

**ODESSA NATIONAL MEDICAL UNIVERSITY**  
**Department of General and Clinical Pharmacology and Pharmacognosy**

**METHODOLOGICAL DEVELOPMENT**

**Course: "Pharmacognosy"**

**practical lesson for students on the topic:**

**"Fats and fat-like substances. Analysis of fatty oils. Olive, almond, peach, castor, sunflower oil. Cocoa butter. "**

Course: 3rd Faculty: medico-pharmaceutical

**Approved on methodical  
meeting of the department  
"30" August 2024  
Protocol № 1  
Head department  
MD, prof. JV Rozhkovsky**



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**Odessa - 2024**

**1. The topic of the lesson:** "Fats and fat-like substances. Analysis of fatty oils. Olive, almond, peach, castor, sunflower oil. Cocoa butter. " - 4 years.

## **2. Relevance of 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 fat in the seeds. In addition to seeds, spare fats are often found in other organs and tissues of plants that are at rest. The accumulation of fat in plants can be quite 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 a temperate climate - it is mainly herbaceous plants (flax, sunflower, peanuts, etc.), less shrubs, even less 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. Accumulating in the cotyledons of wintering seeds, fats allow you to keep the embryo in the cold.

Climatic factors - light, heat and moisture significantly affect the efficiency of oil formation.

The properties of fats are determined by the qualitative composition of fatty acids, their quantitative ratio, the percentage of free, unrelated to glycerol fatty acids, the ratio of various triglycerides, etc.

## **3. Objectives of the lesson:**

*3.1. General goals:* to study LR containing lipids and perform work on macro- and microscopic analysis of raw materials: flax seeds, annual sunflower, corn, castor,

almonds, peach, conduct qualitative reactions on fatty oils and quantify the content of fatty oils in vegetable raw materials.

3.2. *Educational goals*: formation of a professionally significant substructure of personality with relevant aspects of deontological, ecological, legal, psychological, patriotic, professional responsibility.

3.3. *Specific goals*:

- **Know** (level of assimilation according to Bezpalk - II):

1. Definition of "Lipids", their classification.
2. Physico-chemical properties of fatty oils.
3. Morphological characteristics of plants, their habitats (cultivation areas), places of growth.
4. Chemical composition, uses and medical use of medicinal plant raw materials containing fatty oils.

Based on theoretical knowledge and laboratory work:

- **Master the techniques (be able)** (level of assimilation according to Bezpalk - III):

1. Recognize fats and oils by touch and distinguish them from possible impurities;
2. Determine the identity and quality of raw materials by external signs, anatomical structure and histochemical reactions.

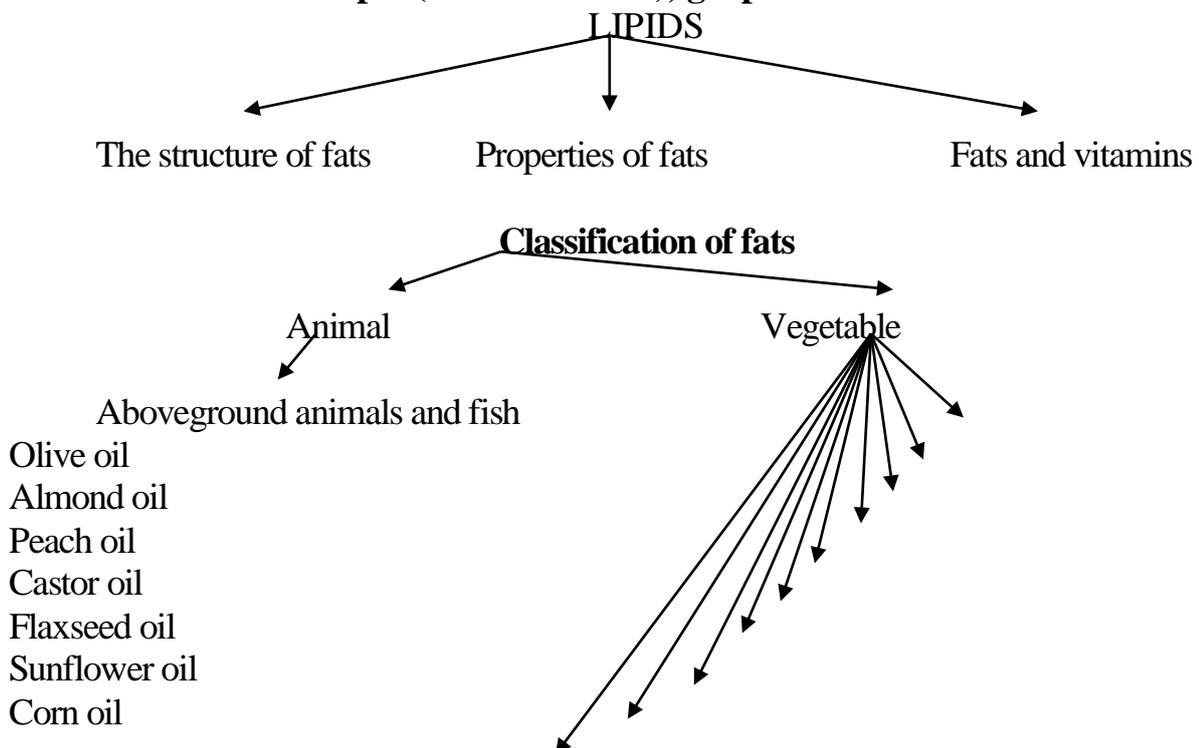
#### 4. Interdisciplinary integration

№ p.p.	discipline	know	be able
1	2	3	4
1.	Previous disciplines: 1. Botany  2. Organic chemistry	Characteristic features of the families of the studied plants. Morphology of stem, bark, leaves, flower, fruit, root and rhizome. Anatomical structure of the leaf, bark, fruit, root, rhizome.  Physical and chemical properties of polysaccharides, glycosides, terpenoids, aromatic derivatives, heterocycles.	Use a microscope, prepare surface preparations and cross-sections.  Carry out qualitative reactions; purification of organic compounds.

	3. Analytical chemistry	Methods of acid-base titration (neutralization) and permanganatometry	Work with analytical scales, measuring vessels, photoelectrocolorimeter, use methods of chromatography on paper and in a thin layer of sorbent.
2.	<p>The following disciplines:</p> <p>1. Physical and colloid chemistry</p> <p>2. Pharmacy technology of drugs</p> <p>3. Industrial technology of medicines</p>	<p>Solubility of solids and liquids in liquids. Distillation. Raoul's law. Konovalov's law. Vapor pressure and composition over mutually insoluble liquids. Buffer solutions. Polarography. Potentiometric titration. Adsorption. Ion exchange adsorption. Chromatography: paper, column, in a thin layer of sorbent, gel chromatography.</p> <p>Methods of measuring mass and volume. Preparation of powders or liquid drugs for internal and external use. Analysis of prepared liquid drugs using a burette system.</p> <p>Conditions of industrial preparation of medicines. Principles of organization of pharmaceutical production of various dosage forms: liquid, solid, soft, injectable solutions, etc. Machines, devices, equipment for the production of medicines.</p> <p>Pharmacodynamics and pharmacokinetics of drugs. The pattern of action of drugs on the human body and its corresponding reactions. Basic principles of treatment in terms of drug</p>	

	4. Clinical pharmacology	selection, evaluation of their effectiveness and safety.	
	5. Pharmaceutical chemistry	Methods of qualitative and quantitative study of drugs.  Pharmaceutical service management. Storage of medicines. Control and analytical service, organization of its work.	
	6. Organization and economics of pharmacy	Accounting for inventory and cash. Economic analysis of the pharmacy.  Management and entrepreneurship. Organization as an object of management. Connecting processes in management. Human Resource Management Pharmaceutical Marketing Management. Pharmaceutical market research. International marketing.	
	7. Management and marketing in pharmacy		

**5. Content of the topic (text and thesis), graphic structure of the lesson.**



Cocoa butter  
 Palm and palm kernels  
 Coconut oil

### 6. Plan and organizational structure of the lesson.

<b>№№ p.p.</b>	<b>The main stages of the lesson, their functions and content.</b>	<b>Learning objectives in the levels of mastery.</b>	<b>Means of training and control.</b>	<b>Materials on methodical forensuring the visibility of the lesson, control the knowledge of those who teachis.</b>	<b>Term (in minutes or in%) of the total class time.</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>1</b>	<i>Preparatory stage</i> Organization of classes Setting learning goals Homework check	II	Oral interview on the topic	Methodical works for students, album	1% 2% 25%
<b>2</b>	<i>The main stage</i> Conducting a practical lesson	III	Herbariums of medicinal plants, LRS, reagents		50%
<b>3</b>	<i>The final stage</i> Testing and assessment of practical skills  Checking the final level of knowledge  Providing homework with a reference to the literature	II- III  II- III	Herbariums of medicinal plants, LRS, reagents	Methodical works for students, album  Tests and situational tasks	5%  15%  3%

### 7. Materials on methodological support of the lesson

**7.1. Control materials for the preparatory stage of the lesson: questions, tasks, tests.**

**Tests:**

1. The oil of which plant is most often used as a solvent in the preparation of injectable solutions of camphor, sex hormone preparations and their analogues:

- A. olive oil
- B. Almond oil
- S. Peach oil
- D. castor oil
- E. sunflower oil

2. From the seeds of which plants receive castor oil:

- A. castor seeds
- B. fennel seeds
- C. cumin seeds
- D. coriander seeds
- E. flax seeds

3. Under the influence of which enzyme contained in all fatty oil seeds in nature is the breakdown of fats:

- A. lipase
- B. amylase
- C. carboxypeptidase
- D. papain
- E. bromelain

4. What method is widely used in laboratory practice for the quantitative determination of fat in raw materials:

- A. extraction
- B. pressing
- C. smelting
- D. distillation
- E. shaking

5. The seeds of which plant are the raw material for the production of Oleum Ricini and, due to the high content of lipase, are used in soap production for the breakdown of fats.

- A. castor oil
- V. flax
- S. sunflower
- D. almonds
- E. soybeans

6. Which of the following oils is analogous to almond oil:

- A. peaches
- V. olive
- S. flax
- D. sea buckthorn
- E. cocoa butter

7. Oils of which two plants promote the excretion of lipids from the body:

- A. corn and flax
- V. sea buckthorn and peach
- S. palm and cocoa butter
- D. coconut and almond
- E. sunflower and soybean oil

8. What oil is used to prepare suppositories:

- A. cocoa butter
- C. linseed oil
- S. hemp oil
- D. sea buckthorn oil
- E. corn oil

9. Specify the medicinal plant that is the source of castor oil.

- A. *Ricinus communis*
- B. *Rhamnus cathartica*
- C. *Frangula alnus*
- D. *Linum usitatissimum*
- E. *Ononis arvensis*

10. What kind of damage is characteristic of plants containing lipids:

- A. rancidity
- B. evaporation
- C. drying
- D. damage by barn pests
- E. rot

**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 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 intensity of oil production.

**7.2. Materials of methodical support of the main stage of employment:  
professional algorithms, orientation maps for formation of practical abilities and  
skills, educational tasks.**

**The list of educational practical tasks that must be performed during the  
practical laboratory lesson:**

**Study of chemical analysis of fatty oils.**

**Task 1.** Qualitative reactions to fatty oils.

1.1. Indicate the name of the analyzed fatty oil and its vegetable oil  
source.

1.2. Apply one to a sheet of filter paper with a glass rod  
a drop of greasy oil and heated over an electric stove.

Observation.

1.3. Reaction to seed oils (Bellier reaction).

Carefully layer equal volumes (1 ml) of nitric acid (density 1.4), test oil and 0.15%  
solution of resorcinol in benzene in the test tube and shake vigorously once. In this  
case, the fatty oils obtained from the seeds, for 5 seconds give a color that quickly  
disappears. When separating the layers, the paint quickly turns into a benzene layer.

Observation.

1.4. Test Kreis for good quality essential oil

(Presence of peroxide, aldehydes). 1 ml of the test oil is shaken for 1 minute with 1  
ml of hydrochloric acid, add 1 ml of an essential solution of floroglucin (1: 1000) and  
shake again. The appearance of pink or red color indicates the poor quality of the test  
oil.

1.5 Determine the numerical indicators of essential oils.

*Acid number* - The number of milligrams of caustic potash,  
necessary to neutralize the free acids contained  
in 1 yearoils. The acid number indicates the number of free  
acids in the studied fat and its size is judged by

benign fat. Fresh fat free acids are almost non-existent contains.

Close 2 years (exact portion) of fatty oil is dissolved in 20 ml of equal volumes of 96% alcohol and pre-neutralized by phenolphthalein 0.1 n. sodium hydroxide solution. Add 3-5 drops phenolphthalein and titrated with constant stirring of 0.1 N. sodium hydroxide solution until pink, no disappears within 30 seconds. 1 ml of 0.1 N sodium hydroxide solution corresponds to 5.61 mg of potassium hydroxide.

The acid number is calculated by the formula:

**and  $\square$  5.61**

$$X = \frac{a}{b}$$

where: a - the number of milligrams of 0.1 N. sodium hydroxide solution, spent on titration;

b- weight of the substance in grams.

1.6. Determination of the number of saponification.

*The number of saponification* - the number of milligrams of caustic potassium, necessary for the neutralization of free acids and saponification esters contained in 1 year test substance.

Close 2 years substances (exact sample) are mixed in a flask with a container 200-250 ml of 25 ml of 0.5 N alcohol solution of potassium hydroxide. To the flask connect the reflux condenser and immerse it in boiling water water bath for 1.5-2 hours, maintaining a gentle boil until complete saponification. The end of saponification is determined by the formation of absolutely transparent and homogeneous solution that does not change when dilution with water. In parallel in the same conditions put control

experience, ie in another flask heat 25 ml of 0.5 N alcohol potassium hydroxide solution. Both solutions immediately after discontinuation heating is diluted with 25 ml of freshly boiled hot water, add 5 drops of phenolphthalein solution and titrate with 0.5 N. hydrochloric acid solution to discoloration. with the number of milliliters of 0.5 N hydrochloric acid solution, spent in the control experiment, subtract the amount milliliters of 0.5 N solution of hydrochloric acid on the titration of the test substance. the difference is obtained there is an amount of 0.5 N potassium hydroxide solution, spent on saponification of ethers and neutralization of free acids contained in the samples.

1 ml of 0.5 N potassium hydroxide solution contains 28.05 mg of potassium hydroxide.

The saponification number is calculated by the formula:

$$(a - b) \div 28.05$$

$$X = \text{_____};$$

**in**

where: a is the number of milligrams of 0.5 n solution hydrochloric acid, spent on titration of control experience;  
 b - the number of milliliters of 0.5 n solution hydrochloric acid, spent on titration of the test substance;  
 in - a portion of the substance in grams.

**Task 2.** Quantitative determination of the content of fatty oils in vegetable raw materials.

2.1. Isolate fat by processing raw materials containing fats  
organic solvents. As solvents

use ethyl ether, petroleum ether, chloroform, benzene, methylene chloride, etc. low-boiling solvents.

2.2. The extraction of fats is carried out in the Soxhlet apparatus, which consists of three parts: receiver, extractor and refrigerator. On the extractor there are two tubes: one serves to conduct vapors with a solvent, heated in the receiver, in the refrigerator; the other is bent is a siphon, which flows from the extractor into the flask a solution of extracted fat.

2.3. Weigh the filter paper bag on the analytical balance and wrap in it 5.0 g pre-weighed crushed

raw materials. The package with raw materials is weighed on analytical balances, and then

placed in an extractor. Before assembling the device, it is necessary also weigh the receiver on analytical balances. After when all parts of the device are connected through the refrigerator, poured solvent until the liquid flows through the siphon

the receiver and then the extractor is filled with solvent about 1/3 volume. The receiver with the solvent is heated in a water bath.

Solvent vapor rises through the tube into the refrigerator, condensed and drained into the extractor on a package of raw materials, where fatty oils are extracted. When the extractor is filled liquid to the height of the siphon, the liquid drains into the receiver. all this process continues until the complete extraction of fatty oil.

Extraction of fats should be carried out carefully!, Without overheating solvent above 60 degrees. It should boil evenly since

when heated strongly, part of the solvent vapor does not have time to condense in the refrigerator and will evaporate. completeness of fat removal is determined by the absence of a fat spot on

filter paper from a few drops of ether extraction,  
flows from the extractor to the receiver. reaching fullness  
removal, the solvent is distilled off and the receiver is weighed,  
pre-drying it in an oven at temperatures  
90-95 C to constant weight. Knowing the weight of the empty receiver and  
receiver with oil, calculate the% of fatty oil in vegetable raw materials  
by the formula:

$$(A - B) \square 100$$

$$\mathbf{X} = \text{_____};$$

**IN**

where:

A - weight of the receiver with dry heat, in g;

B weight of empty receiver, in g;

IN- a sample of raw materials, in

### **Instructional materials for mastering professional skills, abilities:**

Methods of work performance, stages of performance:

- a) get the necessary LRS;
- b) to study and describe the appearance of the obtained LRS, draw LRS;
- c) to prepare LRS;
- e) to study the anatomical and diagnostic features of flax seeds, corn, peach, almond, sunflower;
- f) record the observations in the laboratory journal;

### **7.3. Control materials for the final stage of the lesson: tasks, tasks, tests, etc.**

#### **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 value
- B. acid number

C. number of saponification

D. ethereal number

IS.

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

S. sunflower

D. flax

E. ricin

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

A. palm

V. flax

S. 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 mays*

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 (non-drying) 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
- V. flax
- S. sunflower
- D. soy
- E. corn

## **8. Literature**

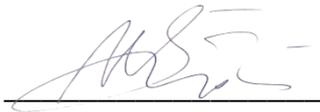
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*Methodical recommendations were made by  associate professor Boyko IA*

*(Signature)*