UNIT-III

Introduction:-

→ Fats and oils belong to the naturally occuring group of compounds called lipids.

→ The lipids occuring in biological systems are either hydrophobic (contain only non-polar group) or Amphipathic, which indicates that it possess both polar and non-polar groups.

BIOLOGICAL IMPORTANCE OF LIPIDS:-

1.) Lipids Act as a source of Energy. They yield twice the energy produced by the same weight of carbohydrates or proteins.

2.) They are natural solvents for fat-soluble vitamins.

3.) Lipids in adipose tissue serve as energy store.

4.) Lipids have a role in protection and fixation of internal organs.

5.) Lipids under the skin serve as thermal insulator.
6.) Lipids in myelin sheath of nerve fibers serve as electrical insulator.
7.) Lipide are essential components in the structure of cell membrane and mitochondria

properties of fats and oils :-

physical properties:-

(1) oils and fats are liquid having greasy feel.
(2) They are colourless, odourless and tasteless.
(3) They are insoluble in water but, soluble in organic solvents such as ether, benzene, chloroform and Alcohol.
(4) They have lower specific gravity than water.

CHEMICAL PROPERTIES :-

(1) Hydrolysis:- when fats are hydrolyzed with alkali or enzyme lipase they yield fatty Acids and glycerol. Lipase being about splitting of fats in steps from triglyceride to diglyceride

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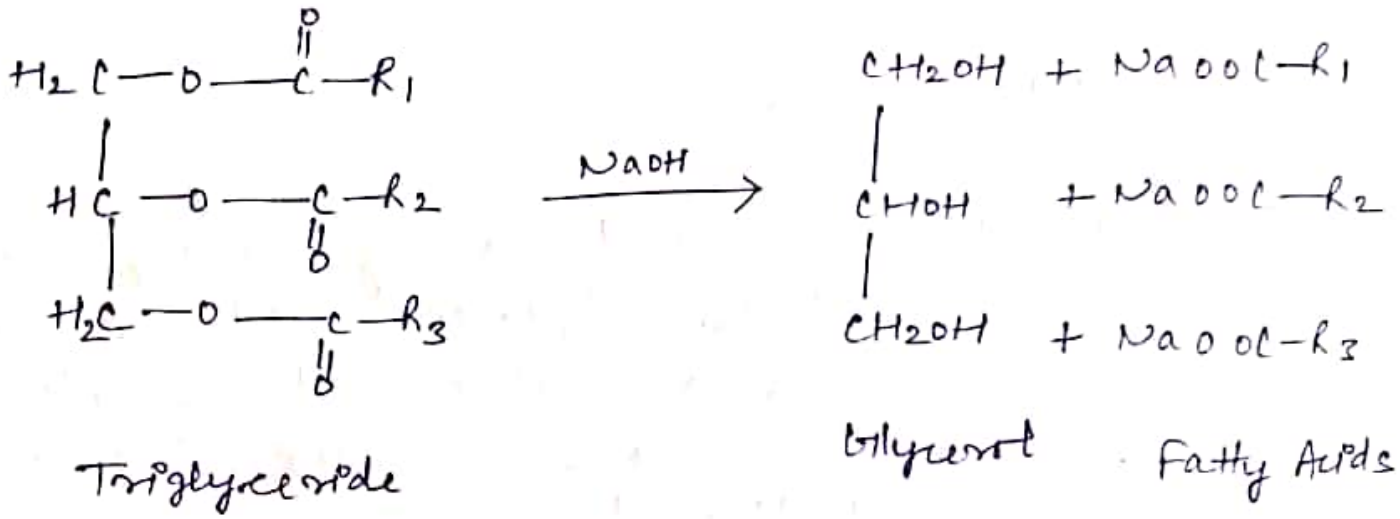
to monoglyceride and finally to glycerol and fatty Acid.

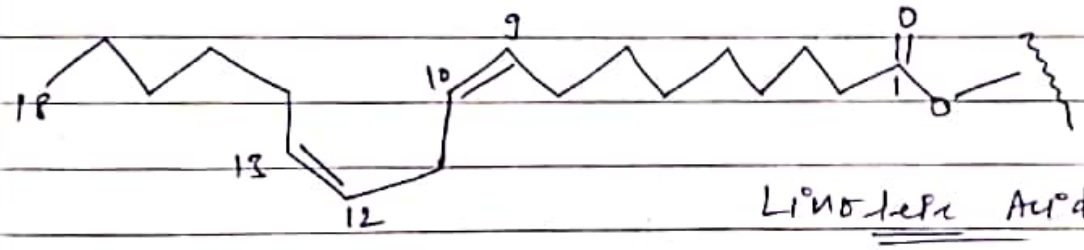
Lipids work at the temperature range from 0–40°C. The fats are hydrolyzed with Alkali and yield the free fatty Acids, which react with Alkali to form salts. These salts are soaps and this process is termed as "saponification".



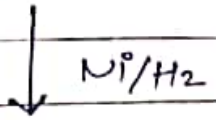
(2). Hydrogenation :-

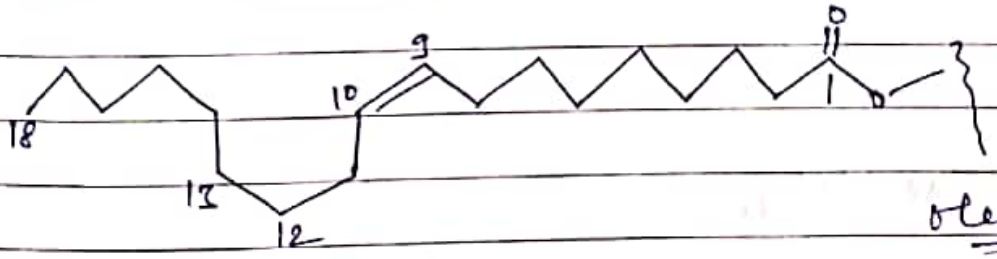
Conversion of unsaturated to saturated fatty Acids using Hydrogen gas on the surface of a metal catalyst such as platinum, palladium or nickel.

The process of Hydrogenation is also called as Hardening of fats.



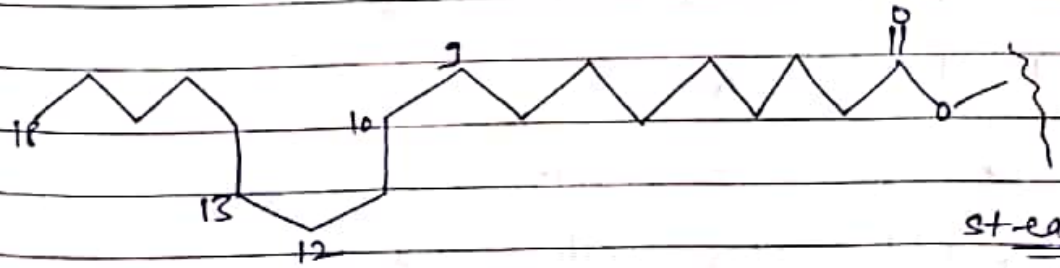
Linoleic Acid





Oleic Acid
(desired product)

+



Stearic Acid
(fully saturated)

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RANCIDITY of OILS

Rancidity is the complete or incomplete oxidation or hydrolysis of fats and oils when exposed to air, moisture or bacterial action, resulting in unpleasant taste and odour.

There are 2 types of Rancidity -

1.) Hydrolytic Rancidity:- fats are hydrolyzed in the presence of moisture and warm temperature and also by bacterial enzymes into glycerol and fatty Acids.

2.) oxidative Rancidity:- It occurs by oxidation of unsaturated fatty Acids present in fats and oils forming lipid peroxides, fatty aldehydes, & ketones.

Effects of Rancidity:-

1.) fats and oils attain bad taste.
2.) Fats and oils attain disagreeable odour.
3.) production of toxic compounds such as lipid peroxides, aldehydes and ketones.

Date

Expt. No. Page No. 6

Prevention of Rancidity :-

1.) Adding Antioxidants such as -
- Butylated Hydroxy Anisole.
- Butylated Hydroxy Toulene.

2.) Refrigeration :- It reduces the temperature and don't allow the microbes to continue their processes.

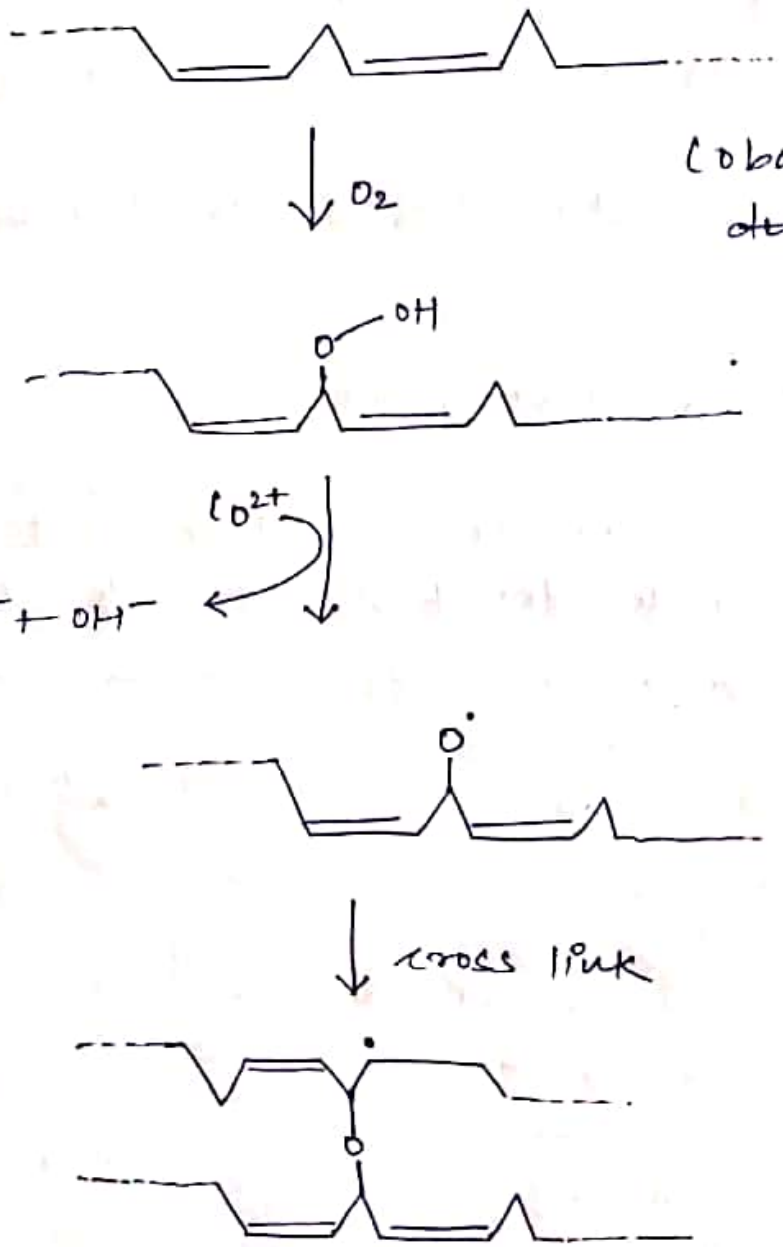
3.) Vacuum packaging :- It is done to keep the oxygen out.

4.) By storing food in dark place.

5.) Adding inert gases in the packet or containers like nitrogen, which donot react with oxygen.

DRYING OILS:-

When highly unsaturated oils are exposed to air, they undergo oxidation and polymerization to form a thin waterproof film, is called as Drying oils and reaction is called as drying.



Cobalt - catalyzed drying process.

Date

Expt. No. Page No. 8

ACID VALUE

- The Acid value is the number of milligram of KOH required to neutralize the fatty Acids present in 1g of the substance (fat or oils).

- It is a measure of the free fatty Acids (FFA) present in the fat or oils.

- principle:- The Acid value is determined by directly titrating the oil/fat in an alcoholic medium against standard KOH/NaOH solution.

- Dissolve 10g of sample, in 50ml of mixture of equal volume of ethanol and ether.

- Titrate with 0.1M KOH solution using phenolphthalein indicator.

$$\text{Acid value} = 5.61 \frac{n}{w}$$

n = burette reading
w = sample weight

Significance:- ① Acid value is the measure of Hydrolytic Rancidity.

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(2). It gives an indication about solubility of the lipid.

SAPONIFICATION VALUE:-

→ It is the number of milligrams of KOH required to saponify one gram of substance (fat or oils).

→ saponification number is a measure of the average Molecular wt. of the fatty Acids present.

→ Eq. molecular wt. of fat:- $\frac{\text{mg of KOH}}{\text{saponification number of fat}}$

principle:- • saponification is the process by which the fatty Acids in the triglycerides or fats are hydrolyzed by an Alkali to give glycerol and potassium salts of fatty Acids.

• A known quantity of fat or oil is refluxed with an excess Amount of Alcoholic KOH.

• After saponification the remaining KOH is estimated by titrating it against a standard Acid.

• The value obtained is used for the determination of saponification no. of fats and oils.

Date

Expt. No. Page No. 10

- saponification value = $\frac{M_w \times N \times (V_{blank} - V_{Test})}{W_s (g)}$

W_s = weight of sample (g)
M_w = Molecular wt. of KOH
N = Normality of KOH
V_{blank} = volume of HCl for blank sample.
V_{Test} = volume of HCl for the Test sample.

Significance:-

1.) Saponification value gives an idea about the Average molecular weight of the fat or oil.

2.) It also indicates the length of carbon chain of the Acid present in that oil or fat.

3.) Higher the saponification value, greater is the percentage of the short chain Acids present in oils or fats.

Iodine number:-

This parameter is a measure of the average degree of unsaturation of fat and oil. The higher ~~the~~ iodine value represents the greater the number of C=C double bonds.

principle:-

→ The oil/fat sample (w) taken in carbon-tetrachloride is treated with a known excess of Iodine monochloride solution in glacial Acetic Acid.

→ The excess of Iodine monochloride is treated with ~~excess~~ potassium iodide.

→ The liberated Iodine estimated by titration with 0.1M sodium thiosulphate solution using starch solution as indicator.

$$\text{Iodine value} = \frac{1.26\,(b-a)}{w}$$

b = perform blank titration,

a = Back reading.

Significance:-

1.) It is the measure of Amount of unsaturation in fat.

2.) Higher the iodine value, more is the unsaturation in ~~fat~~ oils.

Date

Expt. No. Page No. 12

Ester value :-

It is the number of milligrams of KOH required to saponify the ester present in 1gm of substance.

principle :-

It is determined by titrating the sample of oil and fat in alcoholic medium against 0.5M HCl.

→ Weigh accurately about 2g of sample. Add 25ml of 0.5M ethanoic KOH.
→ And boiled under reflux condensor on a water bath for 1 hr.
→ Then, Add 20ml of H_2O in it.
→ Then, Titrate with 0.5M HCl using a indicator (phenolphthalein).
→ Repeat the operation without sample (blank titration).
→ The difference b/w the titrations represents the Alkali required to saponify the esters.

significance :-

1.) It gives an idea about number of OH group present in the fat.
2.) Ester value shows the Amount of Alkali consumed in the saponification of esters.

Acetyl value:-

It is the mg of KOH required to neutralize the Acetic Acid obtained by saponification of 1g of fat (Acetyled fat).

principle:- It is determined through saponification value.

→ Boil the 1g of sample with 20ml of Acetic Anhydride for 2 hrs.

→ Add 600ml H_2O and boil for 30 minutes.

→ Separate and wash the Acetylated product.

→ Determine the saponification value of the Acetylated substance.

→ Determine the saponification value of the substance.

$$\text{Acetyl value} = \frac{1335\,(b-a)}{(1335-a)}$$

where, a = saponification of the substance.
b = saponification value of the Acetylate substance.

significance:-

1) It gives an idea About number of OH groups present in fat.

2) High Acetyl value indicates high Amt. of free fatty Acids.

Reichert - Meissl value / RM value :-

The ml of 0.1N KOH required to completely neutralize the volatile fatty Acids distilled from 5g fat.

Principle :-

→ fat is saponified using glycerol - Alkali soln and Acidified by sulphuric Acid to liberate free fatty Acids.

→ The liberated fatty Acids are steam distilled and the steam volatile fatty Acids are collected as condensate.

→ The cooled condensate of the volatile fatty Acids is filtered for separation of water soluble and water insoluble fatty Acids.

→ The water soluble fatty Acids is titrated with Alkali to give RM value.

Significance :-

1) It is the measure of water soluble steam volatile fatty Acids.

2) It is Also used for ~~Analyze~~ Analysis of butter and margarines.