

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

METHODICAL DEVELOPMENT OF THE LECTURE

Course: "Pharmacognosy"

Lecture № 1

**"The general part of pharmacognosy. Methods of pharmacognosy. Methods of pharmacognostic analysis; ways and forms of use of medicinal raw materials of plant and animal origin. "**

Course: 3rd Faculty: medico-pharmaceutical

The lecture was discussed  
at the methodical meeting  
departments

August 30, 2024

Protocol № 1

Head departments \_\_\_\_\_

Prof. Rozhkovsky Ya.V.



Odessa-2024

Lecture № 1: «**The general part of pharmacognosy. Methods of pharmacognosy. Methods of pharmacognostic analysis; ways and forms of use of medicinal raw materials of plant and animal origin.** "- 1:00

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

One of the main tasks of practical pharmacognosy is to determine the identity (identity) of medicinal plant raw materials. Both macroscopic and microscopic methods of analysis play an important role in performing this task. Histological reactions to various classes of natural compounds contained in plant tissues also help to establish authenticity to a great extent. Analysis of the quality of medicinal plant raw materials is impossible without establishing the content of active substances. For this purpose various biochemical methods, modern equipment, standard and modified methods are used.

Knowledge and skills in determining the identity and quality of medicinal plant raw materials are necessary for the pharmacist in his practical activities in the process of procurement of raw materials, its acceptance from the public or laboratory analysis.

**2. Objectives of the lecture:**

- **training:**
  - definition of pharmacognosy as a science and academic discipline;
  - the task of pharmacognosy, its importance in the practical activities of the pharmacist;
  - basic concepts of the subject: medicinal plant, medicinal plant raw materials, biologically active substances, standardization;
  - nomenclature of LR and LRS, which are studied in the course of pharmacognosy;
  - ways and forms of use of medicinal raw materials of plant and animal origin;
  - methods of pharmacognostic analysis.

- **educational:**

The lecture is aimed at developing a professionally significant personality structure; education of students of modern professional thinking with relevant aspects of legal, professional responsibility.

### 3. Lecture plan and organizational structure.

№	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
<b>I.</b>	<b>Preparatory stage</b>			
1.	Defining a learning goal			5%
2.	Providing positive motivation			
<b>II.</b>	<b>The main stage</b>			90%
3.	Teaching lecture material Plan: 1. Definition of pharmacognosy as a science and academic discipline. 2. The task of pharmacognosy 3. Basic concepts of the subject 4. Nomenclature of LR and LRS, which are studied by pharmacognosy. 5. Methods of pharmacognostic analysis	I  II II II  III	Combined, tables, overhead projector, slides, herbariums of LR, samples of LRS, drugs	
<b>III.</b>	<b>The final stage</b>			5%
4.	Summary of the lecture, general conclusions.		References, questions, tasks	
5.	Lecturer's answers to possible questions. Tasks for self-preparation			

## 4. Content of lecture material:

**-structural and logical scheme of the content of the topic:**5. **Materials on activating students during the lecture:****Question:**

1. What does pharmacognosy study?
2. When did this science originate?
3. What are your goals?
4. What plants are called medicinal?
5. Thanks to what plants show medicinal properties?
6. What plant particles or organs can be used as LRS?
7. What substances are called biologically active? Pharmacologically active?
8. For what purpose is the pharmacognostic analysis of LRS performed? What does it matter?

**Situational tasks:**

1. Pupils cut off its inflorescences together with the stem while

harvesting LRS of chamomile. How will this affect the quality of the collected raw chamomile?

2. Important diagnostic features of raw materials (rhizomes) of aloe vera are a specific odor and air cavities in the parenchyma. What methods can be used to detect these signs and establish the identity of raw materials?

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**

*Question*

1. Origin and stages of development of pharmacognosy as a science.
2. Definitions: "medicinal plant", "medicinal raw materials"
3. The concept of biologically active substances and their classification
4. The main groups of LR and LRS in terms of BAS content, which are studied in the course of pharmacognosy.
5. The concept of identity and good quality of LRS.
6. Methods of pharmacognostic analysis.
7. What is the purpose of microscopic analysis?

*Situational and test tasks*

1. Divide into groups by origin (plant, animal) medicinal raw materials: propolis; olive oil; deer hinges; birch fungus Chaga; birch buds; bee venom; cocoa butter; cod oil.
2. Important diagnostic features of raw materials (rhizomes) of aloe vera are a specific odor and air cavities in the parenchyma. What methods can be used to detect these signs and establish the identity of raw materials?

3. Divide into groups according to the predominant content of a certain BAS (polysaccharides; fats) such LRS: marshmallow roots; potato tubers; soybean seeds; flax seeds; plantain seeds; castor seeds; apple fruits.
4. After extraction of medicinal plant raw materials of hawthorn flowers the sum of flavonoids is received, it is necessary to define presence in it of separate components. Choose the best method to identify the individual components.
5. The name 'Fructus' is understood in pharmaceutical practice
  - A. Fruits
  - B. Roots
  - B. Leaves
  - G. Bark
  - D. Aboveground part of plants
6. Under the name "Herba" in pharmaceutical practice is understood
  - A. The aboveground part of the herbaceous LR
  - B. Leaves
  - B. One-year LR
  - D. Perennial herb
  - D. Stems
7. In which cases are LRS standardized for the content of extractive rather than specific active substances?
  - A. The active substances are not yet known
  - B. Very high content of active substances in raw materials
  - B. Very low content of active substances in raw materials
  - D. A method for quantifying active substances has not been developed.

**B) 3 topics of the next lecture "Carbohydrates. Glycosides. General characteristics.**

Chemical analysis of LRS. Starch and its derivatives, inulin, pectin, gums ").

### *Question*

1. Definition of "polysaccharides". their classification, physical and chemical properties, localization.
2. Carbohydrates. Glucosamine. Honey.
3. Starch. The structure of starch grains. Structure of amylose and amylopectin.
4. Name the raw material sources of starch. What is the use of starch?
5. Give the structure of inulin and name the raw materials. Medical significance
6. Mucus. Chemical composition. Physical properties. Localization and origin in plants. LR and LRS, which contain mucus. Biological action.
7. Comedy. Origin in plants. Building. Classification. Raw materials. Application.
8. Pectins. Building. Isolation from medicinal plant raw materials. Drugs, their use. LR and LRS, which contain pectins.

### *Test tasks*

1. Plant mucus is a polysaccharide of various compositions. What is the reaction based on the physical properties of mucus used to detect them:
  - A. With methylene blue
  - B. From Sudan Sh
  - B. The precipitation reaction
  - D. Reaction with aniline sulfate
  - D. With ferric chloride
2. Which LRS containing polysaccharides (mucus) is used to make the drug "Mukaltin":
  - A. Althaea herb
  - B. Althaea roots
  - B. Mother-and-stepmother leaves
  - D. Flax seeds

D. Plantain leaves

3. Which BAR contained in vegetable raw materials shows a positive qualitative reaction to Lugol's solution:

A. Starch

B. Slime

B. Fiber

G. Jury

D. Inulin

4. To establish the identity of the root of marshmallow HFC requires a histochemical reaction to detect:

A. Mucus

B. Starch

V. Tanin

G. Routine

D. Fats

5. What kind of LRS *Althaea officinalis* is not provided by HFC:

A. Flowers

B. Roots

C. Grass

G. Leaves

6. A polysaccharide that is completely insoluble in water is:

A. Cellulose

B. Starch

B. Slime

G. Inulin

D. Pectin

7. To assess the quality of raw materials *Semina Lini* State Pharmacopoeia provides a definition

A. Swelling index

B. Foam number

B. Iodine number

G. Bitterness index

## 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

Pharmacognosy is a Greek word consisting of two words: Pharmakon - medicine, poison and gnosis - study, cognition - one of the pharmaceutical sciences that studies medicinal plants, medicinal plant raw materials and some products of primary processing of plant and animal origin. Thus, pharmacognosy means drug science or knowledge of drugs.

Medicinal raw materials are understood as dried or freshly harvested plants or their parts and organs, which are needed as a raw material source for the manufacture of medicines. The products of primary processing of plants are the essential and fatty oils obtained from them, gums, and other resins. Of the means of animal origin in pharmacognosy remained only the products of processing of raw materials - animal fats. With the advent of Vaseline, paraffin and artificial ointment bases, they began to be used less frequently. But do not lose their importance fish oil and lanolin. Objects such as snake venom, bee venom and other products of bee life have become important.

Currently, pharmacocognosy is significantly different from the narrow, applied and commodity science, which it was until recently. Pharmacognosy faces great challenges:

- 1) In-depth study of already known medicinal plants and raw materials included in the State Pharmacopoeia (GF) and other manuals. Study of factors influencing the accumulation of active substances: rational methods of collecting and drying raw materials; loss of active substances during storage, phytochemical study of individual chemical groups. Compilation of normative and technical documentation (NTD), which regulates the quality of medicinal raw materials: pharmacopoeial articles, state standards and others; compilation of manuals on pharmacognostic analysis and new methods of analysis of active substances.

- 2) Search for new domestic medicinal plants and their study. The use of information from folk medicine, the search for plants on the principle of botanical kinship, the study of "forgotten" old plants that fell into disuse in the 19th century during the heyday of synthetic chemistry and fascination with chemicals.

3) The study of medicinal plants locusts of people's democracy, as well as used in Chinese, Tibetan, Mongolian, Indian, Iranian medicine and others.

4) Cultivation and introduction of medicinal plants. Cultivated not only foreign plants such as Rauwolfia, nightshade, foxglove, but also plants that grow widely in nature in the wild, the collection of which for one reason or another is unprofitable.

5) Conducting resource studies. Medicinal plants are studied in natural conditions: places of mass growth are found, the sizes of thickets, potential and operational stocks of the used parts of plants are established. On the basis of data of resource researches scientifically substantiated annual and perspective plans of preparations of medicinal plant raw materials are developed. Knowledge of the dynamics of accumulation of pharmacologically active substances makes it possible to regulate the timing and methods of collection, drying and storage of medicinal raw materials.

6) Rational methods of harvesting medicinal plant raw materials and protection of plant thickets.

In the modern arsenal of drugs, herbal medicines are 30-40%, and in some heaps of drugs derived from plants, reach 70% (drugs used in the treatment of cardiovascular disease). A large number of herbal medicines are used as sedatives, diuretics, laxatives, expectorants. Some substances derived from plants are not used directly for medicinal purposes, but serve as a starting material for the synthesis of effective drugs.

The use of herbal medicines in modern medicine not only remains stable, but tends to increase.

Drugs of natural and synthetic origin harmoniously complement each other in the fight against human diseases.

Many medicinal plants are used not only in medicine but also in other sectors of the economy; in the perfume and cosmetics and food industries, mint, coriander, wormwood, and others are used. plants. Fatty oils are known to find a variety of technical uses, not to mention the fact that many of them are everyday

foods. Ketamine was indispensable in lubricants for aircraft engines. A powerful foaming agent, which have a variety of technical applications, is an extract made from licorice roots, etc.

Medicinal plants include types of various pharmacological effects on humans and animals, which can be divided into three groups:

- 1) "official", entered in the State Pharmacopoeia;
- 2) "semi-official", which are not included in the State Pharmacopoeia, but are widely known for their medicinal properties (eg hops);
- 3) "unofficial", used only in folk medicine in Ukraine and other countries.

Honeybees include:

- Nectar bearers - plants that form nectar (linden) in their flowers, from which bees receive honey;

-Perganosi-plants that give only pollen, which is processed by bees with the formation of perga (sitniki). Perganos can be pollinated by insects (rose hips) and wind (willows).

The group of vitamin-bearing plants includes species that accumulate mainly carotene (provitamin A), vitamins B1 B2, C, D, E, K, PP, and multivitamins.

The group of food plants is very diverse. The following parts (organs) are used for food: shoots (stems with leaves), leaves, flowers and buds, fruits and seeds, roots and rhizomes.

By the nature of use, food plants are divided into:

- 1) nuts (hazelnuts);
- 2) fruit and berry (barberry);
- 3) vegetable roots (chastukha), leaf (dandelion) and stem (dream);
- 4) starch-bearing plants - plants from the underground organs of which (sometimes from the fruit) can be extracted starch flour. They do not contain gluten and resemble potato starch in their properties. For preparation of usual bakery products to it it is necessary to add in an equal proportion usual wheat flour (wheat);

5) cereals, give quite edible benign grain, which can sometimes be used in the form of ground porridge (shchiritsa, mannik);

6) sugar-bearing and inulin-bearing - plants containing sugar and inulin in the roots (licorice, ergot high) or spring srke (maple, birch);

7) oil, producing edible oils (ryzhik);

8) plants from which drinks are made and used for preparation of drinks of cool type (barberry), coffee type (burdock), tea type (raspberry), alcoholic drinks and vinegar (calamus), and also foam for drinks (sweet naked) and lemon acids (mulberry);

9) aromatic and spicy plants, which in themselves have no nutritional value, but are used in limited quantities as a condiment. They improve the taste or serve to add the smell of other foods. Some of these plants can serve as substitutes for well-known spices and condiments, such as mustard, allspice, and others.

10) Fatty oils include species that contain as a spare nutrient fatty oils of three categories: drying, semi-drying and those that do not dry. Drying agents can greatly affect the technical value, in particular for the preparation of drying oils. Drying and semi-drying oils are also part of varnishes. Semi-drying oils are widely used in soap making, in the preparation of margarine. Drying oils are also widely used in engineering, soap making, lubrication, leather and dyeing.

13) Essential oils include species that contain essential oils - volatile and highly fragrant substances of complex chemical composition. Most essential oils are found in flowers and fruits, less - leaves and roots. In the stems, the oil content is usually meager.

The value of essential oils in human life is very great. They are the basis for the production of fragrant substances and are widely used in the perfume industry. Essential oils are widely used by confectioners to add flavor and spice to foods. The role of spicy food plants depends on the presence of essential oils. Essential oils are also used in medicine. Some essential oils repel insects and protect people from bites.

Tannins are those that can turn skin into skin. After exposure to tannins, the skin does not harden and does not become hard, does not rot in the presence of cold water and does not give glue with boiled water.

Tannins can be found in various plant organs. They are most often found in the bark of trunks, then in the bark of roots, rhizomes, leaves and shells of fruits. Less of them in wood and in flowers.

Plants that produce toxic substances (phytotoxins), which even in small quantities have a toxic effect on humans and animals, are considered poisonous.

Among all the variety of poisonous plants there are species that are definitely poisonous (with a subgroup of particularly poisonous) and species that are conditionally poisonous. The latter are toxic only in certain habitats, at certain stages of development, with improper storage of raw materials, enzymatic effects of fungi and microorganisms. Plant toxins can accumulate in all parts of the plant and in its individual organs.

From the group of poisonous separately selected insecticidal plants - poisonous to insects, which can be used to control moths (sand immortelle), cockroaches, pests of garden and vegetable crops (wormwood, chamomile, etc.)

### **METHODS OF PHARMACOGNOSTIC ANALYSIS.**

Pharmacognostic analysis of medicinal raw materials is to determine: 1) reliability, 2) purity, 3) good quality. Determining the validity of raw materials is reduced to establishing the conformity of the test sample to the name under which it was received. The purity of medicinal raw materials is determined by the absence of unacceptable impurities and admixture. Permissible impurities should not exceed certain standards. The quality of raw materials depends on a number of reasons. It is determined by the correctness and timeliness of raw material collection, drying and the absence of mold and pests, normal humidity, ash content and content of active substances.

The investigated raw materials can be: 1) whole, 2) cut, crushed, 3) powdered. At its test it is necessary to resort to various methods of the analysis: 1) | macroscopic, 2) microscopic, 3) commodity, 4) phytochemical, 5) biological.

DFH or scientific and technical documentation serve as a guide for the study of medicinal raw materials. Until recently, state all-Union standards (GOST or OST), temporary technical conditions (VTU) and inter-republican technical conditions (MRTU) were used. Currently, the Ministry of Health is introducing pharmacopoeial articles, permanent or temporary (FS and VFS) instead of the listed standards. GOSTs remain only for medicinal and technical raw materials, which are used in other industries (food, essential oil, etc.).

## Macroscopic analysis

The purpose of macroscopic analysis is to determine the authenticity of whole raw materials by external morphological features. Determine: appearance, size, color, smell, taste.

1. The appearance of raw materials is determined by the naked eye or by hand magnifier. The shape of the object, the structure of its surface and its internal structure (cross section of roots and rhizomes) are important.

2. The size of raw materials, except for small seeds and fruits, is determined by a ruler. Since the size of the raw material is always prone to fluctuations, to measure take a few average specimens and draw a conclusion from them. Dimensions do not play a decisive role in determining authenticity.

3, The color is always determined on dry raw materials.

4. The smell is best felt in dry material or rubbing it between your fingers. Solid objects are scraped with a knife or ground in a mortar. In some cases, the smell is better felt when pouring hot water over the raw material.

5. The taste of dry leaves, flowers and herbs is best determined in decoctions. When determined on a dry object, take a small piece, chew well and immediately spit it out; it should always be borne in mind that medicinal raw materials can be poisonous.

Different morphological groups of raw materials require different research methods. Some signs are determined on dry raw materials, others on soaked.

**Leaves - Folia.** The name "leaves" in pharmaceutical practice means dried whole leaves or parts thereof, ie leaf plates with a torn petiole or individual parts of a complex leaf (hay leaf).

On a dry leaf, determine under a magnifying glass or pubescent leaf on the upper and lower sides, the nature of the branching of the veins, whether they protrude or indented, as well as the color of the leaf on both sides and its smell. Thin large sheets, which in the raw material are usually crumpled and wrinkled, immersed for a few minutes in hot water, and then gently spread with tweezers or needles on oilcloth. Note the shape of the leaf blade, dissected plates, edge,

veining, absence or presence of sprouts, vagina, leaf size (length and width of the plate, and sometimes the length of the petiole). Leathery leaves do not require pre-treatment.

**Flowers - Flores.** In raw materials under this name individual flowers and whole inflorescences (for example inflorescences of a camomile, tansy), and also their parts (for example lingual flowers of a sunflower) can be dried.

On a dry sample determine whether the flowers are pubescent, color, odor and size, ie the diameter of the flower or baskets of inflorescences. Then the flowers are soaked in hot water to determine their structure and taste. Soaked flower is placed on a glass slide and under a magnifying glass dissect it with two needles, successively tear and examine the cup, corolla, stamens and pistil. The most convenient for these works dissecting magnifiers with a table or tripod magnifiers.

**Herbs - Nerba.** Grass is the whole aboveground part of herbaceous plants, ie stems with leaves, flowers and sometimes with fruits, as well as small grassy branches of the bush. On dry raw materials determine the presence of pubescence of the plant, its color, odor (when rubbed), veining of leaves, size - the length of the stem. The diameter of the flower or inflorescence is determined on a dry sample, the length and width of the leaves - in soaked form. In soaked herbs determine the shape and nature of leaf placement, the nature of the attachment of the leaf to the stem, the shape of the stem, the type of inflorescence, the structure of the flower and the type of fruit, if any. Leaves, flowers and fruits are torn off and identified separately.

**Seeds - Semina.** As raw materials are usually used whole, fully mature seeds and very rarely parts of them. The seeds do not require pre-treatment; they are examined with the naked eye or with a magnifying glass. Determine the shape and appearance of the seed coat, which can be pubescent, or bare, smooth or pitted, often with a noticeable scar. In the seeds of the nucleus determine the presence and nature of nutrient tissue (endosperm) and the structure of the embryo. The sizes of

small seeds establish, having laid out them in a row on a millimeter paper, and spherical sift through a sieve with round apertures of a certain diameter.

**Fruits - Fructus.** The name "fruits" in pharmaceutical practice means real and false fruits, fruits, prefabricated (complex) fruits: as well as their parts. The fruits can be dry and juicy. On a dry sample determine first the shape of the fruit, its type (in botanical terminology), appearance, color, taste, smell, then make a cross section and determine the number of nests and seeds in each nest. Fruits belonging to the type of juicy, after drying become more -less wrinkled and lost their original shape; after inspection in dry form soak them in boiling water for 5-10 minutes, remove the seeds or seeds, wash them from the pulp and examine.

**Underground organs. Roots and rhizomes - Radices et Rhizomata.** Dried underground organs of perennial, mainly herbaceous plants, cleaned and whole or cut into pieces according to the form adopted for each object. Less common tubers - Tubera and bulbs - Bulbi.

Underground organs are considered without pre-treatment, and note which of the types of underground organs belongs to the raw material, their shape and method of procurement (they can be whole, cut into pieces, split lengthwise, covered with periderm or more or less deeply cleaned). On the untreated surface, pay attention to longitudinal and transverse wrinkles, remnants of leaves or their traces, etc. Fracture of roots and rhizomes depends on the internal structure and abundance of mechanical elements and can be granular and smooth or whiter or less fibrous, woody, etc.

On dry material the color of a surface and an internal part of a root is specified, necessarily on a fresh break or a cut as at long contact with air of a surface of a storm. To determine the size measure the length of the root and its diameter in the widest place.

The structure of the conducting system is especially important for the recognition of underground parts. In the rhizomes of monocotyledons, the location of the leading bundles is scattered; dicotyledons have either separate conductive bundles located by an interrupted beam, less often scattered, or the structure of the

conductive system is bundleless, with a cambium separating the phloem from the xylem. At roots of old dicotyledons the structure is secondary, with ring cambium, at thin roots the structure is primary or more often transitional.

**Bark - Cortices.** The bark in the raw material is called the dried outer part of the trunks, branches: the roots of trees and shrubs, removed along the cambium. The bark can be in the form of flat grooved pieces or rolled into tubes, if removed from the thin young branches. The bark is considered dry, measure the length and thickness of the pieces (too thick pieces belong to the old bark and usually contain less active substances). Determine the color of the same features of the outer and inner surface (lentils, grooves, cracks, etc.), the nature of the transverse fracture, which depends on the internal structure of the bark. If the bark has a lot of bast fibers, the fracture will be unevenly skewed, with thin bast fibers fracture bristly, fibrous. If there are no or few fibers, the fracture is smooth, granular.

### **MICROSCOPIC ANALYSIS**

To determine the reliability of crushed raw materials cut, crushed, powdered and briquettes, as well as for some types of difficult to determine whole raw materials need analysis under a microscope.

Depending on the morphological group and the form of raw materials, the methods of preparation of drugs are different.

When examining raw materials under a microscope to determine authenticity, it is necessary to focus all your attention on those features that distinguish a particular organ of one plant from the same organ of another plant. Such signs are called diagnostic, and microscopic analysis is reduced to finding them.

The diagnostic features of the letter are:

- The presence of chlorophyll-bearing tissue;
- Epidermis, which is characterized by different cell shapes (tortuous, polygonal, strongly elongated);

- Hairs (outgrowths of the epidermis), which are the most characteristic feature, as their shape is diverse (unicellular, multicellular, cephalic, warty, bundle, etc.);
- The nature of the cuticle (smooth, folded, of different thickness);
- Epidermal glands and immersed container with essential oil (the structure of which is typical for each plant species, and sometimes for the whole family);
- Crystals of calcium oxalate or calcium carbonate (Rafid friends, single crystals, cystolites, etc.);
- stomata and accompanying cells of the epidermis near the stomata.

Cells of the epidermis surrounding the stomata (stomatal cells) can have a different type of structure: 1) cells near the stomata 2) they are located across the slit of the stomata (carnation family and labiate family); 2) respiratory cells 2; they are located along the stomatal slit (family Cranberry, heather); 3) respiratory cells 3, and one cell is much smaller than the others (family Crucifers); 4) respiratory cells in an indefinite number (3, 4, 5, 6) and not typical, do not differ from other cells of the epidermis (most families).

Diagnostic signs of fruits and seeds are:

- The structure of the seminal vesicle or pericarp (mechanical tissue, essential oil tubules, hairs on the epidermis);
- The chemical nature of the spare nutrients in the seeds of the kernel.

In the case of whole fruits and seeds, microscopic examination is not performed, only in doubtful cases resort to microscopy.

Diagnostic signs of the cortex are mechanical elements:

- Bast fibers, which can be narrow and long, thick and short, lying in groups or alone, may be accompanied by a crystalline coating;
- Stony cells that are arranged singly or in groups.

You should also pay attention to the structure of the plug.

Diagnostic signs of roots and rhizomes are:

- The presence of the leading elements of the xylem - vessels that can be reticulate, porous, spiral, stair, etc .;

- Mechanical elements - fibers and stony cells;
- Spare nutrients - starch, inulin, rarely fatty oil.

#### Luminescent microscopic method of analysis

The active substances contained in plants in anatomical preparations will give in a luminescent microscope bright, colorful fluorescence, and various chemicals have various characteristic coloring. For example, tropane alkaloids give yellow fluorescence; anthraglycosides - orange of different shades, depending on the substance. Luminescent microscopy is used mainly to identify the localization of active substances in plant tissues. The fluorescence intensity tentatively indicates a higher or lower concentration of these substances.

### **Phytochemical analysis**

Phytochemical analysis includes the determination of moisture, ash content, characteristic numerical indicators (in fats - acid number, iodine number, etc.), as well as qualitative and quantitative determination of active substances.

**Qualitative reactions.** Chemical reactions to the presence of various substances are used in determining the authenticity of raw materials in addition to macroscopic analysis.

**Quantitative analysis.** The amount of active substances in the plant is the main indicator of the quality of raw materials, so in GFH and FS are the norms of the allowable minimum content of substances. In addition to the long-known weight and volume quantitative analysis, currently for the analysis of raw materials are used as the most accurate and fastest to perform physical and chemical methods. These include: electrochemical (potentiometric, polarographic, etc.), optical (spectrophotometric, photocolometric, refractometric, etc.).

Chromatographic analysis is used in combination with extraction methods to extract substances from plants to study new plants that contain physiologically active substances (alkaloids, coumarins, flavones, etc.) that require not only summary determination but also their division into components.

### **Chromatographic analysis**

The chromatographic method of analysis was first developed in 1903 by the botanist M. Tsvet for the separation of plant pigments. Since then, various variants of this method have been developed. The chromatographic method of separation of a mixture of substances into components is based on differences in their physical and chemical properties, which affect the rate of distribution of substances from mixtures between two phases under conditions of directed relative motion of these phases. In the study of plants use different variants of the method of chromatography, which have independent significance.

There are adsorption, ion exchange, precipitation, distribution and other types of chromatography. Of great importance in the study of plants acquired distribution chromatography, which, depending on the method of obtaining chromatograms is divided into paper, a thin layer of sorbent and columnar. Using the methods of chromatography, you can divide the extract from plants into components of active substances, to establish their authenticity, to quantify the components, to determine the degree of purity of herbal preparations.

**Chromatography on paper.** The method is based on the differences in the partition coefficients between two immiscible liquids. The analysis is carried out on a specially treated filter paper in a closed chamber for chromatography. Depending on the direction of movement of the mobile phase, there are three methods of chromatography: descending, ascending and circular. In descending chromatography, the movement of the solvent, and with it the separated substances, takes place from top to bottom, in ascending chromatography - from bottom to top, in circular from the center in radii to the periphery. Most often use the ascending method with a mixture of solvents (butyl alcohol, water, acetic acid), which are used as a mobile and stationary phases. On a strip of paper impregnated with a stationary phase, apply a pencil line "start". Drops of the investigated plant extracts and several solutions of pure substances are applied along the line with intervals of 2-3 cm as standards, the presence of which was assumed in the investigated extract. The paper is immersed for 2-3 cm in the mobile phase, fixed vertically in one way or another and, closing the lid of the chamber, allow the

solvent to slowly spread along the paper, capturing substances from the analyzed extraction and application of standards. After chromatography and development of chromatograms compare the position and color of the obtained spots. If the test substance and the standard sample are identical, then the obtained spots have a close value of the height from the starting line and the same color. allow the solvent to slowly spread along the paper, capturing substances from the analyzed extraction and application of standards. After chromatography and development of chromatograms compare the position and color of the obtained spots. If the test substance and the standard sample are identical, then the obtained spots have a close value of the height from the starting line and the same color. allow the solvent to slowly spread along the paper, capturing substances from the analyzed extraction and application of standards. After chromatography and development of chromatograms compare the position and color of the obtained spots. If the test substance and the standard sample are identical, then the obtained spots have a close value of the height from the starting line and the same color.

Chromatography in a thin layer of sorbent (thin layer chromatography). The method is a later version of paper chromatography. It is used for faster separation of substances on a thin layer of sorbent applied to a glass plate. A promising method of analysis, which is gaining value at present, is the method of gas-liquid chromatography.

### **Biological method of analysis**

This method allows you to determine the effect of raw materials on experimental animals: frogs, guinea pigs, cats. The result is expressed in units of action (usually the lowest dose that causes a certain physiological effect). The activity of raw materials is expressed in the number of units of action in 1 g of raw materials. This method is used in pharmacological laboratories.

