

# Lipids

- Lipids are the natural products of vegetable and animal origin, that is insoluble in water and soluble in alcohol, ether, and chloroform.
- They are natural substances (from plants and animals), consisting of esters between fatty acids and alcohols or polyols
- Soluble in apolar solvents and insoluble in water, water:ethanol mixture
- Lipids can be classified as-----
- 1. Saponifiable lipids
- 2. Unsaponifiable lipids
- Fatty acids (aliphatic acids) + alcohol----ESTER (Lipids)----alkaline (KOH/NaOH)----heating--- fatty acids salt called "soap" + free alcohols

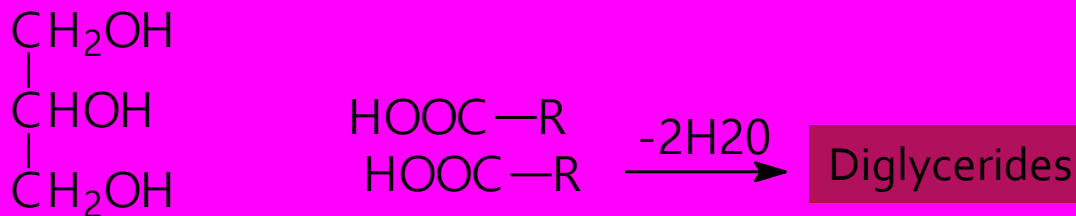
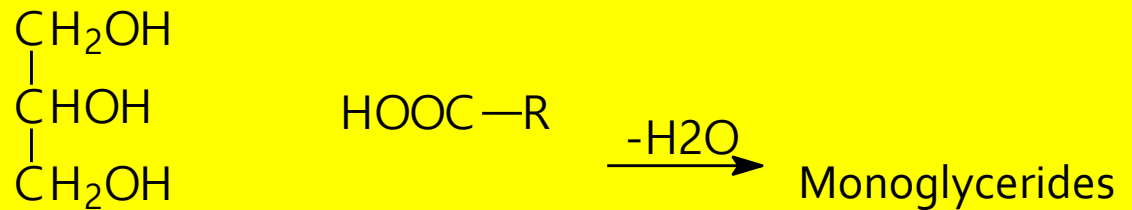
# Lipids

## Saponifiable Lipids

- 1) Simple lipids are composed of "C, H, O" → Glyceride, and other esters
- 2) Complex Lipids (C, H, O + S, N, P):  
Phospholipids → Phosphoaminolipids

# Lipids - Saponifiable Lipids

## ■ 1) Glycerides----fixed oils (Oleum-Olea)

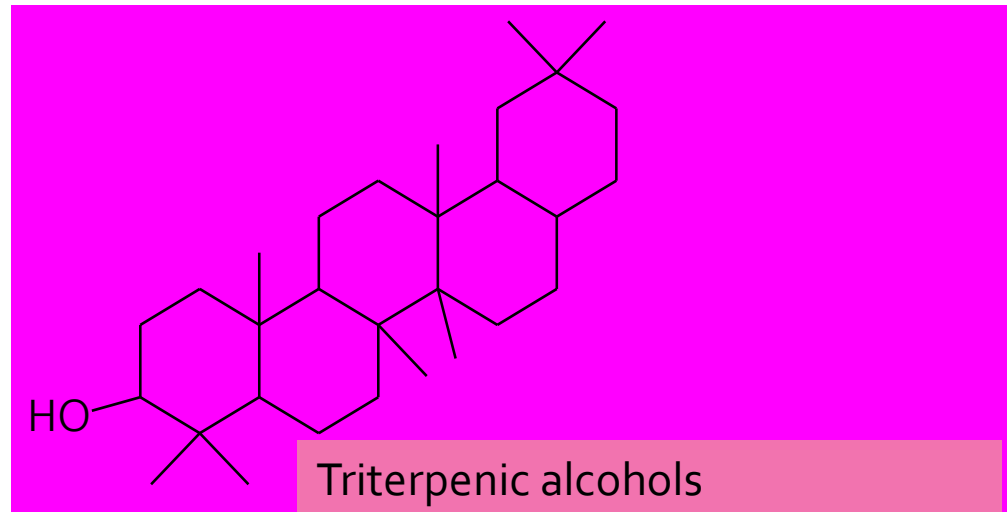
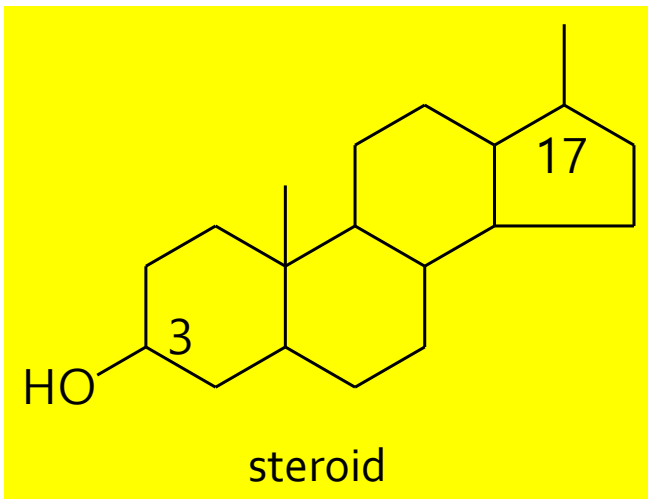


# Lipids - Saponifiable Lipids

- 2) Esters of high molecular weighed aliphatic alcohols such as; C<sub>16</sub>, C<sub>18</sub>, C<sub>20</sub>, C<sub>22</sub>-----C<sub>32</sub> and high molecular weighed fatty acids are main constituents of waxes

# Lipids

## 3) Steroids are also constituents of waxes



# Lipids

- Active part of the fixed oils are fatty acids--  
-Alcohols do not have biological activity
- Fatty acids:
  - 1) Saturated fatty acids(aliphatic)
  - 2) Unsaturated fatty acids (aliphatic)
  - 3) Cyclopentenic fatty acids
  - 4) Hydroxy fatty acids
  - 5) Acetoxy fatty acids

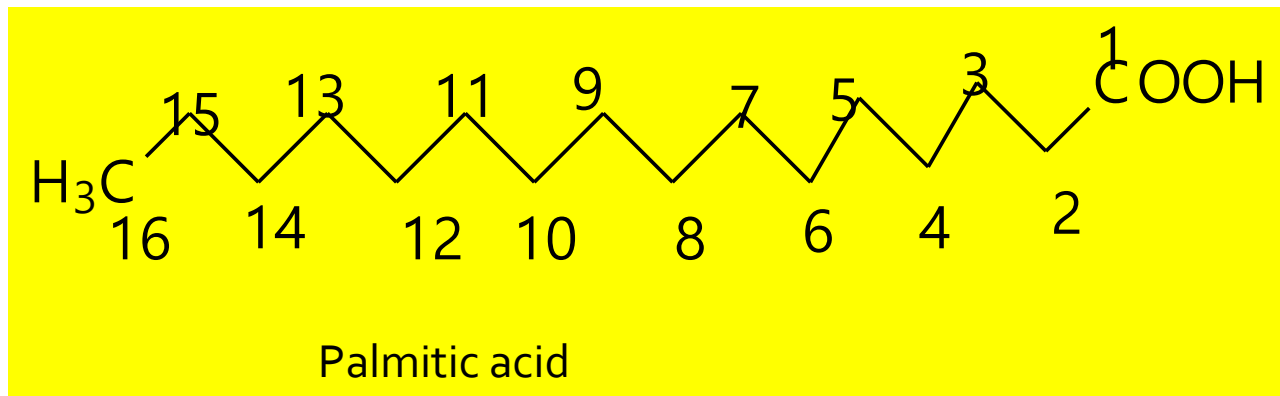
# Lipids

## 1) Saturated fatty acids: $C_nH_{2n}O_2$

- Number of  $n=4-44$ ,  $n$  = always even number
- $n=12$ -----Lauric acid
- $n=14$ -----Myristic acid
- $n=16$ -----Palmitic acid
- $n=18$ -----Stearic acid
- $n=20$ -----Arachidic acid (Eicosanoic acid)
- $n=22$ -----Behenic acid
- $n=24$ -----Lignoceric acid

# Lipids

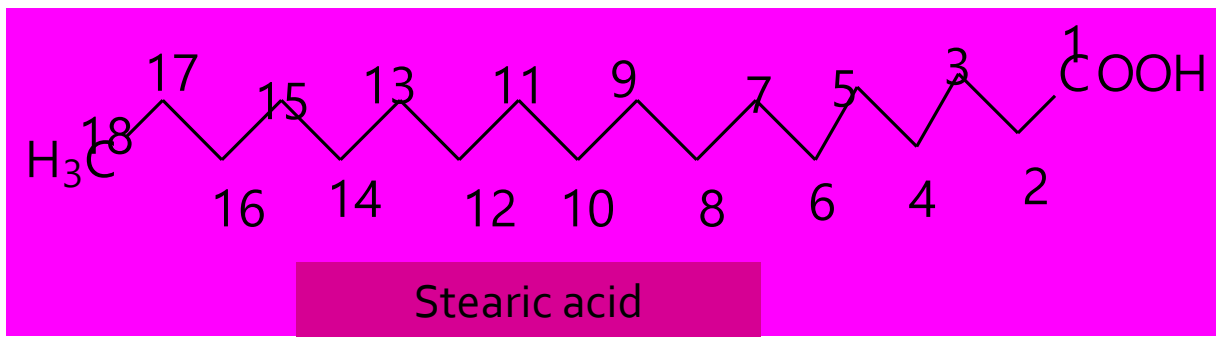
- **n=16-----Palmitic acid**
- **Found both in plants and animals**





# Lipids

- **n= 18-----Stearic acid**
- **Constituent of plant fixed oils and especially animal fixed oils. Recorded in many codex and pharmacopoeia, used in pharmaceutical technology widely.**



# Lipids

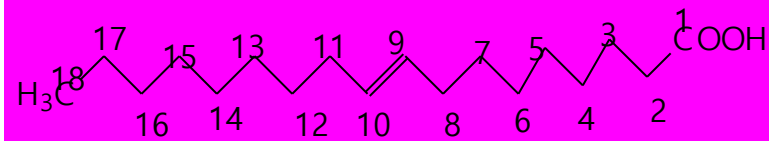
2) Unsaturated fatty acids:  $C_nH_{2(n-a)}O_2$

- $a$  = the number of unsaturation

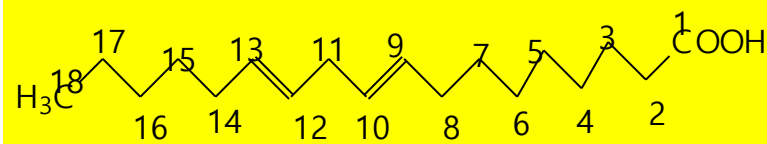
Usually contain 18 C

- $n = 18$  --- Oleic acid  $a = 1$  (9-10)
- $n = 18$  --- Linoleic acid  $a = 2$  (9-10, 12-13)
- $n = 18$  --- Linolenic acid  $a = 3$  (9-10, 12-13, 15-16)
- $n = 20$  — Arachidonic acid  $a = 4$  (5-6, 8-9, 11-12, 14-15)

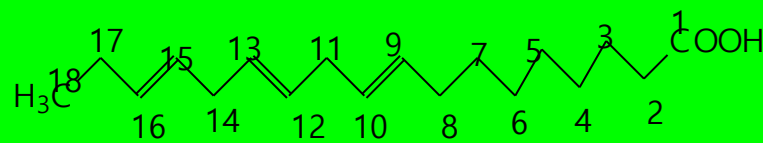
# Lipids



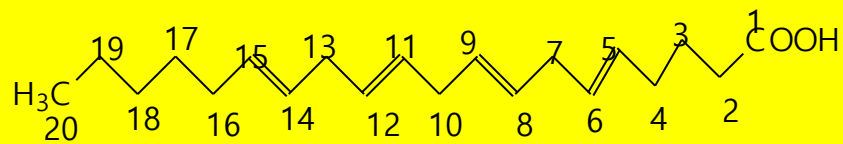
Oleic acid



Linoleic acid



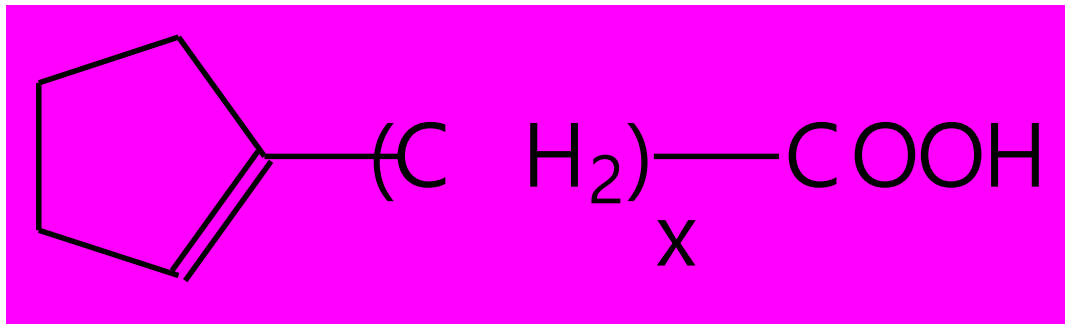
Linolenic acid



Arachidonic acid

# Lipids

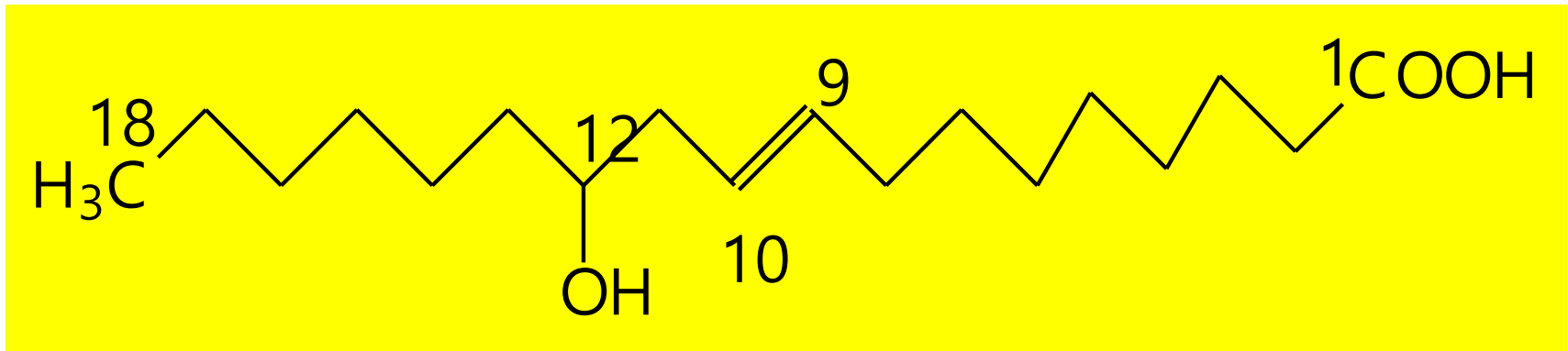
- Cyclic fatty acids: for treatment of lepra



- X= 10 (C<sub>16</sub>)---HYDNOCARPIC ACID
- X= 12 (C<sub>18</sub>)---CHAULMOOGRIC ACID

# Lipids

- Hydroxy fatty acids : Purgative
- n=18, a=1---Ricinoleic acid (12-hydroxy oleic acid)



# Lipids

- Acetylenic fatty acids: They possess antifungal and antibacterial properties.

# Fixed oils

- Fixed oils are mixture of;
  - ❖ Saponifiable part
    - Glycerides
    - Free fatty acids
  - ❖ Unsaponifiable parts (steroids + fat soluble vitamins)

# Fixed oils

## Production

### 1) Extraction by solvents

- Percolation
- Soxhlet extraction

### 2) by Expression

- Hot expression
- Cold expression
- Cold expression type is selected for pharmaceutical usage



# Fixed Oils

## Refining procedure of the crude oil

1. Neutralization → Neutralization of free fatty acids by dilute sodium hydroxide
2. Deodorizing → Unpleasant odour, aldehydes and ketones generally, removed by vacuum and steam injection
3. Bleaching → By active charcoal or diatomaceous earth
4. Wax removal → By cooling/winterization and then waxes are removed

# Fixed oils

## Identification

- 1) Sudan III Reagent-----Orange colour
- 2) 80-90° EtOH treatment----fixed oil stable .  
Essential oil soluble
- 3) Glycerides;
  - Fixed oil +  $\text{KHSO}_4$ -----heating---acrolein odour
  - Acrolein+Schiff reagent---(+)  
reak.
  - Acrolein + silver nitrate ( $\text{AgNO}_3$ )--- $\text{NH}_3$ ---  
reduction

# Fixed Oils

## Specificity

- Saturated fatty acids are in solid form
- Unsaturated fatty acids are in liquid form
- Vegetable oils and fish oils are liquid
- They are dissolved in nonpolar solvents such as ether, petroleum ether, chloroform
- Hydroxy fatty acids are soluble partly or insoluble in petroleum ether; dissolved in ethanol partly

# Fixed oils

- Polyhydroxy fatty acids----partly soluble in water
- Hydrogenation using Ni (nickel)—margarin
- Unsaturated fatty acids show----vitamin F activity

# Fixed oils

## Quality control

- Physical properties
- Chemical properties

### 1) Physical properties

- Determination of density
- Determination of gelling point
- Refractive index
- Optical rotation
- Solubility

# Fixed oils

## 2) Chemical properties:

- Acid degree: The amount of potassium hydroxide (mL) needed to neutralize the free acids present in 100 gram of substance
- Acid value(AI): The number of milligrams of potassium hydroxide needed to neutralize the free acids present in one gram of substance

- **Saponification value**: The number of milligrams of potassium hydroxide needed to neutralize the free acids and saponify the esters present in one gram of substance
- **Ester value** : The difference between the saponification value and the acid value
- **Unsaponifiable matter**: The substances which are not volatile and obtained by extraction with an organic solvent.

# Fixed oils

- **Peroxide value:** This number expresses, in miliequivalents of active oxygen, the amount of peroxide contained in 1000 g of substance
- **Iodine value:** The iodine number equals the number of mg of iodine required to saturate the fatty acids present in 100 mg of the oil or fat.
- Oils rich in saturated fatty acids have low iodine numbers, while oils rich in unsaturated fatty acids have high iodine numbers.
  - Drying oils---150-190
  - Semi-drying oils-----100-150
  - Non-drying oils---75-100



# Fixed oils

## Usage

- **Laxative internally**
  - Hydroxy fatty acids are purgative
- **Fixed oils rich in unsaturated fatty acids are useful against arteriosclerosis and show vitamin F activity**
- **They are useful because of their vitamin content such as, vitamin A, D and E**

# Fixed oils

- **Emollient externally**
  - **To soften skin**
  - **Fixed oils exhibited Vitamin F activity (essential fatty acids)---for treatment of eczema**
- **In pharmaceutical technology;**
  - Solvent for preparing ampul as well as excipient for production of suppository**

# OLEUM OLIVAE (TF) Olive oil

## ZEYTİNYAĞI

- *Olea europaea* var. *sativa* (Oleaceae)
- Produced by cold expression of ripe fruits
- Grows naturally in Mediterranean countries
- Cultivated in California
- *Olea oleaster*
- Wild olive
- Not used as source for production of olive oil

# OLEUM OLIVAE (TF) Olive oil, ZEYTİNYAĞI

- In Turkey two different varieties of *Olea europaea* L. grow naturally;
- *O. europaea* var. *europaea* (Graft oil): Leaves are longer than 4 cm, fruits 35 mm, spineless
- *O. europaea* var. *sylvestris* (Male olive, wild olive): Leaves are shorter than 4 cm, fruits 15 mm, spined especially subbranches, grows especially Aegean and Mediterranean region

# **OLEUM OLIVAE , olive oil**

## **(TF) ZEYTİNYAĞI**

- Immature olive fruits are green and ripe fruits are reddish. Olive fruits are drupe and contains edible mesocarp
- Following of washing the fruits, they are crushed and pericarp pressed to obtain pastry, and this is followed by pression to obtain olive oil
- The remain part , after obtaining olive oil is called as “Pirina” and this part used as forage.
- This part can also be used for obtaning olive oil by extraction.

# OLEUM OLIVAE (TF), olive oil

## ZEYTİNYAĞI

### Components;

- Fruits (mesocarp)----- 28-32 %fixed oil.
- By pressing -----20 % fixed oil is obtained
- Fixed oil contains:
- Unsaturated fatty acid, oleic acid triglyceride-----OLEIN (80%) and linoleic acid triglycerides
- Palmitic and stearic acids are saturated fatty acids
- Vitamin E is found mainly in unsaponifiable part.

# **OLEUM OLIVAE (TF), olive oil, ZEYTİNYAĞI**

- **Laxative**
- **Choleretic and cholagogue**
- **Solvent for drugs, for parenteral preparations after neutralization**
- **Used in soap industry**
- **As a food**
- **Clinical studies have revealed that leaves of the plant effective for lowering blood pressure**

# OLEUM SESAMI (EP)

## Sesam oil, SUSAMYAĞI

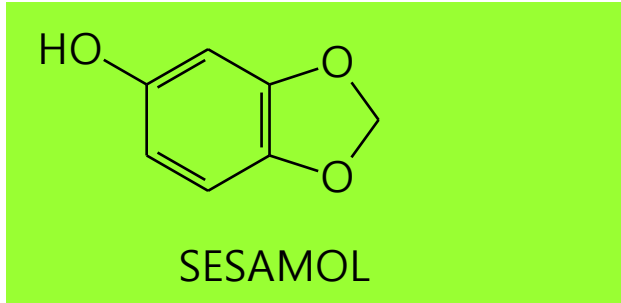
- *Sesamum indicum* (*S.orientale*)  
(Pedaliaceae) ---cultivated plant
- Product by pressing ripe seeds
- Native country is India
- China, India, Japan, Egypt, Russia, Europe and Turkey are the producers for cultivation



# OLEUM SESAMI (EP), Sesam oil, SUSAMYAĞI

- Seeds contain-- 47-50% fixed oil.
- Oleic acid (75%) Linoleic acid are the main constituents
- Myristic acid, stearic acid (14%) and palmitic acid are the saturated fatty acids
- Unsaponifiable part of the oil (1.4%);
- Phytosterols
- Sesamol ----phenolic
- Sesamolin----lignan
- Sesamin (%1) ----lignan structure (in Crystallin form) are the main components

# OLEUM SESAMI (EP), Sesame oil, SUSAM YAĞI



# OLEUM SESAMI (EP), Sesame oil, SUSAMYAĞI

- Identification; BAUDOUIN Reaction;
- Sesame oil + 1% sucrose HCl---heating---pink-red colour occurs

# **OLEUM SESAMI (EP), Sesame oil, SUSAMYAĞI**

- **Antioxidant activity**
- **Purgative internally**
- **Sesame oil and sesamin----synergistic activity with pyrethrins**
- **As a food**
- **Sesame pasta “tahin” is obtained by pressing sesame seeds after peel off**
- **Solvent in perfumery**

# OLEUM ARACHIDIS, Peanut oil, YER FISTIĞIYAĞI

- *Arachis hypogaea* (Fabaceae/Leguminosae) seeds fixed oil
- Grows naturally in West Africa and South Asia
- Cultivated in South Africa, West, South and South-west Anatolia
- Sweet tasted fixed oil produced by cold expression is used with its pharmaceutical properties. Hot expression is used to obtain fixed oil with bitter taste and used in industry.

# **OLEUM ARACHIDIS, Peanut oil, YER FISTIĞIYAĞI**

- **Seeds (cotyledon)---45-50% fixed oil.**
- **Fixed oil contains---Oleic acid (56%) and Linoleic acid as unsaturated fatty acids**
- **Palmitic, Arachidic and Lignoceric acid saturated fatty acids triglycerides.**
- **Thiamin (vitamin B<sub>1</sub>) as unsaponifiable part.**

# OLEUM ARACHIDIS, Peanut oil, YER FISTIĞIYAĞI

- Laxative
- As solvent for parenteral solutions
- Oleum Arachidis hydrogenatum-----  
excipient for pomades in pharmaceutical  
technology
- Diet against arteriosclerosis due to its  
unsaturated fatty acids contents.

# OLEUM AMYGDALAE EXPRESSUM (TK), Almond oil, TATLI BADEMYAĞI

- *Prunus amygdalus* var. *dulcis* (Rosaceae) produced by expression of seeds
- Native country is Anatolia
- Cultivated in Mediterranean countries



- **Seeds (cotyledon)--- contains 45-50 %fixed oil**
- **Fixed oil contains;**
- **Unsaturated fatty acids;OLEIC ACID (50-60%)  
ve LINOLEIC ACID glycerides**
- **Saturated fatty acids; Myristic acid and  
palmitic acid glycerides**

# **OLEUM AMYGDALAE EXPRESSUM (TK), Almond oil, TATLI BADEMYAĞI**

- **Laxative internally**
- **Emollient and demulcent**
- **Components of cold cream and some pomades**

# OLEUM CACAO (TF), KAKAO YAĞI, Theobroma oil, cocoa butter

- *Theobroma cacao* (Sterculiaceae)  
Seeds oil
- Fixed oil
- Grows naturally in  
United States, Brasil, west Africa,  
A tree, 10-15 m lenght

# OLEUM CACAO (TF)

- Seeds contain 50% fixed oil
- White or yellowish-white
- Special smell
- Solid in room temperature
- Melting point 30-35°C--
- Fixed oil contains;
- Oleic acid(37%)
- Linoleic acid(2%)
  
- Lauric acid
- Palmitic acid (25%)
- Stearic acid(35%) glycerides

# OLEUM CACAO (TF)

- Used as excipient to prepare suppository and ovul in pharmaceutical technology
- To obtain stearic acid
- Used for treatment of haemorrhoid and for treatment of chest fissure and wounds in womens

# Mg- Stearate

- This is the salt which is prepared from the mixture of fatty acids obtained from fixed oils and magnesium
- Mixture of Mg stearate + Mg palmitate
- This salt should contains MgO between 6.8-8.0%

# Mg- Stearate

- Production: Na-stearate water solution.  
+MgCl<sub>2</sub>—heating----Mg-stearate collapsed
- Stearic acid + MgO or MgCO<sub>3</sub>---heating----  
Mg-stearate collapsed
- It has special odour
- Adhesive, white and slight powder
- Insoluble in water
- Soluble in ethanol and ether

# Mg- Stearate

- Used as lubricant in tablets preparation
- In baby powder



# Zn Stearate (TF)

- This is the salt which is prepared from the mixture of fatty acids obtained from fixed oils and zinc
- Mixture of Zn stearate + Zn palmitate
- This salt should contain ZnO between 12.5-14%

# Zn Stearate (TF)

- Production: Stearic acid + water +  $\text{Na}_2\text{CO}_3$  +  $\text{ZnSO}_4$  solution—Zn-stearat collapsed. This precipitate is washed and dried at 60 °C.
- Used as drier and protective agent for skin
- Used to prepare pomade and powder
- Toxic to babies by inhalation therefore it should not be used