ODESSA NATIONAL MEDICAL UNIVERSITY

Department of General and Clinical Pharmacology and Pharmacognosy

METHODICAL DEVELOPMENT OF THE LECTURE

Course: "Pharmacognosy"

Lecture № 10

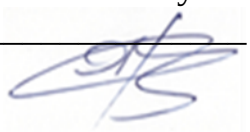
"Cardioglycosides. General characteristics Methods of qualitative and quantitative determination »

Course: 3rd Faculty: medico-pharmaceutical

The lecture was discussed
at the methodical meeting
departments
30.08.2024

Head department

MD, prof. JV Rozhkovsky



Odessa - 2024

Lecture № 10: «Cardioglycosides.General characteristics. Methods of qualitative and quantitative determination." (2 hours)

1. **Actuality of theme. Rationale for the topic.**

Cardioglycosides are triterpene organic compounds that have a steroid part in their structure, which makes them close to steroid saponins and hormones. The importance of this group of BAS is that they specifically act on the heart muscle, are still not synthesized, and modern individual drugs of this group are of plant origin. When studying the topic, special attention should be paid to the strong action of individual drugs-cardioglycosides and the toxicity of raw materials from which they are obtained, which requires appropriate precautions when working with raw materials, and also provides storage of most of its species on list B.

2. ***Objectives of the lecture***

-educational:

Define the concept: cardioglycosides (cardiosteroids);

To acquaint students with the chemical structure and classification of cardiac glycosides;

To form an idea of the connection of the chemical structure of cardioglycosides with their biological functions and pharmacological activity;

To acquaint with methods of research of chemical composition and quality of LRS and drugs of cardiotonic action;

Focus students' attention on measures to prevent poisoning when working with the appropriate LRS and when using drugs of cardiotonic action with this LRS;

To acquaint students with the modern range of cardiotonic drugs and the rules of their storage and release in pharmacies.

-educational:

Education of students' professional and personal responsibility for compliance with the conditions for storage of plant raw materials containing cardioglycosides, the rules of storage and release of appropriate drugs.

2. Plan and organizational structure of the lecture

№	The main stages of the lecture and their content	Goals in levels of abstraction	Type of lecture, lecture equipment	Time distribution
1	2	3	4	5
I. 1. 2.	**Preparatory stage** Defining a learning goal Providing positive motivation			5%

II. 3.	**The main stage** Teaching lecture material Plan: 1. Definitions. 2. Classification of cardioglycosides 3. Physico-chemical properties of cardioglycosides 4. Physico-chemical properties of cardioglycosides 5. The relationship of biological activity of cardioglycosides with their structure 6. Preparations of cardiotonic action and characteristics of the raw material base for its manufacture. 7. Methods of research of cardioglycosides (raw materials and preparations), safety precautions and storage conditions.	 I II II II I II-III II-III	Combined, tables, overhead projector, slides, LR herbariums, LRS samples, drugs	90%
III. 4. 5.	The final stage Summary of the lecture, general conclusions. Lecturer's answers to possible questions. Tasks for self-preparation		References, questions, tasks	5% 2% 2% 1%

3. **Contents of lecture material**

- **Structural and logical scheme of the content of the topic:**
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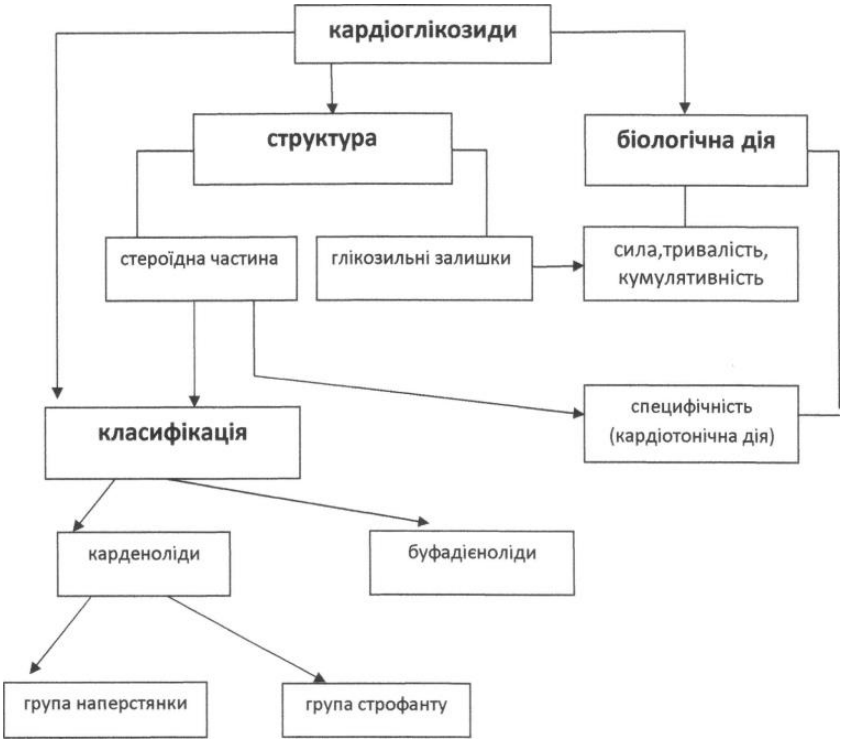


-text of the lecture

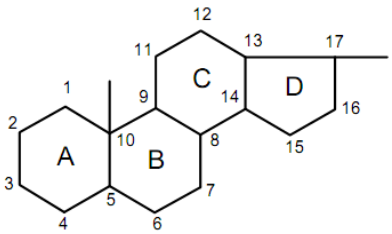
LECTURE TEXT
CARDIOGLYCOSIDES (CARDIOSTERIADI)

Glycosides are natural substances in the molecules of which the remnants of cyclic forms of sugars - glycosidic residues are connected through the O atom (C, S, N) with the main, active part of the molecule - aglycone. The most common in nature are O-glycosides.

Classification of O-glycosides:

Cyanoglycosides; cardiac glycosides; saponins; anthraglycosides; bitter glycosides..

Steroids (general formula: (C5H8) 6 - triterpenoids) - organic compounds of plant and animal origin, based on steran, or cyclopentaneperhydrophenanthrene::



Стеран

Depending on the nature of the substituents in C17 steroids are divided into: Sterols (cholesterol, ergo - and phytosterols), bile acids; steroid hormones; steroid sapogenins, cardiosteroids (gene of cardiac glycosides), steroid alkaloids (glycoalkaloids), ecdysteroids, vitanolides, etc..

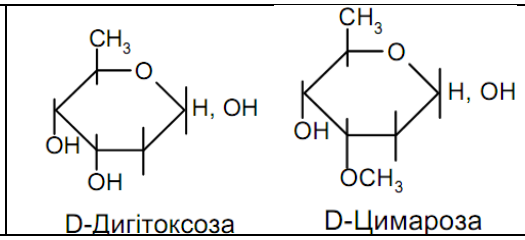
Cardiac glycosides are a large group of natural glycosides that selectively act on the heart muscle inthe basis of their aglycones is cyclopentaneperhydrophenanthrene.

Among natural glycosides (SG) occupy a special place because they have no synthetic analogues. Plants that contain SG, as well as the drugs derived from them are still the main tools in the treatment of cardiovascular failure. SGs have a specific effect on the heart muscle: in small doses increase its contraction, in large - on the contrary, suppress the heart until it stops. CNS in small doses of SG have a calming effect..

Structure and classification of cardiac glycosides

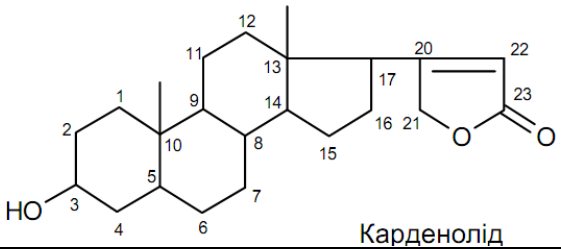
The steroid part of the SG molecule has a specific spatial orientation: the rings A \ B and C \ D - in the cis position, and the rings B \ C are in the trans position (in other steroids C \ D - in the trans position).

Glycosyl residues connected through the O atom to the steroid nucleus of the SG molecule are specificdeoxysugar:

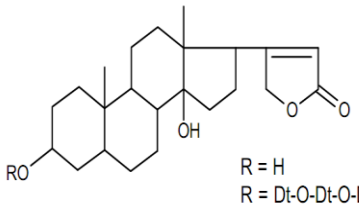
D-Digitoxose (Dt), D-Cymarosis (Cym), Oleandrosis, L-Rhamnose	 D-Дигітоксоза D-Цимароза

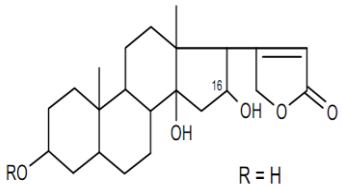
Classification of SG

Depending on the side chain in position C17 SG divided into 2 groups: Cardenolides - C17 - unsaturated 5-membered (butenolide) lactone ring

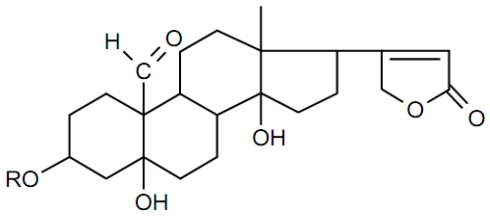

Карденолід

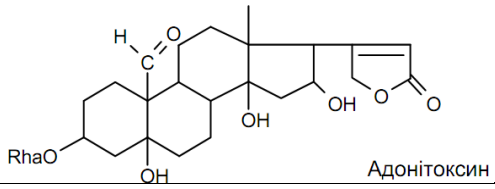
foxglove group - have several groups, sugar. remainderdigitoxosis


R = H — Дигітоксигенін
R = Dt-O-Dt-O-Dt — Дигітоксин
R = Dt-O-Dt-O-Dt-O-Glu — Пурпуреаглікозид А

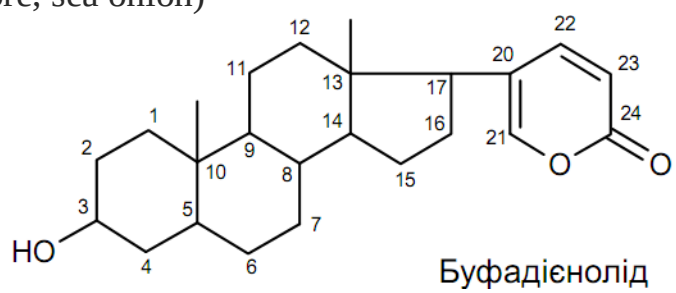

R = H — Гітоксигенін
R = Dt-O-Dt-ODt — Гітоксин
R = Dt-O-Dt-O-Dt-O-Glu — Пурпуреаглікозид В

strophanth group - have in addition to hydroxyl groups, aldehyde group SON in position C10, as well as the sugar residue of cimarose, rhamnose


R = H — К-строфантидин
R = Cym (цимароза) — Цимарин
R = Cym-O-β-Glu — К-строфантин-β
R = Cym-O-β-Glu-O-α-Glu — К-строфантозид


Адонітоксин

Bufadienolides – C17 - unsaturated 6-membered (coumalin) lactone ring (group of hellebore, sea onion)


Буфадієнолід

According to the number of monosaccharides in the chain in position C3 there are monosides (convalotoxin, erysimin, cimarin), biosides (k-strophanthin-β), triozides (digitoxin, digoxin), tetrazides (purpureaglycosides).
Biological activity is inherent in genin (aglycone), but sugars enhance the specific action of SG..

Distribution and localization of cardiac glycosides
In the world flora of 434 families of flowering plants SG found in 14 families. and 34 births. Most of these plants contain cardenolides, and only in plants sem. Onion, hyacinth, lily, iris, contain bufadieolides.
SG is localized in various organs - seeds (strophanthus), leaves (foxglove, oleander), stems, rhizomes, roots, bark (obvoynik)). Their content varies depending on the eco-conditions, the growing season, the drying process, etc.

Physico-chemical properties

Physico-chemical properties of SG - b / c or white, crystalline, less amorphous odorless substances, bitter in taste, have a certain melting point (100-2700), optically active, fluoresce a lot in UV light.
Most SGs are soluble in water, well - in aqueous solutions of methyl and ethyl alcohol. Glycosides with a long carbohydrate chain - better soluble in water and aqueous solutions of alcohols, aglycones - in organic solvents (chloroform, ether).
SG can be subjected to acid and enzymatic hydrolysis. In an alkaline environment, the aglycone part of the molecule is destroyed, which leads to a loss of cardiotonic action.

The mildest step splitting occurs during enzymatic hydrolysis. In this case, the secondary glycosides form secondary, differing in the length of the carbon chain. For example, the enzymatic hydrolysis of purpureaglycoside A first produces a digitoxin, then a digitoxygenin, and 3 digitoxose molecules. In acid hydrolysis, cleavage to aglycone and the sugar component occurs immediately..

Drying and storage

Raw materials containing SG are dried quickly at a temperature of 50-600 to minimize the action of enzymes. If you want to get secondary glycosides, they are dried slowly, 7-10 days at a temperature of 200. It is noted that at relatively low drying temperatures (candy, mustard) is the synthesis of K-strophanthin -β from cimarin and increases the number of native lanatosides in foxglove leaves woolly.
Store raw materials with care, according to list B (strophanthus seeds - according to list A), and pure glycosides (individual substances) - according to list A.
Once a year, raw materials and drugs are inspected, so the label must indicate the date of analysis and the number of units of action..

Methods of selection and research of SG

When isolating SG use organic solvents that do not cause their hydrolysis (ethyl, methyl alcohol). When isolating secondary glycosides - use enzymatic hydrolysis.
Stages of SG isolation: 1-extraction from raw materials; 2-cleaning of the obtained extract; 3 - division of the amount of SG, recrystallization and selection of individual SG..

Qualitative reactions:

1. Color reactions to the steroid nucleus:
- Lieberman-Buhard reaction
- Rosenheim's reaction

2. Color reactions to the lactone ring:

- Legal's reaction
-Raymond's reaction.
3. Reactions to the sugar component
- Keller-Kiliana reaction
-Reaction with Fehling's reagent.

Quantitative definition

Two groups of methods: biological and physicochemical. Biological methods are based on determining the biological activity of SG in laboratory animals: cats, frogs, pigeons. The quantity is determined in the corresponding units. actions: KED, ICE, GED. The unit of action is the smallest amount of the studied object (1 mg of the substance or 1 ml of extract from the plant), which causes systolic cardiac arrest in animals for 1 hour. This method is complex, time-consuming, not always available and has low accuracy (from 10 to 25%), but is indispensable in the analysis of galenic preparations and plant raw materials.

Physico-chemical methods:

Titrometry - used for SG with a carbonyl group. Polarographic; spectrophotometric; colorimetric; combined methods: chromatographic separation followed by spectrophotometric or colorimetric determination.

Biological action and use of SG

It is established that the nature and mechanism of action of different SG on the cardiovascular the system is generally the same, but each of them has some features: strength, duration and speed of action, cumulativeness, etc.
The cardiotonic effect of SG develops due to their direct action on the myocardium. Cardiosteroids change all its functions:

- increase heart rate (positive inotropic effect);
- enhance myocardial tone (positive tonotropic effect);
- reduce heart rate (negative chronotropic effect);
- increase myocardial excitability (positive bathotropic effect).

The first three effects occur in the range of therapeutic doses: they determine the main clinical value of SG. The latter effect contains signs of SG overdose and indicates their toxic effect on the myocardium.
Except cardiotonic action, SG have a cytostatic effect, have a calming effect on the central nervous system.
SG drugs are prescribed for chronic heart failure with circulatory disorders.

LR AND LRS, WHICH CONTAIN CARDIOGLYCOSIDES

-cardenolides:

Foxglove leaves –Folia Digitalis (D. purpurea, D. grandiflora, Scrophulariaceae)

Chemical composition: purpureaglycosides A, B, gitaloxygenin, gitaloxin, digitoxin, gitoxin; steroid saponins, flavonoids, aro.do-ti. Toxic! Sp.B! Ind. vykl.-sp.A! Action and drugs: cardiotonic. Ind. Glycosides - digitoxin, gitoxin; cleansing extract "cordygit", complete homeopathic off. "Pump".

Foxglove leaves woolly- Folia Digitalis lanatae (Digitalis lanata, Scroph.)

Chem. composition: lanatosides A, B, C, D, C; flavonoids, steroid saponins.

Action and drugs: cardiotonic. Ind.glycosides-digitoxin, digoxin, celanide (isolanide, lanatoside C; novogalen.excl.-alcohol.r-n amount of glycosides lanicor (lantoside). Toxic! Sp.B! Ind.glyc.

Seeds of strophanthus- Semina Strophanthi (Strophanthus Kombe, S.hispidus-bristle., S.gratus- attractive, Apocynaceae- angular) Homeland-East Africa, India-tropical forest

Chemical composition: K-strophantoside, K-strophanthin-β, cimarin, G-strophanthin (oubain); saponins, choline, enzymes, fatty oil.
Action and drugs: cardiotonic. A mixture of ser.gldyk. S. Combe - strophanthin K, oubain with S. attracts the imagination. –Strofantin G. Poisonous! Spa!

Spring mustard grass- Herba Adonidis vernalis (Adonis vernalis, Ranunc.)

Chemical composition: adonitoxin, cimarin, acetyladonitoxin, K-strophanthin-β, acetylstrofantogenin, verpadigenin; flavonoids, saponins, coumarins, alcohol adonite. Action and drugs: cardiotonic, sedative. Infusion, dry extract, novogalen.prep. Adoniside, complete use: cardiovalent, adonis-bromine, cardiophyte, Traskov's medicine. List B!!

Grass; Leaf; Lily of the valley flowers- Herba; Folia; Flores Convallariae (Convallaria majalis, Convallariaceae) Harvest: l.-to flowering, grass, tsv. During tsv., Drying-600 Toxic! Sp.B!

Chemical composition: convalotoxin, convalotoxol, convaloside; flavonoids, coumarins, terpenoids, steroid saponins.

Action and drugs: cardiotonic, choleretic, antispasmodic. Tincture, tincture of fresh herbs, sum.off. "Corglycon", a set of prep.

Jaundice grass –Herba Erysimi (Erysimum canescens = E.diffusum, Brassicaceae)

Chemical composition: eryzimin, eryzimoside, glucoerizimozid, neurotoxin, erychroside; flavonoids, fatty oil. Poisonous! Сп.Б! Drying-600.

Action and drugs: cardiotonic, diuretic, sedative. Jaundice liquid extract, ind. glycoside "Erichroside", comb. Cardiovalen.

Other LR and LRC, which contain SG cardenolides:

Caucasian species of foxglove: n. rusty, leaves (digilanides A and B = lanatosides A and B), n. ciliated, grass (lanatosides A, B, C, D, digitoxin, gitaloxin)

Caucasian lily of the valley, l.Keyske(along with May Day)

Oleander ordinary, leaves -Nerium oleander, Apocynaceae, (oleandrin = oleandrin preparation)

Greek obvoynik, bark –Periploca graeca, Asclepiadaceae-swallows (periplocin. PP periplocin, tincture)

Cannabis hemp, rhizome and roots - Apocynum cannabinum, Apocynaceae - mountains of North America, cult. in the USSR (cimarin, K-strophanthin-β, excl .: cimarin-insignificant cumulative action, expression of diuretic St.

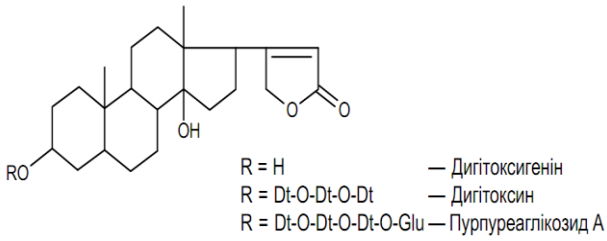
-bufadienolides:

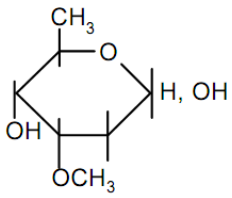
Rhizomes with hellebore roots- Rhizomata cum racidibus Hellebori (Helleborus purpurascens; H.caucasicum, Ranunculaceae). Drying air, shadow. Toxic! Sp.B!

Chemical composition: bufadienolides, the aglycone of which is hellebrigenin, corelborin; saponins.

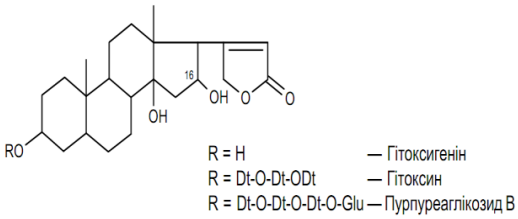
Action and drugs: cardiotonic. Ind.glycosides Corelblorin K, Corelborin P.

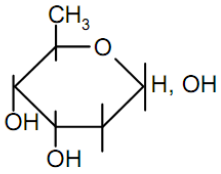
Sea onion bulbs- Bulbi Scillae (Scilla maritima, Liliaceae) grows wild in the coastal strip of the Mediterranean. Two varieties - white (honey target and red, bulb weight about 2 kg. Sp.B!
Chemical composition: white bulbs-10 bufadienolides - scillarenes; scillipicrin, polysach., e. m, containing sulfides.
Action and drugs: cardiotonic, diuretic, deratization. Water infusion..



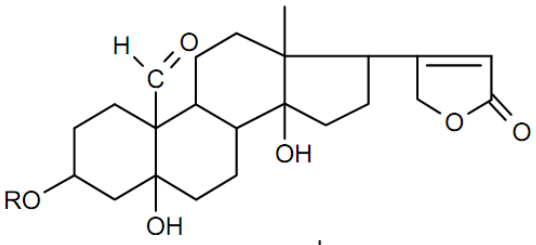


D-Цимароза

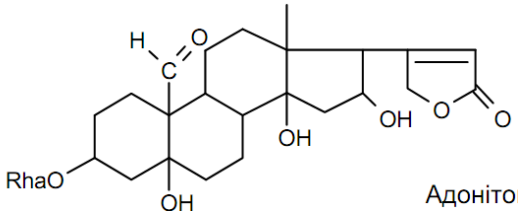




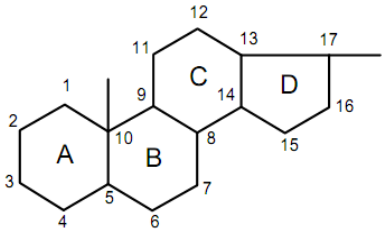
D-Дигітоксоза



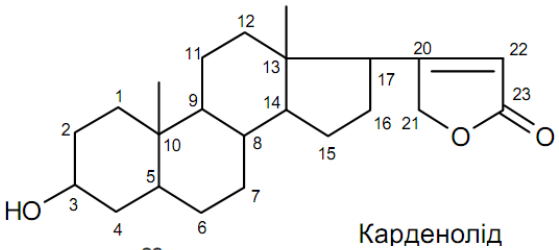
R = H — К-строфантидин
R = Cym (цимароза) — Цимарин
R = Cym-O-β-Glu — К-строфантин-β
R = Cym-O-β-Glu-O-α-Glu — К-строфантозид



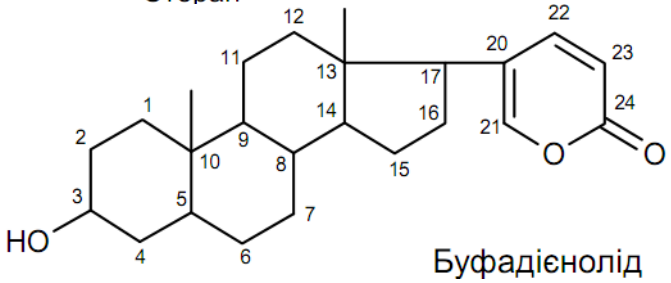
Адонітоксин



Стеран



Карденолід



Буфадієнолід

5. Materials on activating students during the lecture: Questions:

1. What does the word "cardio" mean in the name "cardiosteroids"?
2. What is the structural formula of cardioglycosides if they belong to triterpenoids?
3. Why are cardioglycosides also called cardiosteroids?
4. What do cardioglycosides and steroid saponins have in common?
5. What is the cardiotonic effect of cardiosteroids?
6. What plants do you know are used to improve heart function?
7. Whichdo you know "laboratory" animals?

Situational tasks:

1. Indicate the advantages and disadvantages of drugs of the group of foxglove and strophanthus.
2. Indicate which group of heart drugs will have the greatest cumulative effect.
3. Select the optimal drying temperature of foxglove leaves to preserve the primary glycosides.

6 General material and methodological support of the lecture:

- equipment: overhead projector (or multimedia projector), screen;
- illustrative materials: slides, herbariums of LR, samples of LS, packed up LRS, pharm. preparations.

7. **Materials for self-preparation of students:**

A) on the topic of the lecture Literature

main:

1. State Pharmacopoeia of Ukraine: in 3 volumes / State Enterprise "Ukrainian Scientific Pharmacopoeial Center for Quality of Medicines". - 2nd type. - Kharkiv: State Enterprise "Ukrainian Scientific Pharmacopoeial Center for Quality of Medicines", 2015. - Vol. 1. - 1500 p.
2. European Pharmacopoeia. - 8th ed .; - Druckerei CH Beck, Nordlingen (Germany), 2013.- 3655 p.
3. Workshop on the identification of medicinal plant materials: textbook. way. / [B. M. Kovalev, SM Marchyshyn, OP Khvorost and others]; for order. VM Kovaleva, SM Marchishin. - Ternopil: TSMU, 2014. - 250 p.
4. Pharmacognosy: a basic textbook. for students. higher pharmacy. textbook zakl. (pharmac. f-tiv) IV level of accreditation / V.S. Кисличенко, I.O. Журавель, C.M. Marchyshyn and others; for order. V.S. Кисличенко. - Kharkiv: NUPh: Golden Pages, 2015. - 736 p.
5. Medicinal plant raw materials and phytomedicines under Society. ed. Wednesday PI, Kiev, VSI "Medicine", 2010
6. Pharmacognosy. Medicinal raw materials of plant and animal origin. Ed. Яковлева Г.П. St. Petersburg, Spetslit 2013
7. Pharmacognosy: a textbook (University of I-III years) / VP Khodakivska, IA Бобкова, Л.В. ВарлаховаAll-Ukrainian specialized publishing house "Medicine" 2018.
8. Pharmacognosy: textbook (I-III years) / I.A. Бобкова, Л.В. Варлахова. - 3rd edition All-Ukrainian specialized publishing house "Medicine" 2018, 504p.
9. Pharmacognosy with the basics of phytotherapy A. Pastushenkov, N. Bespalova Phoenix Publishing House 2016.

Question

1. Definitions of "cardioglycosides", "cardiosteroids".

2. Classification of cardioglycosides.
3. Distribution of glycosides in the plant world.
4. Ways of use and application in medicine of raw materials that contain cardioglycosides -cardenolides and cardioglycosides-bufadienolides.
5. What is "biological standardization", what are the units of action?
6. Features of drying, storage and processing of raw materials containing cardiac glycosides.

Test and situational tasks

1. Which of the conditions helps to restore the action of enzymes during storage of glycosidic raw materials:
A. Moisture
B. Low temperatures
C. Darkness
D. High temperatures
D. Light

2. At what temperature should be dried raw materials (leaves) of foxglove to avoid loss of glycosides:
A.50-60 ° C
B. 40-50 ° C
B. 35-40 ° C
G. 25-30 ° C
D. 100 ° C

3. Establishment of benign lily of the valley leaves is carried out on the quantitative content of cardiac glycosides. To do this, use the method:
A. Biological standardization
B. Chromatographic analysis
C. Gravimetric analysis
D. Back titration method
E. Distillation with steam

4. Herbal drug "Cardiovalen" is used as a cardiotonic agent. The herbal source of this remedy is:
A. Jaundice grass
B. Lily of the valley leaf
C. Lily of the valley grass
D. Leaf of foxglove
E. Large foxglove leaf

2.Which of the plants is the raw material for the production of drugs used in the treatment of heart failure:
A. *Herba Adonidis*
B. *Herba Hyperici*
C. *Herba Belladonnae*
D. *Herba Bursae pastoris*
E. *Herba Thymi serpylli*

6. In which of these drugs cardiac glycosides accumulate mainly in the cortex?
A. Greek upholsterer
B. Strophant
C. Oleander
D. Hellebore
E. Hemp cutter

2. Cardiac glycosides-cardenolides are contained in:
A. Spring mustard grass
B. Letters of mother-and-stepmother
C. Plantain leaves
D. Rhizomes with hellebore roots
E. Letters bought medicinal

8. Cardiac glycosides-bufadienolides are contained in:
A. Rhizomes with hellebore roots
B. Mustard grass
C. Leaves of foxglove woolly
D. Spring mustard grass
E. Rhizomes with valerian roots

9. The principle of the method of biological standardization of cardiosteroids is based on the ability to:
A. Cause cardiac arrest
B. Precipitate erythrocytes
C. Have a hypnotic effect
D. Induce respiratory arrest
E. To have a narcotic effect

10. Write the formulas of the primary glycosides of foxglove; adonitoxin; K-strophanthin β.
11. Find out which types of plant raw materials containing cardiosteroids are included in HFC-1.2, HFC-I.Z.
12. List the plants that contain cardioglycosides and whose inflorescence is a one-sided brush. Which of these plants grow wild in Ukraine?
13. Give a comparative morphological characteristics of spring and Volga mustard. Why are the raw materials of mustard seeds not harvested in Ukraine now?

B) **on the topic of the next lecture (Phenolic compounds. Simple phenols and their derivatives)**

literature

main:

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

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5. 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.
6. Додаткова література:
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8. 2. Сербін А.Г., Сіра Л.М., Слободянюк Т.О. Фармацевтична ботаніка. Підручник. – Вінниця: НОВА КНИГА, 2007. – 488 с.
9. 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.

Question

1. Give a general description, give the classification of phenolic compounds.
2. What are "simple phenols"; "Polyphenols", "polymeric phenols"?
3. Distribution of simple phenols and their glycosides in the plant world.
4. Ways of use and application in medicine of raw materials containing phenolglycosides, phenol alcohols.
5. Features of drying, storage and processing of raw materials containing derivatives of simple phenols.
6. Features of harvesting LRS bearberry and cranberry.

Test tasks

1. What is the main aglycone contained in phenol glycosides:
A. Arbutin
B. Ant aldehyde
B. Vinyl alcohol
D. Acetic acid
D. 1,2-cyclopentaneperhydrophenanthrene

2. Which vegetable raw material contains phenolic compounds with one aromatic ring:
A. Cranberry leaves
B. Marigold flowers
B. Valerian root
G. Marshmallow root
D. Plantain grass

3. Specify biologically active substances, which in their structure contain aromatic rings from the hydroxyl group and their functional derivatives:
A. Phenolic combinations

B. Monosaccharides
B. Lipoids
G. Polysaccharides
D. Fatty oils

4. Chromatographic analysis is a specific method of determining the reliability of LRS and phytopreparations. To identify individual substances in chromatographic analysis determine:
A. The magnitude of Rf
B. The angle of refraction
B. Melting point
D. Boiling point
D. Angle of rotation

5. Which LRS contains arbutin:
A. Leaves of okra
B. Blueberry leaves
B. Birch leaves
G. Birch buds
D. Blueberry fruits

6. Preparations of a plant containing phenolic compounds used as stimulants for fatigue and hypotension:
A. Rhodiola rosea
B. Sea buckthorn buckthorn
V. Raspberry
G. Yellow cat
D. Devyasil is tall

7. What biologically active substances give a positive reaction with solutions of iron-ammonium alum in the chemical analysis of aqueous extract from bearberry leaves::
A. Phenolglycosides
B. Bitterness
B. Tannins
D. Essential oils
D. Polysaccharides

8. The first phenol glycoside isolated by the French scientist Leroy from willow bark was::
A. Salicin
B. Floroglucin
V. Arbutin
G. Rhodioloside
D. Echinacoside

9. From the rhizome of which LR receive crude filicin ", understanding it as the amount of phloroglucides::

A. Dryopteris male
B. Valerian medicinal
B. Lapchatka erect
G. Devyasil is tall
D. Air marsh

10. Simple phenols and their glycosides (individual substances) are
A. Crystalline substances
B. Oily liquids
B. Volatile liquids
D. Amorphous substances
D. Gaseous substances

8. Literature used by the lecturer to prepare the lecture

- additional

1. Фармакогнозія: підручник (I—III р. а.) / І.А. Бобкова, Л.В. Варлахова. – 3-є видання Всеукраїнське спеціалізоване видавництво «Медицина» 2018, 504с.
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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.
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11. Pharmacognosy with the basics of phytotherapy A. Pastushenkov, N. Bespalova Phoenix Publishing House 2016.

The lecture was composed by _____ MD, Professor Ya.V. Rozhkovsky