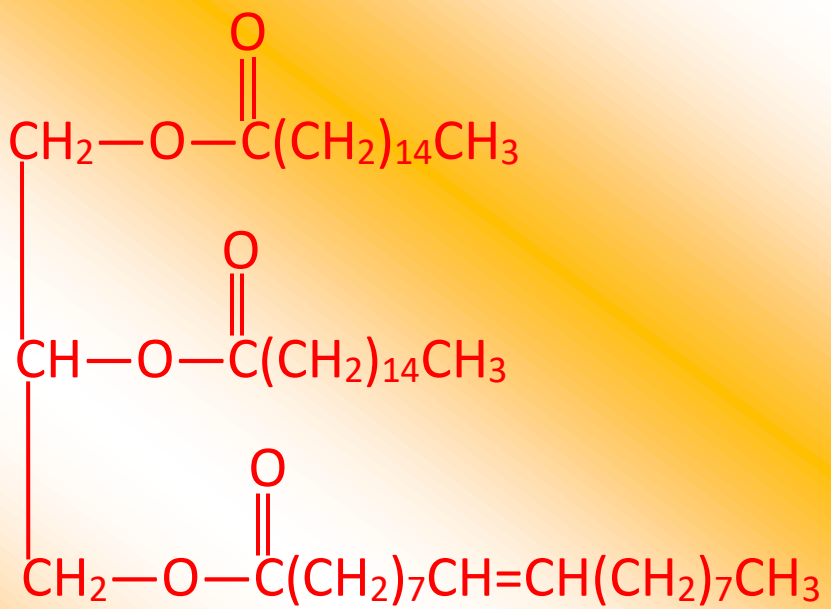
Glycerol Carboxylic Acid A triglyceride

When the three **OH** groups of glycerol are esterified with the same acid, the triester is known as a **Simple glyceride,** and if with two or three different acid, a **Mixed glyceride.** For example



Glyceryl tripalmitate

(a simple glyceride)



Glyceryl palmitostearooleate

(a mixed glyceride)

The carboxylic acids that form ester chain in natural triglycerides (oils or facts) may be saturated or unsaturated. Some of these are listed in the table below.

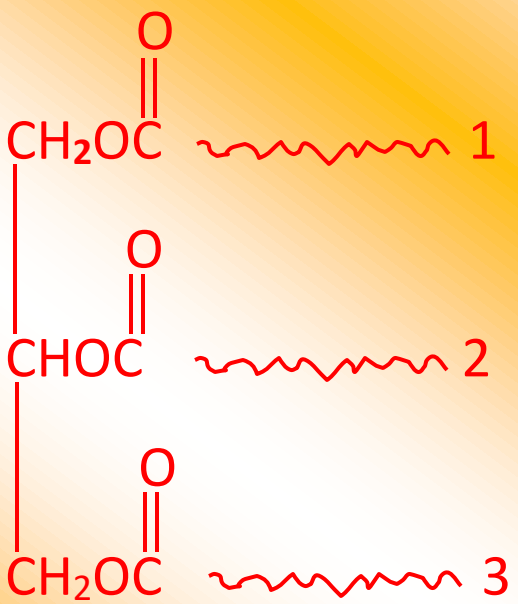
SOME COMMON FATTY ACIDS

Name	Formula	mp°C
Myristic acid	$CH_3(CH_2)_{12}COOH$	58
Palmitic acid	$CH_3(CH_2)_{14}COOH$	63
Stearic acid	$CH_3(CH_2)_{16}COOH$	70
Oleic acid	$CH_3(CH_2)_7\,CH{=}CH(CH_2)_7COOH$	4
Linoleic acid	$CH_3(CH_2)_4\,CH{=}CHCH_2CH{=}CH(CH_2)_7COOH$	-5

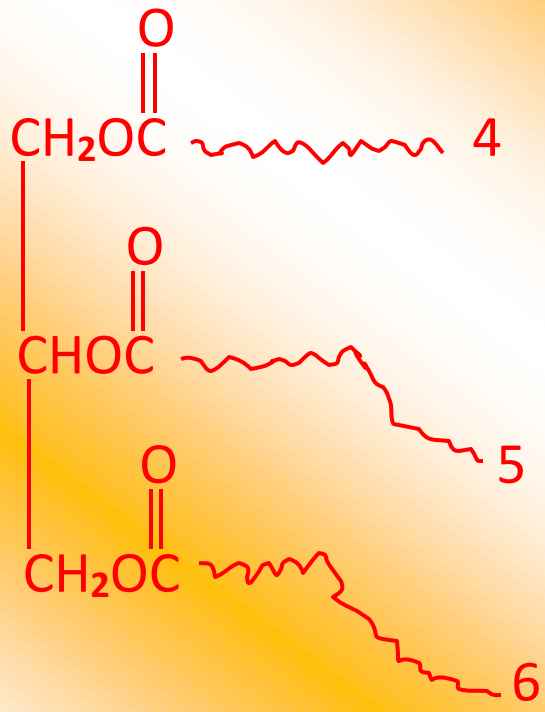
DISTINCTION BETWEEN FATS AND OILS

The distinction between fats and oils is primarily based upon the difference in melting points. **Fats are composed of solid trimesters of glycerol, while oils are composed of liquid trimesters of glycerol at room temperature.** However, this distinction is not well founded as the physical state depends on climate and weather. The same glyceride may be solid at a hill station and liquid in plains.

The melting point of a fat on oil depends on its structure. If all the fatty acids forming a triglyceride are saturated, their carbon-chains can align themselves in a regular pattern. Such molecules can pack well in a crystal, and thus form solids at room temperature. On the other hand, if some of the ester bonds that have cis configuration. These kinks make the carbon-chains at the double close-packing of the molecules. Thus in general, oils contain glycerides in which unsaturated acids preponderate. On the other hand, in solid fats saturated acids preponderated.



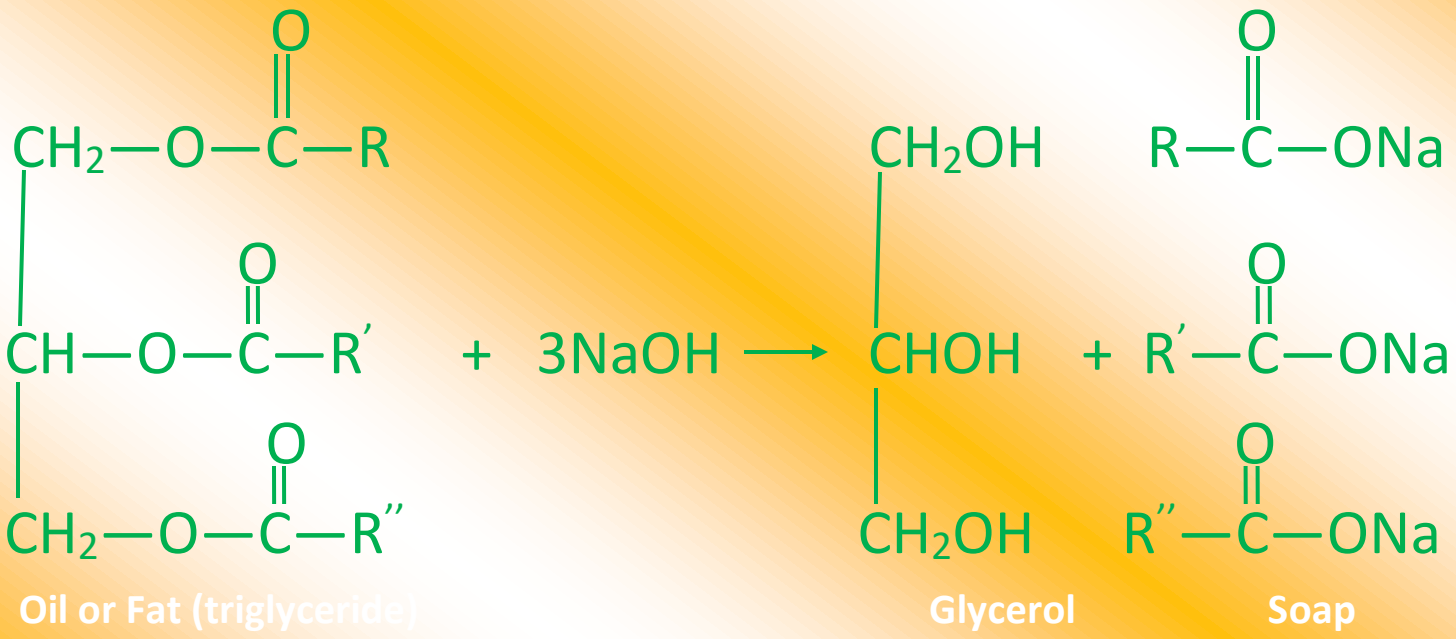
A saturated glyceride (solid)



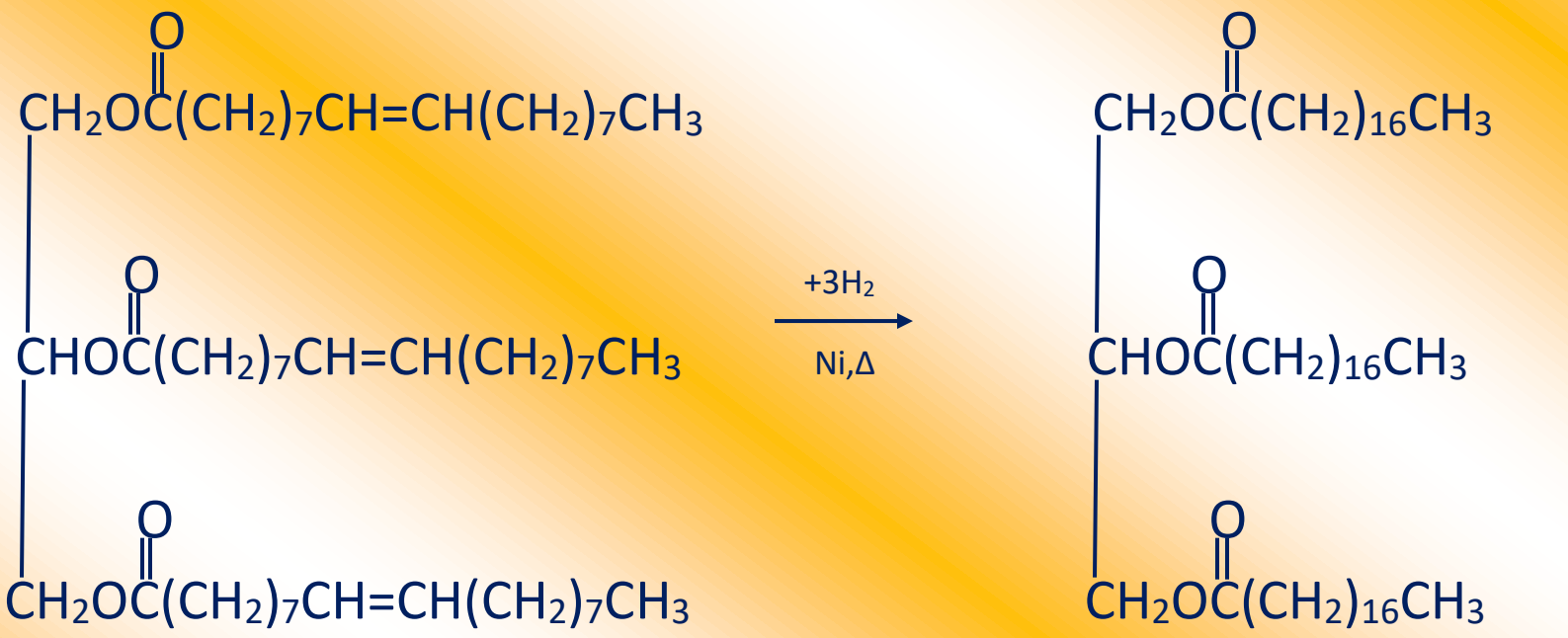
A partially saturated triglyceride (liquid)

Chemical Properties. Fats and oils readily hydrolysed by heating with saturated ad unsaturated fatty acids. Their reactions are those of ester groups in triplicate and carbon-carbon double bonds.

(1) Hydrolysis. They are readily hydrolysed by heating with acids or alkalies or superheated steam. When boiled with sodium or potassium hydroxide solution, the hydrolysis products are sodium or potassium salts of long-chain fatty acids. The latter are called **Soaps** and alkaline hydrolysis is referred as **Saponification.**



(2) **Hydrogenation.** Vegetable oils are triglycerides of unsaturated fatty acids as oleic acid and linoleic acid. On catalytic hydrogenation at low pressures, hydrogen adds across the carbon-carbon double bonds of the acid components of the triglycerides. This results in the formation of saturated glycerides which are solid fats at room temperature. This hydrogenation process is called **Hardening**. For example,

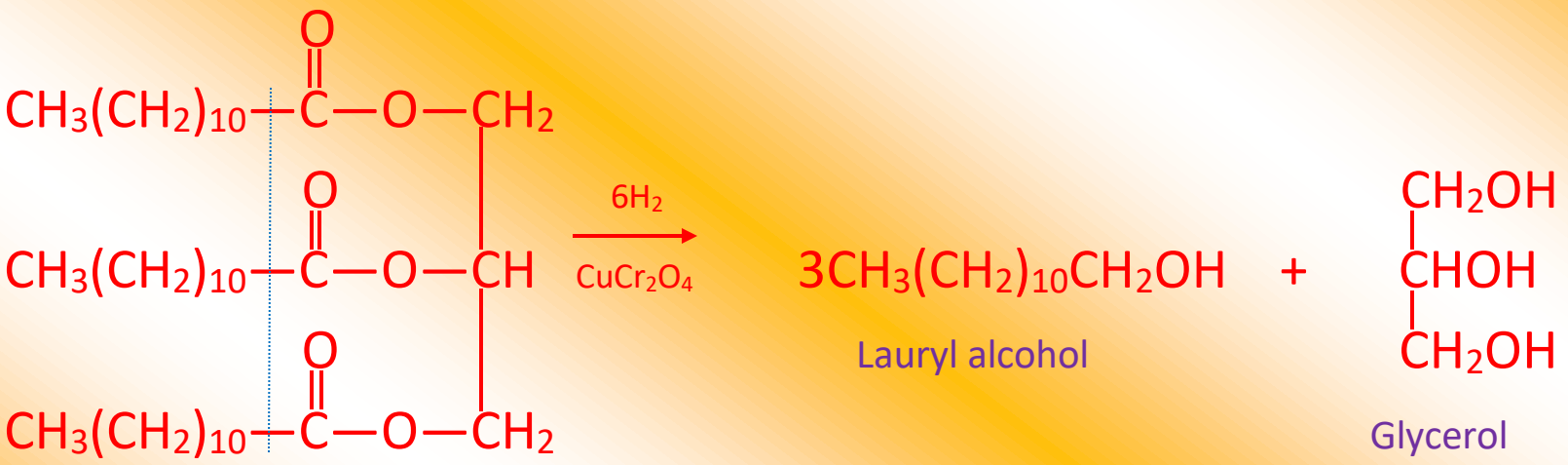


Glyceryl trioleate (mp - 17°c)
(A liquid vegetable oil)

Glyceryl tristearate (mp 55°c)
(A solid fat)

Partial hydrogenation of vegetable oils is used for the manufacture of **Vegetable Ghee** (Dalda). Complete hydrogenation according to the above equation would produce a gard brittle fat.

(3) **Hydrogenolysis**. Like a simple ester, the ester group of triglycerides (fats of oils) can be reduced with hydrogen in the presence of copper chromite catalyst, $CuCr_2O_4$, at high pressure and temperature. This reaction, called hydrogenolysis (hydrogenation involving cleavage) gives in addition to glycetol, long-chain primary alcohols corresponding to the acid portion.



Glyceryl trilaurate

The long-chain alcohols so obtained are used for manufacturing Detergents.

ANALYSIS OF FATS AND OILS

(1) **Saponification Number (Saponification Value).** The saponification number tells the approximate molecular weight of a fat or oil, as also whether lower or higher fatty acids preponderate in the formation of its ester groups.

Saponification number is defined as the number of milligrams of KOH required to saponify one gram of a fat or oil.

In the saponification reaction, one mole of a fat reacts with three mole of KOH since the former has three ester groups. **If M** be the molecular weight of the fat, M grams of it require 3×56 = 168 grams of 168,000 milligrams of KOH for saponification. Therefore,

$$\text{Saponification Number of Fat} = \frac{168000}{M}$$

(2) Iodine Number (Iodine vlue). The degree of unsaturation of a fat or oil is measured by its Iodine Number.

Iodine Number is the number of grams of iodine that would to carbon-carbon double (c=c) present in 100 grams of the fat or oil.

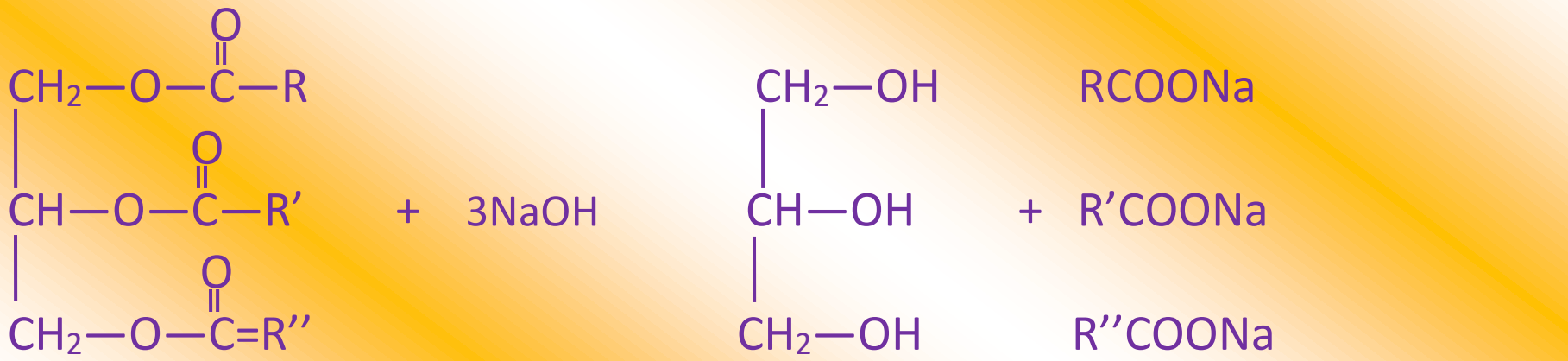
ANALYSIS OF SOME FATS AND OILS

Fat or Oil	Saponification Number	Iodine Number
Coconut fat	250-260	8-10
Butter fat	210-230	26-28
Tallow	190-200	30-48
Lard	193-200	46-70
Olive oil	197-196	79-90
Cottonseed oil	190-198	105-114
Sunflower oil	188-194	140-156
Linseed oil	187-195	170-185

WHAT ARE SOAPS ?

Soaps are sodium or potassium salts of fatty acids. Chiefly oleic, stearic, palmitic, lauric and myristic acids. Ordinary soaps are the products of hydrolysis of oils and fats with sodium hydroxide.

The oils and fats are mixed triglycerides, and as such soaps are mixtures of salts of saturated and unsaturated long chain carboxylic acids containing 12 to 18 carbon atoms.



Fat (mixed triglyceride) Glycerol Soap (mixture of sodium carboxylates)

A higher proportion of salts of saturated acids (plamitic, stearic) gives **Hard Soaps,** while a higher proportion of salts of unsaturated acids (oleic acid) yields **Soft Soaps**.

The potassium soaps, produced by the saponification of fats with KOH, are usually softer and more soluble than the sodium soaps. Therefore, potassium soaps are used mainly in shaving creams and liquid soaps (Shampoo).


Thank you