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

METHODOLOGICAL DEVELOPMENT

Course: “Pharmacognosy”

practical lesson for students on the topic:

"Phenolic compounds.Methods of qualitative and quantitative determination. LR and LRS containing simple phenols and their glycosides. Common bearberry, cranberry, rhodiola rosea, violet tricolor and field, male fern. "

Course: 3rd Faculty: Medical and Pharmaceutical

Approved on methodical meeting of the department
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Protocol № 1
Head department
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1. Topic of the lesson: "Phenolic compounds.**Methods of qualitative and quantitative determination. LR and LRS containing simple phenols and their glycosides. Common bearberry, cranberry, rhodiola rosea, violet tricolor and field, male fern.** " - 4 years.

2. Relevance of the topic.

Phenolic compounds are very common in the plant world. According to the structure of the carbon skeleton, they are divided into a number of groups. Natural glycosides in which simple phenols, their di- or trimers act as aglycones, are called phenolglycosides.

A number of compounds of phenolic groups have antimicrobial, antiviral, disinfectant, adaptogenic, anthelmintic and antitumor effects. The knowledge and skills acquired by students in the study of this topic will be useful in mastering various sections of pharmacy and factory technology of drugs, pharmacology, pharmacotherapy, as well as in the practical activities of the pharmacist.

3. Objectives of the lesson:

3.1. General goals: to study ARS containing simple phenols, their glycosides, and to perform work on morphological and anatomical analysis and chemical analysis of raw materials: bearberry leaf and shoots, cranberry leaf and shoots, rhizome of male fern, violet grass, rhizome with rhodiola rosea roots.

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:

- to know (level of assimilation according to Bezpalk - II):

1. Definition of "phenol glycosides", their classification.
2. Distribution of phenol glycosides in the plant world.
3. Habitats and resources of the studied plants.
4. Chemical composition of the rhizome of male fern, bearberry leaves, cranberry leaves, rhizomes of Rhodiola rosea. Drugs and their use in medicine.
5. Formulas of basic biologically active compounds.
6. Ways of use and medical application of raw materials.

Based on theoretical knowledge of the topic and practical work:

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

- Recognize the external features of the plant (bearberry, cranberry, rhodiola rosea, violet tricolor and field, male fern) and distinguish them from possible impurities;
- Determine the authenticity and good quality of raw materials by external signs, anatomical structure and histochemical reactions.
- To quantify arbutin.

4. Interdisciplinary integration

№ p.p.	discipline	know	be able

1	2	3	4
1.	Previous disciplines: 1. Botany	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.	Use a microscope, prepare surface preparations and cross-sections.
	2. Organic chemistry	Physical and chemical properties of polysaccharides, glycosides, terpenoids, aromatic derivatives, heterocycles.	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, photoelectro-colorimeter, use methods of chromatography on paper and in a thin layer of sorbent.
2.	The following disciplines: 1. Physical and colloid chemistry	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.	
	2. Pharmacy technology of drugs	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. Conditions of industrial preparation of medicines. Principles of organization of pharmaceutical production of various dosage forms: liquid, solid, soft, injectable	

	3. Industrial technology of medicines 4. Clinical pharmacology 5. Pharmaceutical chemistry 6. Organization and economics of pharmacy 7. Management and marketing in pharmacy	solutions, etc. Machines, devices, equipment for the production of medicines. 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 selection, evaluation of their effectiveness and safety. Methods of qualitative and quantitative study of drugs. Pharmaceutical service management. Storage of medicines. Control and analytical service, organization of its work. 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.	

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

6. Plan and organizational structure of the lesson.

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

	level of knowledge Providing homework with a reference to the literature			tasks	 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. Rhizome with the roots of which the plant contains BAS - derivatives of simple phenols and their glycosides:
A. Rhodiola rosea
B. Oman
V. ginseng
G. rhubarb
D. coil

2. What is the main aglycone contained in phenyloglycosides:
A. arbutin
B. acetic acid
B. formic aldehyde
G. vinyl alcohol
D. α-aminocaproic acid

3. Preparations of which plants containing phenolic compounds are used as stimulants for fatigue and in the treatment of hypotension:
A. Rhodiola rosea
B. yellow cat
B. raspberries are common
G. sea buckthorn buckthorn
D. tansy ordinary

4. Preparations of which plant containing phenolic compounds are used as diuretics, used in urolithiasis, gout, rheumatism:
A. cranberry is common
B. sweet naked
B. cyanosis blue
G. horsetail
D. thyme

5. Which plant contains phenolic compounds with one aromatic ring:
A. cranberry leaves

B. plantain grass
B. valerian root
G. marshmallow root
D. calendula flowers

6. In which the plant has a disinfectant and anti-inflammatory effect due to the presence of phenolic compounds (arbutin, hydroquinone, tannins):
A. common bearberry
B. rose hips brown
B. cyanosis blue
G. horsetail
D. Lobel's hellebore

7. Name the plants, unacceptable impurities to which are the rhizomes of male ferns and ostriches:
A. rhizome of male fern
B. rhizome of cyanosis
B. rhizome of Eleutherococcus
G. the root of the Manchurian aralia
D. Patrin root

8. Name the rhizome of a plant whose main biologically active substances are phenolic compounds: phenolic alcohols and their glycosides, flavonoids and tannins:
A. rhizome of Rhodiola rosea
B. rhizome of madder dye
B. horse sorrel root
G. root and rhizome of Tangut rhubarb
D. rhizome of Eleutherococcus

9. Woody vine up to 10-15 m and 1-1.5 cm thick, leaves and stems have a characteristic lemon odor, which is enhanced by rubbing, fragrant flowers, heterosexual, prefabricated fruit, in the form of a drooping brush:
A. Chinese lemongrass
B. field honeycomb
B. burkun medicinal
G. Baikal helmet
D. sand immortelle

10. Which of the following plants contains phenologlycosides with anthelmintic action:
A. fern (thyroid) male
B. calendula
B. Immortelle is sandy
G. common bearberry
D. horsetail

Question:

1. Definition of "phenol glycosides", their classification.
2. Distribution of phenol glycosides in the plant world.
3. Features of harvesting, drying and storage of raw materials containing phenol glycosides and measures for the protection of wild medicinal plants.
4. Latin and Russian names of raw materials that produce plants and families of all objects of the research topic.
5. External signs of the studied types of medicinal plant raw materials.
6. Possible impurities to raw materials (bearberry sprouts, cranberries, violet grass tricolor and field, rhizomes of male fern, bearberry leaves, rhizomes and roots of Rhodiola rosea), and their main differences.
7. Habitats and resources of the studied plants.
8. Characteristic anatomical diagnostic signs of the rhizome of the male fern, bearberry leaf, cranberry leaves, rhizomes of Rhodiola rosea. Drugs and their use in medicine.
9. Chemical composition, ways of use and medical application of medicinal plant raw materials containing phenol glycosides.
10. Formulas of basic biologically active compounds.
11. Qualitative and quantitative determination of arbutin.
12. Ways of use and medical application of ARS containing phenolglycosides.

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 lesson:

Task 1. To study a man's shield and to carry out the analysis of raw materials on AND (sections: external signs, microscopy)

1. To study the external features of the male thyroid gland and possible impurities: female fireweed and ostrich on herbarium specimens (Scheme 1).

Scheme 1:

DETERMINATION OF THE PRODUCING PLANT ACCORDING TO EXTERNAL SIGNS

- life form (herbaceous plant, shrub, shrub, tree).
- type of underground organs (root, rhizome, tuber, etc.)
- stem structure (shape, nature of branching, pubescence, diameter, etc.)
- leaf placement (regular, opposite, whorled)
- leaves (simple or complex. The shape of the leaf blade or leaves, edge, veining, color, size).
- flowers (single or inflorescences, flower structure, color, size, etc.)
- fruit (type, shape, color, size)
- bark (in woody species), (color, presence, shape and color of lentils, thorns, etc.).

Write the Latin and Russian names of raw materials, plants and families (give synonyms).

2. Carry out a comparative morphological analysis of the rhizomes of the male thyroid gland, the female thyroid gland and the ostrich (Scheme 2).

Scheme 2:

ANALYSIS OF RAW MATERIALS "UNDERGROUND AUTHORITIES" BY EXTERNAL SIGNS

- commodity type of raw material (unharvested, cut, cleaned or uncleaned from cork, etc.)
- type of underground organs (roots, rhizomes with roots, rhizomes, tubers, bulbs, bulbs, etc.)
- shape (cylindrical, conical, lumpy, twice curved, etc.)
- dimensions
- surface (smooth or wrinkled, the presence of longitudinal or transverse folds, scars from leaves, stems, traces of lateral roots, etc.)
- color outside, at the break.
- the nature of the fracture (granular, fibrous, smooth, rolling, bristly, etc.)
- the presence of the core
- type of structure of the conductive system (beam, bundleless).
- odor when scraping or wetting with water.
- taste (in non-toxic objects).

3. Prepare a cross section of the leaf petiole of the male thyroid gland. Draw a diagram of the structure of the sprout under a magnifying glass. to study the micropreparation at low and high magnification (Scheme 3).

Scheme 3:

MICROSCOPIC ANALYSIS OF RAW MATERIALS "UNDERGROUND ORGANS"

- structure: primary, secondary; (Beam, non-beam type).
- integumentary tissue (plug, epidermis).
- elements of xylem, phloem (histological composition, location).
- shape and structure of core rays.
- main parenchyma (dense, loose, aerenchyma, etc.)
- containers, milk vessels, secretory passages, etc.
- crystalline inclusions
- spare nutrients (starch, inulin)

Draw and mark diagnostic signs:

- partially destroyed epidermis;
- hypodermis, consisting of 5-8 rows of strongly thickened brown cells;
- the main parenchyma, which consists of thin, loosely arranged cells that form large intercellular spaces, and is filled with starch grains 4-6 μm in size.
- in the intercellular spaces are spherical or oval glands on a thin stalk with a yellowish-green content;
- leading centroxylem bundles, consisting of tracheids and reticular tubes. They are separated from the main tissue by the endoderm.

4. Conduct a comparative morphological study of the scales covering the base of the leaf petioles of the male thyme, female kochedyzhnik and ostrich.
5. Prepare micropreparations scales of the male thyroid gland, female fireweed and ostrich. Examine the structure of the edge of the scales.

Draw and mark the characteristic features:

- double teeth formed by the protruding ends of adjacent cells (male thyroid gland);

- the edge is integral, the teeth are absent (female pyrite);
- the edge is integral, the teeth are absent (ostrich);

6. Carry out histochemical reactions:

- on a cross section of a leaf petiole of a thyroid gland to put a drop of solution of Sudan III. Observations: the contents of the glands turn orange-red;
- on a cross section of a leaf petiole of a thyroid gland to put a drop of 1% of alcoholic solution of vanillin with concentrated sulfuric acid. Observations: the contents of the glands turn red (floroglucin derivatives).

7. Note the compliance of the investigated sample of raw materials (by external signs, microscopy and qualitative reactions) to the requirements of GF.

Task 2. To study a violet tricolor and field, to carry out the analysis of raw materials on AND (sections: external signs, microscopy).

1. Examine the appearance of violets tricolor, violets field on herbarium specimens (see Figure 1 above).
2. Write the Latin and Russian names of raw materials, plants and family (give synonyms).
3. Describe the appearance of violet grass tricolor on the example of samples of raw materials (Scheme 4).

Scheme 4:

ANALYSIS OF RAW MATERIALS "GRASS" BY EXTERNAL SIGNS

- "Commodity type" of raw materials (unharvested, cut, threshed)
- Stem structure (shape, branching, pubescence, color, size, specific features).
- The nature of the leaf arrangement (alternate, opposite, whorled).
- leaf
- The location of the flowers on the stem.
- flowers
- Fruits and seeds
- Sizes of stems, leaves, flowers.
- Color.
- 3apah when rubbing.
- Taste (in non-toxic objects).

4. To note conformity of the investigated sample of raw materials (on external signs) to requirements of GF XI, item 62.

Task 3. To study rhodiola rosea and to carry out the analysis of raw materials on AND (section: external signs).

1. Examine the appearance of Rhodiola rosea by herbarium specimen (Scheme 1). Write down the Latin and Russian names of the raw materials that produce plants and families (give synonyms).
2. Describe the appearance of the rhizome with the roots of Rhodiola rosea on the example of a sample of raw materials (Scheme 2)
3. Note the compliance of the test sample of raw materials (on external grounds) to the requirements of GF XI, Article 75.

Task 4. Examine bearberry (bear's ear) and analyze the raw materials for AND (all sections except "numerical indicators").

1. To study oyster mushroom on a herbarium sample (scheme 1). Write down the Latin and Russian names of the raw materials that produce plants and families (give synonyms).
2. Describe the appearance of bearberry shoots on the example of a sample of raw materials. Carry out a comparative morphological analysis of bearberry leaf and possible impurities - cranberry leaf, blueberry, blueberry. Draw the appearance of a bearberry leaf.
3. Prepare a micropreparation of bearberry leaf from the surface, study it at low and high magnification (Scheme 5).

Scheme 5

MICROSCOPIC ANALYSIS OF RAW MATERIALS "LEAVES"

- structure (dorsoventral, isolateral)
- mesophile (nature of palisade and spongy tissues).
- inclusions crystalline (single crystals, crystal-bearing coating, friends, Rafida, crystalline sand, cystolites); secretory (containers, milk vessels, canals).
- epidermis of the upper and lower sides of the sheet (shape and contour of cells: isodiametric, erect, convoluted; stomatal type: diacytic, parasitic, anisocytic, anocytic; number and location of periosteal cells.
- type of trichomes: hairs, glands.
- cuticle: thin, thick, straight, folded, warty.

Draw and mark diagnostic signs:

- polygonal cells of the epidermis with straight, thick walls;
- stomata are located on the underside of the leaf, they are large with 8 (5-9) periosteal cells;
- along the edge of the young leaves and along the central vein are 1-2-3 cell hairs with a short, thick-walled cell at the base and a longer, curved terminal cell;
- large veins are accompanied by prismatic crystals of calcium oxalate.

4. Carry out qualitative reactions for the presence of arbutin and tannins in raw materials:

take a portion of crushed raw materials - 0.5 g;
place in a flask and add 10 ml of water;
boil for 2-3 minutes;
after cooling filter;
To 1 ml of filtrate add a crystal of ferrous sulfate.
Observations: the liquid turns purple, then dark purple, and finally a dark purple precipitate (arbutin) is formed.
To 1 ml of filtrate (in a porcelain cup) add 4 ml of a solution of ammonia and 1 ml of a 10% solution of sodium phosphorus-molybdate in hydrochloric acid.
Observations: there is a blue color (arbutin).
Add 2-3 drops of iron-ammonium alum solution to 2-3 ml of filtrate.
Observations: there is a black and blue color (tannins).
Record the results of observations in a laboratory journal.
5. Determine the content of arbutin.

1. Extraction.

- Grind raw materials to 1 mm
- Take the exact sample of about 0.5 g
- Place in a 100 ml conical flask
- Pour 50 ml of water and boil for 30 minutes
- Filter into a 100 ml volumetric flask so that the raw material does not fall on the filter
- Pour 25 ml of raw material again and boil for 20 minutes
- Filter into the same volumetric flask
- Rinse the residue on the filter twice with 10 ml of hot water

2. Cleaning.

-to the filtrate add 3 ml of lead acetate solution, mix and bring to the mark with water
-place the flask in a boiling water bath and heat until complete sedimentation
-Filter the hot liquid into a dry flask with a section, covering the funnel with glass
-after cooling to the filtrate add 1 ml of concentrated sulfuric acid
-weigh the flask
-heat with a refrigerator for 1.5 hours in a water bath
-after cooling, weigh and bring to the initial mass with water
-filter into a dry flask
-add to the filtrate 0.1 g of zinc dust
-shake for 5 minutes
-Add sodium bicarbonate to a neutral reaction to litmus
-Add another 2 g of sodium bicarbonate
-after dissolving, filter into a dry flask

3. Own quantitative definition

Dilute 50 ml of filtrate with 200 ml of water
titrate from the microburette with 0.1 N iodine solution until the blue color disappears within 7 minutes. The indicator is starch. 1 ml of 0.1 N iodine solution corresponds to 0.01361 g of arbutin.

4. Calculation.

The content of arbutin is calculated by the formula

X = V ⊕ 0.01361⊕ 2 ⊕ 100 ⊕ 100

b ⊕ (100 – χ), ωηερε

V - volume of 0.1 N iodine solution spent on titration, ml
b Sample of raw materials,
in –Moisture,%

Carry out statistical processing of the results of at least three experiments.

5. Evaluation of raw material quality.

On the basis of the conducted analysis to make a conclusion on conformity of the investigated sample of raw materials to requirements of NTD.

Task 5. To study cranberries and to analyze raw materials according to AND (sections: external signs, qualitative reactions).

1. Examine the appearance of cranberries on herbarium specimens (Scheme 1). Write down the Latin and Russian names of the raw materials that produce plants and families.

2. Describe the appearance of a cranberry leaf on the example of a sample of raw materials (Scheme 6).

Scheme 6

ANALYSIS OF RAW MATERIALS "LEAVES" BY EXTERNAL SIGNS

- type of leaf and dissection of the leaf blade: (simple: palchatorassechennaya, palchato- or pinnate, peristolopastnye, three- or five-lobed; complex: even or imparipinnate.
- leaf stem or sessile.
- shape (round, elliptical, ovoid, lanceolate, linear).
- leaf edge (solid, serrated, toothed, crenate, etc.)
- nature of veining (arcuate, reticular, finger, pinnate, parallel).
- pubescence
- color of the upper and lower sides
- sheet and leaf sizes
- odor when rubbing the object or wetting with water.
- taste (for non-toxic objects)
- specific features.

3. Prepare a micropreparation of cranberry leaf from the surface and examine it at low and high magnification (Scheme 5).

Draw and mark diagnostic signs:

- epidermal cells are slightly tortuous
- stomata small with two accompanying cells located parallel to the stomatal slit
- on the underside of the leaf there are glands with a multicellular stalk and an oval multicellular head with brown contents
- along the vein there are unicellular straight or curved thick-walled hairs with a smooth or warty surface
- mesophilic contains prismatic crystals.

4. Carry out qualitative reactions to arbutin and tannins.

5. Determine the content of arbutin.

6. Note the compliance of the test sample of raw materials to the requirements of the AND.

Instructional materials for mastering professional skills, abilities:

Methods of work performance, stages of performance:

a) get the necessary ARS

b) to study and describe the appearance of the obtained ARS, to draw ARS

c) to conduct ARS training

d) to study ARS on herbarium specimens

e) to study the anatomical and diagnostic features of the leaves

f) to study the anatomical and diagnostic signs of roots and rhizomes

g) draw observations and record them in a laboratory journal

h) to analyze the violet grass on the basis of external signs

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

Question:

1. Which plants contain phenolic glycosides (their Russian and Latin names)?
2. What are the morphological features of bearberry leaves?
3. What may be the impurities in the leaves of bearberry? The main signs of their differences?
4. How to react to the presence of tannins in bearberry leaves? What are the results of this reaction?
5. How to open arbutin in medicinal raw materials (for example, bearberry leaves, cranberries)?
6. What are the external features of a cranberry leaf?
7. What is the characteristic surface of the cranberry leaf blade?
8. What types of violets are used to obtain medicinal raw materials?
9. Do flowers always have a tricolor color in the grass of tricolor violets?
10. What are the external signs of raw tricolor violets?
11. What part of the plant is used as a raw material in Rhodiola rosea?
12. What are the external signs of raw rhodiola rosea?
13. Why is the raw material of Rhodiola rosea called the "golden root"?
14. What is characteristic of the anatomical structure of the rhizome of Rhodiola rosea?
15. Name the Latin names of raw materials that produce plants and families of Rhodiola rosea.

Tests:

1. Which plant is used as an adaptogen:

A. Rhodiola rosea
B. common bearberry
B. thyme
G. mother-and-stepmother
D. althaea medicinal

2. Tincture of the fruits and seeds of this plant, containing lignans, increases performance "gently" without noticeable disturbance, has a tonic effect on the human body, increases body weight, muscle strength.

A. Chinese lemongrass
B. mountain ash is common
B. dried marsh flowers
G. corn
D. the herd is threefold

3. Specify the pharmacologically active substances of the group of podophyllin, which have a carcinolytic effect:

A. lignans
B. fatty oils
B. lipoids
G. monosaccharides
D. polysaccharides

4. Specify biologically active substances which in the structure contain aromatic rings with hydroxyl group and their functional derivatives
A. phenolic compounds
B. monosaccharides
B. polysaccharides
G. fatty oils
D. lipoids

5. From the rhizome of which medicinal plants receive "raw felicin", meaning the amount of floroglucid:
A. male fern
B. blueberry
V. lapchatka erect
G. sumac half-winged
D. Lusitanian oak

6. Name a plant containing phenolic compounds, which is characterized by the following macroscopic features: rhizome oblique, powerful with numerous cordate roots. At the upper end of the rhizome are snail-shaped rolled leaf buds, densely covered with rusty-brown membranous scales.
A. fern (shield) male
B. calendula
B. Immortelle is sandy
G. common bearberry
D. horsetail

7. Name the plant, the harvest of which ostrich and plantain are unacceptable impurities
A. thyroid gland male
B. mountain ash is common
V. dried marsh
G. corn
D. a series of three parts

8. Name the plant in the glands of which (mine cells) are floroglucin:
A. male fern
B. common bearberry
B. thyme
G. mother-and-stepmother
D. althaea medicinal

9. At the stages of harvesting any of these plants as impurities may be the leaves of cranberries, blueberries, blueberries. The leaves of this plant are used in the form of decoctions for diseases of the genitourinary tract.
A. toloknyanka ordinary
B. blueberries

V. lapchatka erect
G. sumac half-winged
D. Lusitanian oak

10. The main active substances in the rhizome of this plant - phenolic alcohols and their glycosides, flavonoids and tannins. The taste is bitter and tart, the smell of fresh fracture resembles the smell of a rose
A. Rhodiola rosea
B. calendula
B. Immortelle is sandy
G. common bearberry
D. horsetail

8. Literature for the teacher.

1. Фармакогнозія: підручник (І—ІІІ 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.

Додаткова література:

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. Сербін А.Г., Сіра Л.М., Слободянюк Т.О. Фармацевтична ботаніка. Підручник. – Вінниця: НОВА КНИГА, 2007. – 488 с.
3. 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.

10. The topic of the next lesson:

Coumarins and chromones.Methods of qualitative and quantitative determination. LR and LRS containing coumarins and chromones. Cranberry, horse chestnut, parsnip, but large, fig tree.

Methodical recommendations were made by

associate professor Boyko IA