

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

METHODOLOGICAL DEVELOPMENT

Course: "Pharmacognosy"

practical lesson for students on the topic:

"Flavonoids. Methods of qualitative and quantitative determination. LR and LRS containing flavonoids: Sophora japonica, dog nettle species, pepper bitter, marsh dried flower, sand cumin, lupus field, hawthorn species, cornflower blue, chokeberry, herd three-parted, ginkgo biloba, elderberry.

Course: 3rd Faculty: Medical and Pharmaceutical

**Approved on methodical
meeting of the department**

"30" 08.2024

Protocol № 1

Head department

MD, prof. JV Rozhkovsky



Odessa – 2024

1. The topic of the lesson: "Flavonoids. Methods of qualitative and quantitative determination. LR and LRS containing flavonoids: Sophora japonica, dog nettle species, pepper bitter, marsh dried flower, sand cumin, lupus field, hawthorn species, cornflower blue, chokeberry, herd three-parted, ginkgo biloba, elderberry. - 8 hours.

2. Relevance of the topic.

Flavonoids are a large group of polyphenolic compounds derived from diphenylpropane of varying degrees of oxidation and saturation of the propane moiety. The use of medicinal raw materials and preparations containing flavonoids is diverse: many of them have P-vitamin activity, reducing the fragility of blood capillaries, enhance the action of ascorbic acid (rutin), have a sedative effect (motherwort, hellebore, hawthorn). Flavonoids are characterized by anti-inflammatory, antiulcer (Flacarbin, Likviriton), some - hemostatic action (pepper bitter, bitter bitter, lupus). In recent years, there have been reports of antitumor and hypoglycemic action of flavonoids.

As a rule, flavonoids are not used in their pure form, they are much more often referred to as substances that are part of the total and complex drugs, because their action is potentiated by concomitant substances (vitamins, polysaccharides, etc.).

Pharmacies harvest dog nettle grass, peppermint, periwinkle and bird grass, herds, horsetail, cumin flowers, hawthorn fruits and flowers, etc., so the pharmacist's practical activities require skills in harvesting, analysis and storage of these species of medicinal plants.

3. Objectives of the lesson:

3.1. General goals: to study medicinal plants containing flavonoids and to perform work on macroscopic and microscopic analysis of raw materials (grass of dog nettle, grass of bitter pepper, pochechuynoy and avian, grass of a herd of three-part, field of a wolf field).

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 "flavonoids", their classification.
2. Latin and Ukrainian names of raw materials, producing plants and families of objects of this topic.
3. Morphological characteristics of plants. Distinctive features of the species of bitter gourd used in folk medicine, and related species.
4. Areas (areas of cultivation), places of growth.
5. External signs of the studied types of medicinal raw materials.
6. Excellent microscopic signs of pepper, pochechuynoy and avian mustard.
7. Features of harvesting, drying and storage of raw materials containing flavonoids. Measures for the protection of wild medicinal plants.
8. Ways of use and medical use of medicinal raw materials containing flavonoids.

Based on theoretical knowledge and practical work:

- master the techniques (be able to) (level of assimilation according to Bezpalk - III):
 - Identify on the external features of the plant (dog nettle five-bladed and heart, bitter pepper, pochechuyny and bird, three-part herd, wolf field) and distinguish them from possible impurities;
 - Determine identity and good quality of raw materials containing flavonoids, by external features, anatomical structure and qualitative reactions.

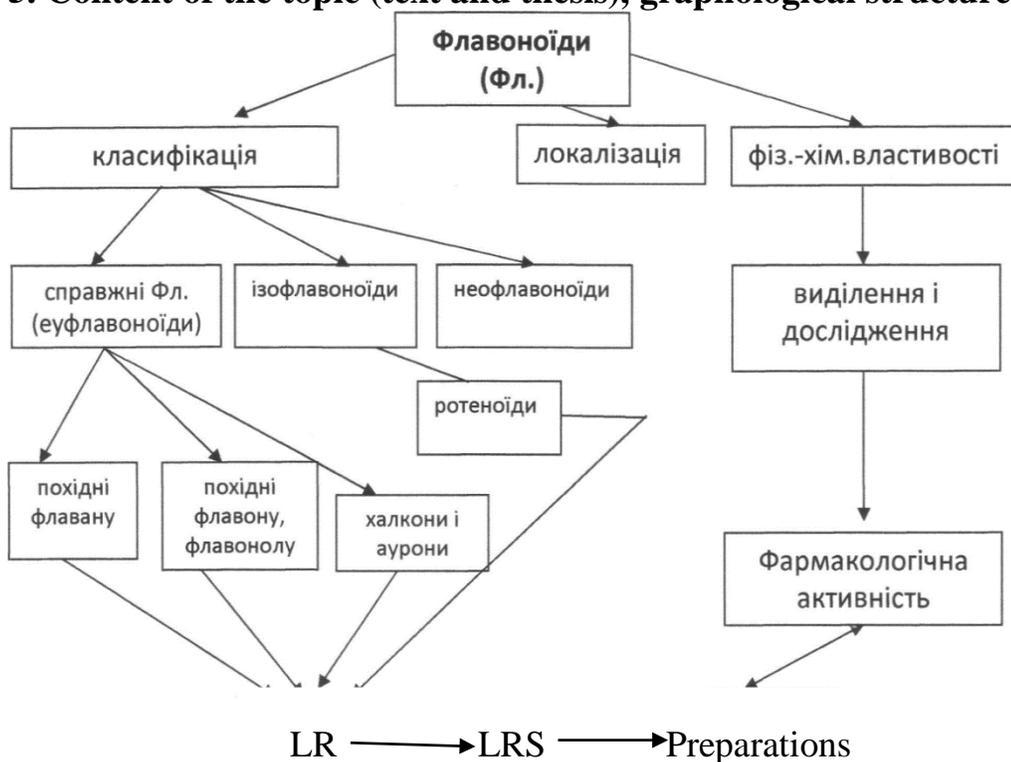
4. Interdisciplinary integration

№ p.p.	discipline	know	be able
1	2	3	4
1.	Previous disciplines: 1. Botany 2. Organic chemistry 3. Analytical 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. Methods of acid-base titration (neutralization) and permanganatometry	Use a microscope, prepare surface preparations and cross-sections. Carry out qualitative reactions; purification of organic compounds. 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.	

	<p>2. Pharmacy technology of drugs</p> <p>3. Industrial technology of medicines</p> <p>4. Clinical pharmacology</p> <p>5. Pharmaceutical chemistry</p>	<p>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 selection, evaluation of their effectiveness and safety.</p> <p>Methods of qualitative and quantitative study of drugs.</p> <p>Pharmaceutical service management. Storage of medicines. Control and analytical service, organization of its work. Accounting for inventory and cash. Economic analysis of the pharmacy.</p>	
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	<p>6. Organization and economics of pharmacy</p> <p>7. Management and marketing in pharmacy</p>	<p>Management and entrepreneurship. Organization as an object of management. Connecting processes in management. Human Resource Management. Pharmaceutical Marketing Management. Pharmaceutical market research. International marketing.</p>	
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5. Content of the topic (text and thesis), graphological structure of the lesson.



6. Plan and organizational structure of the lesson.

№№ р.р.	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	<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%
2	<i>The main stage</i> Conducting a practical lesson	III	Herbariums of medicinal plants, LRS, reagents		50%
3	<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. A batch of medicinal plant raw materials of a three-part herd of herbs arrived at the pharmacy warehouse. According to which indicator in accordance with the requirements of the Pharmacopoeia conduct an analysis of the content of active substances:

- A. Flavonoids
- B. Essential oil
- V. Saponin
- G. Anthracene derivatives
- D. Kumarinov

2. The pharmacy received a plan for the procurement of medicinal plant raw materials of the wolf. What part of this plant is used as LRS:

- A. Roots
- B. Letter
- B. Bulbs
- D. Seeds

D. Flowers

3. From the five-bladed dog nettle collected at the beginning of flowering and dried grass, a tincture and a thick extract are obtained, which are used as sedatives and antihypertensives. The content of the following active substances in the raw material is determined by the spectrophotometric method:

- A. Flavonoids
- B. Cardioglycosides
- V. Atropine
- G. Papaverine
- D. Cytisine

4. Mustard herb pochechuynogo is prescribed as a hemostatic agent. This raw material is temporarily absent in the pharmacy. What should replace the herb bitter gourd:

- A. Herba Polygoni hydropiperis
- B. Herba Leonuri
- B. Herba Origani
- G. Herba Chelidonii
- D. Herba Bidentis

5. For the industrial production of quercetin using medicinal plant raw materials:

- A. Fructus Sophorae japonicae
- B. Fructus Hippophaes rhamnoides
- B. Herba Origani
- G. Herba Chelidonii
- D. Herba Bidentis

6. For the purpose of complex use of lily of the valley herb, in addition to phytomedicines that contain cardiosteroids, also receive a substance (convaflavin), which has a choleric effect. Specify the BAR group that contains it:

- A. Flavonoids
- B. Coumarini
- B. Terpenoids
- G. Saponins
- D. Lignans

7. When developing analytical and regulatory documentation for a new type of plant material containing flavonols, the pharmacist should choose a reaction to confirm this class of compounds.

- A. Cyanidinova
- B. Wagner's reaction
- B. Dragendorff reaction

- G. reaction with methylene blue
- D. Lactone test

8. To identify the raw material to the infusion of dog nettle grass was added magnesium metal powder and concentrated hydrochloric acid. Formed a pink color, which indicates the presence of:

- A. Flavonoids
- B. Kumarinov
- B. Tannins
- G. Saponins
- D. Chromonov

9. To determine the identity of the bird's-foot grass to the aqueous extract was added an alcoholic solution of aluminum chloride. Observed a yellow-green color, which indicates the presence of:

- A. Flavonoids
- B. Anthracene derivatives
- B. Cardosteroids
- G. Phenoglycosides
- D. Saponin

10. Based on the amount of flavonoids of Keyske lily of the valley, get a drug that is used as a cholagogue. Name this drug:

- A. "Convaflavin"
- B. "Korglikon"
- B. "Cardiovalen"
- G. "Cordygit"
- D. "Cardiophyte"

Question:

1. Definition of "flavonoids", their classification.
2. Morphological characteristics of plants. Distinctive features of the species of bitter gourd used in folk medicine, and related species.
3. Features of harvesting, drying and storage of raw materials containing flavonoids and measures for the protection of wild medicinal plants.
4. Latin and Ukrainian names of raw materials, producing plants and families of all objects of the researched topic.
5. External signs of the studied types of medicinal plant raw materials.
6. Habitats and resources of the studied plants.
7. Excellent microscopic signs of pepper, pochechuynoy and avian mustard.
8. Ways of use and medical application of LRS containing flavonoids.

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 dog nettle and to carry out the analysis of raw materials on AND (sections: external signs and microscopy).

1. To study appearance of dog nettle five-bladed and related species: dog nettle bluish, dog nettle Tatar, dog nettle Siberian on herbarium specimens (Scheme 1).

Scheme 1:

DEFINITION PRODUCING PLANTS ON EXTERNAL SIGNS

- Vital form (herbaceous plant, shrub, tree).
- Type underground organs (root, rhizome, tuber, etc.)
- Building stems (shape, nature of branching, pubescence, diameter, etc.)
- Leaf arrangement (alternate, 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.).

2. Describe the appearance of grass on the example of a sample of raw materials (Scheme 2).

Scheme 2:

ANALYSIS OF RAW MATERIALS "GRASS" ON EXTERNAL SIGNS

- «Commodity type "of raw materials (whole, cut, threshed)
- Building stems (shape, branching, pubescence, color, size, specific features).
- Nature leaf arrangement (alternate, opposite, whorled).
- Leaves
- Location flowers on the stem.
- Flowers
- Fruits and seeds
- Dimensions stems, leaves, flowers.
- Color.
- Запах when rubbing.
- Taste (in non-toxic objects).

3. Prepare a micropreparation of dog nettle leaf from the surface and study it at low and high magnification (Scheme 3).

Scheme 3:

MICROSCOPIC ANALYSIS OF RAW MATERIALS "SHEETS"

- Structure (dorsiventral, isolateral)
- Mesophile (nature of palisade and spongy tissues).

- Inclusions are crystalline (single crystals, crystalline coating, friends, raffides, crystalline sand, cystolites); secretory (containers, milk vessels, canals).
- Epidermis of the upper and lower sides of the leaf (shape and contour of cells: isodiametric, rectangular, tortuous; type of respiratory system: diacytic, parasitic, anisocytic, anocytic; number and location of peritoneal cells).
- Trichomes type: hairs, glands.
- Cuticle: thin, thick, straight, folded, warty.

Draw and mark the diagnostic signs:

1. Cells epidermis with tortuous walls, especially on the underside;
 2. Breathe only on the underside, surrounded by 3-4 cells, rarely two;
 3. Ethereal oil glands on both sides of the leaf, rounded, consisting of 2-4-6, rarely 8 secretory cells;
 4. Hairs: multicellular, coarse-warty, expanded at the junction of cells; head with a rounded head on a single- or double-celled stalk.
4. Note the compliance of the test sample of raw materials (by external features) to the requirements of the AND.

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

1. To study the appearance of pepper bitter and possible impurities: soft bitter and small bitter on herbarium specimens (see Scheme 1). Write down the Latin and Ukrainian names of raw materials, plants and families.
2. Describe the appearance of peppermint grass on the example of a sample of raw materials (see Scheme 2).
3. Prepare a micropreparation of peppermint leaf from the surface, study it at low and high magnification (see Scheme 3).

Draw and mark diagnostic signs:

1. The cells of the upper epidermis are slightly tortuous, the lower - with strongly tortuous contours;
 2. The stomata on the underside of the leaf are numerous;
 3. Beam hairs only on the edge of the leaf;
 4. Small glands on both sides of the leaf, consisting of 2-4 cells;
 5. Large oval containers of brown color;
 6. Acute friends of calcium oxalate.
4. Note the compliance of the test sample of raw materials (by external signs and microscopy) to the requirements of the AND.

Task 3. To study bird's-foot trefoil and to carry out the analysis of raw materials on AND (section: external signs).

1. Examine the appearance of bird's-foot trefoil (knotweed) on herbarium specimens (see Scheme 1). Write down the Latin and Ukrainian names of raw materials, plants and families.

2. Describe the appearance of bird's-foot trefoil on the example of a sample of raw materials (see Scheme 2).
3. Note the compliance of the test sample of raw materials (by external features) to the requirements of the AND.

Task 4. To study a three-part herd and to carry out the analysis of raw materials on AND (sections: external signs, microscopy).

1. Examine the appearance of a herd of three-part and possible impurities: herds drooping, herds radiant, herds eastern on herbarium specimens (see Scheme 1). Write down the Latin and Ukrainian names of raw materials, plants and families.
2. Conduct a macroscopic analysis of the grass of the herd and describe its appearance on the example of a sample of raw materials (see Figure 2).
3. Prepare a micropreparation of a leaf of a herd of three parts from the surface and study it at low and high magnification (see Scheme 3).

Draw and mark diagnostic signs:

1. Epidermis with tortuous walls;
 2. Stomata on both sides of the leaf, surrounded by 3-5 cells of the epidermis (anocytic type of the respiratory tract);
 3. The cuticle is folded along the edge of the leaf and on the veins;
 4. Hairs: simple, multicellular with 9-12 (up to 16) thin-walled short cells, at the base of the hair is a large elongated cell with a folded cuticle. The hairs are inclined to the surface of the leaf and the shape resembles a caterpillar ("caterpillar" hairs);
 5. Larger simple thick-walled hairs with a multicellular basis, located in 2-3 rows, are found on the edge of the leaf and large veins; in the mesophyle, near the veins, there are secretory passages with brown content.
4. Note the compliance of the test sample of raw materials (by external signs and microscopy) to the requirements of AND.

Task 5. To study the field wolf and to carry out the analysis of raw materials on AND (sections: external signs, microscopy).

1. Examine the appearance of the field wolf on herbarium specimens (see Figure 1). Write down the Latin and Ukrainian names of the raw materials that produce the plant and the family.
2. Describe the appearance of the root of the field wolf on the example of a sample of raw materials (Scheme 4).

Scheme 4:

ANALYSIS OF RAW MATERIALS "UNDERGROUND ORGANS" BY EXTERNAL SIGNS

- Commodity type of raw material (whole, cut, cleaned or uncleaned)
- 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 conducting system (beam, beamless).
- Odor when scraping or wetting with water.
- Taste (in non-toxic objects).

3. Prepare a cross section of the root, study the micropreparation at low and high magnification (Scheme 5).

Scheme 5:

MICROSCOPIC ANALYSIS OF RAW MATERIALS "UNDERGROUND ORGANS"

- Building: primary, secondary (beam, beamless type).
- Covering fabric (plug, epidermis).
- Elements xylem, phloem (histological composition, location).
- Form and the structure of the core rays.
- Basic parenchyma (dense, loose, aerenchyma, etc.)
- Containers, milk vessels, secretory passages, etc.
- Crystalline inclusion
- Spare nutrients (starch, inulin)

Draw a general diagram of the structure of the root and mark the diagnostic signs:

1. Cortical layer multi-row, yellowish-gray;
2. Parenchyma cells are thin-walled, single-row;
3. Bast fibers arranged singly or in small groups;
4. Large crystals of calcium oxalate;
5. The cambium is pronounced;
6. Xylem, represented by vessels, tracheids, libriform and wood parenchyma;
7. The core rays are multi-row, their cells are large, radially elongated, with slightly thickened porous shells.

4. Carry out a histochemical reaction with concentrated sulfuric acid. The cells of the parenchyma of the primary cortex and core rays are colored pink-red (triterpene alcohol onocerin)

5. Note the compliance of the test sample of raw materials (by external signs and microscopy) to the requirements of AND.

Instructional materials for mastering professional skills:

and) get the necessary ARS

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

in) to conduct ARS training

d) to study the anatomical and diagnostic signs of the cortex

e) to study the anatomical and diagnostic features of roots and rhizomes

is) sketch observations and record in a laboratory journal

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

Question:

1. What types of mustard can be impurities in the grass of peppermint (water pepper)?
2. What is the difference between pepper inflorescences and many other species?
3. Why is this plant called "water pepper", or "bitter pepper"?
4. In nature, bitter gourd with dark anthocyanin spots on the leaves; are they stored in raw materials?
5. What are the external characteristics of bird's-foot trefoil grass?
6. What are the common microscopic characteristics of plants of the buckwheat family?
7. Which plant has the name "spore"?
8. What is the difference in the microscopic characteristics of bitter gourd, bird, pepper?
9. What parts of the plant are included in the raw materials of dog nettle?
10. What plants indicate GF XI as possible impurities in the grass dog nettle?
11. What producing plants are adopted GF XI for harvesting dog nettle grass?
12. On what external grounds can we judge the benignity of dog nettle grass?
13. What are the microscopic features of the leaf of dog nettle differs from the leaves of other members of the family Labiatae?
14. What is the raw material of the wolf, what are its external features?
15. What characterizes the root of the wolf under the microscope?
16. What are the external features of the raw materials of Baikal sagebrush?
17. What reactions can open flavonoids in medicinal raw materials?
18. What is the fluorescence of flavonoids in ultraviolet light?

Tests:

1. From the herb mountain pepper get a liquid extract and tincture, which are used as hemostatic agents. The good quality of this plant raw material is determined by the content of flavonoids using:

- A. chromatographic method
- B. method of biological standardization
- B. method of distillation with water
- G. spectrophotometric method
- D. permanganatometric method

2. St. John's wort comes to pharmacies and is processed to obtain antibacterial agents. The good quality of this plant material is determined by the content of the sum of flavonoids, which are determined by the strength

- A. spectrophotometric method
- B. chromatographic method
- B. method of acid-base titration
- G. permanganatometric method

D. method of distillation with water vapor

3. The drug "Silibor" and its foreign counterparts "Legalon" and "Carsil", being from the sum of flavalignans, have a hepatoprotective effect. The growing source of these drugs is:

- A. milk thistle seeds
- B. parsnip seeds
- B. fruits of Amma dental
- G. parsnips
- D. juniper berries

4. To determine the authenticity of the root of the field honeysuckle to obtain a profit-alcohol solution of aluminum chloride. Observed yellow-green coloration, which indicates the presence of raw materials:

- A. Flavonoids
- B. tannins
- V. Kumarinov
- G. Anthracene derivatives
- D. Saponin

5. Japanese sophora buds are an industrial source of rutin. What qualitative reaction should be carried out to detect this biologically active substance in medicinal raw materials:

- A. with metallic magnesium and concentrated hydrochloric acid
- B. with iron-ammonium yeast
- B. with picric acid
- G. with a solution of phosphoric-tungstic acid
- D. with a solution of iodine in potassium iodide

6. The plant received a batch of St. John's wort, which is used for the production of antimicrobial and anti-inflammatory drugs. Qualitative and quantitative analysis of this plant material is carried out on the content:

- A. Flavonoids
- B. Kumarinov
- B. tannins
- G. Phenolglycosides
- D. essential oils

7. The plant received a batch of roots of honeycomb used for the production of tincture. Quantitative standardization of these raw materials is carried out in terms of:

- A. Ononin
- B. Hyperoside

- B. Quercetin
- G. Rutin
- D. Alizarin

8. A batch of ARS grass of the Pochechuy mountaineer arrived at the pharmacy warehouse. According to which indicator, in accordance with the requirements of the Pharmacopoeia, an analysis is performed for the content of active substances:

- A. Flavonoids
- B. tannins
- B. Anthracene derivatives
- G. Saponins
- D. Iridoids

9. What biologically active substances of plant origin give a yellow-green color with an alcoholic solution of aluminum chloride:

- A. Flavonoids
- B. Saponins
- B. Polysaccharides
- G. Bitterness
- D. fatty oils

10. The liquid extract obtained from this ARS is used as a blood-restoring agent, mainly in gynecological practice. This extract is also part of the anti-hemorrhoidal candles "anesthesia". Vegetable raw materials for the production of these funds are:

- A. mountain pepper
- B. peppermint
- V. horsetail
- G. motherwort ordinary
- D. sage

9. Literature for students:

- *main*:

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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:

Quinones. Methods of qualitative and quantitative determination. LR and LRS, containing anthraquinones: buckthorn alder, laxative, rhubarb, Tangut, horse sorrel, aloe species, cassia sharp-leaved and narrow-leaved, madder, species of St. John's wort.

Methodical recommendations were made by



associate professor Boyko IA