

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

METHODICAL DEVELOPMENT OF THE LECTURE

Course: "Pharmacognosy"

Lecture № 2

“Carbohydrates. Glycosides. General characteristics. Chemical analysis of LRS.
Starch and its derivatives, inulin, pectin, gums. »

Course: 3rd Faculty: medico-pharmaceutical

The lecture was discussed
at the methodical meeting
departments

August 30, 2024

Protocol № 1

Head of the Department _____

prof. Rozhkovsky Ya.V.



Lecture № 2: «Carbohydrates. Glycosides. General characteristics. Chemical analysis of LRS. Starch and its derivatives, inulin, pectin, gums»(1 year)

1. Actuality of theme. Rationale for the topic.

The study of plant sources of starch, inulin, mucus, gum, pectin, drugs that have anti-inflammatory, enveloping, expectorant pharmacological action is relevant for future pharmacists.

Polysaccharides represent high molecular weight polycondensation products of monosaccharides linked to each other by glycosidic bonds and which form linear or branched chains. They make up most of the dry matter of higher plants and algae and are the most common organic compounds in the soil.

Mucaltin, plantaglucid, laminaride are successfully used in medical practice. For the practical activities of the pharmacist requires knowledge of procurement, analysis of LRS, which contain polysaccharides.

2. Objectives of the lecture:

-educational - to form students' knowledge:

- the concept of polysaccharides, their classification,
- Physico-chemical and biological properties,
- Phytopreparations containing polysaccharides,
- starchy plants,
- gummy plants,
- mucous plants.

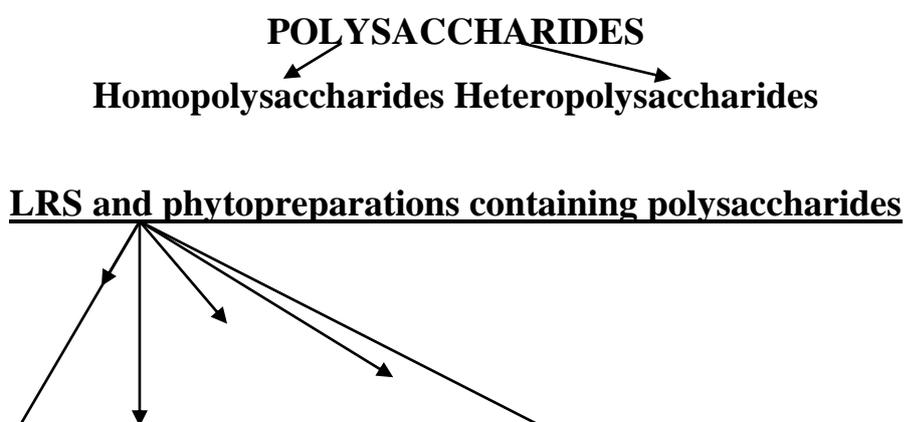
-educational: the lecture promotes the formation of modern professional thinking, the material of the topic develops a sense of responsibility for the use of LRS.

3. Plan and organizational structure of the lecture.

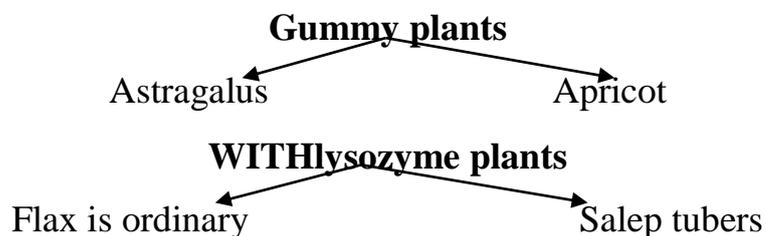
№	The main stages of the lecture	Goals in accreditation levels	Type of lecture, equipment of the lecture	Time distribution
1	2	3	4	5
1.	Preparatory stage Defining educational goals.		Combined,	1%
2.	Providing positive motivation		tables,	2%
	The main stage Presentation of lecture material.		herbariums,	
3.	Plan: 1. Pnotion of polysaccharides, their classification	I	LRS, drugs	90%
	2. Physico-chemical and biological properties	II		
	3. Phytopreparations containing polysaccharides.	III	List of references	
	4. Kdeciduous plantsand.	II		
	5. Kamedo-bearing plantsand	I		
	6. Clysozyme plants.			
	The final stage Lecture summary, general conclusions. Lecturer's answers to possible questions. Tasks for student self-preparation.			2%
4.				2%
				3%

4. Content of lecture material:

- structural and logical scheme



- Marshmallow root
- Althaea grass,
- plantain flea herb (plantaglucid)
- Mother and stepmother
- Seaweed (Laminarid, Spirulina).
- Grass herds (Elekasol, Brusniver)



- **the text of the lecture is attached.**

5. Materials for activating students during the lecture/ questions, tasks, problem situations and more /.

1. Definition of "polysaccharides", their classification.
2. Plants rich in polysaccharides.
3. Features of harvesting, drying and storage of raw materials containing polysaccharides.
4. Chemical structure of polysaccharides and their classification.
5. Physico-chemical properties of polysaccharides.
6. The main reactions to mucus.
7. Latin and Ukrainian names of raw materials, plants and families of all objects of the topic under study.
8. Morphological characteristics of plants, their habitats (areas of cultivation), habitats.
9. External signs of the types of medicinal plant raw materials that are studied in this topic.
10. Possible impurities in raw materials (marshmallow, plantain, mother-and-stepmother), and their main differences.
11. The main anatomical diagnostic features of marshmallow root and plantain leaves.

12. Reactions to woody elements of marshmallow root.
13. Chemical composition, ways of use and medical application of medicinal plant raw materials containing polysaccharides.
14. Phytopreparations based on polysaccharides produced by the medical industry.

Problem situations in the form of tests:

1. LRS powder can be used as a laxative, especially in the elderly
 - A. sugar kelp
 - B. nightshade grass
 - B. roots of Rauwolfia snake
 - G. marigold flowers
 - D. rowan fruit

2. Which plant powder is used in atherosclerosis and for the treatment of goiter (presence of iodine):
 - A. sugar kelp
 - B. parsnip fruit
 - B. dill fruit
 - G. gentian roots
 - D. tansy flowers

3. Name the plant that secretes gum:
 - A. Apricot usual
 - B. Eucalyptus ordinary
 - B. bird cherry
 - G. juniper
 - D. sea buckthorn buckthorn is visible

4. Name the plant that is the raw material for the drug "Mukaltin"

- A. althaea medicinal
- B. marigold flowers
- B. nightshade grass
- G. gentian roots
- D. apricot ordinary

5. Roots,, which plants are washed quickly to prevent slipping, cut into pieces 10-25 cm, and then clean the plugs with knives and immediately dry:

- A. marshmallow roots
- B. valerian roots
- B. burdock roots
- G. ginseng roots
- D. roots of Manchurian aralia

6. The roots of a plant have a therapeutic effect due to mucus, which protects the nerve endings of the gastrointestinal mucosa from the irritating effects of other substances

- A. marshmallow roots
- B. valerian roots
- B. burdock roots
- G. ginseng roots
- D. roots of Manchurian aralia

7. From the roots of which plants make an infusion of cold water (1:10)

- A. marshmallow roots
- B. calamus roots
- B. burdock roots
- G. valerian roots
- D. dandelion roots

8. The roots of which plant is used as an anti-inflammatory and enveloping agent, mainly in diseases of the respiratory tract:

- A. marshmallow roots
- B. roots of Rauwolfia snake
- B. the roots of the wolf
- G. licorice roots
- D. roots of Manchurian aralia

9. A batch of medicinal plant raw materials of plantain leaves 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. polysaccharides
- B. flavonoids
- B. tannins
- G. Anthracene derivatives
- D. essential oil

10. Preparations from the roots of marshmallow are used to treat diseases of the upper respiratory tract. When procuring these raw materials, the impurity may be:

- A. Hutma of Thuringia
- B. plantain is large
- B. tansy usual
- G. chicory usual
- D. dandelion

6. **General material and methodological support of the lecture:**

- *equipment: overhead projector, codegrams, slides, tables;*
- *illustrative materials - herbariums, LRS.*

7. Materials for self-preparation of students:

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

Task: Describe workbook for practical classes possible impurities in raw materials (marshmallow, plantain, mother-and-stepmother), and their main differences.

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

Medicinal plants and raw materials that contain fats.

1. Definition of "lipids".
2. Distribution of fats in the plant world and resources of raw materials studied.
3. Morphological characteristics of plants that contain lipids, their ranges (areas of cultivation), habitats.
4. Measures for the protection and rational use of medicinal plants that contain lipids.
5. What factors affect the process of formation and accumulation of fats in plants.
6. Name the chemical process of fat spoilage during storage in adverse conditions and what indicators characterize this process.
7. Ways of use and medical application of LRS, which contains lipids.
8. Name the climatic factors that significantly affect the efficiency of oil formation.

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

Basic literature

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

2. Фармакогнозія: базовий підручн. для студ. вищ. фармац. навч. закл.(фармац. ф-тів) IV рівня акредитації / В.С. Кисличенко, І.О. Журавель, С.М. Марчишин та ін.; за ред. В.С. Кисличенко. – Харків: НФаУ: Золоті сторінки, 2015. - 736 с.
3. Навчальний посібник з дисципліни «Фармакогнозія» / Я. В. Рожковський, Б. В. Приступа, І. А. Бойко, Н. В. Герасимюк, В. В. Черногорюк -: Методична розробка кафедри фармакогнозії ОНМедУ. – Одеса: ОНМедУ, 2019 – 51 с.
4. Державна Фармакопея України: в 3 т. / Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Харків: Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2015. – Т. 1. – 1500 с.

Additional literature:

- 1 Державна Фармакопея України: в 3 т. / Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів». – 2-е вид. – Харків: Державне підприємство «Український науковий фармакопейний центр якості лікарських засобів», 2014. – Т. 3. – 732 с.
2. Практикум з ідентифікації лікарської рослинної сировини: навч. посіб. / [В. М. Ковальов, С. М. Марчишин, О. П. Хворост та ін.] ; за ред. В. М. Ковальова, С. М. Марчишин. – Тернопіль: ТДМУ, 2014. – 250 с.



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

LECTURE TEXT

CARBOHYDRATES - organic substances consisting of carbon, oxygen and hydrogen, the ratio of hydrogen and oxygen is mostly the same as that of water, hence the general formula $C_m (H_{2O})_n$.

General scheme of carbohydrates:

Carbohydrates

<p>Monosaccharides By the number of C atoms (3-9): (Trio); tetr-; pent-; (Hex) oz, heptoses. Examples: glucose, fructose</p> <p>Derivatives of monosaccharides: Deoxysaccharides, uronic acids, aminosaccharides</p>	<p>Oligosaccharides By the number of monosaccharide residues (2-5 (10): (di) saccharides, tri-, tetra-, pentasaccharides. Examples: sucrose, lactose.</p>	<p>Polysaccharides natural polymeric high molecular weight carbohydrates constructed from monosaccharides linked by glycosidic bonds. General formula: $(C_n H_{2n-2O_{n-1}})_m$</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; padding: 5px;"> <p>homo-polysaccharides Zamonosah. leave: (glitch) ani; fruit-; galactic; mann-; xyl-; Arabic-; polyuronides etc.</p> </td> <td style="width: 50%; border: none; padding: 5px;"> <p>hetero-polysaccharide. For chem. and phys. properties Excluding chemical structure: gum. mucus, pectin substances</p> </td> </tr> </table>	<p>homo-polysaccharides Zamonosah. leave: (glitch) ani; fruit-; galactic; mann-; xyl-; Arabic-; polyuronides etc.</p>	<p>hetero-polysaccharide. For chem. and phys. properties Excluding chemical structure: gum. mucus, pectin substances</p>
<p>homo-polysaccharides Zamonosah. leave: (glitch) ani; fruit-; galactic; mann-; xyl-; Arabic-; polyuronides etc.</p>	<p>hetero-polysaccharide. For chem. and phys. properties Excluding chemical structure: gum. mucus, pectin substances</p>			

Polysaccharides can be connected by covalent bonds with other natural polymers of protein or lipid nature, forming mixed polysaccharides.

Examples of polysaccharide classification:

Glucans: amylose, amylopectin (starch mixture), glycogen, cellulose, etc.

Polyuronides: galacturonans-pectin substances, mannuronans-alginic acid

Polysaccharides also include chitin and mucopolysaccharides.

Distribution and biological functions

U. and P. are part of the tissues of all living organisms.

According to their physiological role in the life of plants (animals) carbohydrates are divided into:

- Metabolites - mono- and oligosaccharides that participate in biochemical processes and serve as starting materials for secondary synthesis (eg, glycosides);
- spare substances - polysaccharides that perform a reserve function (starch, inulin, pectin, sometimes mono- and oligosaccharides);
- structural or skeletal substances - cellulose and hemicellulose, which are the main supporting material of the plant cell.

Biological functions of polysaccharides:

1. Energy - energy reserve of the cell (starch, glycogen, inulin, laminarin, some mucus, etc.);
2. Protective - capsular polysaccharides of microorganisms, hyaluronic acid and heparin - in animal tissues, gum - in plants;
3. Maintenance of water balance - due to the colloidal ionic properties of mucus, pectin, algae polysaccharides, as well as selective ionic permeability of cells;
4. Providing specific intercellular interactions and immunological reactions - cell surfaces and membranes formed by complex polysaccharides; glycolipids (mixed polysaccharides) - the most important components of the membranes of the nerve cell membranes of erythrocytes; carbohydrates of cell surfaces often cause the interaction of cells with viruses, etc.

Procurement and storage of LRS containing polysaccharides

Such LRS is harvested during the period of the greatest accumulation of BAR.

For spare glycans, this is the end of the growing season and the period of extinction (roots, tubers, grains, seeds).

For hemicellulose, pectin (herbs, leaves, flowers, fruits) - summer.

The collection is carried out in dry weather to avoid slipping of raw materials containing mucus in the epidermal cells.

The roots are washed in running water, dried and dried quickly at 50-600.

High drying temperatures can lead to gelatinization of starch or caramelization of sugars.

Raw materials that contain carbohydrates should be stored in dry, well-ventilated rooms, as high humidity and carbohydrate substrate are a good environment for mold growth.

Physico-chemical properties

Amorphous, rarely crystalline, high-molecular-weight compounds with a molecular weight of 2,000 to several million.

As a rule, natural polysaccharides are a mixture of polymer homologues. They easily form intermolecular bonds. P. molecules are highly polar due to the large number of free hydroxyl groups. Due to this, they are insoluble in alcohol and non-polar organic solvents.

The solubility in water is different. Most parasites dissolve in hot water to one degree or another. P. dissolve better in an alkaline than in an acidic or neutral medium.

Insoluble -Cellulose, chitin (linear polymers with high molecular weight, which form strong supramolecular bonds), amylopectin (branched structure of the molecule)

Soluble (in hot water) - glycogen, dextrans, inulin

They swell- starch

Form peculiar solutions, such as colloidal (gels) - mucus, pectin, alginates, agar-agar, gums.

P. solutions are optically active.

Treatment of P. with acids causes their depolarization. Under the influence of dilute or concentrated acids, glycosidic bonds are partially or completely cleaved in the formation of mono- or oligosaccharides, and sometimes they can precipitate.

P. are able to form complexes with metals and low molecular weight organic compounds. These properties, as well as the ability to hold more water, give P. important biological properties of enterosorbents and detoxifiers.

Methods of selection and research

P. is most often isolated from pre-crushed and purified raw materials with hot water. Dialysis, precipitation with alcohol (95%) or Quaternary ammonium bases, ultrafiltration, fermentolysis, etc. are used to purify the extract.

The study of the structure includes the determination of the molar mass, monosaccharide residue, the nature of the relationships between monosaccharide residues, the type of branching of the molecule. The methods of chromatography, spectroscopy, immunochemical reactions, etc. are used.

Qualitative reaction to homopolysaccharides (starch): with iodine solution (Lugol's solution) - blue color, which fades when heated and disappears at 1000, and after cooling - reappears. Note: Amylopectin starch with iodine solution gives a red-violet color.

Qualitative reaction to inulin: with 20% solution of β -naphthol and concentrated sulfuric acid (Fehling's reagent) - red-violet or orange-red color.

Mucus is identified by: methylene blue - a blue color is formed; solutions of alkalis, ammonia - yellow; carcasses - mucus does not stain.

The amount of paraffin in raw materials is determined by the weight method after their precipitation from aqueous solutions.

Biological action and use

P. are used as independent medicines and as an auxiliary material in the technology of drug preparation.

Mono-, oligo- and polysaccharides are used as fillers, binders, disintegrants, correcting substances in the production of complex powders, tablets, granules, etc. For example, starch (varieties: potato, wheat, corn, rice; structure: starch grains, their form, amylose and amylopectin, obtaining soluble starch when heated with glycerol at 90°C or hydrolysis of 7% hydrogen chloride to-y);

Gum is used as an emulsifier and thickener.

Cellulose (fiber) (linear structure of glucopyranose residues; sources - wood, grass, cotton); from cotton - the basis for the production of cotton wool, bandages. After acid hydrolysis of cellulose, a microcrystalline compound is obtained, which is used as a filler in the pharmaceutical industry.

Fructans (including inulin) are used to produce fructose.

Inulin (formula on the slide) is used in therapeutic and prophylactic nutrition in dietary supplements to normalize carbohydrate metabolism, increase the number of bifidobacteria in the intestine, as well as an immunomodulator and enterosorbent.

Pectin is used to prolong the action of the main substance and as an additive that reduces the side effects of chemotherapeutic substances.

The concept of "dietary fiber" combines cellulose, hemicellulose, gums, mucus, pectin, spare polysaccharides, polyphenolic polymer lignin. Pectic substances are able to bind radionuclides, heavy metals (as an enterosorbent), improve digestion, reduce inflammation in the digestive system, normalize the motor function of the intestine - are used as part of dietary supplements.

Total polysaccharide drugs are used: mucaltin (from marshmallow herb), plantaglucid, plantain juice (from plantain leaves), laminaride, algigel, ointment algofin (from kelp), camilazide (from chamomile), as well as drugs which have enveloping (protective), anti-inflammatory, emollient, expectorant, antiulcer, reparative, etc. types of action.

Polysaccharides, especially from plants seven. Aster, legumes, cuttings, root, affect some parts of the immune system (immune -from grass, prostonorm - extract of org. Echinacea), inhibit the growth of tumor cells, normalize metabolism (Liv-52, Gastrovitol - chicory roots).

Heteropolysaccharides

GUM(Rubber). Constructed of neutral monosaccharides and hexuronic acids, the cations of which are calcium and magnesium. These are protective P. formed in plants as a result of mucosal cell degeneration. Mass mucus - in woody plants, in case of injury (apricots, cherries) - harden in the air in the form of transparent pieces. The yield of gum increases with the age of the tree.

K. - tasteless, insoluble in fatty oils, alcohol, ether, etc. org. solvents. When burning K., you can smell burnt paper.

According to the solubility in water, K. is divided into:

- Soluble in cold water - called. Arabic, (Arabian gum arabic and apricot gum). Arabian gum - from the African species of acacia-A. senegal; apricot gum - from the apricot tree -Armeniaca vulgaris

-Slightly soluble, but highly swollen - called. Bassorin (tragacanth). Of the species of tragacanth astragalus - A.gummifer

- Insoluble in cold water and do not swell when heated - called. Caesarins (cherry gum) - almost not used in pharmacy.

Very often gums are mixed with resins (gums), essential oils (aromatic gums), tannins (tannins)

MUCK (Mucilaginis) is a mixture of homo - and heteropolysaccharides, which are formed in plants as products of normal metabolism and serve as a food reserve or substances that retain water, especially in succulents.

By origin S .:

- Formed by mucous degeneration of cell walls;
- Formed by slipping of living cells;

- Mucus of algae;

- Bacterial mucus

By being in the tissues of S .:

- Intercellular (in the epidermis of flax seeds, plantain);

- Intracellular (in the parenchyma of roots, marshmallow leaves, mother-and-stepmother leaves, bark and wood of fruit trees)

- Membrane (kelp and other algae).

S. have the properties of hydrophilic colloids - have high viscosity, swelling. Is a good environment for microorganisms. They have a limited shelf life and therefore mucus preparations are prepared extemporaneously.

S. are used in medicine as enveloping and emollients. Contained in the roots and grass of marshmallow, flax seeds, plantain, mother-and-stepmother leaves, linden flowers, wild flowers, chamomile, kelp and other brown algae.

PECTIN SUBSTANCES (pectins) are polyuronides (polygalacturonase formula - on the slide), widely distributed in higher plants and algae, contained in cell walls, fruit juices and roots.

Insoluble pectin -name. protopectins. After treatment with acids, water-soluble pectic acids are formed, the salts of which are called pectinates.

Amorphous powders are white or yellowish in powder, almost odorless, poorly soluble in cold water, and form colloidal solutions when heated. Insoluble in organic solvents, have optical activity. In the presence of sugars and acids form wells.

In its pure form, pectin is obtained from squeezed apples and dried beet pulp. It contains a large amount of raspberries, cranberries, red currants, dogwood.

LRS mother-and-stepmother, linden, plantain contain a mixture of pectin and mucus.

Alginate groups are found in kelp. P. have hemostatic and antiulcer effects, lower blood cholesterol levels, affect the metabolism of bile acids, reduce the

toxicity of antibiotics and prolong their action, promote the binding and excretion of radionuclides and chemical poisons.