ODESSA NATIONAL MEDICAL UNIVERSITY

Department of General and Clinical Pharmacology and Pharmacognosy

METHODICAL DEVELOPMENT OF THE LECTURE

Course: "Pharmacognosy"

Lecture № 3

"Fats and fat-like substances. General characteristics. LRS and products that contain fats and fat-like substances. Analysis of fatty oils. "

Course: 3rd Faculty: medico-pharmaceutical

The lecture was discussed
at the methodical meeting
departments
August 30, 2024
Protocol № 1

Head departments _____
prof. Rozhkovsky Ya.V.

Odessa-2024

Lecture № 3: “Fats and fat-like substances. General characteristics. LRS and products that contain fats and fat-like substances. Analysis of fatty oils "(2 hours)

1. Relevance topics. Rationale for the topic.

Fats (lipids) consist almost entirely of triglycerides of high molecular weight fatty acids. They are accompanied by pigments, sterols, vitamins and some other fat-soluble substances. Fatty oils of plants and fats of spare tissues of animals represent along with carbohydrates the concentrated power and building reserve of vital activity of an organism. Up to 90% of plant species contain spare fats in the seeds. In addition to seeds, spare fats are often found in other organs and tissues of plants. The accumulation of fat in plants can be very significant: for example, in domestic varieties of sunflower oil content reaches 60% by weight of the nucleus, and in algae cells chlorella - up to 80% by dry weight. Plants with a high oil content in seeds and fruits in the tropics and subtropics are represented mainly by trees (palms, tung, castor, cotton, etc.), And in areas with temperate climates, these are mainly herbaceous plants (flax, sunflower, peanuts, etc.), less often shrubs, and even less often trees. The sign of oiliness is genetically related to a certain type of metabolism. Spare fats play an important role in protective substances that help organisms tolerate adverse environmental conditions, including low temperatures. Accumulated in the cotyledons of wintering seeds, fats allow you to keep the embryo in frost. Climatic factors - light, heat and moisture significantly affect the efficiency of oil production. which help organisms to tolerate adverse environmental conditions, including low temperatures. Accumulated in the cotyledons of wintering seeds, fats allow you to keep the embryo in frost. Climatic factors - light, heat and moisture significantly affect the efficiency of oil production. which help organisms to tolerate adverse environmental conditions, including low temperatures. Accumulated in the cotyledons of wintering seeds, fats allow you to keep the embryo in frost. Climatic factors - light, heat and moisture significantly affect the efficiency of oil production.

Properties of fats are defined by qualitative structure of fatty acids, their quantitative ratio, percentage of free which are not connected with glycerin of fatty acids, a ratio of various triglycerides, etc.

2. Objectives of the lecture:

- *Educational*
- to form students' knowledge:
- the concept of lipids, their classification.
- physicochemical and biological properties.
- phytopreparations containing lipids.
- plants that contain lipids.

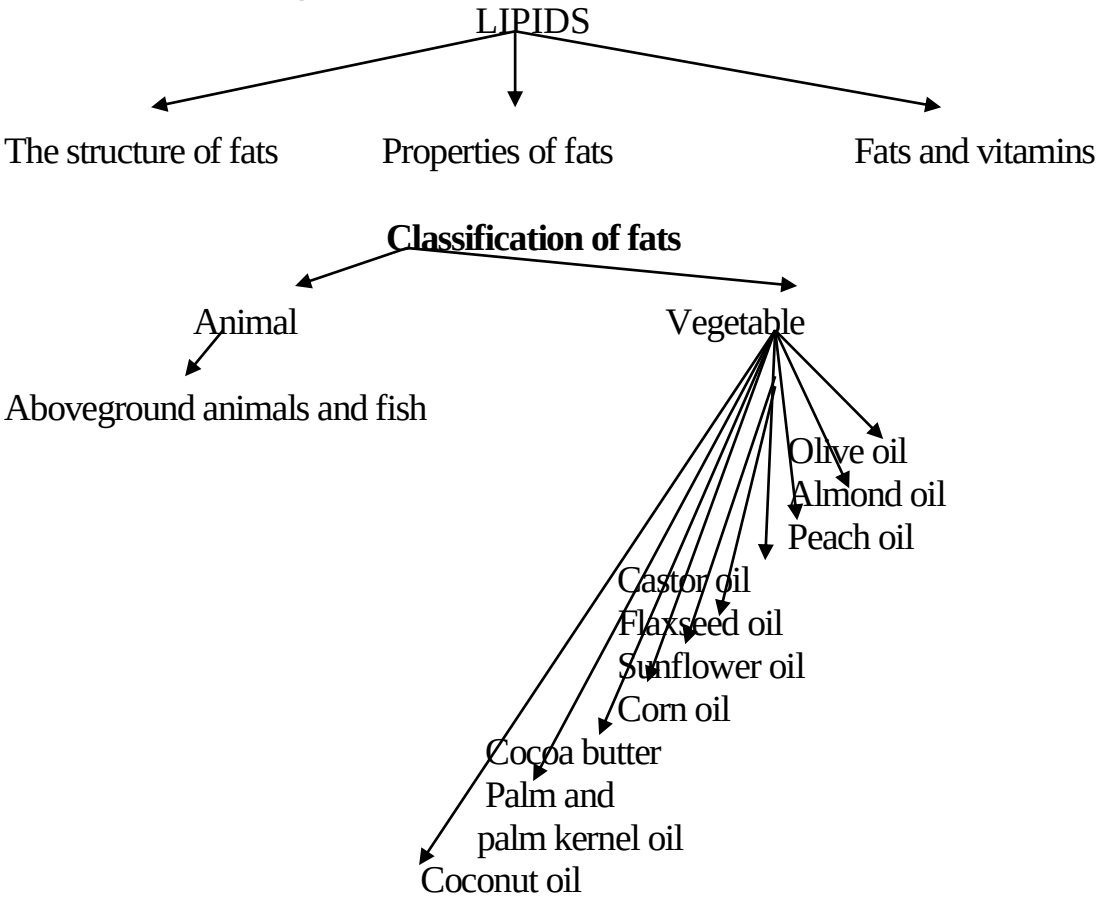
- *Educational:* the lecture promotes the formation of modern professional thinking, the material of the topic develops a sense of responsibility for the use of LRS.

3. Plan and organizational structure of the lecture

№	The main stages of the lecture	Goals at accreditation levels	Type of lecture, lecture equipment	Time distribution
1	2	3	4	5
1. 2. 3. 4.	**Preparatory stage** Defining educational goals. Providing positive motivation. **The main stage** Presentation of lecture material. plan: 1. Definition of lipids and their classification 2. Physico-chemical and biological properties 3. Phytopreparations containing lipids **The final stage** Lecture summary, general conclusions. Lecturer's answers to possible questions. Tasks for student self-preparation.	 I II III	Combined, tables of herbarium, LRS, drugs List of references	1% 2% 90% 2% 2% 3%

4. **The composition of the lecture material:**

- structural and logical scheme



- the text of the lecture is attached

5. Materials for activating students during the lecture:

Question:

1. Definition of "lipids".
2. Distribution of fats in the plant world and resources of the studied raw materials.
3. Morphological characteristics of plants containing lipids, their habitats (areas of cultivation), habitats.
4. Fats consist of triglycerides of fatty acids. Write the general formula of triglycerides.
5. Chemical composition of LRS of the researched topic.
6. Measures for the protection and rational use of medicinal plants that contain lipids.
7. What factors affect the process of formation and accumulation of fats in plants.

8. Name the chemical process of fat spoilage during storage in adverse conditions and what indicators characterize this process.

9. Ways of use and medical application of LRS containing lipids.

10. Name the climatic factors that have a significant impact on the efficiency of oil formation.

Tests:

1. Which of the following indicators is one of the most important for the qualitative assessment of oils, which gives an idea of their ability to dry and reflects the content of unsaturated acids:

A. iodine number

B. acid number

C. the number of saponification

D. ethereal number

E. chloroform number

2. Name the plant, the seeds of which contain 45-47% of fatty oil, 1-2% of the alkaloid theobromine and traces of caffeine.

A. chocolate tree

B. almonds

C. sunflower

D. flax

E. ricin

3. Which tropical or subtropical plant has a high oil content in seeds and fruits:

A. palm tree

B. flax

C. sunflower

D. corn

E. almond tree

4. The oil of which plant is obtained by pressing and it resembles ghee (different density), yellow, has a pleasant smell and taste ("nut"):

A. palm oil

B. cedar oil

C. cocoa butter

D. hemp oil

E. soybean oil

5. Non-drying fatty oils are used as solvents for injectable drugs. Name the medicinal plant that is the source of this type of oil:

A. Amygdalus communis

B. Helianthus annuus

C. Salvia officinalis

D. Inula helenium

E. Zea maydis

6. One of the indicators of authenticity and quality of fatty oil is insolubility in alcohol. Specify the fatty oil, which is an exception and should be soluble in ethanol:

A. Oleum Ricini

B. Oleum Maydis

C. Oleum Lini

D. Oleum Persicorum

E. Oleum Olivarum

7. Peach oil is used as a solvent for injectable drugs (camphor, hormones). What fatty oil can replace peach oil:

A. Oleum Amygdalarum

B. Oleum Ricini

C. Oleum Helianti

D. Oleum Maydis

E. Oleum Gossypii

8. The main component of oils that do not form a film (do not dry out) are glycerides:

A. oleic acid

B. linolenic acid

C. elaidic acid

D. linoleic acid

E. arachidonic acid

9. Almond oil is used in the manufacture of a number of dosage forms. The method of obtaining this oil is:

A. pressing

B. enfleurage

C. distillation with water

D. distillation with water vapor

E. sublimation

10. The seeds of which plants contain from 40 to 55% of fatty oil and a large amount of the enzyme lipase, which breaks down fats.

A. castor oil

B. flax

C. sunflower

D. soy

E. corn

6. General material and methodological support of the lecture:

- Equipment: overhead projector, codegrams, slides, tables;
- Illustrative material - herbariums, LRS.

7. Materials for self-preparation of students:

a) on the topic of the lecture / literature, questions or tasks /;

Task: Describe in the workbook for practical classes the name of the analyzed fatty oil and its vegetable source.

b) on the topic of the next lecture / literature, list of main issues.

"MEDICINAL PLANTS and raw materials containing vitamins "

Question:

1. Definition of "vitamins".
2. Distribution of vitamins in the plant world and resources of the studied raw materials.
3. Terms, methods of collection and rules of storage of LRS containing vitamins.
4. Measures for the protection and rational use of wild medicinal plants containing vitamins.
5. Latin and Russian names of LRS, derived plants and families of all objects of the research topic.
6. Morphological characteristics of plants, their habitats (areas of cultivation), habitats,
7. External signs of the studied types of medicinal raw materials.

8. Literature used by the lecturer to prepare the lecture.

Basic literature

5. 1. Фармакогнозія: підручник (I—III р. а.) / І.А. Бобкова, Л.В. Варлахова. – 3-є видання Всеукраїнське спеціалізоване видавництво «Медицина» 2018, 504с.

2. Фармакогнозія: базовий підручн. для студ. вищ. фармац. навч. закл.(фармац. ф-тів) IV рівня акредитації / В.С. Кисличенко, І.О. Журавель, С.М. Марчишин та ін.; за ред. В.С. Кисличенко. – Харків: НФаУ: Золоті сторінки, 2015. - 736 с.

3. Навчальний посібник з дисципліни «Фармакогнозія» / Я. В. Рожковський, Б. В. Приступа, І. А. Бойко, Н. В. Герасимюк, В. В. Черногорюк -: Методична розробка кафедри фармакогнозії ОНМедУ. – Одеса: ОНМедУ, 2019 – 51 с.

4. Державна Фармакопея України: в 3 т. / Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Харків: Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1500 с.

Additional literature:

1 Державна Фармакопея України: в 3 т. / Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Харків: Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.

2. Практикум з ідентифікації лікарської рослинної сировини: навч. посіб. / [В. М. Ковальов, С. М. Марчишин, О. П. Хворост та ін.] ; за ред. В. М. Ковальова, С. М. Марчишин. – Тернопіль: ТДМУ, 2014. – 250 с.

The lecture was composed by _____MD, Professor Rozhkovsky Ya.V.

LECTURE TEXT

LIPIDS

Lipids are calledgroup of organic compounds - fats and fat-like substances, inhomogeneous in chemical composition, but have common physicochemical properties, namely: they are insoluble in water (hydrophobia) and well soluble in organic solvents (ether, acetone, chloroform, benzene, etc.).). Lipos - fat (Greek).

CLASSIFICATIONS

There are three main classifications of lipids.

Chemically: 1 real fats; 2 fat-like substances -lipoids.

Biological:1 - reserve; 2 - structural.

Physico-chemical: 1 saponified; 2 - unsaponifiable.

TRUE (TRUE) FATS

I.Zh.- This is the most common group of compounds among lipids. They are represented by triglycerides of fatty acids (that is, they are triacylglycerides and may contain the same acid - simple triacylglycerides, or different - mixed, etc.) - (Formula on the slide). Natural fats are mainly mixed triacylglycerides.

Ž. - organic compounds of primary synthesis, are part of human, animal and plant organisms.

Originally: 1-vegetable, October 2.

By consistency: 1 solid (with residues of saturated acids), 2 liquid (with residues, mainly unsaturated acids).

*Vegetable fats*accumulate in fruits, seeds as a spare material. Occur in the cells of the parenchyma in the form of drops. Most of all. in the fruits of the genus. Cabbage, Poppy, Flax, Olive and others. Their number in the seeds can reach 50-55% (castor), 29-44 (flax), 25-30 (sunflower).

Animal fats deposited mainly in the abdominal cavity in the form of adipose tissue, it is also abundant in milk, liver (especially marine).

FATTY ACIDS

In the plant world, more than 200 living quarters have been identified. These are mainly monocarbonate to-you with an unbranched carbon chain and an even number of carbon atoms. They are divided into: 1 saturated; 2 monounsaturated (with one double bond); 3 polyunsaturated (with 2 or more double bonds). There are also acids of special structure: hydroxy acid - ricinoleic or hydroxyoleic (in castor oil) and cyclic acid - chaulmugrov (in chaulmugrovy oil).

The composition of fats in the human body often includes residues of saturated acids (stearic and palmitic) and unsaturated acids (oleic, linoleic, linolenic and arachidonic). Saturated acids enter the body with food and are also formed during biosynthesis. Polyunsaturated acids - come only with food. They are called essential (irreplaceable) - vit.F.

According to the composition of zh.k. fatty oils are classified into:1 - drying (oleic glycerides); 2 - semi-drying (glycerides of linoleic to-you); 3 - drying (glycerides of linolenic to-you).

Fats always contain concomitant substances that affect the appearance, physicochemical properties and pharmacological activity. They make up an unsaponifying fat residue (2-3%). Concomitant substances include: sterols (phyto-cholesterol), fat-soluble vitamins, pigments. Some vegetable oils contain a significant amount of complex lipids - phosphatides (phospholipids) - triglycerides.k. to-tu; glycolipids-glycerides with sugar residue, emulsifiers; lipoproteins, is a part of plastids; chromoproteins - ent. to the composition of hemoglobin.

PHYSICO-CHEMICAL PROPERTIES OF FATS

F.-x. properties of the same.depend on the structure of the housing, as well as related substances that are part of them. Solid fats contain residues of saturated acids, liquid - unsaturated. Animal fats are usually solid (exception - fish oil), and vegetable - liquid (exception - cocoa butter).

Fats and oils, oily to the touch, leave a stain on the paper, which increases when heated. At normal temperatures, they do not ignite, but after heating or with wicks - burn with a bright flame.

The color of fats depends on the method of obtaining them. Most fats are white or light yellow. Yellowish - from the presence of carotenoids, greenish - from the presence of chlorophyll. Occasionally there is a red-orange color or other due to the presence of lipochromes.

Smell and taste - specific and determined by the presence of concomitant substances.

All fats are lighter than water. As mixtures of compounds - they do not have a clear melting point (for most it ranges from 22-55o.

J. and zh.k. easily soluble in organic solvents (diethyl ether, chloroform, benzene, petroleum ether, vaseline oil, etc.); slightly soluble in ethyl alcohol (except for castor oil, soluble in equal amounts of alcohol); insoluble in water, but in the presence of emulsifiers (surfactants) form emulsions. Among themselves. and zh.m. - are mixed in all proportions. They are good solvents for essential oils.

Zh.m. optically inactive (except for castor oil), have significant refraction.

Able to hydrolyze. Under the action of alkali metal hydroxides, glycerol and salts of higher fatty acids (soap) are formed, so the reaction of alkaline hydrolysis of fats is called saponification. In nature, saponification is due to the enzyme lipase in the presence of moisture. The saponification reaction is widely used to make soap. This reaction is used to determine the composition of fats and their benignity: determine the number of saponification-the number of ml of potassium hydroxide required to neutralize free acids and saponification of esters contained in1 yeartest fat; acid number is the amount of ml of potassium hydroxide required to neutralize the free acids contained in1 yeartest fat; saponification ethereal number is the amount of ml of potassium hydroxide required for saponification of esters contained in1 year of the studied raw material, ie this is the difference between the saponification number and the acid number.

At long storage. they undergo a complex chemical process - rancidity. In the light in the presence of moisture and air. acquire a specific odor, unpleasant and bitter taste. As a result of this process, peroxides, aldehydes, ketones, acids, etc. are formed. The content of peroxides in fats and preparations is characterized by a chemical indicator - peroxide value.

An important property of fats -drying. Under the influence of air fats containing unsaturated fatty acids, when spread in a thin layer change their consistency: there is a thickening with the formation of a transparent resin-like elastic film - linoxin, insoluble in organic solvents.

Oils that do not form a film are called non-drying (in their composition - glycerides of oleic acid-olive, almond, peach, castor). Oils that form a dense film are called drying (glycerides of linolenic and linoleic to-you - linseed oil); oils that form soft films are called semi-drying (glycerides of linoleic to-you - corn, sunflower, pumpkin oil).

The drying rate is the same. there is an elaidin test or iodine number.

If the elaidin test is positive (oleic acid under the action of nitric acid turns into trans-isomers - elaidin to-that, which precipitates at room temperature) - the oil is non-drying.

An indicator of drying oils is the iodine value - the number of grams of iodine that binds to 100 gtest substance. The method is based on the interaction of fat attachment with iodine monochloride solution: halogens are added at the place of rupture of double bonds. It is easy to determine the type of oil by the value of the iodine number.

Hydrogenation of iron is the process of attaching hydrogen to unsaturated acid residues at the site of double bonds, as a result of which. become solid (occurs at high temperatures in the presence of a nickel catalyst. Hydrogenated fats are used as a basis for ointments. The amount of g of hydrogen required for hydrogenation10 kg fat, is called the number of hydrogenation and is an analytical constant that indicates the degree of unsaturation of fat.

METHODS OF FAT ISOLATION AND RESEARCH

Getting fat:

Cold pressing - used for seeds containing more than 10% fat. The oils are pale, neutral, have a pleasant taste. Used as solvents for vitamins, hormones, camphor.

Hot pressing - provides a higher oil yield, has a weakly acidic reaction environment, because they have more free acids. The quality of such Fr. below - they contain many impurities that dye substances. Used externally, and after refining (centrifugation, adsorption, treatment with sulfuric acid) - internally.

Extraction with organic solvents is the highest yield, but the following are used. only in technology, and after careful refining - in food. In medicine - not used.

Heating - used to obtain animal fats.

Fat studies:

The main stages of the study are. is:

-organoleptic analysis (consistency, taste, color, smell);

-establishment of solubility;

-establishment of physical indicators (specific gravity, refractive index);

-determination of chemical parameters (acid, ether, iodine and saponification number);

-establishment of purity;

-establishment of authenticity and quantitative content.

Establishment of purity (detection of impurities): peroxides, aldehydes are detected by the Kreis reaction: 1 ml of oil is shaken from 1 ml. salt to-you, add 1 ml of ethereal solution of floroglucin (1: 1000). Pink or red color indicates poor quality oil.

Authentication:

-Bieber's reaction - to stone oil (peach, apricot): 5 ml of oil is shaken from 1 ml of the cooled mix of sulfur to-you, water and steaming sulfuric acid. There is a pink (to red) color, which gradually turns orange.

-Bellier reaction - to grain oils (flaxseed, olive, almond): In vitro, layer equal volumes of nitric acid, oil and a saturated solution of resorcinol in benzene and shake vigorously. In the presence of oil from the seeds immediately appears color, which quickly disappears. When the layers stratify, the color turns into a benzene layer. Red or blue-violet color is formed with linseed oil; with olive oil - dirty green; with almond - red or blue-purple.

-Reaction to fish oil:

- with chloroform and a solution of antimony chloride - blue color (vitamin A); with chloroform and concentrated sulfuric acid - blue-violet color, quickly turns brown (lipochrome);

-Reaction to lanolin (detect cholesterol - with chloroform and conc. Sulfuric acid - brown-red ring at the site of separation);

- Baudouin reaction - to sesame oil - with hydrochloric acid and an alcoholic solution of furfural or0.5 g sugar - the acid layer acquires a bright purple-red color.

Chromatographic analysis of fats is performed to determine the composition of fatty acids (GFA); to determine the class of lipids (TLC on silica gel).

Quantitative determination of fat content in vegetable raw materials -method of extraction with organic solvents in the Soxhlet apparatus.

BIOLOGICAL ACTION AND USE

J. in the body - the main sources of energy. In the oxidation of the same. it is released twice as much as in the oxidation of carbohydrates and proteins. Fats, which are part of the membrane formations of cells, perform a structural function. Due to the low thermal conductivity, they are deposited in the subcutaneous layer and are thermal insulators that protect the body from cooling and give the skin elasticity. Fats obtained from food are suppliers of vitamins A, D, E, F.

In the pharmaceutical industry. used as:

-Basics for ointments, plasters, liniments, emulsions, suppositories;

- Solvents for camphor, sex hormones, vitamins (olive, peach, almond oil)

-food additives for the prevention of atherosclerosis (oils containing unsaturated LCD -hypocholesterolemic action -vit. F)

In addition, the same. widely used in perfumery and cosmetics and for the production of soap, glycerin, stearin, plastics, rubber, lubricants, etc.

Fat-like substances (lipoids)

Fat-like substances include: waxes (beeswax, wool wax-lanolin) and complex lipids that are part of cell membranes (phospholipids and glycolipids).

Lipoids are insoluble in water, soluble in organic solvents, when heated with alkali are saponified.

Waxes are mainly esters of high molecular weight aliphatic monobasic acids and higher alcohols. There are plant, animal, fossil and synthetic.

Vegetable waxes are produced by plant tissues.

Animal waxes: bee, wool-lanolin (obtained by washing sheep's wool), spermaceti (obtained from sperm whales).

Fossil wax -caesarine (from rock wax ozokerite) and Montana -from brown coal and peat.

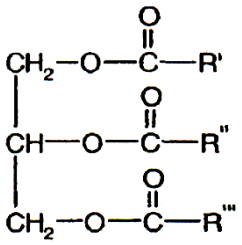
The main part of the wax is esters. In addition to them -fatty acids (unsaturated), free alcohols, acids, hydrocarbons. Waxes are solid oily substances. Serve as protection against moisture because they do not get wet with water.

Beeswax is used in ointments to seal the base; it also promotes wound healing through the presence of vitamin A.

Lanolin - a thick viscous yellowish-brown mass with a specific odor, neutral reaction, produced by the skin glands of sheep. Poorly soluble in alcohol and insoluble in water, but when rubbed absorbs it 1.8-2 times its weight and does not lose its consistency. Used as an emulsifier in suppositories, ointments and cosmetic creams.

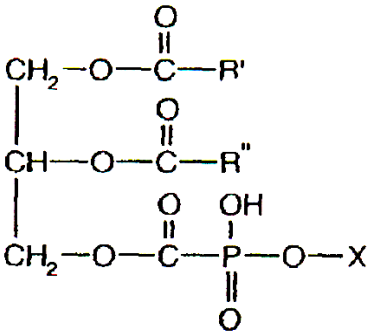
Spermacet is a waxy mass obtained from sperm whales. Spermacet is the basis for ointments and medicated creams.

Phospholipids -esters of polyhydric alcohols, fatty acids and phosphoric acid. From plant phospholipids make preparations of hepatoprotective action - essential.



GENERAL FAT FORMULA

RI; RII; RIII - higher monobasic fatty acids with the number of C atoms in the chain - from 6 to 24



GENERAL FORMULA OF PHOSPHOLIPIDS

RI; RII - fatty acid residues

X is the residue of alcohol, sugar or amino alcohol

$CH_3-(CH_2)_7-CH=CH-(CH_2)_7-COOH$

Unsaturated fatty acids

- oleic

$CH_3-(CH_2)_4-(CH=CH-CH_2)_2-(CH_2)_6-$

- linoleum