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B.PHARMA SEM-3

UNIT - 3

PART- 2

PHARMACEUTICAL ORGANIC CHEMISTRY II

FATS & OILS

REACTIONS OF FATS AND OILS

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TOPIC:- Reactions of fats & oils

- ✓ Hydrogenation
- ✓ Hydrolysis
- ✓ Saponification

Most scoring

MMMP

Reactions of fats/oils

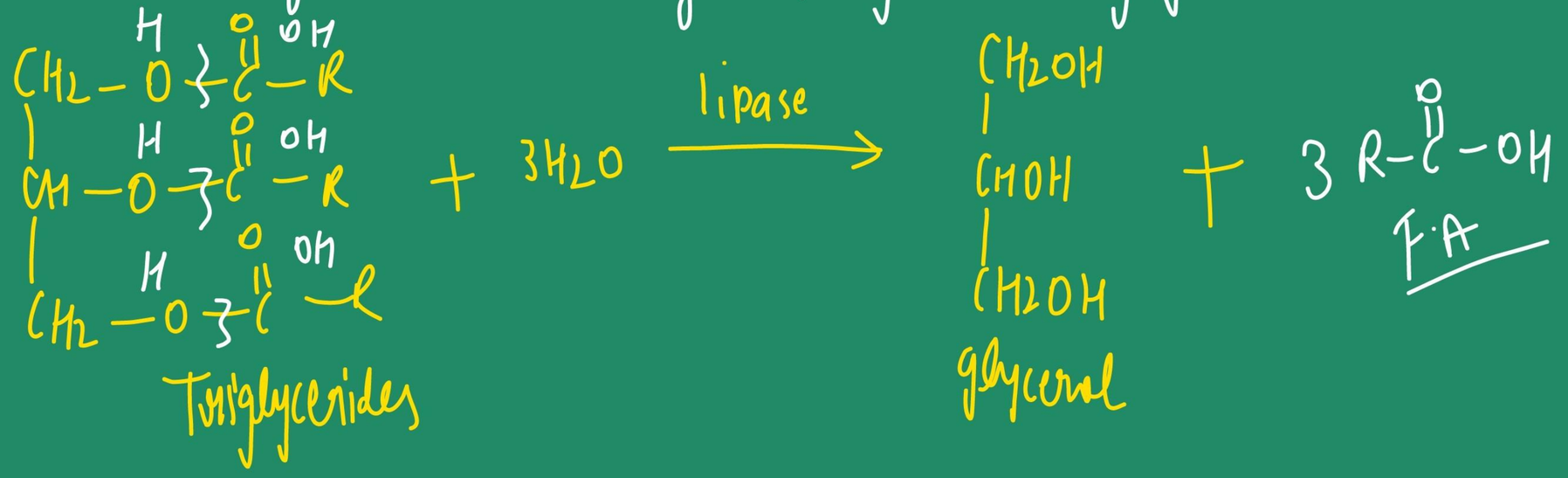
They shows various chemical reactions where conversion of fatty acids takes Place.

- Hydrogenation → Rancidity of oils
- Hydrolysis → Drying of oils
- Saponification

1. Hydrolysis

it involves the cleavage of tri-glycerides into fatty acids & glycerol. by using water.

In this reaction, truglycerides are hydrolysed by lipase in the digestive tract of animal to give fatty acids & glycerol.



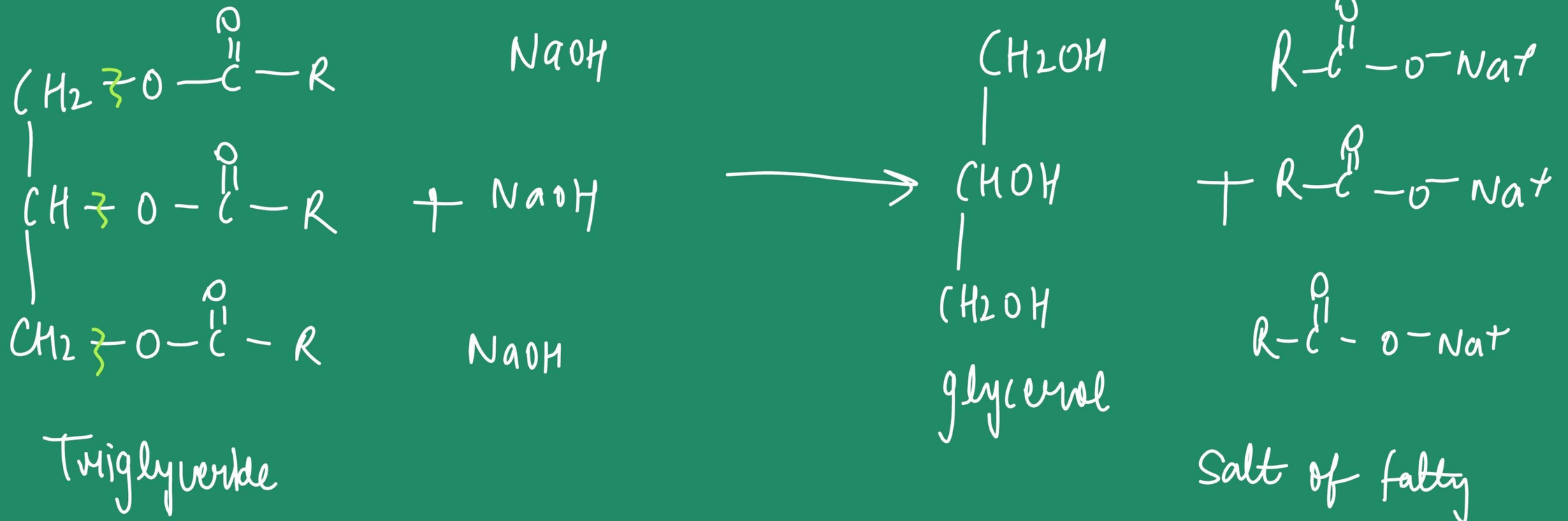
Saponification Reaction

'Soap + formation'

detergent

It is the process involving hydrolysis of fats & Oils with Base / alkali resulting in the formation of a soap.

When triglycerides are saponified by any base, glycerol & salts of fatty acids are produced.



Triglyceride

Thus, formation of soap with fats/oils with base is called Saponification.

Types:

It is mainly of two types of soaps.

1.) **Hard soap** :— These are the sodium salt of higher fatty acids.

Hard soaps are formed when NaOH reacts with fats/oils.

Eg: Sodium Palmitate soap, common soaps etc.

→ Low solubility in water.

→ High cleansing activity.

2.7 Soft Soaps :—

These are the Potassium salts of higher fatty acids.

These are formed when KOH reacts with fats / oils.

→ Soft - gel like Texture.

→ less cleansing ability.

→ High solubility in water.

→ These are used in many personal care products.
such as: Body wash, Hand wash etc.

3. Hydrogenation (Addition of H)

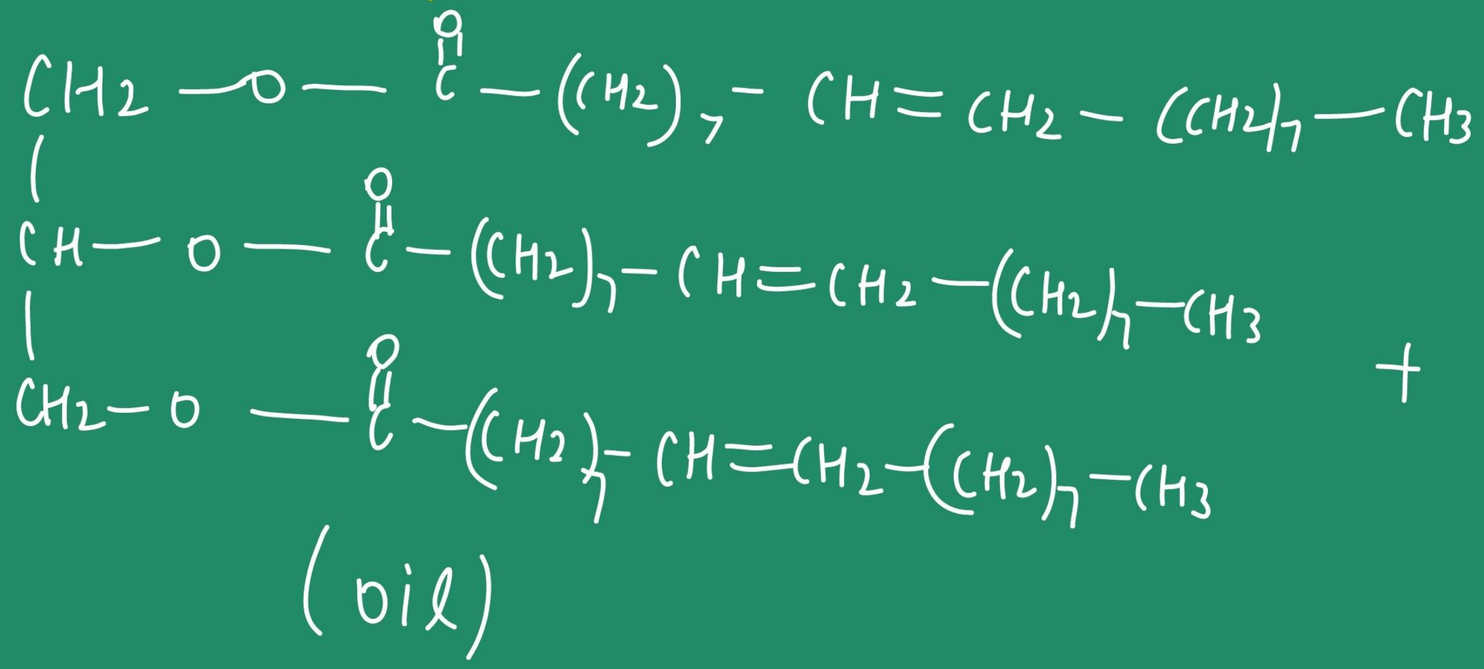
→ It is a chemical reaction which involves addition of hydrogen to unsaturated fats/oils.

→ It is used to improve the texture, stability & the shelf life of fats/oils.

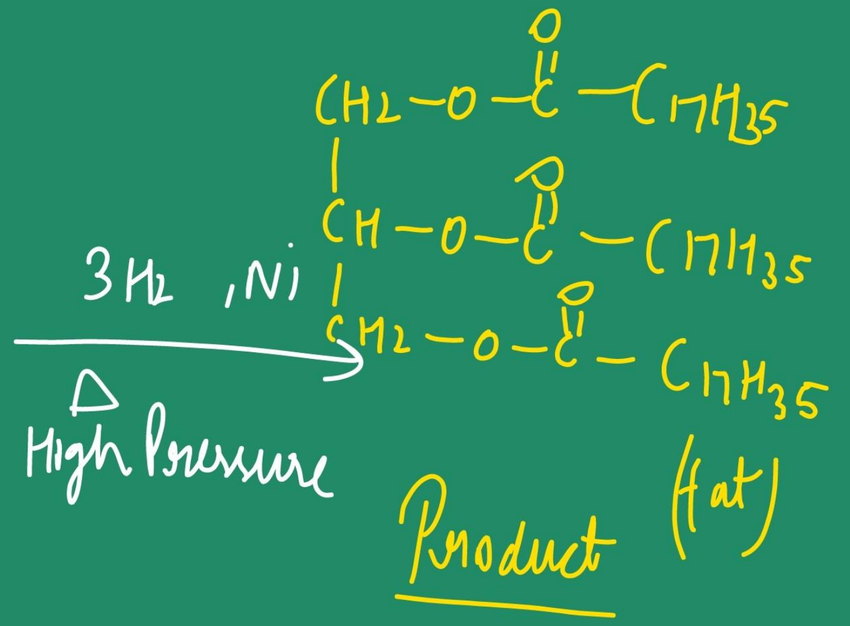
Reaction

It involves the addition of H-atom in unsaturated fats/oils in the presence of a catalyst.

This reaction typically Proceeds in the Presence of High Temp. and Pressure.



(oil)



Product (fat)

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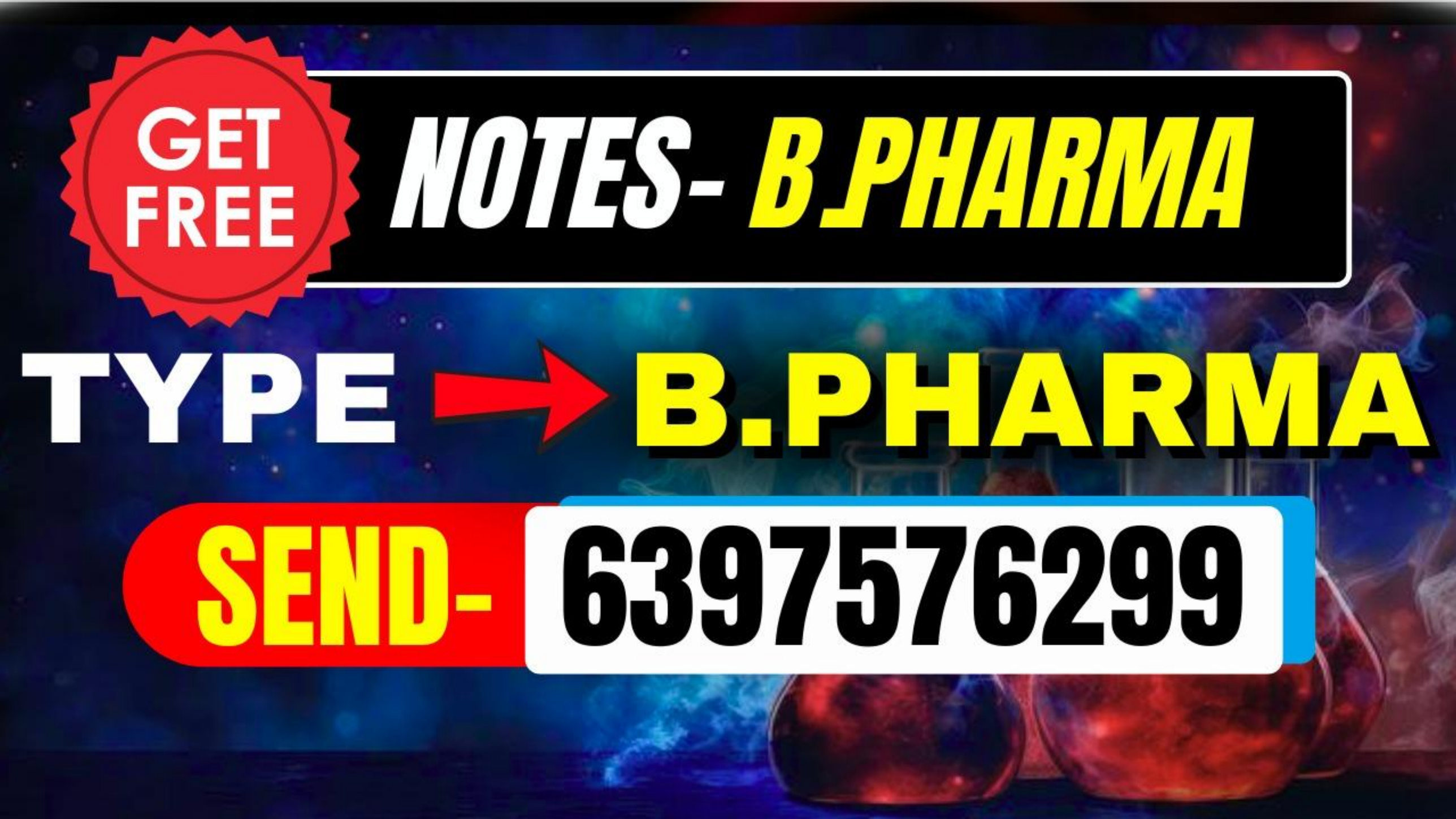
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PART- 3

PHARMACEUTICAL ORGANIC CHEMISTRY II

FATS & OILS

REACTIONS OF FATS AND OILS
-RANCIDITY OF OILS
-DRYING OF OILS

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TOPIC: Rancidity of oils
&
Drying of oils

Rancidity of oils

Rancidity is a Process which occurs in fats/oils.
In which fats/oils are spoiled and degraded due Oxidation, Hydrolysis etc.

Rancidity

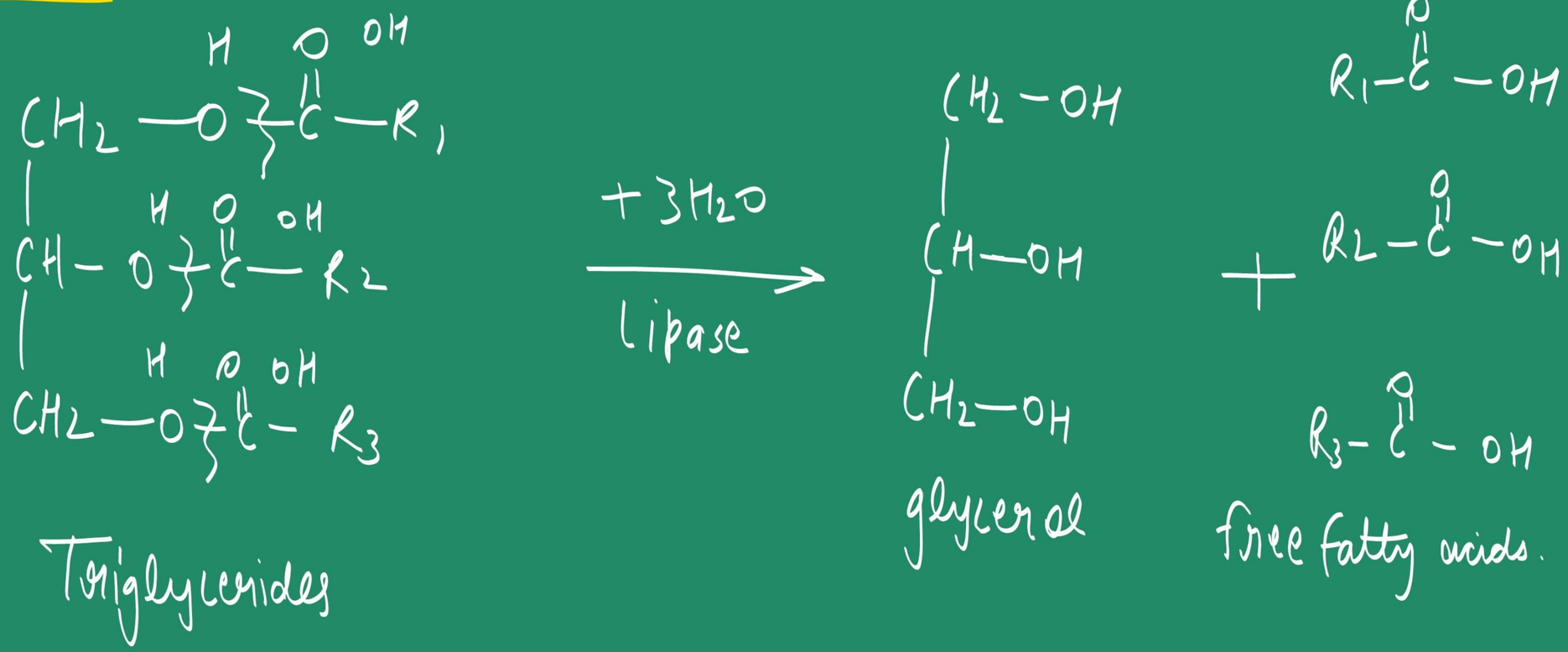
When fats/oils are left exposed to moist air, they develop different colour & unpleasant odour due to fatty acids.

Types

1.) **Oxidative Rancidity** :- When fats/oils react with oxygen, Oxidative rancidity takes Place.
It leads to the formation of an Intermediate (free radical) and it breakdowns.

2.) **Microbial Rancidity** :- It occurs when micro-organism (bacteria) breakdown oil/fats leading to the development of odd flavours.

Reaction



Prevention

1. Use airtight containers.
2. Store oil/fats in a cool dry place, away from light & heat.

Drying of oils

When highly unsaturated oil are exposed to air they undergoes oxidation and Polymerisation.

for the formation of a thin film (Protecting layer)

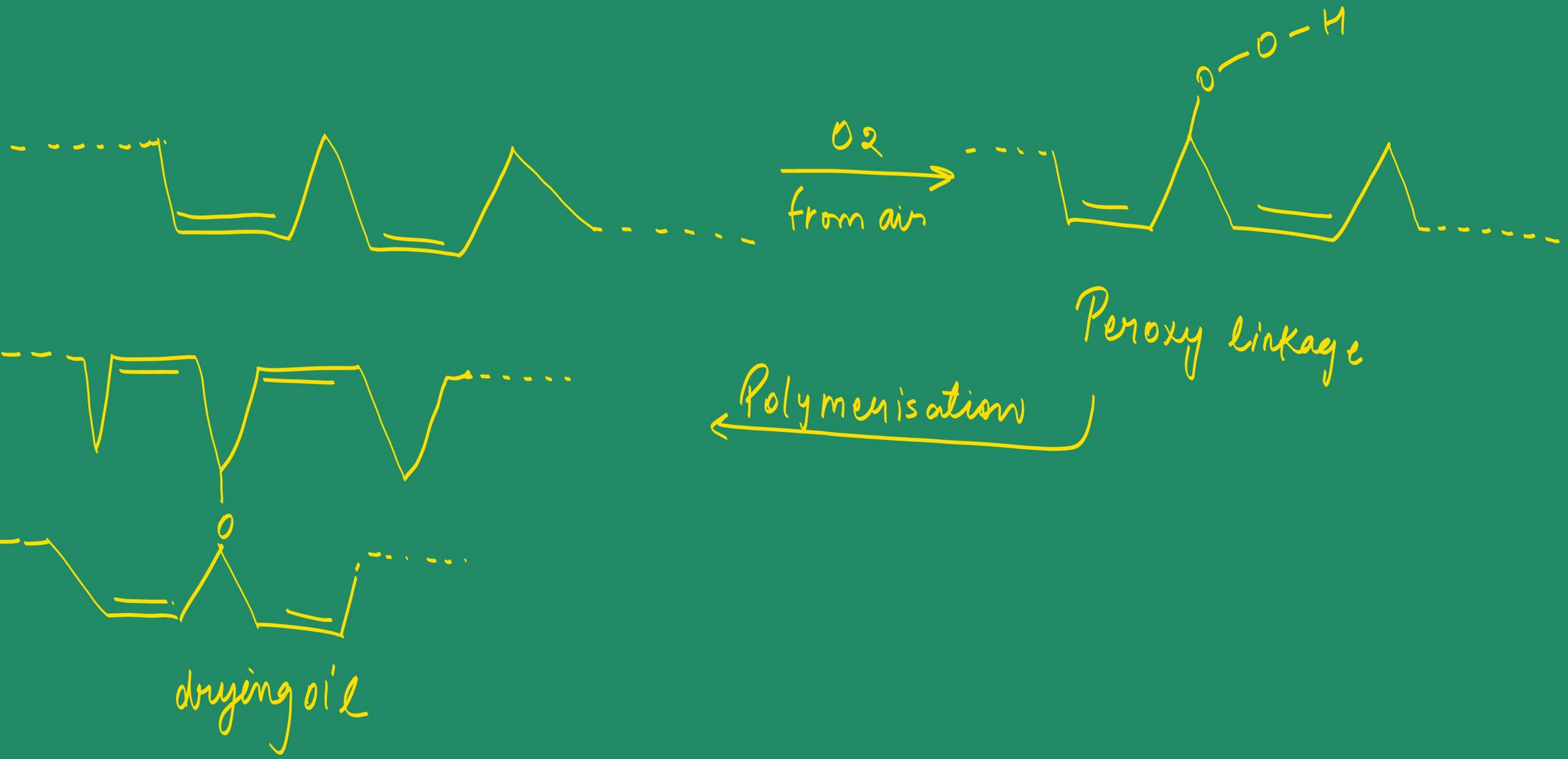
These oils are also called as drying oils.

Reactions

It involves the oxidation of oil's fatty acid, which further reacts with air and forms an intermediate (free radical).

→ Free radical again reacts with oxygen to form Hydroperoxides that decompose to Aldehyde & other volatile compounds.

→ Formed Aldehyde again reacts with each other & shows Polymerisation i.e; Hard & dry. (Polymerised film)


O2
from air
O-O-H
Peroxy linkage
Polymerisation
O
drying oil

Example

Linseed oil (oil-based Paints)

→ used in formation of Paints & Warnishes etc.

→ which enhances flexibility & durability.

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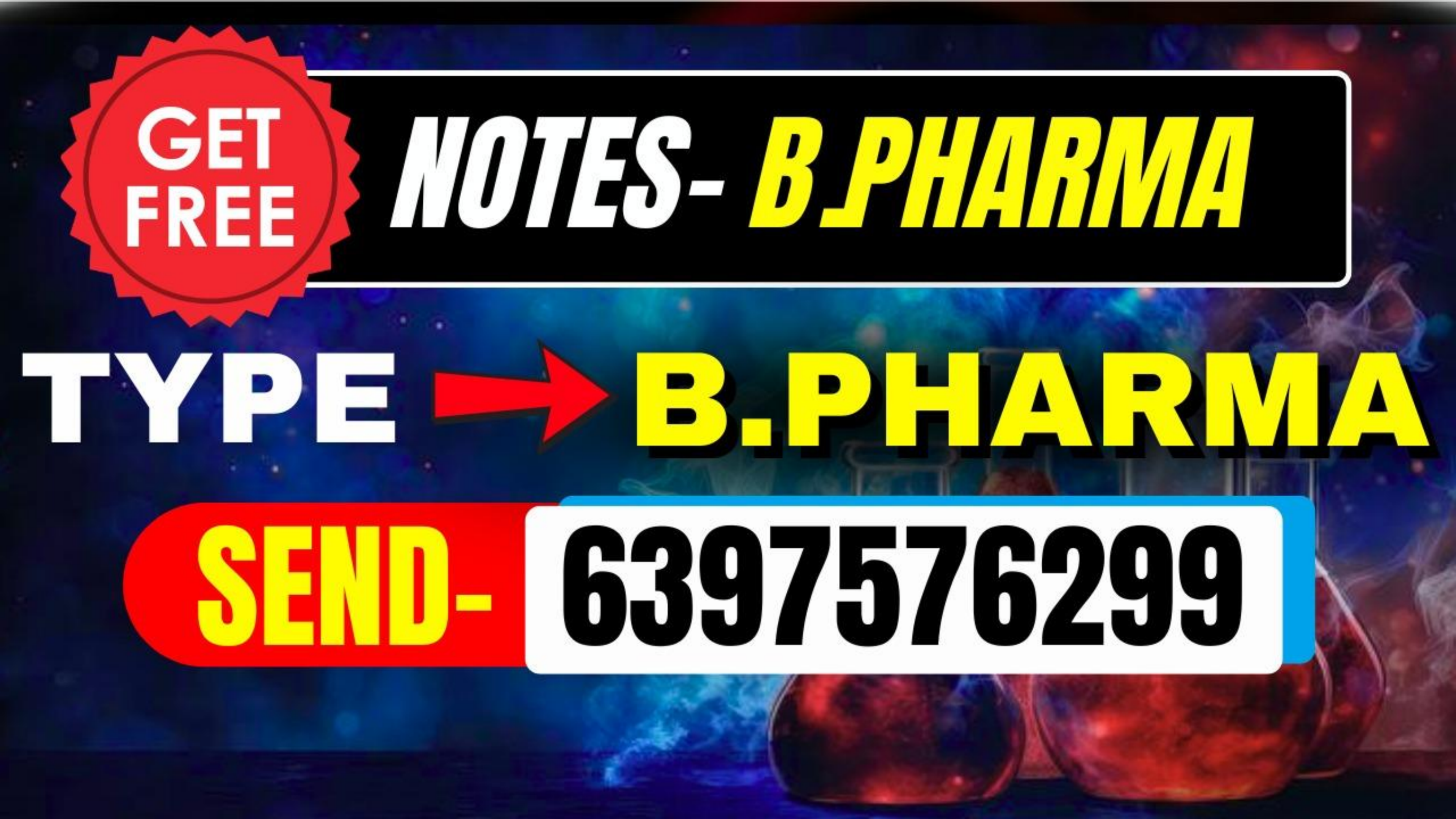
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FATS & OILS

ANALYTICAL CONTENTS

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TOPIC :- Methods of Analysis of Fats & Oils.

Methods of Analysis

Analysis constant is a numerical value which is used to characterize & identify the Physical & chemical Properties of fats / oils.

It contains various methods :

1. Acid Values
2. Saponification value
3. Acetyl value
4. Iodine value
5. RM value
6. Ester value

Acid Value

It is an analytical method used to determine the value of free fatty acid Present in any sample.

" Free fatty acids are those type of acids which do not bound with any glycerol and formed due to hydrolysis / oxidation of fatty acids / oil"

These are harmful for human being.

It is defined as the, no. of mg. of KOH (strong base) required to neutralize free fatty acids.
in the presence of 1 gm fat/oil.

Principle

→ It is measured by titrating any fat or oil with any strong Base in the Presence of any solvent.

→ It involves the neutralization of free fatty acids. (By the base)

** [Amount of Base ∝ Acid value of sample]

Determination

→ Determines by Titration method.

→ Dissolve 10 gm. of sample into 50 ml of mixture by equal volume of Ethanol (95%) & ether.

→ Titrate against a strong Base (NaOH, KOH)

→ Take Phenolphthalein as an indicator.

***

$$\text{Acid value} = \frac{\text{Amount of base required to neutralize free fatty acids}}{\text{Weight of sample}} \times 100$$

$$\text{Acid Value} = 5.61 \frac{n}{W}$$

n = Burette Reading

W = Molecular Weight

If acid value;

$< 0.5\%$:- low, Good Quality.

$0.5 - 1.5\%$:- Medium, Some amount of rancidity.

$> 1.5\%$ High, Indicates poor quality

2. Saponification value

→ It is defineds as the no. of mg of KOH required to saponify 1 gm of fats/oil.

→ It is used to measure the molecular weight of any fat/oil.

Principle It is based on the Principle of hydrolysis where Triglycerides are broken in the Presence of any Base. (NaOH/KOH).

(Amount of Base $\propto$ Saponification value)

Determination

→ It is determined by titration method.

→ A fat/oil is dissolved in any solvent.

→ Phenolphthalein is used as an indicator.

→ Known quantity of fat/oil is refluxed with excess alc. KOH.

→ Blank Titration Also Performs here.

$$\text{Saponification Value} = \frac{28.05\,(\text{Blank Titration} - \text{sample value})}{\text{Weight of sample.}}$$

Significance :-

It determines the average molecular weight of any fat / oil.

$$\text{Molecular weight of fats/oils} = \frac{\text{mg of KOH}}{\text{Saponification Value}}$$

3. Acetyl Value

It is used for the determination of amount of acetic acid in any fat/oil.

→ No. of mg of KOH/NaOH required to neutralize acetic acid obtained by the saponification of 1 gm of fat/oil..

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

[Acetyl value $\propto$ Amount of free fatty acid]

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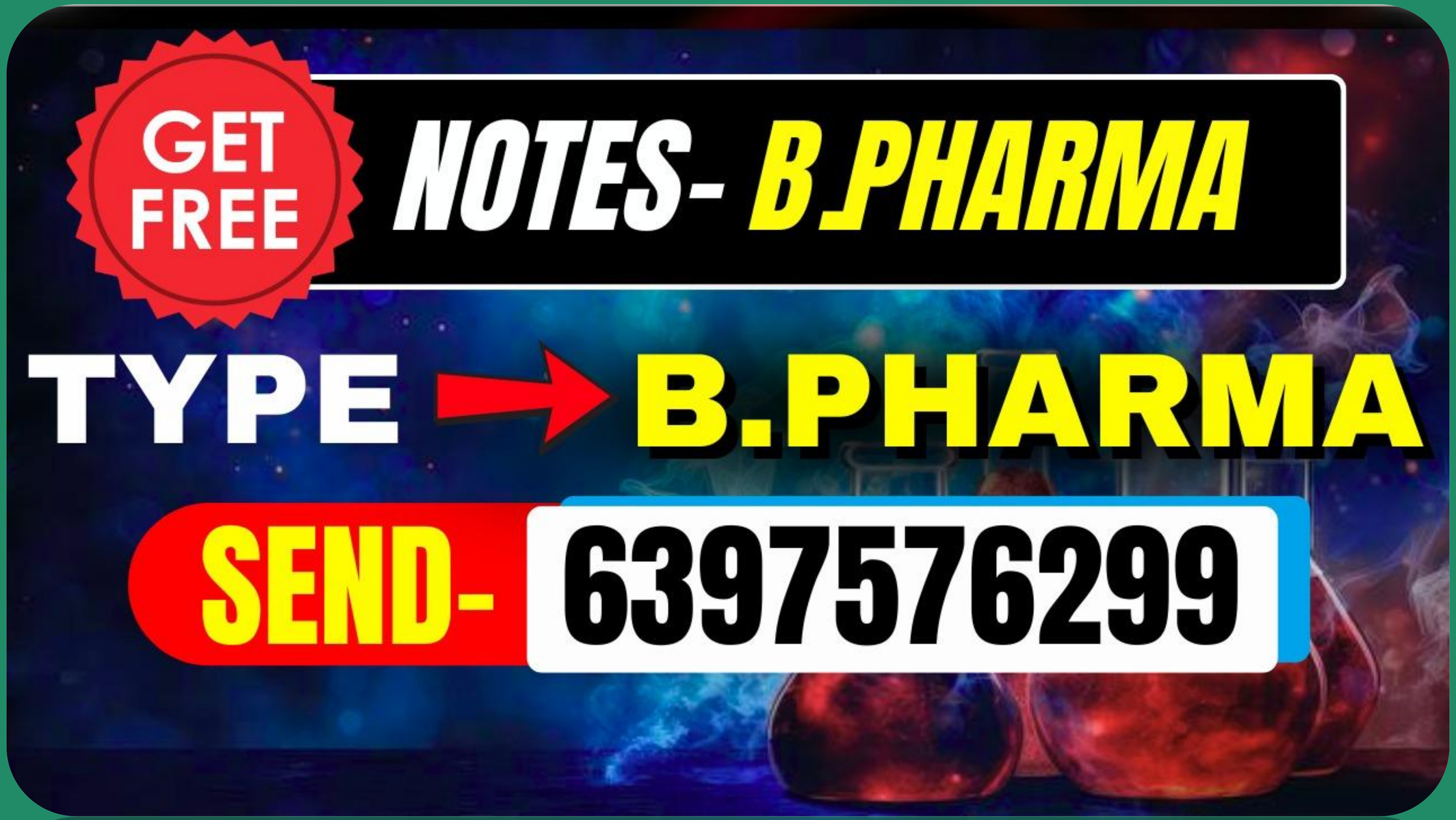
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TOPIC: Ester value

Iodine value

RM value

4. Ester-Value

It is the no. of mg. of KOH/NaOH required to saponify ester present in 1 gm fat/oil.

Principle:-

Ester value = Acid value − saponification value

It is Based on esterification reaction.

Where fatty acid reacts with an alcohol for the formation of an ester.

Esters reacts with a base NaOH/KOH to saponify.

≠ Determination

→ This value can be determined by Titration method.

→ Obtained by titrating a fat/oil with NaOH/KOH in the presence of an indicator Phenolphthalein.

→ Repeat this operation but without sample (Blank Titration)

$$\text{Ester value} = \frac{\text{Actual Test} - \text{Blank Test}}{\text{Weight of sample}} \times 20.05$$

[Amount of a Base ∝ Ester value]

5. Iodine Value

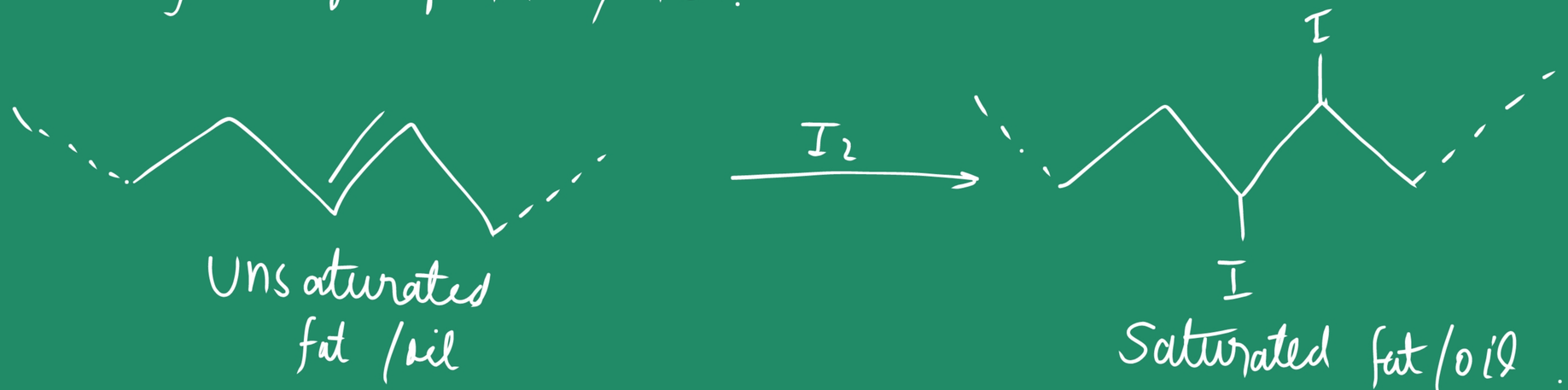
→ It is a measure of amount of unsaturated fatty acids present in fats / oils.

→ It is used to determine the 'degree of unsaturations' from any fat/oil.

Principle

It is based on the reaction of Iodine with any unsaturated fatty acid for the formations of saturated compounds.

→ Iodine value is the no. of gm. of Iodine that is observed by 100 gm of fats/oils.



Determination

→ It is determined by Wij's Method

→ Involving reaction of a fat/oil with excess amount of Iodine in the Presence of CH_3COOH.

→ Excess of Iodine monochloride is treated with KI.

→ Now this sample is titrated against 0.1N solution of Sodium thiosulphite

→ Here, Starch solution is used as an indicator.

→ Then Perform blank Titration.

$$\text{Iodine value} = \frac{(B-S) \times N \times 12.69}{\text{Weight of sample}}$$

Where,

B = Volume of thiosulphate in blank method. (ml).

S = Volume of thiosulphate in sample method (ml)

N = Normality of Thiosulphate.

Significance :-

1. It is used to measure the degree of unsaturation.
2. The amount of Iodine which is required to saturate a double bond is directly proportional to Iodine value.
3. [Iodine value $\propto$ unsaturation]

→ Unsaturated lipids are more susceptable of Rancidification.

6. R-M Value

Reichert - Missl Value

→ It is used for the measurement of amount of volatile fatty acid in fat/oil.

→ It is used for the Purity Testing of butter.

→ It is defined as 0.1 N KOH required to neutralize the volatile fatty acid.

Principle

→ The RM value is based on the reaction of Volatile fatty acid with a base ($NaOH$ / KOH).

→ The amount of KOH required to neutralize Volatile fatty acid is directly prop to the RM value.

[RM value ∝ Amount of Base]

Determination

→ Fat is saponified using glycerol alkali solution with conc. H_2SO_4.

→ liberated fatty acid is then steam distilled and then contain it in any flask.

→ Now, cooled condensed F.A is ready for separation

→ The water soluble fatty acid is treated with 0.1 N of KOH for RM value.

$$\text{RM value} = \frac{\text{No. of ml. of 0.1N of KOH}}{\text{Weight of sample}} \times 5$$

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PART- 1

PHARMACEUTICAL ORGANIC CHEMISTRY II

FATS & OILS

INTRODUCTION

STRUCTURE & USES FATS VS OILS

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Fats & oils

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Topic: Introduction
Structure, Properties
& Difference b/w 'Fats & Oils'

FATS & OILS

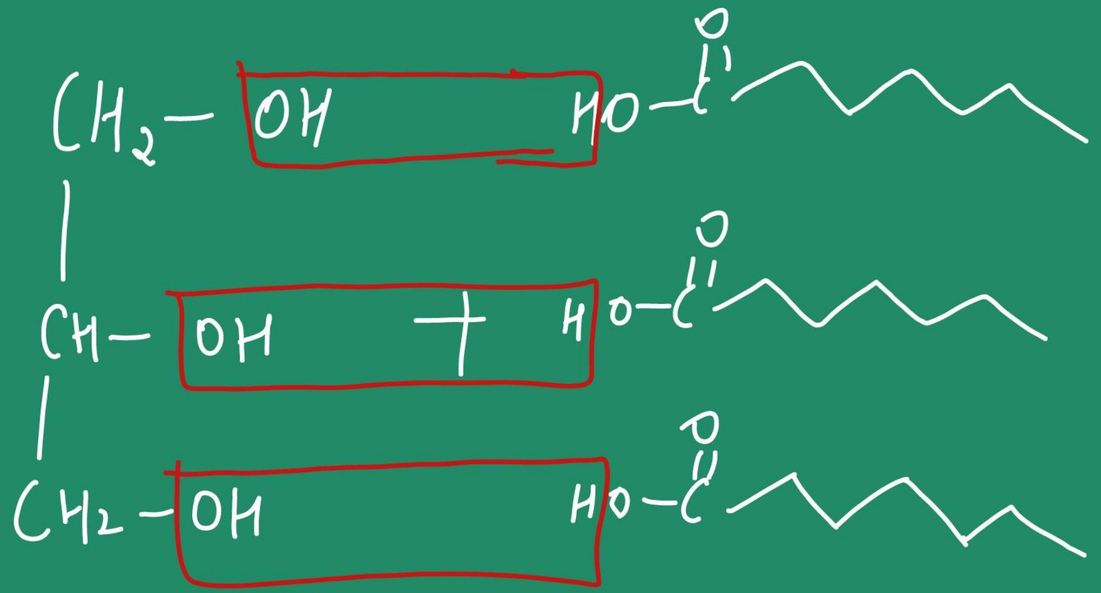
(घी) (तेल)

Fats and oils are belong to the naturally occuring group 'lipid'.

These are the triesters of glycerol having a long chain of carboxylic acid.

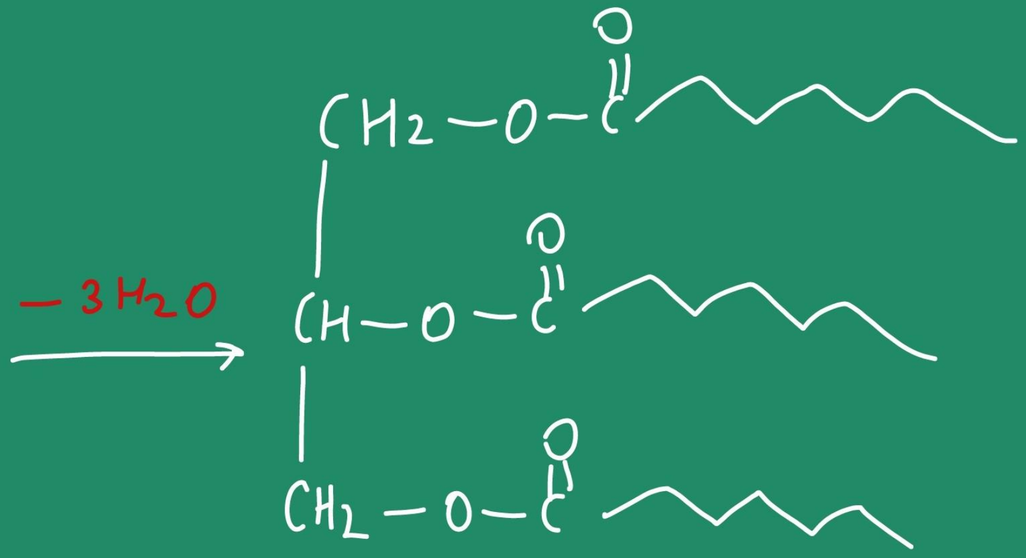
They are also known as Triglycerides & Triglycerols.

eg:- Olive oil, coconut oil, Almond oil etc.



glycerol

Fatty acids



Fatty acids:

Fatty acids are the carboxylic acid which contains long chain of carbon atoms.

(R- 20) C-atom

Fatty acids can be classified into two categories :—

1. **Saturated fatty acids :-** Those fatty acids in which C-atoms are connected with only single bond.

   eg :- Stearic acid. etc.

2. **Unsaturated fatty acids :—** There are the acids which contains double or Triple bonds between C-atoms.

   eg :- Oleic acid. etc.

Difference between fats & Oils :—

	Fats	Oils
1.	It is solid / Partially solid at room Temp.	→ These are liquids at room Temp.
2.	It is less soluble in waters.	→ Comparitively more soluble in waters.
3	Typically saturated, contains single bond.	→ Typically unsaturated, contains double or Triple bonds.
4.	Higher melting Point.	→ lower melting Point.

5: found in animals such as meat, eggs etc.	found in Plant Products.
6: They're having longer shelf life.	They're having shorter Shelf life.

Properties

1. They are insoluble in waters but soluble in Organic compounds.
2. Colourless ⟶ yellow colour.
3. Appearance always varies.
4. Three fatty acids are attached to glycerol.
5. Having Neutral odour.
6. It undergoes various chemical rxns such as:
   → Hydrogenation ⟶ Saponification ⟶ Hydrolysis etc.

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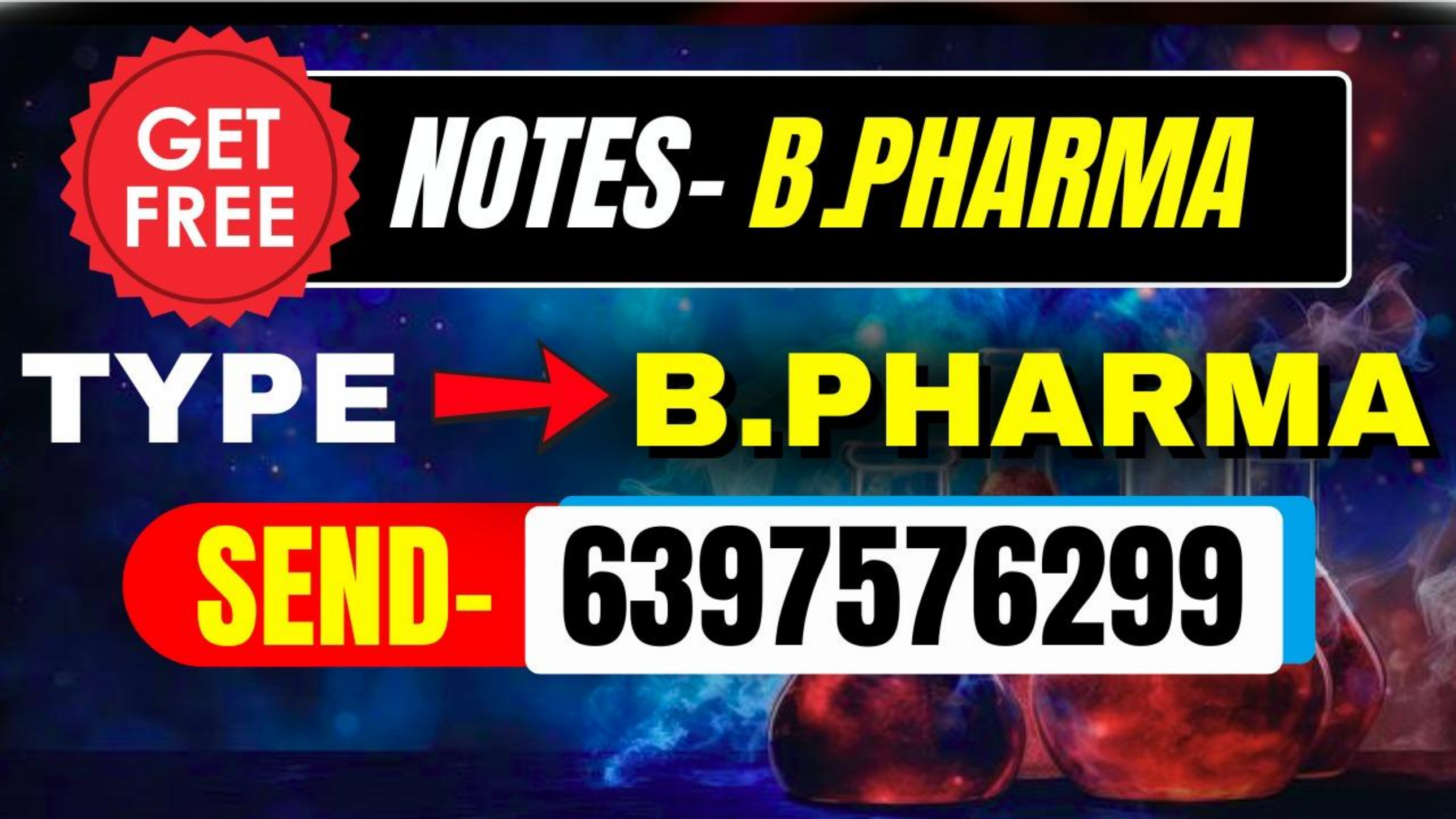
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