

**MINISTRY OF HEALTH OF UKRAINE  
BOGOMOLOLETS NATIONAL MEDICAL UNIVERSITY  
DEPARTMENT OF PHARMACOGNOSY AND BOTANY  
DANYLO HALYTSKY LVIV NATIONAL MEDICAL UNIVERSITY  
DEPARTMENT OF PHARMACOGNOSY AND BOTANY**

# **LABORATORY HANDBOOK ON PHARMACOGNOSY**

## **PART II**

**Name**

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**Faculty**

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**Specialty**

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**Course**

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**Group**

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**Laboratory Handbook on Pharmacognosy. Part 2:** textbook / Minarchenko V. M., Kovalska N. P., Karpiuk U. V., Yemelianova O. I., Cholak I. S., Pidchenko V. T., Lysyuk R. M., Mychailovska V. O. – K.: Pabliher PALYVODA A. V., 2018. – 148 c.

ISBN 978-966-437-522-8.

This handbook covers the established methodologies for morphological, anatomical, and chemical analysis of medicinal plants that can successfully teach the theoretical and practical course of pharmacognosy in accordance with the "Program of Pharmacognosy."

For students of higher educational establishments of level III-IV pharmaceutical accreditation full-time and part-time training in the specialty "Pharmacy."

Цей посібник охоплює навчальні методики морфологічного, анатомічного та хімічного аналізу лікарських рослин, які вивчаються в теоретичному та практичному курсі фармакогнозії відповідно до "Програми фармакогнозії".

Для студентів вищих навчальних закладів III-IV рівнів фармацевтичної акредитації денна та заочна форма навчання за спеціальністю "Фармація".

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U. V., Yemelianova O. I., Cholak I. S., Pidchenko V. T.,  
Lysyuk R. M., Mychailovska V. O., 2018**

ISBN 978-966-437- 522-8

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## **Notation conventions**

**MP** – medicinal plant

**MPM** – medicinal plant material

**BAS** – biologically active substances

**SPhU** – State Pharmacopoeia of Ukraine

**GPh IX** – USSR Pharmacopoeia 11<sup>th</sup> ed.

**PhEur** – European Pharmacopoeia

**QCM** – Quality Control Methods

**TLC** – thin-layer chromatography

**PC** – paper chromatography

## TOPIC: SIMPLE PHENOLS AND THEIR DERIVATIVES

**Aim:** to establish the identity of MPM containing simple phenols and their derivatives according to macroscopic and microscopic characteristics, and to determine the qualitative composition and quantitative content of BAS using methods of phytochemical analysis.

**Objects for laboratory work:** bearberry, cowberry, willow, rhodiola, echinacea roots and herb, wild pancy, fern.

**Objects for independent study:** bilberry, vanilla, turmeric, chicory, artichoke, hemp, cotton plant bark of roots.

**Structural formulas of main BAS:** arbutin, methylarbutin, phloroglucin, thyrosol, salidroside, salicylic acid, methylsalicylate, caffeic acid, chlorogenic acid.

### I. Phytochemical analysis of MPM containing simple phenols and their derivatives

**Task 1.** Fill an Appendix 2 on the topic of the lesson.

**Task 2.** Prepare extract of MPM and make the qualitative reactions for arbutin and tannin. On the basis of reactions make a conclusion about the chemical composition of MPM.

*Method.* 0.5 grams of powdered herbal drug is boiled with 10 ml of water for 2-3 minutes. Hoods hot filtered through a paper filter. The filtrate was used for qualitative reactions, monitor results and make conclusions.

Name of reaction	Methods	Observation
Reaction with ferrous (II) sulfate	Add a crystal of ferrous (II) sulfate to 1 ml of filtrate.	
Reaction with phosphorous molybdate sodium solution	Add 4 ml of ammonia and 1 ml 10% phosphorous molybdate sodium to 1 ml of filtrate in porcelain dish.	
Reaction with alum solution	Add 4 drops of 1% alum solution to 2 ml of filtrate in porcelain dish.	
Conclusions:		

**Task 3.** Do the chromatographic analysis of simple phenols by TLC method for the MPM bearberry.

*Method:* Add 5 ml of ethanol to 0,5g powdered MPM and extract, shaking periodically, heat for 1h. Apply an extract on chromatography paper by capillary (3-5 applications) and carry out chromatography in 5% acetic acid. Allow the solvent front to ascend 15-17 cm above the line of application. Dry the chromatogram on the air, add 10% alcoholic solution of sodium hydroxide, then Paulie's reagent (white streptocide 3,0g; concentrated hydrochloric acid - 6ml; n-butanole - 14ml; distilled water - 200ml. Crystals of sodium nitrite should be added to reagent before use). Arbutin has the highest indication of Rf 0,70 and is detected as brightly-red spot.

Sketch of chromatogram	Spots	Rf	Colour of spots

System of solvents	Resolving reagent

Conclusions: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Task 4.** Make a scheme of quantitative determination of arbutin in *Folia Uvae ursi*. (StPh 11,v.2, p.276)

Approximately 0.5 g (accurately weighted sample of MPM) of *Folia Uvae ursi*, powdered and sieved (a sieve of nominal mesh aperture 1mm), transfer to a 100 ml flask, add 50 ml of water and boil for 30 min. Filter the hot extract in 100 ml volumetric flask. Add 25 ml of water to the flask with MPM and boil for 20 min. Transfer the hot extract with MPM on filter, wash with hot water twice (each time with 10 ml). Add 3 ml of lead acetate solution into filtrate, mix, cool and adjust the volume of liquid with water to 100 ml. Place the flask on a water bath till precipitate coagulation has been completed. Filter the hot liquid into dry flask, covering the funnel with a watch-glass. Cool an extract, add to it 1 ml of concentrated sulphuric acid, weigh the flask, attach a reflux condenser, heat for 1.5 h. Cool the flask contents, add sufficient water to dilute to primary volume, filter the liquid fully in a dry flask. Add 0.1 g of zinc powder into filtrate and shake for 5 min. Neutralize the liquid with 1.0-1.5 g sodium hydrogen carbonate (lacmus as an indicator), then add 2 g of sodium hydrogen carbonate additionally, filter in the dry flask after its dissolving. Place 50 ml of filtrate in a 500 ml flat-bottomed flask, add 200 ml of water, titrate immediately from micro- or semimicroburette with iodine solution (0.1M/l), shaking to produce a blue colour, which persists for 1 min (starch as an indicator).

Arbutin content with reference to the dried MPM, %, is calculated from the expression:

$$X = \frac{V \cdot 0,01361 \cdot 100 \cdot 100 \cdot 100}{m \cdot 50 \cdot (100 - W)}$$

0,01361 - amount of arbutin, that is equivalent to 1 ml of iodine solution (0.1M/l), g;

V - volume of iodine solution (0.1M/l), used in titration, ml;

m - mass of MPM, g;

W- loss on drying, %.

Conclusions: \_\_\_\_\_  
 \_\_\_\_\_

## II. Macro- and microscopic analysis of MPM containing simple phenols and their derivatives

### Sample 1. *Uvae ursi folium* (bearberry leaves)

	Latin name	English name
MPM		
MP		
Family		

Dissemination of MP		<i>Structural formula</i>          <i>arbutin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

### Macroscopic analysis of *Uvae ursi folium*

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

### Possible adulterants (Latin and common names):

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**Microscopic analysis of *Uvae ursi folium*:**

<p>A</p> <p>B</p> <p>C</p> <p>D</p> <p>E</p>	<p>Sign anatomic diagnostic features of <i>Uvae ursi folium</i>:</p> <p>A –</p> <p>B –</p> <p>C –</p> <p>D –</p> <p>E –</p> <p>1.</p> <p>2.</p> <p>3.</p> <p>4.</p> <p>5.</p>
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**Biological effects and application of *Uvae ursi folium*:**

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**Sample 2. *Vitis idaeae* folium (cowberry leaves)**

	Latin name	English name
MPM		
MP		
Family		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		



**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Vitis idaeae folium***

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

**Microscopic analysis of *Vitis idaeae folium*:**

	<p>Sign anatomic diagnostic features of <i>Vitis idaeae folium</i>:</p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> </ol>
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**Biological effects and application of *Vitis idaeae folium*:**

\_\_\_\_\_

\_\_\_\_\_

**Sample 3. Salicis cortex (willow bark)**

	Latin name	English name
MPM		

<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>salicylic acid</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Salicis cortex***

occurrence, fracture of drug		outer surface colour	
shape		inner surface colour	
surface characters		odour after grinding	
section fracture, internal appearance		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Salicis cortex*:**

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**Sample 4. *Rhodiolae roseae rhizoma et radices* (rhodiola rhizome et roots)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		



**Sample 5. Echinaceae radix (echinacea roots)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>       <i>caffeic acid</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Echinaceae radix***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Echinaceae radix*:**

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**Sample 6. *Violae herba* (wild pansy herb)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>methylsalicylate</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

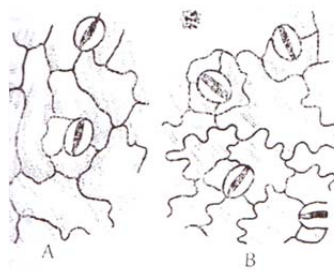
1. \_\_\_\_\_

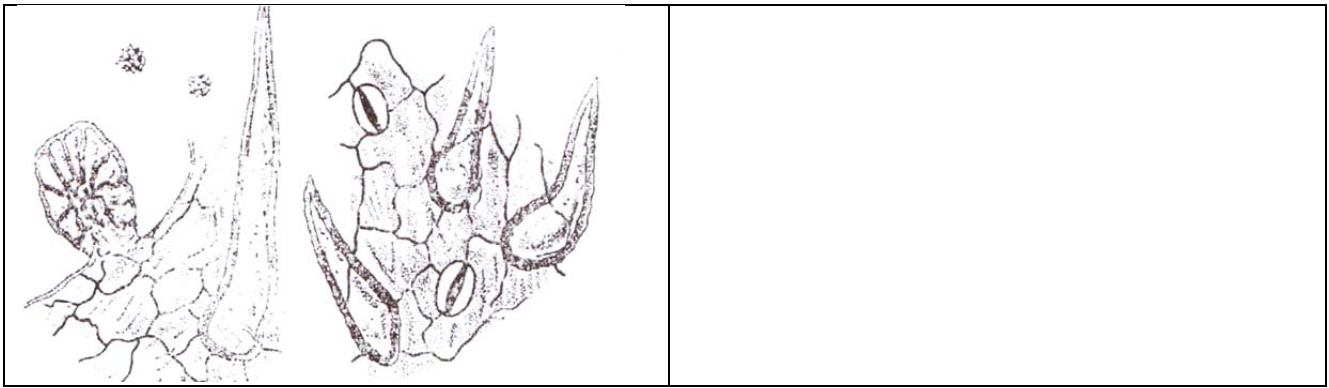
2. \_\_\_\_\_

**Macroscopic analysis of *Violae herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Microscopic analysis of *Violae herba***

	<p>Sign anatomic diagnostic features of <i>Violae herba</i></p> <p>A –</p> <p>B –</p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> </ol>
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**Biological effects and application of *Violae herba* :**

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**Sample 7. *Filicis maris rhizoma* (male fern rhizome)**

	Latin name	English name
MPM		
MP		
Family		

Dissemination of MP		<i>Structural formula</i>          <i>phloroglucin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Filicis maris rhizoma***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_

2. \_\_\_\_\_

**Microscopic analysis of *Filicis maris rhizoma***

<p>Diagram A: A cross-section of the rhizome showing various tissues. Labels 1-6 point to: 1. Epidermis, 2. Cortex, 3. Endodermis, 4. Pith, 5. Medulla, 6. A vascular bundle. Diagram B: A detail of a vascular bundle showing: 1. Metaxylem, 2. Metaphloem, 3. Cambium.</p>	<p>Sign anatomic diagnostic features of <i>Filicis maris rhizoma</i></p> <p>A –</p> <p>Б –</p> <p>1.</p> <p>2.</p> <p>3.</p> <p>4.</p> <p>5.</p> <p>6.</p>
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**Biological effects and application of *Filicis maris rhizoma*:**

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Signature of the teacher \_\_\_\_\_

**INDEPENDENT STUDENTS WORK**

**Sample 1. Folia Vaccinii myrtilli (bilberry leaves)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of *Folia*:**

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**Sample 2. *Vanillae fructus* (vanilla fruits)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of *Vanillae fructus*:**

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**Sample 3. *Curcumae rhizoma* (turmeric rhizome)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		



<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of Curcumae rhizoma:**

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**Sample 4. Cichorii radices (chicory root)**

	<b>Latin name</b>	<b>English name</b>
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of Cichorii radices:**

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**Sample 5. Folia et anthodia Cynarae (artichoke leaves and inflorescences)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of *Folia et anthodia Cynarae*:**

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**Sample 6. Cannabis herba (hemp herb)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of *Cannabis semina*:**

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**Sample 7. *Gossypii radices cortex* (cotton plant bark of roots)**

	Latin name	English name
MPM		
MP		
Family		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

*gossypol*

**Biological effects and application of *Gossypii radices cortex*:**

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**Signature of the teacher** \_\_\_\_\_

## TOPIC: COUMARINS AND CHROMONES

**Aim:** to establish the identity of MPM containing coumarins and chromones according to macroscopic and microscopic characteristics, and to determine the qualitative composition and quantitative content of BAS using methods of phytochemical analysis.

**Objects for laboratory work:** melilot, ammi, parsnip, fig tree leaf, angelica, khella.

**Objects for independent study:** chestnut horse, rue, dill, carrot wild.

**Structural formulas of main BAS:** coumarin, phurocoumarin, pyranocoumarin, chromone, phuranochromone and their derivatives: umbelliferone, aesculetine, hydroxycoumarin, 3,4-dihydrocoumarin, psoralen, bergaptene, xanthoxine, isopimpinelline, visnagine, visnagine dihydrosamidin, khellin.

### I. Phytochemical analysis of MPM containing coumarins and chromones

**Task 1.** Fill an Appendix 2 on the topic of the lesson.

**Task 2.** Prepare extract from MPM, containing coumarins, and to detect them by qualitative reactions.

*Method.* Put 1.0 g powdered MPM into a 100 ml glass-stoper flask and add 15 ml 96% ethanol solution. Attach a reflux condenser and heat on a water bath for 15 min. Filter the hot alcoholic extract through a cotton and detect coumarins. Add 2-5 drops of 5% alcoholic sodium hydroxide solution to 5 ml of extract, heat on a water bath for 5 min. Describe the changes and explain them. Use alkalined extract for the following reactions:

Name of reaction	Methods	Observation
Lactone reaction	Add for 1 ml of alkalined extract 4 ml of water. Neutralize the mixture with 20% sulphuric acid solution (litmus in an indicator).	
Write the scheme of chemical equation:		
Nitrodye formation	1) to 1 ml of alkalined extract, add 3-5 drops of freshly prepared dinitro- $\pi$ -nitroaniline solution (add 1 ml of 5% sodium nitrite solution to 1 ml of 0.1N HCl solution; 0.5 ml of mixture add for 1 ml of 0.5% $\pi$ -nitroaniline solution). Solution develops reddish-orange colour, indicating the presence of coumarins. 2) to 1 ml of alkalined extract add 3-5 drops of freshly prepared dinitrosulphanilic acid solution (add 1 ml of 5% sodium nitrite solution to 1 ml of 0.1N HCl solution; add 0.5 ml of mixture to 10 ml of 0.1% sulfanilic acid solution). Mixture develops reddish-orange colour, indicating the presence of coumarins. Fix the change.	
Write the scheme of chemical equation:		
Conclusions:		

**Task 3.** Obtain an extract of MPM, containing chromones, and carry out qualitative detection.

Add 5 ml of 96% ethanol solution to 1.0 g of powdered MPM, place in glass - stoppered flask, attach a reflux condenser and heat on a water bath for 15 min. Filter the hot alcoholic extract in a porcelain dish, evaporate the filtrate on a water bath up to dryness.

Place 2 grains of KOH (carefully in a dish melt, mixing with a rod). Development of purplish-red colour indicates the presence of chromones in the extract.

**Task 4.** To carry out chromatographical detection of coumarins.

Evaporate in a porcelain dish on a water bath 5 ml of alcoholic extract, containing coumarins, until the volume is 0.5 ml, apply at the line of application on a thin-layer chromatographic plate (Silica Gel). Place a plate in the vertical tank, using a mixture of petroleum spirit: ethyl acetate (1:1).

Allow the solvent front to ascend 15 cm above the line of application, then dry. Examine at ultraviolet light and spray the plate with 5% sodium hydroxide solution, dry at 100 C for 5 min, then spray the plate with solution of dinitro- $\pi$ -nitroaniline or sulphanilic acid.

Compare the data of Rf of coumarins in extract and used markers, identify components of analyzed extract and make a conclusion on qualitative contents of coumarins.

Sketch of chromatogram	Spots	Rf	Colour of spots

System of solvents	Resolving reagent

Conclusions: \_\_\_\_\_

## II. Macro- and microscopic analysis of MPM containing coumarins and chromones

### Sample 1. Meliloti herba (melilot herb)

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		





**Sample 3. *Pastinacae sativae fructus* (parsnip fruit)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		Structural formula
Harvesting time		<i>Isopimpinelin</i>
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Pastinacae sativae fructus***

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

**Biological effects and application of *Pastinacae sativae fructus*:**

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**Sample 4. *Ficusi caricae folia* (fig tree leaves)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		



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Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		<i>Bergaptene</i>

### Macroscopic analysis of *Ficusi caricae folia*

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

### Biological effects and application of *Ficusi caricae folia*

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### Sample 5. *Angelicae radices* (angelica root)

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		

Other substances		<i>Angelicin</i>
Standardization by the content of BAS		

**Macroscopic analysis of *Angelicae radices***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Angelicae radices*:**

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**Sample 6. *Visnagae daucoides* (*Ammi visnagae*) fructus (khella fruit)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Khellin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**Macroscopic analysis of *Visnagae daucoides fructus***

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

**Biological effects and application of *Visnagae daucoides fructus*:**

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**INDEPENDENT STUDENTS WORK**

**Sample 1. Hippocastani semina (horse chestnut semen)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>esculetine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of Hippocastani semina:**

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**Sample 2. Rutae herba (rue herb)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of Rutae herba:**


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**Sample 3. Anethi graveolentis fructus (dill fruits)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of Anethi graveolentis fructus:**

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**Sample 4. Dauci carotae fructus (wild carrot fruits)**

	Latin name	English name
MPM		
MP		
Family		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

*8-methoxypsoralen*

**Biological effects and application of Dauci carotae fructus:**

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**Signature of the teacher** \_\_\_\_\_

## TOPIC: LIGNANS AND XANTHONES

**Aim:** to establish the identity of MPM containing lignans and xanthenes according to macroscopic and microscopic characteristics.

**Objects for laboratory work:** centaury genus, Lemongrass Chinese, Eleutherococcus senticosus, Milk thistle.

**Objects for independent study:** gentian, podofil, species Hypericum

**Structural formulas of main BAS:** schizandrine, syringoresinol, podophyllotoxin, silybin, 1,6,8-trihydroxy-3,5,7-trimethoxyxanthon, glucomangiferin

### Sample 1. *Schizandrae fructus et semina (Schizandra fruit and seed)*

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>Schizandrine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

### Possible adulterants (Latin and common names):

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

### Macroscopic analysis of *Schizandrae fructus*

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

**Macroscopic analysis of *Schizandrae semina***

occurrence, fracture of drug		size	
shape		odour after grinding	
surface		taste	
colour		other diagnostic characters	
characters of ridges, their number			

**Biological effects and application of *Schizandrae fructus et semina*:**

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**Sample 2. *Eleutherococci rhizomata et radices* (*Eleutherococcus rhizome and roots*)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>Syringoresinol</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Eleutherococci rhizomata et radices***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	

section fracture		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Eleutherococci rhizomata et radices*:**

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**Sample 3. *Silybi fructus (Milk-thistle fruit)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Silybin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Silybi semina***

occurrence, fracture of drug		size	
shape		odour after grinding	
surface		taste	
colour		other diagnostic characters	
characters of ridges, their number			

**Biological effects and application of *Silybi semina*:**

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## INDEPENDENT STUDENTS WORK

### Sample 1. *Podophylli rhizoma* (Mayapple rhizome)

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>Podophyllotoxin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

#### Biological effects and application of *Podophylli rhizoma*:

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Signature of the teacher \_\_\_\_\_

**ANALYSIS OF MEDICINAL PLANT MATERIALS  
CONTAINING XANTHONES AND THEIR DERIVATIVES**

**Sample 1. *Centaurii herba* (centaury herb)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>1,6,8-trihydroxy-3,5,7-trimethoxyxanthon</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		


**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**Macroscopic analysis of *Centaurii herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

### Microscopic analysis of *Centaurii herba*

	<p>Sign anatomic diagnostic features of <i>Centaurii herba</i>:</p> <ol style="list-style-type: none"> <li>1. _____</li> <li>2. _____</li> </ol>
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### Biological effects and application of *Centaurii herba*:

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### Sample 2. *Hedysari herba (hedysarum herb)*

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Glucomangiferin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

### Possible adulterants (Latin and common names):

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**Macroscopic analysis of *Hedysari herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Biological effects and application of *Hedysari herba*:**

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**INDEPENDENT STUDENTS WORK**

**Sample 1. *Gentianae radices* (*gentian root*)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of *Gentianae radices*:**

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## TOPIC: FLAVONOIDS

**Aim:** to establish the identity of MPM containing flavonoids according to macroscopic and microscopic characteristics, and to determine the qualitative composition and quantitative content of BAS using methods of phytochemical analysis.

**Objects for laboratory work:** Scholar-tree (pagoda-tree) buds and fruit, cornflower, chokeberry, lemon buckwheat, green tea, motherwort water piper, southwestern persicaria, knotweed, gnaphalia, tickseed, sandy, tansy, hawthorn, sandy everlasting, elder black, equisetum, glycyrrhiza, restharrow.

**Objects for independent study:** pansy, hibiscus, calendulas, st-john's-wort, ginkgo, neckmould.

**Structural formulas of main BAS:** flavan, catechin, anthocyanin, leucoanthocyanidine, flavanone, flavanol, flavon, flavonol, chalkon, dihydrochalcone, auron, quercetin, routine, hyperosid.

### I. Phytochemical analysis of MPM containing flavonoids

**Task 1.** Fill an Appendix 2 on the topic of the lesson.

**Task 2.** Prepare extract of MPM and make the qualitative reactions for flavonoids. On the basis of reactions make a conclusion about the chemical composition of MPM.

Stages of carrying out

1. Accurate weighting of MPM sample.
2. Extraction of MPM with 80% ethanol solution.
3. Evaporation of alcoholic extract.
4. Purification of aqueous portion.
5. Obtaining of aqueous extract for detection of flavonoids.

**Method.** Place 2 g of MPM in 250 ml glass bulb and add 50 ml 80% ethanol solution. Attach a reflux condenser and heat on a water bath for 30 min. Filter a hot alcoholic extract, evaporate the filtrate on a water bath and concentrate to about 3-4 ml. Add to a residue 15 -20 ml hot distilled water, mix by a glass rod, continue to heat till has been completed alcohol evaporation (absence of odour). Filter the aqueous extract through a filter paper, bring the extract into separatory funnel and shake with 15 ml chloroform. After separation, investigate the presence of flavonoids in purified aqueous extract (upper layer) chromatographically (15 ml of extract) and by qualitative reactions.

**Task 3.** To detect flavonoids by means of qualitative reactions. As an example of comparison, use a 0.1% alcohol rutine solution. Record the results of the reaction in the table and draw conclusions.

Name of reaction	Methods	Observation	
		Investigated extract	Solution of rutine
1. Cyanidin reaction	Into 2 ml of extract, add 0,5 ml ethanol with 5-6 drops concentrated hydrochloric acid. Boil the mixture on a water bath for 4-5 minutes, then add 10-15 mg metalline magnesium or zinc. Fix the result of reaction in 3-5 minutes		
2. Cyanidin reaction by Briant	To the colored product of the cyanidin reaction add 1/3 of the volume of butanol, dilute with water to the distribution of layers, shake.		
3. Reaction with 10% alkaline	To 1 ml of the extract add 1-2 drops of 10% alcohol-aqueous solution of potassium or sodium hydroxide		

4. Reaction with 3% aluminium chloride	To 1 ml of the extract, add 1 ml of 3% alcohol solution of aluminum chloride.		
5. Reaction with 2% ferric chloride.	To 1 ml of the extract add 2-3 drops of 1% alcohol solution of ferrum chloride.		
6. Wilson`s reaction	To the 2 ml extract, add 1 ml of a 2% solution of boric acid and 1 ml of a 2% alcoholic solution of citric acid (or oxalic acid).		
7. Reaction with vanillin in concentrated hydrochloric acid	To 1 ml add a few drops of 1% solution of vanillin in concentrated hydrochloric acid.		
8. Reaction with 2% lead acetate solutions	To 1 ml of the extract, add 1 ml of 2% lead acetate solutions.		
Conclusions:			

**Task 4.** To analyze flavonoids chromatographically.

Evaporate 5 ml extract in a porcelain dish on a water bath, dissolve the residue in 1 ml of ethanol. Apply at the line of application on a TLC plate (Silica Gel) or paper for chromatography 5 or 6 times of obtained alcoholic solution and 2 or 3 times solutions of markers. Place the plate in the tank, using a mixture of benzene: methanol (8:2) or n-butanol: acetic acid: water (4:1:2). Allow the solvent front to ascend 10-12cm above the line of application, then dry and spray the plate with 5% alcoholic solution of aluminium chloride or concentrated ammonia, examine in ultraviolet light.

Make a conclusion on the identity of flavonoids in MPM on the basis of Rf data and used markers.

Sketch of chromatogram	Spots	Rf	Colour of spots

System of solvents	Resolving reagent

Conclusions: \_\_\_\_\_

\_\_\_\_\_

**Task 5.** To determine quantitative content of flavonoids in MPM.

Quantitative determination of rutin in *Alabastrae Sophorae japonicae* (Temporary Pharmacopoeial Monograph 42-341-74).

Weigh accurately and transfer about 2 g of the reduced to a powder MPM (a sieve of nominal mesh aperture 0.5mm according to GOCT 3924-47), to a 750-1000 ml glass-stopper conical flask, add 5 g of silica (sand according to GOCT 6139-52, parts size 0.5-1.6 mm), 15 glass beads (5-10 mm in diameter), 150 ml of methanol, shake in a vibratory apparatus and then allow to stand for 18 hours. Filter methanol extraction through pleated filter.

Apply 0.2 ml of methanol extract at a line of application on a paper for chromatography ("C", GOCT 10395-63). Dry on the air for 5 minutes and carry out chromatography by a reversed method in 15% acetic acid solution, allowing the solvent front to ascend 30 cm (3.5 h) above the line of application. Dry the chromatogram on the air until the smell of acetic acid disappears and examine in ultraviolet light at 254 nm. Rutin is observed as yellowish-brown spots with Rf 0.70. A paper with spot should be cut out, cut into small pieces, transferred to a 100 ml glass-stopper conical flask, 30 ml of 60% methanol solution added, and shaken for 4 h in a vibratory apparatus. Filter elutriated liquid and determine its optical density spectrophotometrically in 358 nm in a tube having 1 cm layer thickness comparing to elutriated liquid (60% methanol solution) with equal paper by a square, chromatographed in the same conditions without substance.

Simultaneously the optical density of standard rutin solution is measured.

Content of rutin (in %) in MPM is determined by the formula:

$$X = \frac{D_1 \times C_0 \times U_1 \times U_3 \times 100 \times 100}{D_0 \times a \times U_2 \times (100 - B)} \quad \%$$

where:

D1 - optical density of examined solution;

D0 - optical density of standard solution;

C0 - accurately weighted standard sample of rutin, g;

a- accurately weighted sample of MPM, g;

U1 - volume of extract, ml;

U2 - volume of extract, applied in chromatogram, ml;

U3 - volume of elutriated liquid, ml;

B - content of humidity in MPM, %.

## II. Macro- and microscopic analysis of MPM containing flavonoids and their derivatives

### Sample 1. *Sophorae japonicae fructus* (Pagoda-tree fruit)

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		





Dissemination of MP		<i>Structural formula</i>       <b>Rutin</b>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**Macroscopic analysis of *Sophorae japonicae alabastra***

occurrence, fracture of drug		base of rachis	
colour		odour after grinding	
shape, size		taste	
surface		other diagnostic characters	

**Biological effects and application of *Sophorae japonicae alabastrae*:**

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**Sample 3. *Theae folium***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		

Other substances		
Standardization by the content of BAS		<i>Catechin</i>

**Macroscopic analysis of *Theae folium***

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

**Biological effects and application of *Theae folium*:**

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**Sample 4. *Citri exocarpium***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		



**Biological effects and application of *Centaureae cyani flores*:**

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**Sample 6. *Aroniae melanocarpae fructus recentes***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>Cyanidine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Aroniae melanocarpae fructus recentes***

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

**Biological effects and application of *Aroniae melanocarpae fructus recentes*:**

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**Sample 7. *Leonuri herba***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>       <b>Quercitrin</b>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

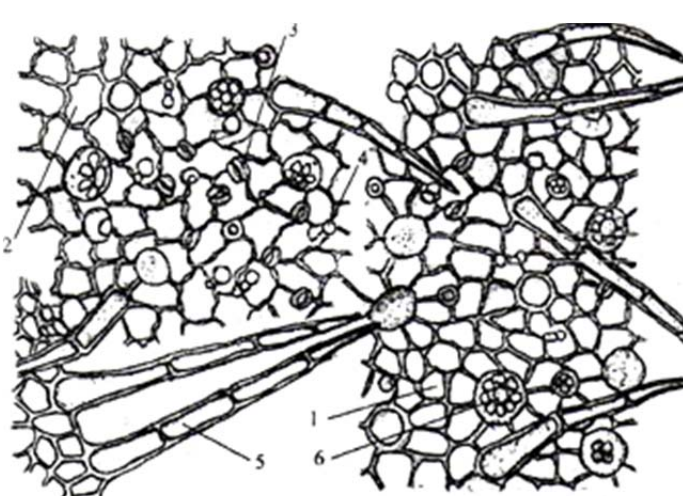
**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Leonuri herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Microscopic analysis of *Leonuri herba***

	Sign anatomic diagnostic features of <i>Leonuri herba</i> : 1. 2. 3. 4. 5. 6.
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**Biological effects and application of *Leonuri herba*:**

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**Sample 8. *Polygoni hydropiperis herba***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Polygoni hydropiperis herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	





**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Polygoni persicariae herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Microscopic analysis of *Polygoni persicariae herba***

<p>Diagram A: Microscopic view of the leaf cross-section. Labels: 1 - upper epidermis, 2 - palisade mesophyll, 3 - spongy mesophyll, 4 - vascular bundle, 5 - lower epidermis with stomata.</p> <p>Diagram B: Microscopic view of the stem cross-section. Labels: 1 - cortex, 2 - vascular bundle, 3 - pith, 4 - vascular bundle.</p>	<p>Sign anatomic diagnostic features of <i>Polygoni persicariae herba</i>:</p> <p>A-</p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> </ol> <p>Б -</p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> </ol>
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**Biological effects and application of *Polygoni persicariae herba*:**

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**Sample 10. *Polygoni avicularis herba***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>       <i>Avicularin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

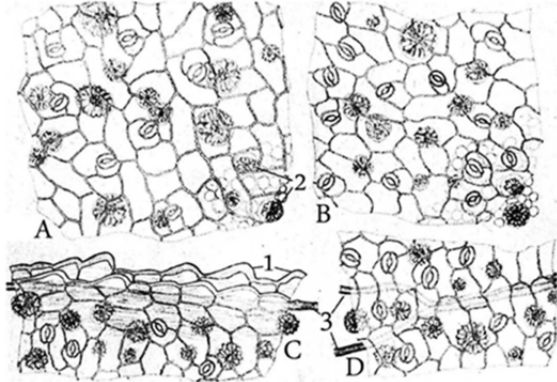
**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Polygoni avicularis herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Microscopic analysis of *Polygoni avicularis herba***

	Sign anatomic diagnostic features of <b><i>Polygoni avicularis herba</i>:</b> A – B – C – D – 1. 2. 3.
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**Biological effects and application of *Polygoni avicularis herba*:**

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**Sample 11. *Helichrysi arenarii flores***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		<i>Naringenin</i>
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Helichrysi arenarii flores***

occurrence, fracture of drug		corolla	
type of inflorescence		size	
symmetry		colour of flower parts	
receptacle		odour after grinding	
involucre, bracts		taste	
florets		other diagnostic characters	
calyx			

**Biological effects and application of *Helichrysi arenarii flores*:**

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**Sample 12. *Crataegi flores***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

*Vitexin*

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**Macroscopic analysis of *Crataegi flores***

occurrence, fracture of drug		corolla	
type of inflorescence		size	
symmetry		colour of flower parts	
receptacle		odour after grinding	
involucre, bracts		taste	
florets		other diagnostic characters	
calyx			

**Biological effects and application of *Crataegi flores*:**

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**Sample 13. *Crataegi fructus***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

*Hyperoside*

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**Macroscopic analysis of *Crataegi fructus***

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	

surface		taste	
number of seeds		other diagnostic characters	

**Biological effects and application of *Crataegi fructus*:**

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**Sample 14. *Glycyrrhizae radices***

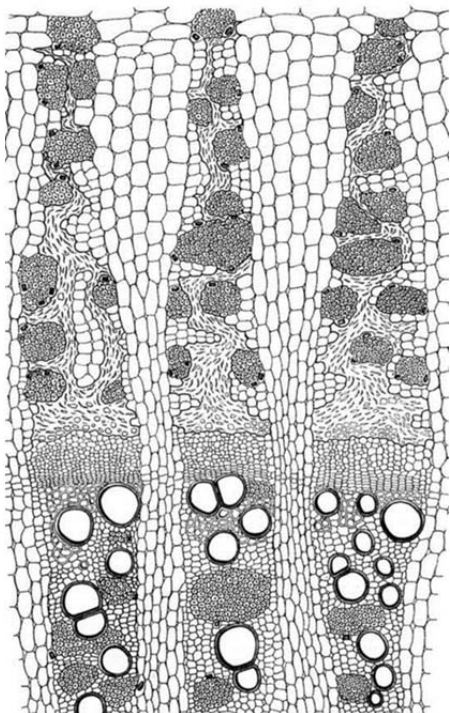
	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		
		<i>Dihydrochalcone</i>

**Macroscopic analysis of *Glycyrrhizae radices***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Microscopic analysis of *Glycyrrhizae radices***

	<p>Sign anatomic diagnostic features of <i>Glycyrrhizae radices</i></p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> <li>7.</li> <li>8.</li> </ol>
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**Biological effects and application of *Glycyrrhizae radices*:**

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**Sample 15. *Ononidis radices***

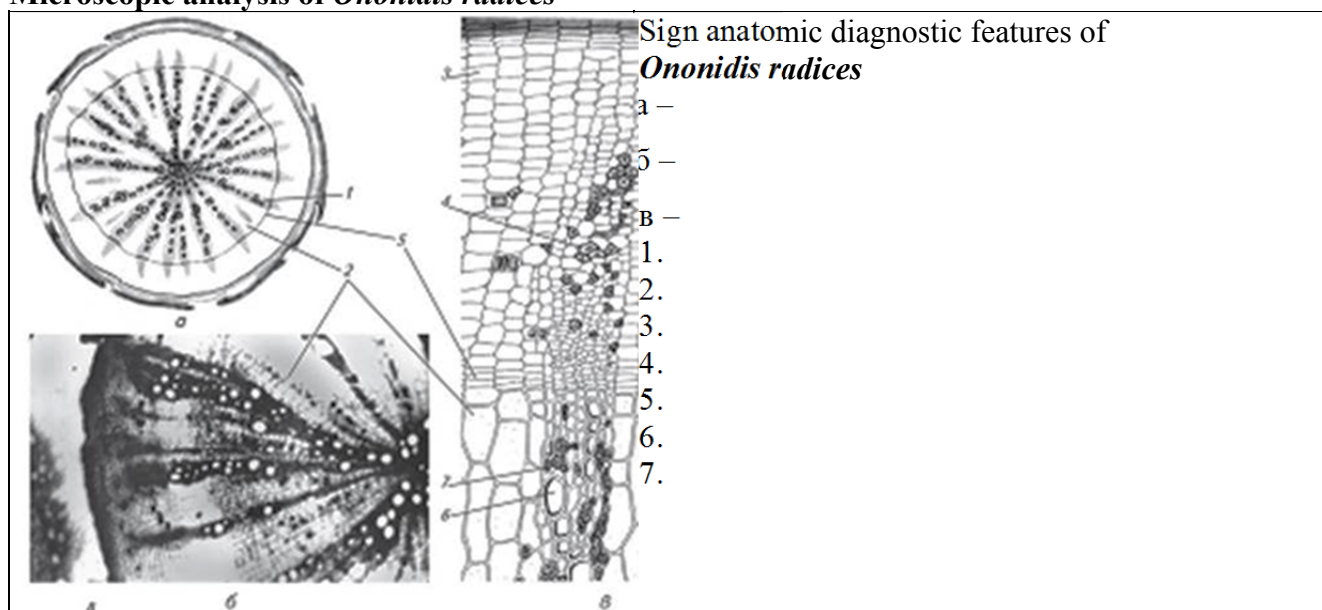
	Latin name	English name
MPM		
MP		
Family		

Dissemination of MP		<i>Structural formula</i>       <b>Ononin</b>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Ononidis radices***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Microscopic analysis of *Ononidis radices***



**Biological effects and application of *Ononidis radices*:**

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**Sample 16. *Vitis viniferae fructus***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		



Basic group of BAS, %		<i>Cyanidin</i>
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Vitis viniferae fructus***

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

**Biological effects and application of *Vitis viniferae fructus*:**

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**INDEPENDENT STUDENTS WORK**

**Sample 1. *Violae herba* (wild pansy herb)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>rutin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of *Violae herba*:**

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**Sample 2. *Calendulae flores* (calendula flowers)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of *Calendulae flores*:**

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**Sample 3. *Hyperici herba* (st-john's-wort herb)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		

Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

*hyperoside*

**Biological effects and application of *Hyperici herba*:**

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**Sample 4. *Ginkgo folium* (ginkgo leaf)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

***Ginkgetin***

**Biological effects and application of *Ginkgo folium*:**

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**Signature of the teacher** \_\_\_\_\_

## TOPIC: ANTHRAQUINONE DERIVATIVES

**Aim:** to establish the identity of MPM containing anthraquinone derivatives according to macroscopic and microscopic characteristics, and to determine the qualitative composition and quantitative content of BAS using methods of phytochemical analysis.

**Objects for laboratory work:** buckthorn, rhineberry, rhubarb, horse sorrel, senna, aloe, dyer's-madder, st-john's-wort.

**Objects for an independent study:** ubiquinone, walnut.

**Structural formulas of main BAS:** anthrone, anthranol, anthraquinone, alizarine, aloe-emodin, glucorhein, rheochrisine, rheum-emodin, chrysacine, chrysophanol, hypericine, sennoside, frangularoside, ruberithrinic acid.

### I. Phytochemical analysis of MPM containing anthraquinone derivatives

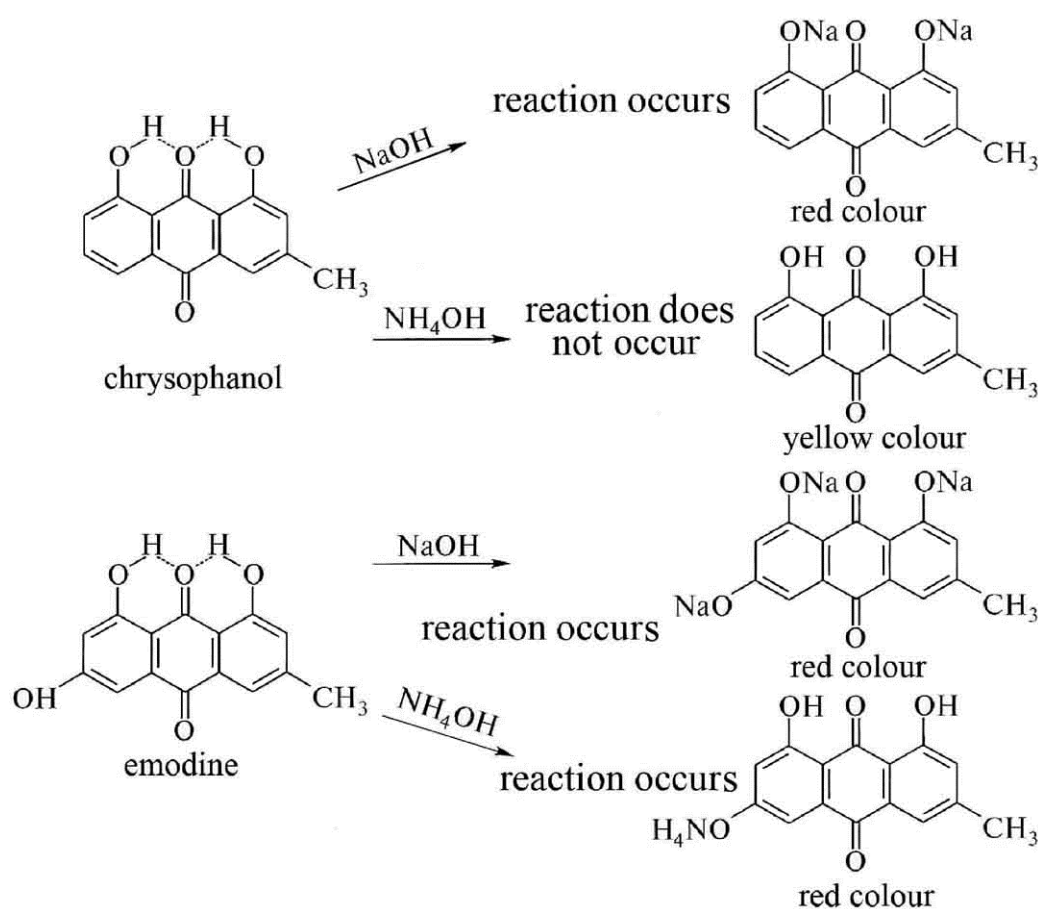
**Task 1.** Fill an Appendix 2 on the topic of the lesson.

**Task 2.** Detect anthraquinones by qualitative reactions.

Name of reaction	Methods	Observation
1. Reaction of microsublimation	Put in a dry test tube 0.1-0.3 g powdered MPM and heat at flame level. Anthraquinones are sublimated and precipitated on the walls of a test tube as yellow crystals, coloured with 5% alcoholic ammonia solution. Note a produced colour.	
2. Tchirch's reaction	Add 5ml of distilled water for 0.5g powdered MPM. Boil for 5 min and filter into a test tube. Add 5% alcoholic sodium hydroxide solution to the filtrate. At the presence of emodines or chrysophane acid cherrish-red colour is obtained, of alizarins - violet.	
3. Borntrager's reaction.	Place 1.0 g powdered MPM into a flask, add 10 ml of 10% sodium hydroxide solution, boil for a few minutes and filter in a test tube. Cool, adjust the acidity, adding 10% hydrochloric acid, to a weak acid reaction (according to the universal indicator). Place in a separatory funnel and extract with 10ml of chloroform. Allow to stand. Chloroform layer gives yellow colour (anthraquinone derivatives). Shake 5 ml of chloroform extract in a test tube with an equal volume of 5% alcoholic ammonia solution. Cherrish-red colour of ammonia solution layer indicates the presence of emodines, blue colour - presence of alizarines, yellow constant colour of chloroform solution indicates chrysophanic acid. Note a produced colour.	
4. Reaction with magnesium acetate.	5 ml of anthraquinones containing extract, obtained after Borntrager's reaction, place in a porcelain dish, evaporate to a dry surplus and dissolve it in 2ml of ethanol. For 1ml of obtained solution, add 1ml of 1% magnesium acetate solution in methanol.	

	Extracted compounds with hydroxylic groups in o-position give red colour, in m-position-orange; blue or violet colour indicates the presence of hydroxylic groups in o- or p-position of anthraquinone system. Note a produced colour.	
5. Histochemical reaction to determine of anthraquinone derivatives	In a Petri dish, a few drops of 5% NaOH solution are applied to a piece of LRC. Observe the formation of color.	
Conclusions:		

### Borntrager's reaction



**Task 3.** To analyze anthraquinone derivatives chromatographically by thin layer chromatography.

Alcoholic solution of anthraquinones (1 ml), obtained after reaction with magnesium acetate, apply at the line of application on a thin-layer chromatoplate (Silica Gel), using a mixture of benzene:ethanol (8:2). After separation of a complex of anthraquinone derivatives, examine chromatograms at day and ultraviolet light before and after spraying of the plate with 5% alcoholic sodium hydroxide solution or 1% magnesium acetate solution.

Comparing the data of  $R_f$  of detected anthraquinone derivatives in extract and the used markers, identify components of an analyzed extract and make a conclusion on qualitative contents, their proportion and identity.

Sketch of chromatogram	Spots	Rf	Colour of spots

System of solvents	Resolving reagent

Conclusions: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Task 4.** To determine a quantitative content of anthraquinone derivatives in the analyzed MPM (according to the State Pharmacopoeia, Y1 ed.).

Transfer 0.05g of powdered MPM (weigh accurately) to a 100 ml glass-stoppered flask, add 7.5ml of glacial acetic acid, attach a reflux condenser and heat on a water bath for 15 min. Cool flask content under a cold water flow, add 20 ml of chloroform and heat on a water bath for 15 min. Cool the extract, filter in a 300 ml separatory funnel, filter, wash with 5 ml of chloroform, adding it to an extract. For combined acetic and chloroform extracts, carefully add up the test-tube walls 50 ml of 5% sodium hydroxide solution, yielding 2% of ammonia, and extract for 5-7 min. After complete separation of an aqueous layer of liquids, coloured in red or violet, not filtering, transfer in 100 ml volumetric flask. Add new portions of alcoholic and ammonia mixture (20 ml of each portion) for chloroform layer in separatory funnel, till completely uncoloured.

25 ml of obtained extract transfer into flask, attach a reflux condenser and heat on a water bath for 15 min. Cool and determine optical density with a photoelectrocolourimetr (green lightfilter, 10mm cuvette).

Determine concentration of anthraquinones according to calibrated graph, using cobalt chloride, by the formula:

$$X = \frac{CxIxK}{ax10(100 - B)}\%$$

C- concentration of anthraquinones, determined in calibrated graph, mg/100 ml;

I - primary volume of alcoholic and ammonia mixture, ml;

a - MPM mass, weighted accurately;

B - moisture of MPM, %;

K - coefficient of dilution after heating.

## II. Macro- and microscopic analysis of MPM containing anthraquinone derivatives

### Sample 1. *Frangulae cortex* (alder buckthorn bark)

	Latin name	English name
MPM		
MP		
Family		

Dissemination of MP		<i>Frangulin A</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

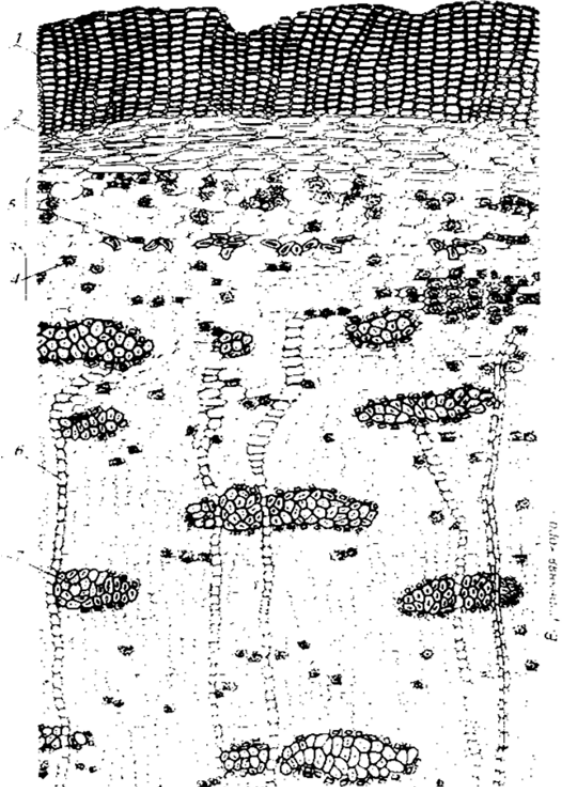
#### Possible adulterants (Latin and common names):

1. \_\_\_\_\_
2. \_\_\_\_\_

#### Macroscopic analysis of *Frangulae cortex*

occurrence, fracture of drug		outer surface colour	
shape		inner surface colour	
surface characters		odour after grinding	
section fracture, internal appearance		taste	
sizes		other diagnostic characters	

**Microscopic analysis of *Frangulae cortex***

	<p>Sign anatomic diagnostic features of <i>Frangulae cortex</i></p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> <li>7.</li> </ol>
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**Biological effects and application of *Frangulae cortex*:**

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**Sample 2. *Rhamni purshianae cortex (cascara bark)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <b>Cascaroside A</b>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		



**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Rhamni purshianae cortex***

occurrence, fracture of drug		outer surface colour	
shape		inner surface colour	
surface characters		odour after grinding	
section fracture, internal appearance		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Rhamni purshianae cortex*:**

\_\_\_\_\_

\_\_\_\_\_

**Sample 3. *Rhamni catharticae fructus* (common buckthorn fruit)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>       <b><i>Rhamnocatharinin</i></b> <b><i>(glucofranguline)</i></b>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

**Macroscopic analysis of *Rhamni catharticae fructus***

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

**Biological effects and application of *Rhamni catharticae fructus*:**

**Sample 4. *Rhei radices (rhubarb root)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Rhei radices***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	



### Macroscopic analysis of *Rumicis radices*

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

### Biological effects and application of *Rumicis radices*:

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### Sample 6. *Aloes arborescentis folia recentes* (aloe leaf)

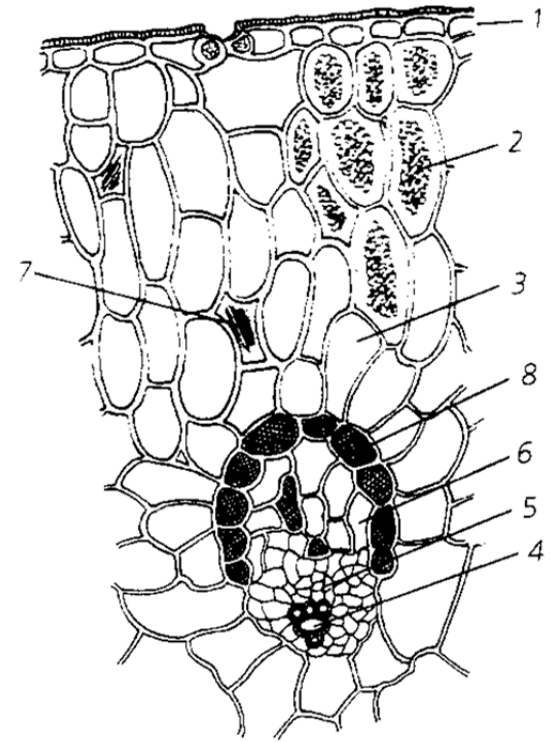
	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

### Macroscopic analysis of *Aloes arborescentis folia recentes*

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

**Microscopic analysis of *Aloes arborescentis folia recentes***



The diagram shows a cross-section of an Aloe leaf. At the top, there is a thin cuticle (1) and a layer of epidermal cells (2). Below the epidermis is the palisade mesophyll (3), consisting of columnar cells. The spongy mesophyll (4) is located below the palisade, containing large air spaces and smaller cells. The vascular bundle (5) is situated in the lower part of the leaf, showing xylem (6) on the upper side and phloem (7) on the lower side. The vascular bundle is surrounded by bundle sheath cells (8). At the bottom, there is a layer of epidermal cells (9) and a thin cuticle (10).

Sign anatomic diagnostic features of *Aloes folium*:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

**Biological effects and application of *Aloes arborescentis folia recentes*:**

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**Sample 7. *Sennae folia (cassia leaf)***

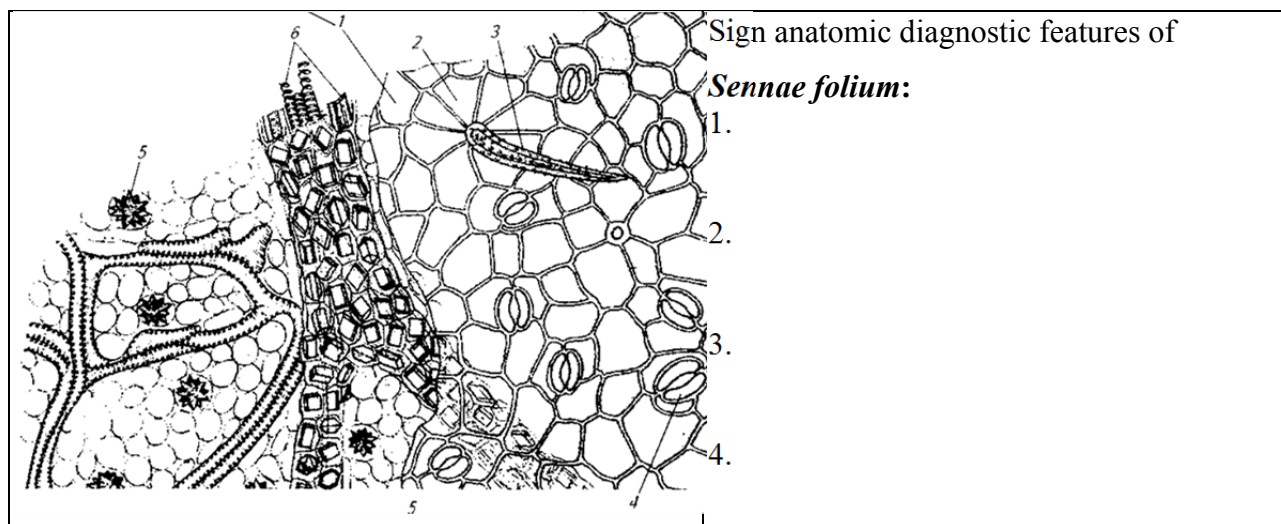
	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		<i>Sennoside A</i>
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Sennae folia***

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

**Microscopic analysis of *Sennae folia***



**Biological effects and application of *Sennae folia*:**

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**Sample 8. *Hyperici herba* (St. John`s wort herb)**

	Latin name	English name
MPM		
MP		
Family		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

### Macroscopic analysis of *Hyperici herba*

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

### Biological effects and application of *Hyperici herba*:

### Sample 9. *Rubiae rhizomata et radices* (common madder rhizome and roots)

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Rubiae rhizomats et radices***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Microscopic analysis of *Rubiae rhizoma et radices***

	Sign anatomic diagnostic features of <i>Rubiae rhizoma et radices</i>
	2.
	3.
	4.
	5.
	6.

**Biological effects and application of *Rubiae rhizomata et radices*:**

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## TOPIC: TANNINS

**Aim:** to establish the identity of MPM containing tannins according to macroscopic and microscopic characteristics, and to determine the qualitative composition and quantitative content of BAS using methods of phytochemical analysis.

**Objects for laboratory work:** witch hazel bark, witch hazel leaves, sumach leaves, smoke tree leaves, bistort rhizome, Greater burnet rhizome and roots, bergenia rhizome, alder fruit, American chestnut leaves, oak bark, common tormentil rhizome, bilberry fruit, bird cherry fruit, pomegranate.

**Objects for an independent study:** turkish nutgall, chinese nutgall, pistachio nutgall, fustic, sumachs.

**Structural formulas of main BAS:** catechine, anthocyanidine, leucoanthocyanidine, structure of gallotannin, gallic acid, ellagic acid, theogalline, proanthocyanidine.

### I. Phytochemical analysis of MPM containing tannins

**Task 1.** Fill an Appendix 2 on the topic of the lesson.

**Task 2.** Obtain an extract of MPM.

Place 3g of MPM in 250 ml flask and add 250 ml of water, heat on a water bath for 15 min. Cool and filter the hot extract through cotton.

**Task 3.** Detect tannins by qualitative reactions.

Name of reaction	Methods	Observation
1. Interaction with ferric salts after the reaction with formic aldehyde and HCl.	For 50 ml of extract add 5 ml of concentrated hydrochloric acid and 15 ml of 40% formic aldehyde solution. Attach a reflux condenser and heat on a water bath for 30 min. Condensed tannins precipitating. Filter the formed precipitate. For 2 ml of filtrate, add 10 drops of 1% alum and 1g of crystalline formic acid sodium. Hydrolyzed tannins give bluish-violet colors. Note and explain the results of reaction, determine the group of tannins, contained in the analyzed MPM.	
2. Reaction with gelatine solution.	For 2 ml of analyzed extract add a few drops of gelatine. Cloudiness is formed, and disappears after addition of gelatine surplus.	
3. Reaction with alkaloids.	For 2 ml of examined extract, add a few drops of 1% chinine hydrochloride solution or papaverine hydrochloride solution. Amorphous precipitate is produced.	
4. Reaction with ferric salts.	For 2 ml of analyzed extract, add 4 or 5 drops of 1% alum solution. Hydrolyzed tannins give bluish-black colour, condensed ones - greenish- brown.	
5. Reaction with lead acetate.	For 2 ml of analyzed extract, add 4 ml of 10% acetic acid solution, 1-2 ml of 10% lead acetate solution. Filter the precipitate. Add a few drops of 1% alum solution for filtrate. Condensed tannins produce a greenish-brown colour.	
5. Histochemical reaction to determine of tannins	In a Petri dish, a few drops of 1% alum solution are applied to a piece of MPM. Observe the formation of color.	
Conclusions:		

**Task 4.** To determine quantitative content of tannins in MPM according to the method of the State Pharmacopoeia, XI ed. (v.1, pp. 286-287).

Weigh approximately 2g (accurately weighted sample) of powdered MPM (a sieve of nominal mesh aperture 3mm), place in 500 ml flask and add 250 ml of hot water, attach a reflux condenser and heat on a water bath for 30 min, mixing periodically. Cool and filter the extract through a cotton.

Place 25 ml of aqueous extract in 750ml conic flask, add 500 ml of water, 25 ml of indigosulphuric acid solution. Titrate with 0.1N potassium permanganate solution, constantly mixing, to produce a yellowish-golden colour. Carry out control test simultaneously, titrating 25 ml of indigosulphuric acid in 525 ml of water.

Calculate the content of tannins by the formula

$$X = \frac{(V - V_1)K \times 250 \times 100\%}{m \times 25}, \text{ where}$$

V- volume of 0.1 N potassium permanganate solution, used in titration of tannins of the weighed analyzed MPM sample, ml;

V<sub>1</sub>- volume of 0.1N potassium permanganate solution, used in titration of 25 ml of indigosulphuric acid solution in control test, ml;

K- amount of tannins, that is equal to 1ml of 0.1N potassium permanganate solution, g; For hydrolyzed tannins (related to tannin) 0.004757, for condensed - 0.00582.

m- accurately weighed sample of MPM, g.

## II. Macro- and microscopic analysis of MPM containing tannins

### Sample 1. *Hamamelidis cortex (witch hazel bark)*

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

### Macroscopic analysis of *Hamamelidis cortex*

occurrence, fracture of drug		outer surface colour	
shape		inner surface colour	
surface characters		odour after grinding	
section fracture, internal appearance		taste	
sizes		other diagnostic characters	

### Biological effects and application of *Hamamelidis cortex*:

### Sample 2. *Hamamelidis folia* (witch hazel leaves )

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

### Macroscopic analysis of *Hamamelidis folia*

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

**Biological effects and application of *Hamamelidis folia*:**

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**Sample 3. *Cotini coggygriae folia* (smoke tree leaves )**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Methylgallate</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Cotini coggygriae folia***

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

**Microscopic analysis of *Cotini coggygriae folia*:**

<p>The diagram shows a cross-section of the leaf with various anatomical features labeled. Part A shows the upper part of the leaf with features 1, 2, 3, 4, 5, and 6. Part B shows a detailed view of a vascular bundle with features 1 and 2. The leaf shows a network of veins, stomata, and epidermal cells.</p>	<p>Sign anatomic diagnostic features of <i>Cotini coggygriae folium</i>:</p> <p>A –</p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> <li>7.</li> </ol> <p>B –</p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> </ol>
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**Biological effects and application of *Cotini coggygriae folia*:**

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**Sample 4. *Bistortae rhizomata (bistort rhizome)***

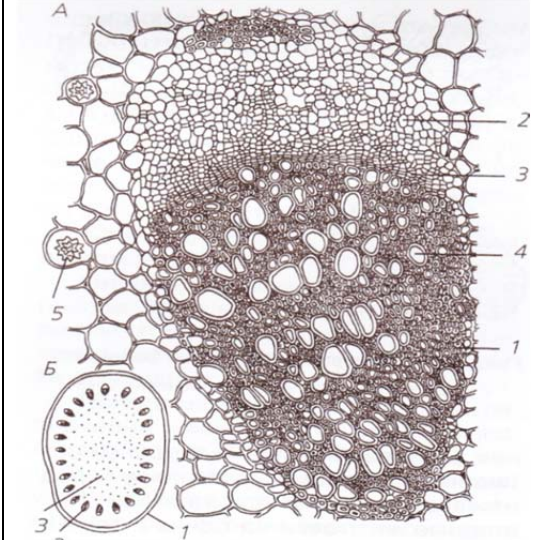
	Latin name	English name
MPM		
MP		
Family		

Dissemination of MP		Structural formula
Harvesting time		<i>Ellagic acid</i>
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Bistortae rhizomata***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Microscopic analysis of *Bistortae rhizomata*:**

	<p>Sign anatomic diagnostic features of <i>Bistortae rhizoma</i></p> <p>A – B – 1. 2. 3. 4. 5.</p>
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**Biological effects and application of *Bistortae rhizomata*:**

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**Sample 5. *Sanguisorbae rhizomata et radices* (Greater burnet rhizome and roots)**

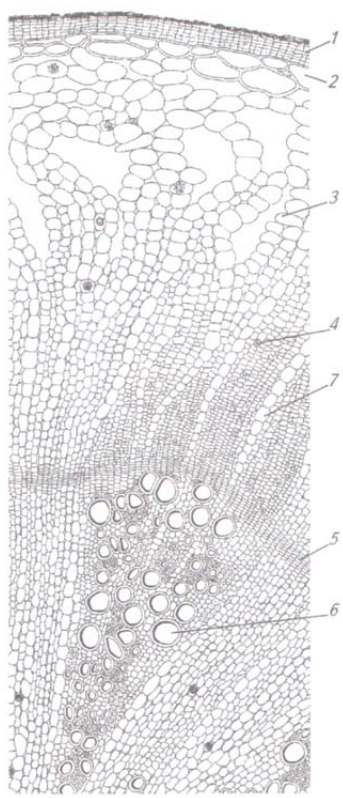
	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Gallic acid</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Sanguisorbae rhizomata et radices***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Microscopic analysis of *Sanguisorbae rhizomata et radices*:**

	<p>Sign anatomic diagnostic features of <i>Sanguisorbae rhizoma et radices</i></p> <p>A –</p> <p>B –</p> <p>2.</p> <p>3.</p> <p>4.</p> <p>5.</p> <p>6.</p> <p>7.</p>
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**Biological effects and application of *Sanguisorbae rhizomata et radices*:**

**Sample 6. *Bergeniae rhizomata (Bergenia rhizome)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

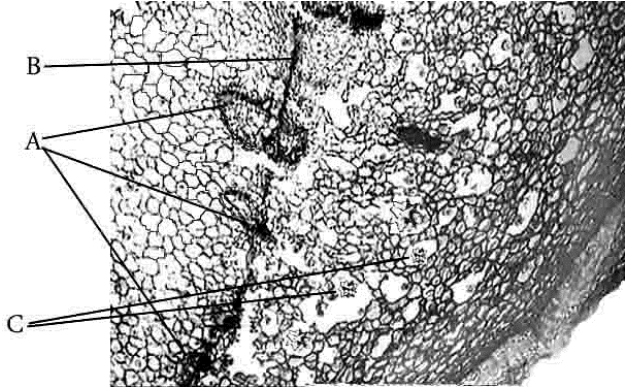
Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		



**Macroscopic analysis of *Bergeniae rhizomata***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Microscopic analysis of *Bergeniae rhizomata*:**

	<p>Sign anatomic diagnostic features of <i>Bergeniae rhizoma</i></p> <p>A- B- C-</p>
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**Biological effects and application of *Bergeniae rhizomata*:**

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**Sample 7. *Alni fructus* (Alder fruit)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <b>Ellagitannin</b>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

### Macroscopic analysis of *Alni fructus*

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

### Biological effects and application of *Alni fructus*:

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### Sample 8. *Castaneae dentatae folia* (American chestnut leaves)

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

### Macroscopic analysis of *Castaneae dentatae folia*

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

**Biological effects and application of *Castaneae dentatae folia*:**

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**Sample 9. *Quercus cortex* (oak bark )**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Catechin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

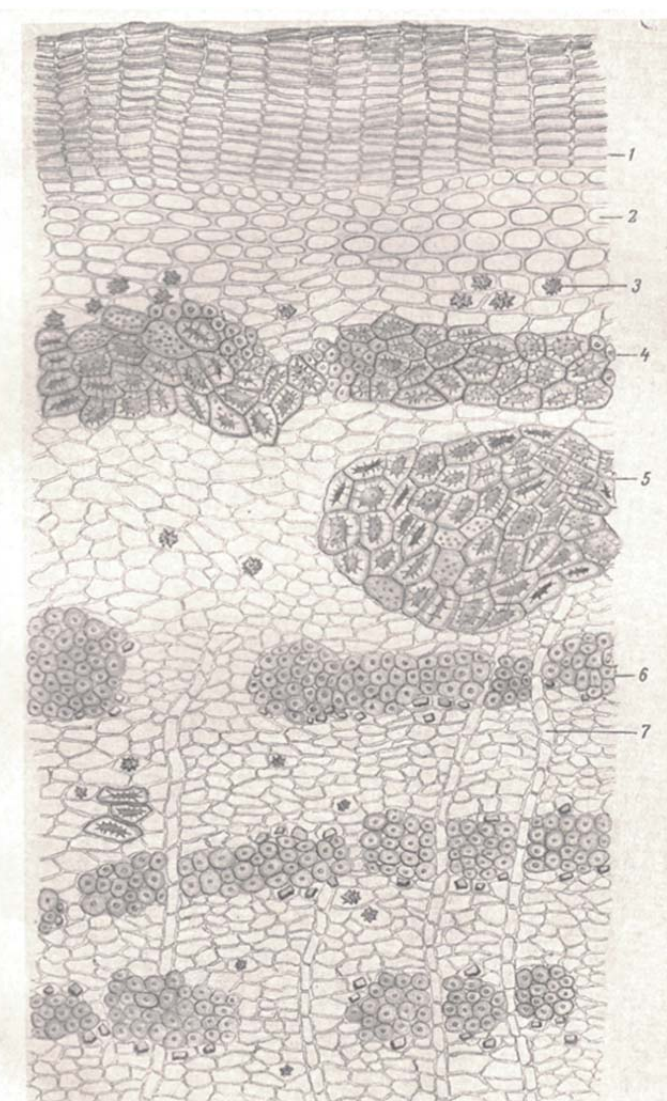
**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Quercus cortex***

occurrence, fracture of drug		outer surface colour	
shape		inner surface colour	
surface characters		odour after grinding	
section fracture, internal appearance		taste	
sizes		other diagnostic characters	

**Microscopic analysis of *Quercus cortex***

 <p>A detailed black and white micrograph of the cortex of Quercus. The image shows several distinct layers. At the top, there is a thin layer of cells (1). Below it is a thicker layer of cells (2). The middle section contains several vascular bundles, each with a central pith (3) and surrounding cortical cells (4). The vascular bundles are arranged in a regular pattern. The bottom part of the image shows more vascular bundles and a layer of cells (7).</p>	<p>Sign anatomic diagnostic features of <i>Quercus cortex</i></p> <p>A –</p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> <li>7.</li> </ol>
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**Biological effects and application of *Quercus cortex*:**

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**Sample 10. *Tormentillae rhizomata* (Common tormentil rhizome)**

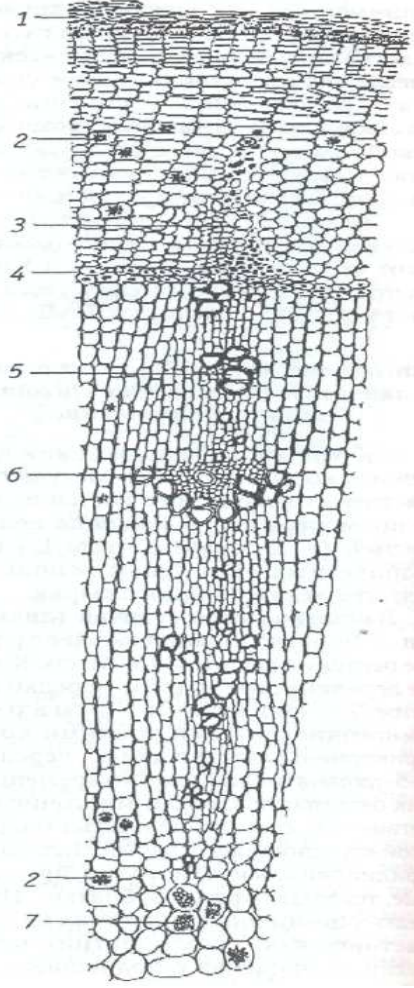
	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>       <i>Proanthocyanidin C<sub>1</sub></i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Tormentillae rhizomata***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Microscopic analysis of *Tormentillae rhizomata*:**

	<p>Sign anatomic diagnostic features of <i>Tormentillae rhizoma</i></p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> <li>7.</li> </ol>
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**Biological effects and application of *Tormentillae rhizomata*:**

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**Sample 11. *Myrtilli fructus* (bilberry fruit)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>Myrtillin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

**Macroscopic analysis of *Myrtilli fructus***

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

**Biological effects and application of *Myrtilli fructus*:**

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**Sample 12. *Padi fructus* (bird cherry fruit)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Amygdalin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

**Macroscopic analysis of *Padi fructus***

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

**Biological effects and application of *Padi fructus*:**

\_\_\_\_\_

\_\_\_\_\_





Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of *Rhois coriariae folia*:**

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Signature of the teacher \_\_\_\_\_

## TOPIC: ALKALOIDS

**Aim:** to establish the identity of MPM containing alkaloids according to macroscopic and microscopic characteristics, and to determine the qualitative composition and quantitative content of BAS using methods of phytochemical analysis.

**Objects for laboratory work:** capsicum, ephedra, belladonna, stramonium, henbane, bush pea, celandine, tulip poppy, barberry, passionflower, snakeweed, periwinkle, catharanthus, ergot, hatched-vetch.

**Structural formulas of main BAS:** capsaicine, ephedrine, colchamine, plathyfilline, atropine, hyoscyamine, scopolamine, cytizin, papaverine, glaucine, morphine, garmine, vincamine, reserpine, vincristine, ergotamine, caffeine, theophylline, theobromine.

### I. Phytochemical analysis of MPM containing alkaloids

**Task 1.** Fill an Appendix 2 on the topic of the lesson.

**Task 2.** Prepare an extract from MPM by one of the methods.

Alkaloids as bases. Transfer approximately 5g of powdered MPM in a 250-ml glass-stoppered flask, moisten with 5ml of ammonia solution, mix and pour 70 ml of chloroform. Close the flask with a stopper, mix in apparatus for shaking (ABY-1) for 40 min (open obligatory flask stopper periodically). Filter an extract through cotton into a flask, covering the funnel with a watch glass. Adjust the solvent volume of obtained chloroform extract to 1-2 ml, transfer residue in flask into a porcelain dish and evaporate to dryness on a water bath. Dissolve the dry residue in 5 ml of hydrochloric acid and carry out qualitative reactions and chromatography.

Alkaloids as salts. Weigh 3g of powdered MPM, transfer it into a glass-stoppered flask, and pour 40 ml of 1% hydrochloric acid. To carry out an extraction of alkaloids, attach a reflux condenser and heat on a water bath for 20 min. Cool, filter an extract, alkalinize to pH 10-12 with sodium hydroxide solution. Extract alkaloid bases with 10-30 ml of organic solvent (chloroform, dichlorethane), mixing in a separatory funnel for 5-10 min. Separate organic fractures from aqueous ones and transfer into a porcelain dish. Evaporate organic solvent to dryness on a water bath, dry the residue, dissolve in 5ml of hydrochloric acid solution, and carry out qualitative reactions on alkaloids and chromatography.

**Task 3.** Detect alkaloids in an extract by general reactions for precipitation of alkaloids.

"General reactions for alkaloids". Apply separate drops of analyzed extract on a glass slide. Near each drop, apply two drops of each reagent. By means of the glass rod, mix a drop of extract with a drop of reagent. Notice cloudiness or precipitation that confirms presence of alkaloids in the extract.

Describe the results of reactions in the table.

Reagent	Reagent constituents	Results of reactions
Buchard's or Vagner's	iodine in potassium iodine solution	
Mayer's	mercuric chloride in potassium iodine solution	
Dragendorff's	bismuth nitrate and potassium iodine in acetic acid	
Sonnenstain's	phosphorous molibdate acid solution	
Marmae's	cadmium iodine in potassium iodine	
Shabler's	phosphorous wolframic acid solution	

Godfrua's or Berthrane's	siliceous wolframic acid	
	10% tannin solution	
	1% picric acid solution	
	5% mercuric chloride solution	
	5% platinous hydrochloric acid solution	

**Task 4.** Isolate purified totality of alkaloids form *Belladonnae folium* and carry out qualitative reaction, in accordance to the *EP* method for the analyzed MPM. Describe the result and make conclusion on occurrence of tropane alkaloids.

Shake 1 g of powdered drug (180) (2.9.12) with 10 ml of 0.05 M sulphuric acid for 2 min. Filter and add to the filtrate 1 ml of concentrated ammonia R and 5 ml of water R. Shake cautiously with 15 ml of ether R, avoiding formation of an emulsion. Separate the ether layer and dry over anhydrous sodium sulphate R. Filter and evaporate the ether in a porcelain dish. Add 0.5 ml of fuming nitric acid R and evaporate to dryness on a water-bath. Add 10 ml of acetone R and, dropwise, a 30 g/l solution of potassium hydroxide R in ethanol (96 per cent) R. A deep violet colour develops.

The Vitali – Morin reaction may be carried out by the following modification: Evaporate to dryness 2 ml of analyzed extract in a porcelain dish. Dissolve a dry residue in 1 ml of concentrated nitric acid. Evaporate the solution to dryness on a water bath; add a few drops of acetone and 1-2 drops of 0.5n alcoholic potassium hydroxide solution.

**Task 5.** Carry out chromatographic examination of *Folia Belladonnae* in accordance to the *EP* method for the analyzed MPM. Draw a scheme of chromatogram and determine Rf values of standard samples and alkaloids in an extract.

Thin-layer chromatography (2.2.27).

*Test solution.* To 0.6 g of powdered drug (180) (2.9.12) add 15 ml of 0.05 M sulphuric acid, shake for 15 min and filter. Wash the filter with 0.05 M sulphuric acid until 20 ml of filtrate is obtained. To the filtrate add 1 ml of concentrated ammonia R and shake with 2 quantities, each of 10 ml, of peroxide-free ether R. If necessary, separate by centrifugation. Dry the combined ether layers over anhydrous sodium sulphate R, filter and evaporate to dryness on a water-bath. Dissolve the residue in 0.5 ml of methanol R.

*Reference solution.* Dissolve 50 mg of hyoscyamine sulphate R in 9 ml of methanol R. Dissolve 15 mg of hyoscyne hydrobromide R in 10 ml of methanol R. Mix 1.8 ml of the hyoscyne hydrobromide solution and 8 ml of the hyoscyamine sulphate solution.

*Plate :* TLC silica gel G plate R.

*Mobile phase:* concentrated ammonia R, water R, acetone R (3:7:90 V/V/V).

*Application:* 10 µl and 20 µl, as bands of 20 mm by 3 mm leaving 1 cm between the bands.

*Development:* over a path of 10 cm.

*Drying:* at 100-105 °C for 15min, allow to cool.

*Detection A:* spray with potassium iodobismuthate solution R2, using about 10 ml for a plate 200 mm square, until the orange or brown zones become visible against a yellow background.

*Results A:* the zones in the chromatograms obtained with the test solution are similar in position (hyoscyamine in the lower third, hyoscyne in the upper third of the chromatogram) and colour to the bands in the chromatograms obtained with the reference solution. The zones in the chromatograms obtained with the test solution are at least equal in size to the corresponding zones in the chromatogram obtained with the same volume of the reference solution. Faint secondary zones may appear,

particularly in the middle of the chromatogram obtained with 20 µl of the test solution or near the starting point in the chromatogram obtained with 10 µl of the test solution.

*Detection B:* spray with *sodium nitrite solution R* until the coating is transparent and examine after 15 min.

*Results B:* the zones due to hyoscyamine in the chromatograms obtained with the test solution and the reference solution change from brown to reddish-brown but not to greyish-blue (atropine) and any secondary zones disappear.

**Task 6.** Determine quantitative content of tropane alkaloids in MPM of the Solanaceae according to the State Pharmacopoeia, XI ed., and conclude on compliance of the analyzed sample to the AND requirements.

Weigh approximately 5 g of powdered MPM accurately and transfer into a 250 ml glass-stoppered flask, moisten with 5 ml of ammonia solution, mix thoroughly and pour 70 ml of chloroform. Close the flask with a stopper, mix in apparatus for shaking (ABY-1) for 40 min (the flask stopper must be opened periodically). Filter the extract through a cotton piece in a flask, covering a funnel with a watch glass.

Transfer 50 ml of obtained extract in a separatory funnel. Wash volumetric cylinder twice with 5ml of chloroform each time, attaching to an extract. Extract alkaloids consequently with 15, 10, 5 ml of 1% hydrochloric acid solution. Filter acidic extract through moistened in water filter, that should be washed twice with 5 ml of 1% hydrochloric acid solution each time, adding obtained water to the extract. Add ammonia solution to the extract until the reaction is alkaline (phenolphthaleine or universal indicator), extract alkaloids consequently with 10, 10, 5ml of chloroform, shaking for 3 min each time. Filter the chloroform extract through a paper filter with anhydrous sodium sulphate, moistened in chloroform. Wash the filter with chloroform twice with 5 ml each time, add it to the whole volume of chloroform extract.

Evaporate a solvent from obtained extract on a water bath, adjusting a volume to 1-2ml. Dry chloroform residue in a flask, blowing the air until the odour is absent. Dissolve dry residue in 15 ml of hydrochloric acid solution (0.22mol/l), heat on a water bath, add 2 drops of methylene red and 1 drop of methylene blue; titrate surplus of hydrochloric acid with sodium hydroxide solution (0.02 mol/l) until a green colour is produced.

Calculate total content of alkaloid, expressed as hyoscyamine in absolutely dried MPM, %:

$$X = \frac{(15 - V) \times 0.005780 \times 100 \times 100}{m \times (100 - W)} \%$$

0.005780 - amount of alkaloids, expressed as hyoscyamine, equal to 1ml of hydrochloric acid solution (0.02mol/l), g;

V - volume of sodium hydroxide (0.02mol/l), used for titration, ml;

m - mass of drug used in grams;

W - loss on drying of MPM, %.

## II. Macro- and microscopic analysis of MPM containing alkaloids

### *MPM containing protoalkaloids*

#### **Sample 1. *Capsici fructus (capsicum fruit)***

	Latin name	English name
<b>MPM</b>		

<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>       <i>Capsaicin</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

#### Macroscopic analysis of *Capsici fructus*

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

#### Biological effects and application of *Capsici fructus*:

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#### Sample 2. *Ephedrae herba (ephedra herb)*

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		

Basic group of BAS, %		<i>Ephedrine</i>
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**Macroscopic analysis of *Ephedrae herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Microscopic analysis of *Ephedrae herba***

	<p>Sign anatomic diagnostic features of <i>Ephedrae herba</i>:</p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>a.</li> <li>b.</li> <li>c.</li> <li>d.</li> <li>e.</li> <li>g.</li> <li>j.</li> <li>i.</li> <li>l.</li> <li>3.</li> </ol>
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**Biological effects and application of *Ephedrae herba*:**

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**Sample 3. *Colchici bulbotubera recens (colchicum corm)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Colchicine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

**Macroscopic analysis of *Colchici bulbotubera recens***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Colchici bulbotubera recens*:**

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***MPM containing purine alkaloids***

**Sample 4. *Theae folium (tea leaf)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

### Macroscopic analysis of *Theae folium*

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

### Biological effects and application of *Theae folium*:

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### Sample 5. *Coffeae semina (coffee bean)*

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		



**Macroscopic analysis of *Coffeae semina***

occurrence, fracture of drug		size	
shape		odour after grinding	
surface		taste	
colour		other diagnostic characters	
characters of ridges, their number			

**Biological effects and application of *Coffeae semina*:**

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***MPM containing tropane alkaloids***

**Sample 6. *Belladonnae folium* (belladonna leaf)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Atropine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Belladonnae folium***

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the		colour of upper leaf	

stem, occurrence of petiole		surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

**Microscopic analysis of *Belladonnae folium***

	<p>Sign anatomic diagnostic features of <i>Belladonnae folium</i>:</p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> </ol>
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**Biological effects and application of *Belladonnae folium*:**

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**Sample 7. *Belladonnae herba* (belladonna herb)**

	Latin name	English name
MPM		
MP		
Family		

Dissemination of MP		<i>Structural formula</i>          <i>Hyoscyamine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Belladonnae herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Biological effects and application of *Belladonnae herba*:**

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**Sample 8. *Belladonnae radices (belladonna root)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>Scopolamine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Macroscopic analysis of *Belladonnae radices***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Belladonnae radices*:**

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**Sample 9. *Hyoscyami folium* (henbane leaf)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Hyoscyami folium***

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of		colour of upper leaf surface	



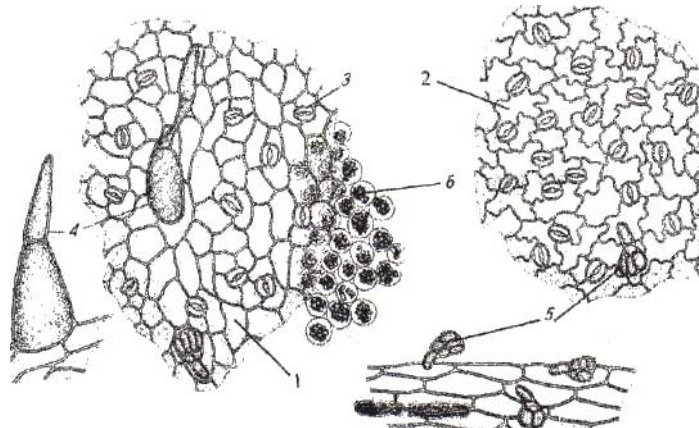
**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Stramonii folium***

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

**Microscopic analysis of *Stramonii folium***

	<p>Sign anatomic diagnostic features of <i>Stramonii folium</i>:</p> <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> </ol>
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**Biological effects and application of *Stramonii folium*:**

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**Sample 11. *Daturae innoxiae semen* (datura seed)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Daturae innoxiae semen***

occurrence, fracture of drug		size	
shape		odour after grinding	
surface		taste	
colour		other diagnostic characters	
characters of ridges, their number			

**Biological effects and application of *Daturae innoxiae semen*:**

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***MPM containing pyrrolizidine alkaloids***

**Sample 12. *Senecionis platyphylloides rhizoma et radices* (senecio rhizome and root)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		

Basic group of BAS, %		<i>Platyphylline</i>
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Senecionis platyphylloides rhizoma et radices***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Senecionis platyphylloides rhizoma et radices*:**

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**Sample 13. *Senecionis platyphylloides herba (senecio herb)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Senecifilline</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		



**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Senecionis platyphylloides herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Biological effects and application of *Senecionis platyphylloides herba*:**

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***MPM containing quinolizidine alkaloids***

**Sample 14. *Thermopsis herba (thermopsis herb)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

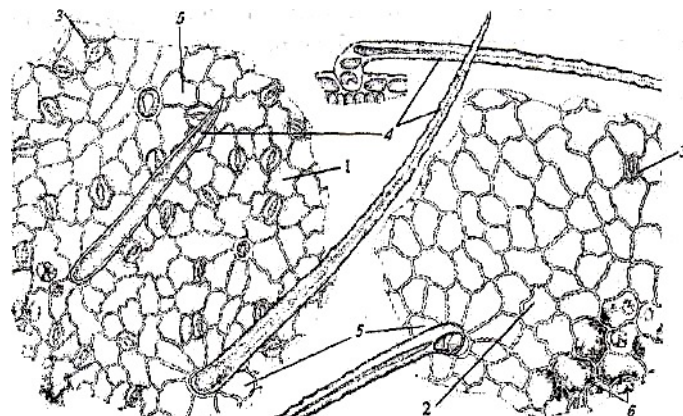
**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Thermopsis herba***

occurrence, fracture of drug		leaf size	
Stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Microscopic analysis of *Thermopsis herba***

	Sign anatomic diagnostic features of <i>Thermopsis herba</i> : <ol style="list-style-type: none"> <li>1.</li> <li>2.</li> <li>3.</li> <li>4.</li> <li>5.</li> <li>6.</li> </ol>
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**Biological effects and application of *Thermopsis herba*:**

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**Sample 15. *Thermopsis semina* (thermopsis seeds)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		
Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		

Storage conditions		<i>Cytisine</i>
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Thermopsisidis semina***

occurrence, fracture of drug		size	
shape		odour after grinding	
surface		taste	
colour		other diagnostic characters	
characters of ridges, their number			

**Biological effects and application of *Thermopsisidis semina*:**

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***MPM containing isoquinoline alkaloids***

**Sample 16. *Papaveris capitata* (poppy capsules)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Morphine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Papaveris capitata***

occurrence, fracture of drug		characters of ridges, their number	
fruit type		colour	
shape, size		odour after grinding	
surface		taste	
number of seeds		other diagnostic characters	

**Biological effects and application of *Papaveris capitata*:**


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**Sample 17. *Glaucii flavi herba (tulip poppy herb)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Glaucine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Glaucii flavi herba***

occurrence, fracture of drug		leaf size	
stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Biological effects and application of *Glaucii flavi herba*:**

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**Sample 18. *Chelidonii herba (celandine herb)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		

Basic group of BAS, %		<b>Chelidonine</b>
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Chelidonii herba***

occurrence, fracture of drug		leaf size	
stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Microscopic analysis of *Chelidonii herba***

Sign anatomic diagnostic features of *Chelidonii herba*:

- A.
- B.
- C.
- 1.
- 2.
- 3.

**Biological effects and application of *Chelidonii herba*:**

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**Sample 19. *Berberidis folium* (barberry leaf)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>       <b>Berberine</b>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Berberidis folium***

occurrence, fracture of drug		venation	
form of leaf		pubescence	
division of lamina		size of leaf blade and petiole	
leaf attachment to the stem, occurrence of petiole		colour of upper leaf surface	
leaf base		colour of lower leaf surface	
leaf apex		odour after grinding	
leaf margin		taste	

**Biological effects and application of *Berberidis folium*:**

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**Sample 20. *Berberidis radix* (barberry root)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>Berberamine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Berberidis radix***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Berberidis radix*:**

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*MPM containing indole alkaloids*

**Sample 21. *Rauwolfiae radix* (rauwolfia root)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>          <i>Serpentine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Rauwolfiae radix***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Rauwolfiae radix*:**

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**Sample 22. *Vincae minoris herba* (periwinkle herb)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>       <i>Vincamine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Vincae minoris herba***

occurrence, fracture of drug		leaf size	
stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Biological effects and application of *Vincae minoris herba*:**

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**Sample 23. *Catharanthi herba* (*catharanthus herb*)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Catharanthi herba***

occurrence, fracture of drug		leaf size	
stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Biological effects and application of *Catharanthi herba*:**

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**Sample 24. *Secale cornutum* (ergot)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Ergometrine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Biological effects and application of *Secalis cornuti cornua stam ergotamini* (ergotoxini):**

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**Sample 25. *Passiflorae herba* (passionflower herb)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		

Basic group of BAS, %		<i>Harmine</i>
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Passiflorae herba***

occurrence, fracture of drug		leaf size	
stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Biological effects and application of *Passiflorae herba*:**

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***MPM containing pseudoalkaloids***

**Sample 26. *Aconiti tubera* (aconite root)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		

<b>Family</b>		
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Dissemination of MP		<i>Structural formula</i>
Harvesting time		<i>Aconotine</i>
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Aconiti tubera***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Aconiti tubera*:**

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**Sample 27. *Delphinii herba (delphinium herb)***

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>       <b>Delphinine</b>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Delphinii herba***

occurrence, fracture of drug		leaf size	
stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	
leaf shape		colour of flower	
size of stem		pubescence	

leaf margin		odour after grinding	
venation type		taste	

**Biological effects and application of *Delphinii herba*:**

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**Sample 28. *Solani laciniati herba* (kangaroo apple herb)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Solanine</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Solani laciniati herba***

occurrence, fracture of drug		leaf size	
stem shape at transverse section		colour of leaf	
leaf attachment to the stem, occurrence of petiole		allocation of flowers on the stem	
colour of stem		flower size	



leaf shape		colour of flower	
size of stem		pubescence	
leaf margin		odour after grinding	
venation type		taste	

**Biological effects and application of *Solani laciniati herba*:**

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**Sample 29. *Veratri rhizoma cum radicibus* (*veratrum rhizome with radicibus*)**

	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Dissemination of MP		<i>Structural formula</i>
Harvesting time		
Drying conditions		
Storage conditions		
Basic group of BAS, %		
Other substances		
Standardization by the content of BAS		

*Jervine*

**Possible adulterants (Latin and common names):**

1. \_\_\_\_\_
2. \_\_\_\_\_

**Macroscopic analysis of *Veratri rhizoma cum radicibus*: *Veratri rhizoma cum radicibus***

occurrence, fracture of drug		outer surface colour	
shape		internal surface colour	
surface characters		odour after grinding	
section fracture		taste	
sizes		other diagnostic characters	

**Biological effects and application of *Veratri rhizoma cum radicibus*:**

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Signature of the teacher \_\_\_\_\_

**TOPIC: BATCH QUALITY ANALYSIS**

**Aim:** to learn to accept the MPM and sampling for batch quality analysis, to determine the identity, purity and quality of the investigated party LRS, which arrived at the analysis.

**Task 1.** To sample the medicinal plant material.

A batch of medicinal plant material is a quantity of medicinal plant material with the weight no less 50 kilos of the same official name, homogeneous according to all characters, which have one document of quality. Each unit is examined for detection of damage and accordance of packaging and labelling according to the requirement of the Pharmacopoeia monograph.

For verification of accordance of the MPM quality to the requirements of Pharmacopoeia monograph an excerpt from different parts of not damaged packages should be taken. In the case of damaged packages each unit is opened.

Carry out the sampling of medicinal plant materials according to the scheme (see below).

Take 3 samples of approximately equal quantity from the top, the middle and the bottom of a package. Combine them together. Mix and quarter, 2 of the diagonal quarters reject, the remaining 2 quarters combine and carefully mix and again quarter in the same way until the required quantity, to within  $\pm 10\%$  is obtained.

Take analytical sample No 1.

**Task 2.** To identify the medicinal plant material.

Prepare a cross section after studying macroscopic signs of the medicinal plant material. Put pieces of the material in boiling water for 10 minutes. After this procedure material becomes soft. Prepare a cross section with the help of a sharp knife or scalpel.

**A protocol pattern (tasks 1-2)**

Date \_\_\_\_\_

Part used	
The form and size	
The colour of outer surface	
Fracture	
Odour	
Taste	
Drawing :	Microscopic characters:

Histochemical reactions	
Conclusion	The examined sample is...

**Task 3.** To determine degree of contamination of the medicinal plant material by drug-eating insects. Determine contamination of medicinal plant material by drug-eating insects either by visual inspection and using magnifying lens.

Put the sample of medicinal plant material in the sieve with diameter of pores 0,5 mm. Calculate quantity of mites in medicinal plant material that passed through sieve pores. Calculate quantity of moth, its larva, pupa and imago and other drug-eating insects in medicinal plant material that didn't pass through sieve pores. Evaluate the quantity of insects per 1 kilogram of medicinal plant material and determine degree of contamination. If you found less than 20 mites per 1 kilogram, medicinal plant material is of the 1<sup>st</sup> degree of contamination; if more than 20 of mites, medicinal plant material is of the 2<sup>nd</sup> degree of contamination; more, than 50 mites, 3<sup>rd</sup> degree of contamination. The results of analysis write down in the protocol.

**Task 4.** To determine degree of fragmentation of the medicinal plant material according to the State Pharmacopoeia, XI-ed, and the State Standard (ГОСТ 24027.1-80).

The samples of medicinal plant material are sifted through the sieve with diameter of pores specified in Pharmacopoeia monograph. Calculate quantity of small non-standard fragments that passed through the sieve. Weigh small non - standard fragments and calculate content (%).

**Task 5.** To determine contents of contamination in the medicinal plant material.

Determine contents of contamination in the part, which remained after sifting. Weigh separately each kind of contamination and calculate its content (in %) using formula:

$$X = \frac{m_1 \times 100\%}{m_2}$$

where:  $m_1$  - mass of contamination in grams,  $m_2$  - mass of analytical sample.

**Task 6.** To determine contents of moisture in the medicinal plant material.

Determination of contents of moisture is carried out according to the State Pharmacopoeia, XI ed. (p. 285) and the State Standard (ГОСТ 24027.2-80).

Cut medicinal plant material (in analytical sample) with a knife or scissors to pieces about 10 mm in diameter, mix them and take 2 samples, weigh them with precision  $\pm 0,01$  g. Put each sample in a previously weighed laboratory kettle with a cover then put it in a drying oven, heated to  $+100$ - $+105^\circ$  C. Dry to the constant weight.

The weight may be accepted as constant if the difference between two successive weight measures after 30 min of drying in a drying oven does not exceed  $\pm 0,01$  g. Carry out the first weight measure of roots, fruits and barks after 3 hour, flowers and herbs after 2 hour. Chill the laboratory kettle and weigh. Calculate moisture of medicinal plant material by formula (in %):

$$X = \frac{(m - m_1) \times 100\%}{m}$$

where:  $m$  - mass of medicinal plant material before drying;  
 $m_1$  - mass of medicinal plant material after drying;



1	Small non-standard fragments being sifted through the sieve with diameter of pores _____ mm				
2	Contamination: - mineral (soil, sand) - organic: - of darkened and brown parts of a plant - of foreign organic matter				
3	Moisture				
4	Common ash				
5	Acid-insoluble ash				
6	Extractive matter				

**Conclusion:** (valuation of quality of medicinal plant material and recommendation on processing and uses in medicine)

### TOPIC: ANALYSIS OF ASSEMBLIES AND TEAS

**Aim:** to learn to determine the composition of assemblies and teas for medicinal plant raw materials; to determine the identity of various forms of cutted MPM on macroscopic and microscopic features according the methods of control quality.

**Task 1.** Conduct an analysis of the collection of MPM according the State Pharmacopea. Identify the components that are part of the collection using determinants of whole and cut raw materials. Analyze each component according to the scheme shown.

- I. Collection number \_\_\_\_\_ (name of the tea for use in medicine)
- II. Number of components in the collection \_\_\_\_\_
- III. Characteristics of each component:

#### Component number 1

Calculate the content of the component in the percentage collection by the formula:

$$X = \frac{m_1 \times 100}{m_2} = \text{-----} = \text{-----} \%$$

where  $m_1$  - component mass, g;  $m_2$  - mass of the analyzed sample, g

Describe the macroscopic diagnostic features of the researched MPM:

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Draw a schematic section of the microprepared substance of the researched MPM:

	Sign anatomic diagnostic features of MPM: 1. 2. 3. 4. 5. 6.
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Describe the results of the conducted qualitative and histochemical reactions:

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	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Indicate the pharmacological effect of the researched MPM:

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**Component number 2**

Calculate the content of the component in the percentage collection by the formula:

$$X = \frac{m_1 \times 100}{m_2} = \text{-----} = \text{-----} \%$$

where  $m_1$  - component mass, g;  $m_2$  - mass of the analyzed sample, g

Describe the macroscopic diagnostic features of the researched MPM:

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Draw a schematic section of the microprepared substance of the researched MPM:

	Sign anatomic diagnostic features of MPM: 1. 2. 3. 4. 5.
--	---

	6.
--	----

Describe the results of the conducted qualitative and histochemical reactions:

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	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Indicate the pharmacological effect of the researched MPM:

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**Component number 3**

Calculate the content of the component in the percentage collection by the formula:

$$X = \frac{m_1 \times 100}{m_2} = \text{-----} = \text{-----} \%$$

where  $m_1$  - component mass, g;  $m_2$  - mass of the analyzed sample, g

Describe the macroscopic diagnostic features of the researched MPM:

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Draw a schematic section of the microprepared substance of the researched MPM:

	Sign anatomic diagnostic features of MPM: 1. 2. 3. 4. 5. 6.
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Describe the results of the conducted qualitative and histochemical reactions:

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	Latin name	English name
<b>MPM</b>		
<b>MP</b>		
<b>Family</b>		

Indicate the pharmacological effect of the researched MPM:

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**Component number 4**

Calculate the content of the component in the percentage collection by the formula:

$$X = \frac{m_1 \times 100}{m_2} = \text{-----} = \text{-----} \%$$

where  $m_1$  - component mass, g;  $m_2$  - mass of the analyzed sample, g

Describe the macroscopic diagnostic features of the researched MPM:

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Draw a schematic section of the microprepared substance of the researched MPM:

	Sign anatomic diagnostic features of MPM: 1. 2. 3. 4. 5. 6.
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Describe the results of the conducted qualitative and histochemical reactions:

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	Latin name	English name
<b>MPM</b>		



<b>MP</b>		
<b>Family</b>		

Indicate the pharmacological effect of the researched MPM:

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**Component number 5**

Calculate the content of the component in the percentage collection by the formula:

$$X = \frac{m_1 \times 100}{m_2} = \text{-----} = \text{-----} \%$$

where  $m_1$  - component mass, g;  $m_2$  - mass of the analyzed sample, g

Describe the macroscopic diagnostic features of the researched MPM:

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Draw a schematic section of the microprepared substance of the researched MPM:

	Sign anatomic diagnostic features of MPM: 1. 2. 3. 4. 5. 6.
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Describe the results of the conducted qualitative and histochemical reactions:

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	<b>Latin name</b>	<b>English name</b>
<b>MPM</b>		

<b>MP</b>		
<b>Family</b>		

Indicate the pharmacological effect of the researched MPM:

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### INDEPENDENT STUDENTS WORK

1. Read the composition of the main assemblies, write the main BAS of all components of the teas and their pharmacological action.

№ з/п	Name of the assemblies	Composition of the assemblies	BAS of all component of the assembly	Pharmacological action of the assembly
1.	<i>Species vitaminicae</i> №1	Rosae fructus Ribes nigri fructus	50,0 50,0	
2.	<i>Species vitaminicae</i> №2	Rosae fructus Sorbi fructus	50,0 50,0	
3.	<i>Species carminative</i> ΦC 42-1027-75	Menthae piperitae folia Foeniculi fructus Valerianae rhizomata cum radicibus	33,3 33,3 33,3	
4.	<i>Species pectorales</i> №1 ΦC 42-1030-75	Althaeae radices Farfarae folia Origanum herba	40,0 40,0 20,0	
5.	<i>Species pectorales</i> №2 ΦC 42 Y-18-438-99	Farfarae folia Plantaginis majoris folia Glycyrrhizae radices	40,0 30,0 30,0	
6.	<i>Species pectorales</i> №3 ΦC 42-1219-78	Pini gemmae Althaeae radices Glycyrrhizae radices Anisi fructus Salviae folia	14,4 28,8 28,8 14,4 14,4	
7.	<i>Species amarae</i> ΦC 42-1017-75	Absinthii herba Millefolii herba	80,0 20,0	

8.	Species cholagogae ΦC 42-1029-75	Helichrysi flores Menyanthidis trifoliatae folia Menthae piperitae folia Coriandri fructus	40,0 30,0 20,0 10,0		
9.	Species cholagogae BΦC 42-639-77	Helichrysi flores Millefolii herba Menthae piperitae folia Coriandri fructus	40,0 20,0 20,0 20,0		
10.	Species cholagogae TY Y 22165380.002-99	Glycyrrhizae radices Chelidonii herba Origani herba Chamomillae flores Menthae piperitae folia	10,0 10,0 10,0 20,0 20,0		
11.	Species sedative ΦC 42-1026-75	Menthae piperitae folia Menyanthidis trifoliatae folia Valerianae rhizomata cum radicibus Lupulus strobuli	33,3 33,3 16,7 16,7		
12.	Species sedative ΦC 42 Y 18-293-98	Menthae piperitae folia Leonuri herba Valerianae rhizomata cum radicibus Lupulus strobuli Glycyrrhizae radices	15 40 15 20 10		
13.	Species sedative TY Y 22165380.004-99	Menthae piperitae folia Leonuri herba Valerianae rhizomata cum radicibus Lupulus strobuli	20 40 20 20		
14.	Species vitaminice	Urticae dioicae folia Sorbi fructus	30,0 70,0		
15.	Species sudoriphicae №1 ΦC 42-1025-75	Rubi idaei fructus Tiliae flores	50,0 50,0		
16.	Species sudoriphicae №2 ΦC 42-1018-75	Rubi idaei fructus Farfarae folia Origani herba	40,0 40,0 20,0		
17.	Species purgative №1	Frangulae cortex Urticae dioicae folia Millefolii herba	30,0 20,0 10,0		
18.	Species purgative №2 ΦC 42-1348-79	Sennae folia Rhamni fructus Frangulae cortex Anisi fructus Glycyrrhizae radices	30,0 20,0 20,0 10,0 10,0		

19.	Species nephricae TY Y 22165380.001-99	Phaseolus exocarpii Myrtilli cornus Millefolii herba Equiseti herba Hyperici herba	15 15 15 30 25		
20.	Asthmatinum	Stramonii folia Hyoscyami folia Sodium nitritis	0,86 0,22 0,12		
21.	Species antihemoroidales ΦC 42-1203-78	Sennae folia Millefolii herba Frangulae cortex Coriandri fructus Glycyrrhizae radices	20,0 20,0 20,0 20,0 20,0		
22.	Species antidiabetes Arphasetinum ΦC 42-1511-86	Myrtilli cornus Phaseolus exocarpii Araliae radices Rosae fructus Equiseti herba Hyperici herba Chamomillae flores	20,0 20,0 15,0 15,0 10,0 10,0 10,0		
23.	Species diuretice №1 ΦC 42-1027-75	Uvae ursi folia Centaureae cyani flores Glycyrrhizae radices	30,0 10,0 10,0		
24.	2 Species diuretice №2 ΦC 42-1028-75	Uvae ursi folia Glycyrrhizae radices Juniperi fructus	40,0 20,0 40,0		
25.	Species stomachicae ΦC 42-1043-76	Frangulae cortex Urticae dioicae folia Menthae piperitae folia Valerianae rhizomata cum radicibus Calami rhizomata	30,0 30,0 10,0 10,0 10,0		
26.	Species antisepticae Species “Aeilecasolum” ΦC 42 Y-18-356-98	Bidentis herba Chamomillae flores Glycyrrhizae radices Salviae folia Eucalypti folia Calendulae flores	10 10 20 20 20 20		

2. Give examples of types of MPM that can be part of the tea with the following pharmacological properties: immunostimulative, sedative, anti-ulcer, anti-hemorrhoidal, anti-sclerotic, antiallergic, diuretic, hypoglycemic, choleric, hemostatic, anti-inflammatory, appetite, laxative, hypoazotemic,

antihypertensive, anticoagulant , litholytic, expectorant, astringent, hepatoprotective, as well as for the treatment of cystitis, heart failure, cholelithiasis do, pyelonephritis, avitaminosis, angina pectoris, chronic colitis in the form of a table according to the scheme:

Pharmacological and pharmacotherapeutic properties of the assemblies	Latin and Ukrainian names of MPM, MP, families	Biological active substances of MPM	Qualitative or hystochemical reactions identification of MPM
1	2	3	4

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**Signature of the teacher** \_\_\_\_\_

## Appendix 1

### Structural formulas of biologically active substances

#### TOPIC: SIMPLE PHENOLS

arbutin	methyларbutin	hydroquinone	thyrosol
phloroglucin	salicylic acid	methylsalicylate	salidroside
caffeic acid		chlorogenic acid	

## TOPIC: CUMARINS AND CHROMONS

coumarin	dicoumarin
aesculetine	psoralen
xanthoxine	bergaptene
isopimpinelline	visnagine



khellin	visnadine
---------	-----------

**TOPIC: LIGNANS AND XANTHONS**

schizandrine	syringoresinol
silybin	podophyllotoxin
1,6,8-trihydroxy-3,5,7-trimethoxyxanthon	glucomangiferin

## TOPIC: FLAVONOIDS

flavan	catechin
anthocyanidine	leucoanthocyanidine
flavanone	flavanonole
flavone	flavonole

chalkon	dihydrochalcone
auron	quercetine
routine	hyperoside

**TOPIC: ANTHRAQUINONE DERIVATIVES**

anthracene	anthraquinone
anthrone	anthranol

emodine	chrysophanol
rheum-emodine	aloe-emodine
alizarine	ruberithrinic acid
sennoside	hypericine

**TOPIC: TANNINS**

catechine	anthocyanidine
leucoanthocyanidine	gallic acid
theogalline	ellagic acid
structure of gallotannin	

**TOPIC: ALKALOIDS**

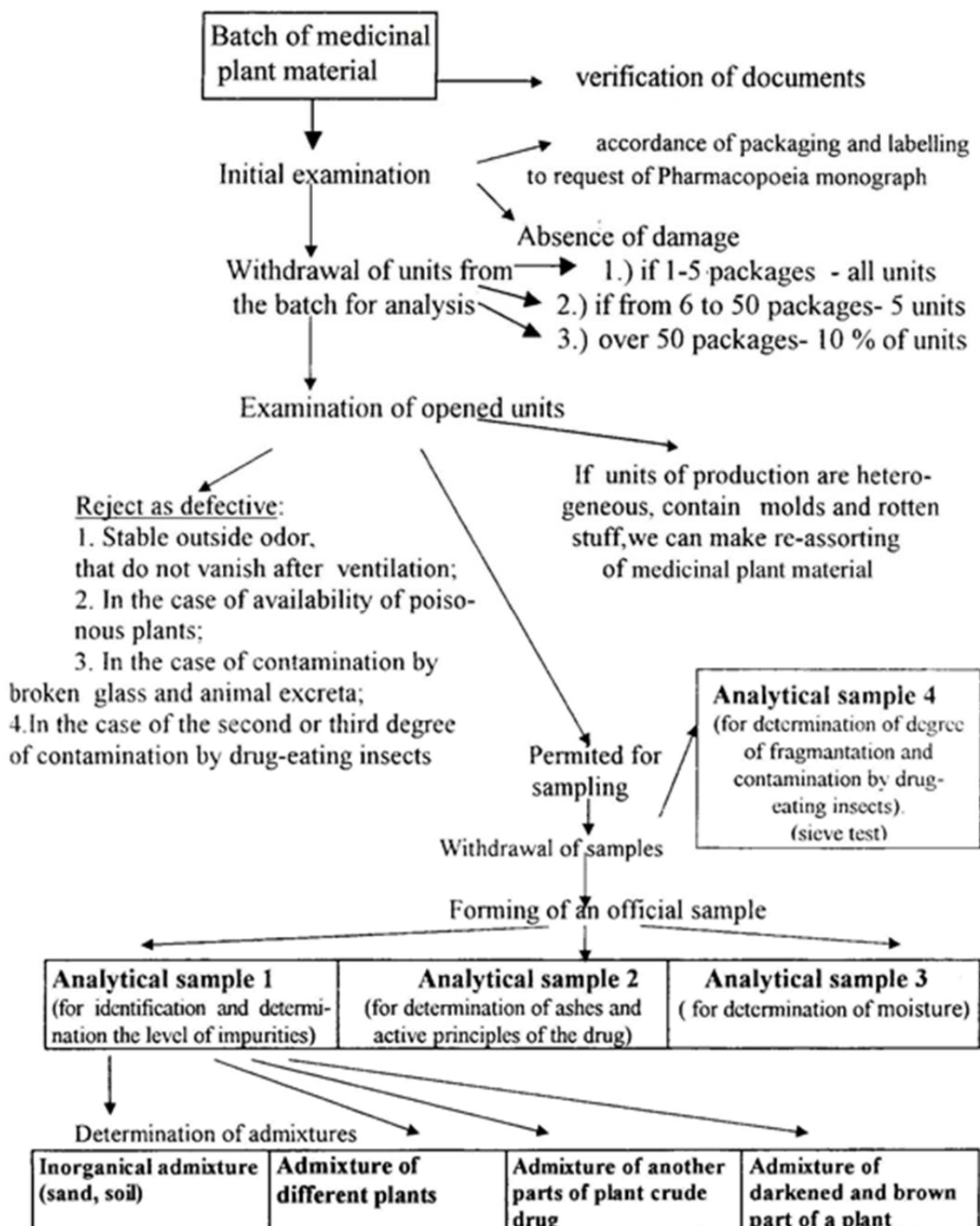
capsaicine	ephedrine

colchamine	plathyfilline
atropine	scopolamine
papaverine	cytizin
glaucine	morphine

garmine	ergotamine
vincristine	vincamine
caffeine	theophylline

## SCHEME

for sampling of medicinal plant material and selected samples





## Weight average and analytical samples of MPM for batch quality analysis

Name of crude drugs	State Standards	Numerical index								
		moisture	total ash	Acid insoluble ash	foreign organic matter	Inorganic matter	Darkened parts	other plant parts	non-Standard parts	active principles
		no more than.... %								
1	2	3	4	5	6	7	8	9	10	11
<i>Folia Menthae piperitae</i>	St.Pharmacopoeia	14	14		1	1	5	10	5	
<i>Folia Salviae officinalis</i>	-” “-	14	12		0,5	0,5	5	10	3	
<i>Folium Urticae dioicae</i>	-” “-	14			2	1		5	10	
<i>Herba Hyperici</i>	-” “-	13	8		1	1	1		10	
<i>Herba Equiseti arvensis</i>	State St.	13	24		4			10		
<i>Herba Absinthii</i>	State St.	13	13		2	1,5	3		5	
<i>Rhizomata et radices Valerianae</i>	St.Pharmacopoeia	16	14							
<i>Folia Tussilago farfarae</i>	State St.	13	20		1	3		3		
<i>Herba Chelidonii</i>	St.Pharmacopoeia	14	15		1	0,5	3			
<i>Radices Belladonnae</i>	State St.	13	6		0,5	1	3	3	3	
<i>Radices Rhei</i>	St.Pharmacopoeia	12	8		0,5	0,5	5		5	
<i>Cortex Quercus</i>	-” “-	15	8		1	1	5		3	
<i>Cortex Frangulae</i>	-” “-	15	5		0,5	0,5		1		

## SAFETY PRECAUTIONS

Execution of educational and scientific experimental work at the Department of Pharmacognosy and Botany in educational and research laboratories associated with various chemicals (organic solvents, acids, alkalis), plant materials using, different chemical utensils, equipment and devices. Therefore, in the laboratory spaces there are continuously possible dangerous and harmful factors which can effect on students. These factors can lead to work-related injury and fire hazards.

Students are admitted to practical training in chemical lab only after a detailed briefing on safety and fire precautions.

Each student works in the laboratory must know the location of fire fighting and be able to know where the first aid kit and know how to provide first aid for various injuries.

Experimental part begins only after a thorough acquaintance with chemical dishes, technique experiments, properties, purpose reagents and solvents used, and the rules of work with devices. The workplace should only has necessary reagents, instruments and a notebook to record results.

Before using glass and porcelain tableware check its purity and integrity. Do not work with the dishes that have chips, cracks, deep scratches.

All transactions with flammable liquids, concentrated acids and alkalis, experiments with the formation of gases and work with metallic sodium should be performed only in a fume hood, if necessary, should use personal protective equipment (masks, goggles, mask, gloves, etc.). Smell of substance in a test tube or flask determine carefully directing couples to himself flick of the wrist. Mixing and dilution of chemicals, accompanied by heat, spend with heatproof bowl and porcelain.

Do not allow heat flasks with inflammable liquids over an open fire, avoid getting water on the heated external surface of glass vessels, gently and carefully to treat laboratory glassware and equipment.

Acids and bases to dial in using only the dropper rubber pear, forbidden to absorb acid and alkali liquid in the pipette mouth, because it can cause burns and poisoning.

Heating of substances in hermetically sealed vessels (safety explosion!) is strictly forbidden. To prevent the release of liquid from the reaction vessel should be carried out uniformly heating the to put to the bottom of the vessel 2-3 boiling stones (pieces of porous inorganic material).

Heating tubes of substances should be carried out at periodic shaking, vent tubes should be directed away from yourself and others that work.

Take and carry glass with substances should, covering them with hand from side, not the neck.

Do not leave without supervision laboratory installation, operating and equipment included.

***It is strictly forbidden to drink water from the chemical dishes, eat, smoke at the laboratory.***

After work should be thoroughly washed and put to dry dishes, cups and place shtanhlasy on their location, wipe the work surface of the table, close the gas and water valves, turn off appliances and exhaust ventilation.

*In case of pouring concentrated acid*, it must first fill with sand so that it is absorbed acid. Sand collect in the container and make out of room to place waste collection. Polluted place pouring rinse with water and wipe dry.

*In case of pouring concentrated and ammonia* - they can fill as sand and sawdust. Pouring place by weak solution of acetic acid after collecting sand or sawdust.

*In case of fire* in a laboratory situation should turn off gas appliances, exhaust ventilation and remove all flammable material from the fire area. Shouting loudly advertise on fire people working together and in neighboring areas.

It is necessary to take urgent measures to eliminate the fire using fire extinguishers or sand. Do not fill the flames with water that in many cases this leads to expansion of the fire. Only water-soluble substances (alcohol, acetone, etc.) quenched with water. In case of fire clothes should not run, you need to throw the victim's robe located in a prominent and accessible place.

**Provision for first aid** is the duty of everyone! In providing assistance priority should be to eliminate the cause of the injury, turn off the power grid, extinguish the flame, remove from the wound

pieces of glass or substance that causes burns, etc. ; the victim must create conditions for the most comfortable position and provide first aid.

If *cuts* must be removed with tweezers glass pieces of glass and wash the wound 3% solution of hydrogen peroxide. The skin around the wound grease 5% solution of iodine and apply a sterile bandage. In severe bleeding tourniquet and attach a note with precisely specified time imposing and send poterpitsloho doctor.

When I degree *thermal burns* (redness) burnt areas should be cool running water, while more severe burns to the provision of skilled care - apply dry aseptic bandage. Do not remove the skin from the burnt remains of clothes that burned.

*Burns by concentrated acids* affected skin should be washed with plenty of water for 10-15 minutes and then process the 2% solution of sodium bicarbonate and again rinsed with water.

*Burns by concentrated alkalis* affected area should be washed with plenty of water, and then - a 1% solution of acetic acid.

When *hit acids or alkalis to the eyes*, they should immediately wash with water for 10-15 minutes, then, if getting acid - 2% solution of sodium bicarbonate, and when it enters the meadow - isotonic sodium chloride solution for 30-60 minutes. After thorough rinsing eyes should consult a doctor.

After *burns by phenol* rub the affected area till restore the natural skin colour.

If poisoning by *gas substances* bring the victim to fresh air and create him complete rest and call a doctor.

When *electric shock* turn off power and, using a wooden or plastic objects poterpioho release from contact with electric wire. It is necessary to ensure the victim calm and bring it to life.

If *breathing or heartbeat stops* it's necessary to carry out artificial respiration and chest compressions and do not stop these operations to full functional recovery or the arrival of the medical workers.

#### **Safety precautions at work, harvesting, drying, processing and storage of plant material that contains toxic and potent substances (alkaloids, cardiac glycosides, etc.):**

1. Teenagers, students are allowed to collect only under the supervision of the responsible team leader or instructor. By collecting MP, which contain these substances, it is better to include the adult population to collect datura, henbane, hellebore teenagers do not allow!

2. During the assembly should not touch your eyes, the face, not to eat. After collecting wash hands thoroughly with soap and water.

3. During the processing, drying, sorting, packaging protecting mouth and nose with a respirator, wet gauze, eye - protective glasses. Do not take food or smoke.

4. After thoroughly shake out of clothes, wash clothes, wash the face with soap and water, wipe with a dust mask, goggles, gauze.

5. When the need to have a first aid kit.

6. To work with the potent and poisonous MP not allowed zhinkm pregnant and lactating.

**Textbook**

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# **Laboratory Handbook on Pharmacognosy**

## **Part II**

*Відповідальний за випуск Мінарченко В. М.*

Підписано до друку 03.05.2018 р. Папір офсетний. Зам. № 0215 . Формат 60x84/8

Друк офсетний. Наклад 150 пр.

Умов. друк. арк. 0,93. Гарнітура Times New Roman

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Свідоцтво про внесення суб'єкта видавничої справи до Державного реєстру видавців,  
виготівників і розповсюджувачів видавничої продукції  
(серія ДК № 283 від 18.12.2000 р.)

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Віддруковано в друкарні ФОП ПАЛИВОДА А. В.

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