IRSTI 34.29.25; 31.23.17 https://doi.org/10.26577/ijbch.2020.v13.i2.09

T.N. Kobylina[1*], N.M. Mukhitdinov[1], K.T. Abidkulova[1],
N.V. Kurbatova[1], N.O. Kudrina[2], M.B. Alimkulova[1],
Jurate Zaltauskaite[3]

[1] Al-Farabi Kazakh National University, Almaty, Kazakhstan
[2]Central Laboratory for Biocontrol, Almaty, Kazakhstan
[3]Vytautas Magnus University, Kaunas, Lithuania
*e-mail: kobylina.tatyana.n@mail.ru

Anatomic-morphological and phytochemical study of an rare species - *Rheum wittrockii* Lundstr.

Abstract. The article presents the features of the anatomical and morphological structure of the vegetative organs of *Rheum wittrokii* Lundstr. and the results of its qualitative and quantitative phytochemical analyses. The structure of the leaf shows the presence of calcium oxalate druses, which are located mainly under the layer of columnar mesophyll, along the Central part of the leaf blade. Druses in the spongy parenchyma are clearly distinguished and have an almost spherical shape with a peculiar needle-like structure. In the main vein, sections of the sclerenchymic lining are adjacent to the conducting bundle. The covering tissue of the roots has a secondary structure and is represented by a three-layer periderm. In the cells of the main parenchyma of the cortex, numerous calcium oxalate druses are found, which have a round-crystal configuration and are collected in small groups. The vessels of the root xylem are large with ladder and mesh perforation. Features of the main stem parenchyma are its larger, rounded-oblong or oval shape with slightly thickened cell walls. The revealed anatomical features can be used in the case of the diagnosis of medicinal plant raw materials. The study of the chemical composition, the study of biological activity and the development of new herbal medicines is relevant. As a result of studying the chemical composition of the ethanol extract of *Rheum wittrokii* obtained by extracting 96% ethanol, 8 main components were identified. Rhizomes are dominated by chrysophanic acid with an identification probability of 41.4%. The presence of components was found: chrysarobin, chrysophanic acid, emodin-3-methyl ether, emodin-1,3,8-trihydroxy-6-methylanthracene-9,10-dione, which are directly involved in the body's metabolism, providing antioxidant, antiseptic and anti-cancer effects, and also help in the removal of toxins from the body, which has a beneficial effect on the liver, increasing the level of glycogen.

Key words: *Rheum wittrokii* Lundstr., rare species, anatomical and morphological characteristics, phytochemical composition, extracts.

Introduction

The greatest phytochemical interest is the study of the root of this species. The rhizome of an rare species Rheum wittrokii Lundstr. contains two main groups of biological substances. The first group includes tannoglycosides-tannins that have antiseptic, antidiarrheal, and astringent properties. Atroglycosides, the second group, are substances that can enhance intestinal peristalsis. Plant raw materials have good choleretic and laxative properties. In the autumn, raw materials are harvested, the decoction of which is used for anemia and tuberculosis, as well as it contains carbohydrates, organic acids, catechins, anthraquinones [1].

Currently, research on the study of rare plant species that are vulnerable and endangered, have a small habitat and are subject to anthropogenic factors, as well as the possibility of obtaining effective herbal medicines with medicinal properties is of particular relevance [2; 3]. To date, the species composition of the flora of South-Eastern Kazakhstan, its number and location of endemic and rare species is little studied and requires a comprehensive study [4; 5]. More than 6 thousand vascular plants with biologically active substances are found in the flora of Kazakhstan, which require special attention to study the factors of their vital activity: the ecological state of populations, the degree of land degradation that determine the species number, their composition, loca-

tion, geographical distribution, which contributes to the restoration and further existence of the dominant in natural conditions [6].

The flora of Kazakhstan consists of 68 species of trees, 266 species of shrubs, 433 species of semi-shrubs, 2598 species of perennial grasses and 849 species of annual grasses, as well as 515 endemic species, 303 species listed as vulnerable, endangered and rare plants, including *Rheum wittrokii*. The *Polygonaceae* family includes about 30 genera and 800 species that are widely distributed around the globe, especially in the Northern temperate zone. Species of the *Polygonaceae* family are characterized by the presence of tannins in all parts of the plants, especially in the rhizomes, which are used as excellent tanning agents, being a valuable raw material for the tanning and extraction industry [7-10]. Rhubarb varieties are very valuable medicinal herbs containing secondary metabolites that grow in the mountainous and flat-desert regions of Kazakhstan: on the grassy and forest slopes of the mountains. Occurs in Dzhungarian Alatau, Zaili Alatau, Kirghiz Alatau, Kungei and Terskei Alatau, Ketmen ridge, Western Tien Shan [11-13].

Rheum wittrokii Lundstr. - a perennial herb with a juicy, furrowed, hollow inside, stem, 50-100 cm high, with reddish droplets and stripes. Numerous fleshy roots radiate from the powerful short rhizome. The basal leaves are five-and seven-lobed, having a diameter of up to 75 cm, at the top with scattered small villi, on the reverse side along the entire surface densely pubescent with long hairs, and on long, up to 30 cm, cylindrical, often reddish cuttings, collected by a rosette. Stem leaves are ovate-triangular, alternate, up to 10 cm in diameter, with short cuttings. Whitish-pink or red flowers are small, regular, bisexual, collected in numerous paniculate inflorescences and are up to 2 mm long. The fruit is a three-sided, broad-winged and wrinkled, brownish-red nut. *Rheum wittrokii* blooms in the third year of life in June-July and bears fruit in July-August. It grows on grassy and forest slopes of mountains, in the habitat of dark coniferous forests, in open spaces between trees, in infrequent spruce trees and cracks in rock crevices, in the forest, rising to the subalpine belt.

Some chemical components from *Rheum* L. species are pharmacologically important. They are used as a herbal therapeutic agent, in vegetables and for the preparation of natural dyes. More than 250 components, including anthraquinones (emodin, chrysophanol, phizion, aloe-emodin and emodin glycides), antrons, flavonoids, acylglucosides, pyrons stilben, tanning components, etc. are the main biologically active substances of rhubarb, which are widely used in folk medicine: for the treatment of fever, dysentery, blood clotting, laxative, antitumor, and are also used for various skin diseases [14; 15].

The healing potential of rhizome extracts of *Rheum wittrokii* is a promising direction for further study of its biologically active components as sources of necessary compounds for life and its maintenance, including those caused by adverse environmental factors. In the absence of additive effects biologically active compounds of natural origin have a therapeutic effect on the regulation of the main metabolic processes of the body [16].

Materials and methods

Plant raw materials were collected in July 2019, in the flowering phase in the Almaty region (Butakovsky gorge), on the left bank of the Butakovka river, the slope of the South-Eastern exposure with a steepness of 40-450. The soil on which this species grows is mountain black soil. Collection coordinates: N 43010/19//, E 07706/50//, 2183 m above sea level.

The objects of anatomical and morphological research were vegetative organs (leaf blade, root and stem) of *Rheum wittrockii* Lundstr. Raw materials were collected and dried in accordance with the requirements of the State Pharmacopoeia of the Republic of Kazakhstan [17].

The extraction of raw materials was carried out twice. Combined extract concentrated and dried in vacuo. Research was carried out in the Laboratory Ecology of the Biosphere, RSE Al-Farabi KazNU, SSE Center for Physical and Chemical Methods of Research and Analysis, and Laboratory of plant anatomy and morphology (Al-Farabi KazNU).

In laboratory conditions, plant material was recorded in order to study the features of the anatomical structure of the plant. Conservation of plants was carried out by the method of Strasburger-Flemming. The preserving liquid was a mixture of alcohol-glycerine-water in a ratio of 1:1:1. Fixation was performed in 96% ethyl alcohol. Aboveground and underground vegetative organs of the studied species were recorded [18; 19].

Anatomical sections were enclosed in glycerine and balsam. Anatomical preparations were made using a microtome with a TOC-2 freezing device (made in USSR).

Microphotographs of anatomical sections were made using a MC 300 microscope (magnification 10x14, 10x20, 10x40) with a CAMV400/1.3 m video camera (Micros company, Austria).

Anatomical and morphological studies were conducted in accordance with generally accepted methods [20-22].

As part of the phytochemical study, the extraction of biologically active substances of plants was carried out using 96% ethyl alcohol. 10 g of dry, crushed raw material was selected, then 50 ml of alcohol was extracted by infusing at room temperature for 5 hours, then 1.5 ml of the extract was transferred to 2 ml vials and analyzed by chromatographic method with mass spectrometric detection (Agilent 7890B/5977A, USA). The analysis conditions were as follows: sample volume 3.0 µl, sample input temperature 240 °C, without flow division. Separation was performed using a chromatographic capillary column DB-35MS (Agilent, USA) with a length of 30 m, an internal diameter of 0.25 mm and a film thickness of 0.25 microns at a constant velocity of the carrier gas (helium) 1 ml/min. The chromatography temperature is programmed from 40 °C (0 min exposure) to 300 °C with a heating rate of 10 °C/min (15 min exposure). Detection was performed in the SCAN mode m/z 34-750. Agilent MSD ChemStation software (version 1701EA, USA) was used to control the gas chromatography system, record and process of the obtained results and data. Data processing included determination of retention times, peak areas, and processing of spectral information obtained using a mass spectrometric detector. The Wiley 7th edition and NIST'02 libraries were used to decipher the obtained mass spectra (the total number of spectra in the libraries is more than 550 thousand).

Results and discussion

Microscopic studies were performed to determine the morphological and anatomical features of roots, stems and leaves.

It is noted that the leaf blade of wittrock rhubarb has a single-layer upper and lower epidermis in cross-section (Figure 1). The upper epidermis consists of narrow cells of an oblong shape with rare single simple hairs. The lower epidermis consists of rounded and rounded-oblong thin-walled cells, between which there are single stomata. The cells of the upper and lower epidermis are weakly sinuous, connected tightly and covered with a thin layer of cuticle. Under the upper epidermis, the palisade mesophyll is located in two rows, the cells of the spongy mesophyll are located under the columnar mesophyll of the leaf blade and have a loose structure, quite large, with numerous intercellular cells filled with air, elongated and few. In vittrok rhubarb, calcium oxalate druses are noted in the structure of leaf blades, which are located mainly under the layer of columnar mesophyll, along the Central part of the leaf blade. Druses in the spongy parenchyma are clearly distinguished and have an almost spherical shape with a peculiar needle-like structure. The conducting system in the area of the Central part of the leaf blade is represented by two open collateral conducting bundles. One small, and the other larger. The conducting beams are surrounded by a parenchymal lining. In the main vein to the conducting beam adjacent areas sclerenchyma lining. Conducting bundles have a thin lining formed of sclerenchyma cells.

Figure 1 – Cross section of a leaf of Rheum wittrockii (magnification 200).
1-upper epidermis, 2-lower epidermis, 3-columnar mesophyll, 4-spongy mesophyll, 5-central conducting bundle, 6-sclerenchyma cells, 7-calcium oxalate druses

Biometric indicators of the leaf blade of wittrock rhubarb were determined, average measurements of the anatomical structure of the leaf blade were obtained by repeating ten times. Results of the Table 1 show that the cells of the lower epidermis are larger, and the thickness of the columnar mesophyll is expressed better than the thickness of the spongy mesophyll.

When studying the anatomical structure of the root of *Rheum wittrockii*, it was noted that it has a rounded shape and consists of tissues of the central cylinder and primary cortex. From the surface is the periderm (plug). Integumentary tissue of roots secondary structure represented by a three-layer periderm (vellema, phellogen, theloderma). The cork layer consists not only of old flaking layers, but also has new layers consisting of even rows of cells,

regular, elongated rectangular shape in an amount of 3 to 5. Next, after the periderm, is the main parenchyma of the cow part of the root, individual cells of which have numerous starch grains-inclusions of a rounded fine-grained structure. Rounded, loosely located cells of the cow parenchyma have more or less thickened cell walls and irregular shape of the cavities. In the cells of the main parenchyma of the cortex, numerous calcium oxalate druses are found, which have a round-crystal configuration and are collected in small groups. The root of the secondary structure is characterized by the presence of a cambial ring that stands out on the cross section. To the center of the cambium are the elements of the secondary xylem, and to the periphery of the secondary phloem. In the secondary xylem, the primary radial rays of the parenchyma are slightly visible, reaching the center of the root, the primary xylem. The secondary phloem of the root has small breaks, wider to the periphery, evenly spaced along the radius of the root. Xylem vessels are large with stair and mesh perforations. The primary xylem, represented by several vessels, is preserved in the center of the root (Figure 2).

Biometric indicators of the vittrok rhubarb root were determined (Table 2). Table 2 shows the average measurements of the anatomical structure of the root obtained by repeating ten times.

Table 1 – Morphometric indicators of the anatomical structure of the leaf blade.

Thickness, µm				
Epidermis		Mesophyll		leaf blade
Upper	Lower	columnar	spongy	197.55± 14.02
10.06± 0.06	13.11± 0.09	93.23± 0.16	81.15± 0.24	

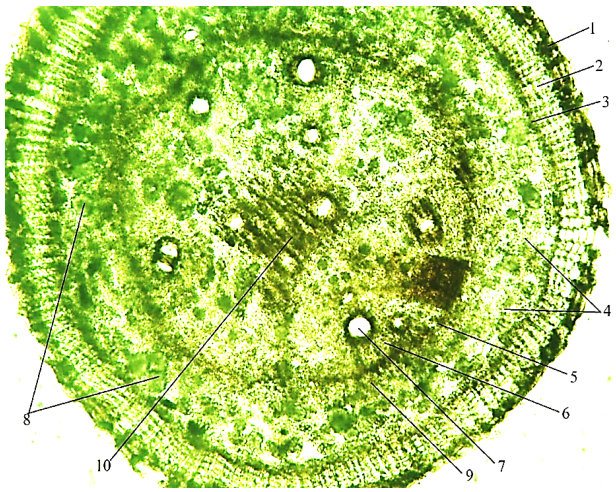

Figure 2 – Cross section of the root of *Rheum wittrockii* (magnification 140).
Note: 1-cork (fellema), 2-phellogen,3-phelloderm, 4-main parenchyma of the cortex,
5-cambial ring, 6-xylem parenchyma, 7-wood vessels (secondary xylem), 8 - calcium oxalate druses,
9 – secondary phloem, 10 – primary xylem.

.

Table 2 – Morphometric indicators of the anatomical structure of the root.

Thickness of the primary crust, µm	Diameter of the central cylinder, µm	Area of xylem vessels, µm^2
120.09± 7.12	161.28± 10.89	86.13± 16.81

It is noted that the diameter of the central cylinder exceeds the thickness of the primary crust.

On the cross section of the stem, it was noted that the shape of the stem is ribbed. Outside the stem is covered with one or two rows of small cells of the epidermis. The cells of the epidermis have an oval, elongated shape. Under the epidermis is the chlorophyll-bearing parenchyma of the primary cortex, consisting of 3-5 rows of loosely arranged isodiametric cells with inclusions.

The cells of the main parenchyma are larger, rounded-oblong or oval in shape with slightly thickened walls. It should be noted that the main part of the central cylinder is occupied by closely spaced vascular-fibrous conducting bundles of the collateral closed type. Each bundle has a distinct sclerenchyma the cover (Figure 3).

In the thickness of the central cylinder, large parenchymal cells are noted. The main biometric indicators of the stem include: the thickness of the primary bark, the diameter of the central cylinder and the area of xylem vessels, whose biometric indicators are shown in Table 3.

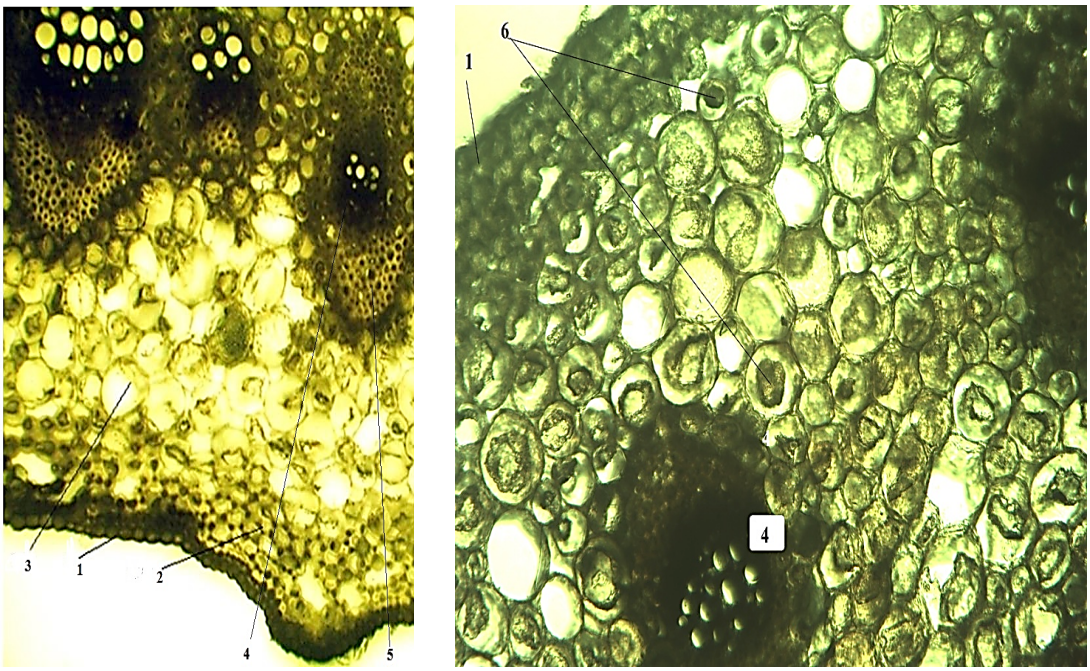

Figure 3 – Cross section of the stem *Rheum wittrockii* (magnification 140).
Note: 1-epidermis, 2-chlorophyll-bearing parenchyma of the primary cortex,
3-rounded cells of the primary cortex, 4-conducting bundle,
5-sclerenchymal lining of the bundle, 6-inclusions.

Table 3 – Morphometric indicators of the anatomical structure of the stem.

Thickness of the primary crust, µm	Diameter of the central cylinder, µm	Area of conducting beams, $x10^{-3}mm^2$
60.18± 3.32	123.17± 9.26	35.72± 6.42

Table 3 shows that the thickness of the primary crust is half the diameter of the central cylinder. Thus, the anatomical study of the leaf blade, root and stem of *Rheum wittrockii* allowed us to determine the features of their structure, as well as to identify additional diagnostic features. As a result of the morphological and anatomical studies of rhubarb wittrockii confirmed the classic structure of the root. Based on the results of morphological and anatomical studies, the criteria for differential diagnosis of the leaf blade, root and stem of *Rheum wittrockii* Lundstr. were determined, which allow for reliable identification of medicinal raw materials.

The next stage of the work was the phytochemical study of this species. Gas-liquid chromatography was used to determine the chemical components

of rhizomes of *Rheum wittrockii*, which allows the analysis, separation and purification of polymers, drugs, proteins, hormones, detergents and other biologically important compounds. When using highly sensitive detectors, the work was carried out with very small amounts of compounds (10^{-11}-10^{-9} g), which is very important. GC-MS chromatogram of the ethanol extract of *Rheum wittrokii* Lundstr. (Figure 4).

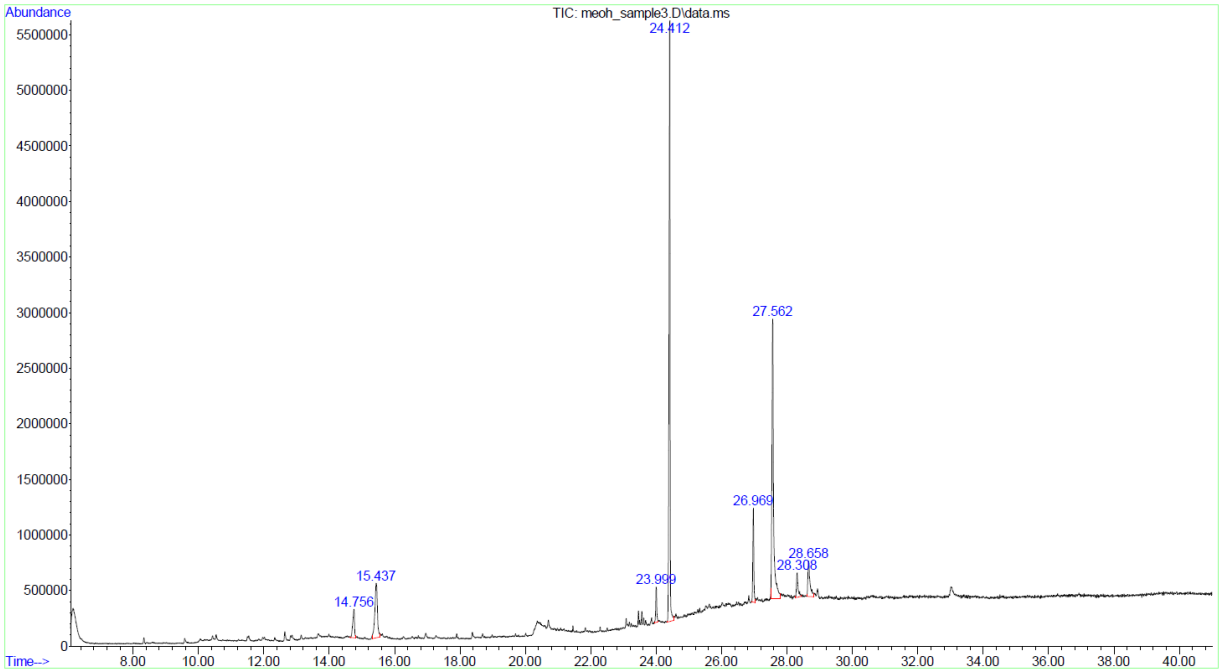

Figure 4 - Chromatogram analysis of *Rheum wittrokii* rhizome extract.

The chromatogram of the analysis of *Rheum wittrokii* rhizome extract (Fig. 4) shows the peak retention time (min) of the following components: sucrose - 14.8, levoglucosan - 15.4, chrysarobin - 24.0, chrysophanic acid - 24.4, emodin-3- methyl ether - 27.0, 4,4'-dimethoxy-2,2'-dimethylbiphenyl - 27.6, emodine 1,3,8-trihydroxy-6-methylanthracene-9,10-dione - 28.3, anthracene octahydrate , 3,9-dimethyl-4-hydroxymethyl-3- [[1-carboxy-2,5,6-trimethyl] heptyl] - 28.7 minutes.

As a result of studying the chemical composition of the ethanol extract *Rheum wittrockii* Lundstr. obtained by extracting 96% ethanol, 8 main components of various chemicals were identified using GC-MS. Chemical analysis of rhizomes allowed to determine useful and medicinal properties with the content of certain components (Figure 5).

Figure 5 determines the chemical content of *Rheum wittrokii* rhizome extract (%), which showed the results: sucrose - 3.2%, levoglucosan - 9.2%, chrysarobin - 2.4%, chrysophanic acid - 41.4%, emodin 3- methyl ether - 6.0%, 4,4'-dimethoxy-2,2'-dimethylbiphenyl - 30.3%, emodine 1,3,8-trihydroxy-6-methylanthracene-9,10-dione - 2.5% , anthracene octahydrate, 3,9-dimethyl-4-hydroxymethyl-3- [[1-carboxy-2,5,6-trimethyl] heptyl] - 4.9%.

Table 4 shows the list and number of biologically active components identified by GC-MS in rhizomes of *Rheum wittrokii*. In the course of a phytochemical study, 8 main compounds of various nature were isolated from the rhizomes of the studied species, according to literature sources: sucrose, laevoglucose, chrysarobin, chrysophanic acid, emodin 3-methyl ether, 4,4'-dimethoxy-2,2'-dimethylbiphenyl, emodin, anthracene octahydrate, 3,9-dimethyl-4-hydroxymethyl-3-[1-carboxy-2,5,6-trimethyl] heptyl], which are shown in table 4. It is obvious that with the probability of identification, the percentage of chrysophanic acid predominates in the rhizomes, which is 41.4%.

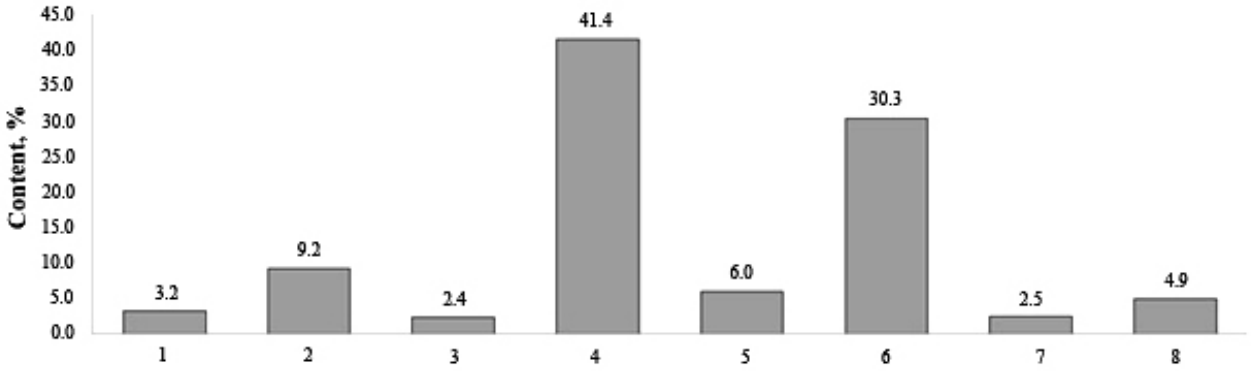

Figure 5 – Content of chemical substances in the extract of rhizomes of Rheum wittrokii (%).
Note: 1- Sucrose, 2 – Levoglucosan, 3 – Chrysarobin, 4 – Chrysarobin,
5 - Chrysophanic acid, 6 - 4,4'-dimethoxy-2,2'-dimethylbiphenyl, 7 - Emodine 1,3,8-trihydroxy-6-methylanthracene-9,10-dione,
8 - Anthracene octahydrate, 3,9-dimethyl-4-hydroxymethyl-3- [[1-carboxy-2,5,6-trimethyl] heptyl]

Table 4 – Results of chromatographic analysis of the extract of *Rheum wittrokii.*

No.	Retention time, min	Compound	Identification probability,%	Percentage,%
1	14.8	Sucrose	71	3.2
2	15.4	Levoglucose	80	9.2
3	24.0	Chrysarobin	69	2.4
4	24.4	Chrysophanic acid	93	41.4
5	27.0	Emodin 3-methyl ether	84	6.0
6	27.6	4,4'-dimethoxy-2,2'-dimethylbiphenyl	76	30.3
7	28.3	Emodin 1,3,8-Trihydroxy-6-methylanthracene-9,10-dione	71	2.5
8	28.7	Anthracene octahydrate, 3,9-dimethyl-4-hydroxymethyl-3-[[1-carboxy-2,5,6-trimethyl] heptyl]	74	4.9

From Table 4 it is seen that the components that make up the rhizomes of *Rheum wittrokii*, such as chrysophanic acid (41.4%), 4,4'-dimethoxy-2,2'-dimethylbiphenyl (30.3%), levoglucosan (9.2%), anthracene octahydrate, 3,9-dimethyl-4-hydroxy-methyl-3-[[1-carboxy-2,5,6-trimethyl] heptyl] (4.9%) are in the largest quantities. The smallest amount was found for emodin 3-methyl ether (6.0%), sucrose (3.2%), emodin 1,3,8-trihydroxy-6-methylanthracene-9,10-dione (2.5%) and chrysarobin (2.4%).

Results of chromatographic analysis of the extract, the activity of some of the studied components of rhizomes of *Rheum wittrokii* Content, % should be distinguished (Table 5).

From Table 5 it should be noted that in the extract of *Rheum wittrokii* rhizomes there are components, such as sucrose used in the treatment of type 2 diabetes mellitus, in the pharmaceutical industry for the manufacture of various medicines. Levoglucosan is an intermediate of the usual distillation of cellulose. Chrysarobin is intended for the treatment of skin diseases (lichen and eczema), is a product of the restoration of chrysophanic acid, has a stable, anti-inflammatory and absorbable effect, can be used for fungal infections of the fingers and feet, pro-inflammatory

and antipruritic, and also relieves cramping in the gastrointestinal tract and biliary tract. Chrysophane acid has an antioxidant effect and is used to treat skin diseases (lichen and eczema). Emodin 3-methyl ether suppresses 26 types of bacteria: *Staphylococcus aureus, Escherichia coli,* green sepsia, streptococcus and dysentery; participates in mutation in an experiment with salmonella TA1535; more strongly inhibits the growth of HeLa cells in cervical cancer, has antibacterial properties, is used as a laxative, etc. Emodin 1, 3, 8-trihydroxy-6-methylanthracene-9, 10-dione inhibits cell proliferation, induces apoptosis and metastasis prophylaxis, and is involved in the death of liver and lung cancer cells.

Table 5 – Activity of Rheum wittrokii rhizome extract.

No.	Components	Formula	Active action	Reference
1	Sucrose	$C_{12}H_{22}O_{11}$	useful in the treatment of type 2 diabetes, in the pharmaceutical industry for the manufacture of various medicines	[23]
2	Levoglucose	$C_6H_{10}O_5$	conventional cellulose intermediate	[24]
3	Chrysarobin (methyldioxyanthranol) chrysarobinum hydroxyl derivatives of anthracene and dihydroanthracene hydrocarbons	$C_{30}H_{26}O_7$	valuable in the treatment of skin diseases (lichen and eczema), it is a product of the restoration of chrysophanic acid, has a stable, anti-inflammatory and resorbing effect, can be used for fungal lesions of the fingers and feet, proinflammatory and antipruritic agent, as well as relieves spasms in the gastrointestinal tract and bile ducts	[25-27]
4	Chrysophanic acid (1,8-dihydroxy-3-methylanthraquinone) or (dioxymethylanthraquinone)	$C_{15}H_{10}O_4$	famous for its antioxidant effect, for the treatment of skin diseases (lichen and eczema)	[28-30]
5	Emodin-3-methyl ether	$C_{16}H_{12}O_5$	destroys 26 types of bacteria: Staphylococcus aureus, E. coli, green sepsis, Streptococcus and dysentery; mutation in the experiment with Salmonella TA1535; stronger inhibition of Hela cell growth in cervical cancer; antibacterial, used as a laxative, etc.	[31-34]
6	Emodin 1,3,8-trihydroxy-6-methylanthracene-9,10-dione	$C_{15}H_{10}O_5$	inhibits cell proliferation, stimulates the induction of apoptosis induction and profilaktiku of metastasis, is involved in cell death of liver cancer and lung cancer	[35–40]

Thus, components such as chrysarobin, chrysophanic acid, emodin 3-methyl ether, emodin-1, 3, 8-trihydroxy-6-methylanthracene-9, 10-dione are directly involved in the metabolism of the body, providing antioxidant, antiseptic and anticancer effects [41; 42]. Based on our results, it can be concluded that *Rheum wittrokii,* as a representative of rare and endangered species, contains in its roots biologically active compounds, which, according to research and literature review, can beneficially affect the human body.

Conclusion

The following morphometric indicators of the leaf blade anatomical structure were found in the medicinal rare plant *Rheum wittrokii*: upper epidermis, lower epidermis, columnar mesophyll, spongy mesophyll, central conducting bundle, sclerenchyma cells, and calcium oxalate druses. The cross section of the stem of *Rh. wittrockii* L. includes: the epidermis, chlorophyll-bearing parenchyma of the primary cortex, rounded cells of the primary cortex, conducting bundle, sclerenchymal lining of the bundle, inclusions. The cross section of the root of *Rheum wittrockii* is characterized by morphological indicators on the anatomy of this plant: cork (fellema), fellogen, felloderm, main bark parenchyma, cambial ring, xylem parenchyma, wood vessels (secondary xylem), calcium oxalate druses, secondary phloem, primary xylem. Thus, morphometric indicators of the anatomical structure of the leaf blade have a thickness of the upper epidermis of 10.06 ± 0.06 μm and the lower epidermis of 13.11 ± 0.09 μm, the thickness

of columnar mesophyll 93.23 ± 0.16 μm and spongy mesophyll 81.15 ± 0.24 μm, and the thickness of the sheet plate itself is 197.55 ± 14.02 μm. Morphometric parameters of the anatomical structure of the root consist of a thickness of the primary cortex of 120.09 ± 7.12 μm, a diameter of the central cylinder of 161.28 ± 10.89 μm, and an area of xylem vessels of 86.13 ± 16.81 μm^2. Morphometric indicators of the anatomical structure of the stem include the thickness of the primary cortex 60.18 ± 3.32 μm, the diameter of the central cylinder 123.17 ± 9.26 μm and the area of the conducting beams 35.72 ± 6.42 x 10^{-3} mm^2.

Phytochemical analysis showed that the root of *Rheum wittrokii* contains carbohydrates, organic acids, catechins, anthraquinones: tannoglycosides and atroglycosides. As is already known, GC-MS (Agilent 6890N/ 5973N, USA) analysis in the study showed the results of chemical compounds, their percentage, retention time can be especially useful in assessing and the likelihood of identifying their chemical characteristics. Components such as chrysophanic acid (41.4%), 4,4'-dimethoxy-2,2'-dimethylbiphenyl (30.3%), levoglucosan (9.2%), anthracene octahydrate, 3,9-dimethyl-4-hydroxymethyl-3-[[1-carboxy-2,5,6-trimethyl] heptyl] (4.9%) are in the greatest quantities. The smallest amount was found for emodin 3-methyl ether (6.0%), sucrose (3.2%), emodin 1,3,8-Trihydroxy-6-methylanthracene-9,10-dione (2.5%) and chrysarobin (2.4%). Thus, 41.4% of the content of ethyl extract of rhizomes of *Rheum wittrokii* contains chrysophanic acid, which indicates an effective antioxidant effect in the treatment of skin diseases (lichen and eczema). Emodin 3-methyl ether is involved in the suppression of 26 types of bacteria: Staphylococcus aureus, E. coli, green sepsis, Streptococcus and dysentery; mutations in the experiment with Salmonella TA1535; in stronger inhibitions of Hela cell growth in cervical cancer; antibacterial, used as a laxative, etc. Emodin 1,3,8-Trihydroxy-6-methylanthracene-9,10-dione inhibits cell proliferation, induces the induction of apoptosis and praphylaxis of metostases, and is involved in the death of liver cancer and lung cancer cells. Chrysarobin is a product of the recovery of chrysophanic acid, has a stable, anti-inflammatory and resorbing effect, can be used for fungal lesions of the fingers and feet, anti-inflammatory and antipruritic agent, and also relieves spasms in the gastrointestinal tract and bile ducts. In the ethyl extract of rhizomes, the presence of chemical components that have great potential in the treatment of many diseases of the body, providing antiseptic, anti-inflammatory, astringent properties that can enhance intestinal peristalsis, which makes it a choleretic and laxative. It also affects the treatment of anemia and tuberculosis, participating in the removal of toxins, which has a beneficial effect on the overall therapeutic state.

References

1 The State Pharmacopoeia of the Republic of Kazakhstan. 2009, no. 2, 802 p. ISBN 9965-759-96-0

2 Dagarova S. S, Sitpayeva G. T. Conservation of Biodiversity of wild Plant of Rheum Wittrockii Lundstr of Kazakhstan. Biosci Biotech Res Asia 2017; 14(1). Available from: http://www.biotech-asia.org/?p=22007

3 Kukenov M.K. Botanical Resource Science of Kazakhstan / M.K. Kukenov. - Almaty: Gylym, 1999. - 176 p. ISBN 9965-473-62-5

4 Borisova M.A., Marakaev O.A. Rare plant species: practice research in nature. - Yaroslavl, 2015. - 64 p. ISBN: 978-0-470-85040-4

5 G. M. Kudabayeva, P. V. Vesselova, M. P. Danilov, B. M. Sultanova, Important Plant Areas of the Peri-North Tien Shan Subprovince as Perspective Protection Areas of Phytobiodiversity, American Journal of Environmental Protection. Special Issue: Applied Ecology: Problems, Innovations. Vol. 4, no. 3-1, 2015, pp. 123-129. doi: 10.11648/j.ajep.s.2015040301.29

6 Holsinger K.E. Demography and extinction in small populations // In: Young A.G., Clarke G.M. (Eds.), Genetics, Demography and Viability of Fragmented Populations. - Cambridge: Cambridge University Press, 2000. - P. 55-74. www.Cambridge University Press. org/9780521783385

7 The Red Book of Kazakhstan. Vol. 2. Part 1. Plants. - Astana, 2014. - 452 p.

8 Chevalier A. Encyclopedia of herbal medicine. DK / Penguin Random House, 2016, p. 127. ISBN: 0-7894-6783-6

9 Mukhitdinov N.M., Ivashchenko A.A., Kurbatova N.V., Abidkulova K.T., Kurmanbaeva M.S., Ametov A.A., Mukasheva K.M. Features of the external and internal structure of the medicinal plant Rheum wittrokii Lundstr in Zailiysky Alatau. Article. International Journal of Applied and Basic Research. Publisher: Publishing House Academy of Natural Sciences (Penza). No. 12. 2017 p. 112-116. ISSN: 1996-3955

10 Gao, L., Xu, X. & Yang, J. Chemical constituents of the roots of Rheum officinale. Chem Nat Compd 49, 603–605 (2013). https://doi.org/10.1007/s10600-013-0689-7

11 Muzychkina R.A., Kurbatova N.V., Korulkin D.Yu. The component composition and biological activity of polyphenolic metabolites of Rumex tianschanicus A. Los. KazNU Bulletin. Biology series. No. 4 (69). 2016. Pp. 22-31. ISSN 1563-0218

12 Shynar S. Dagarova, Gulnara T. Sitpayeva, Jae-Hong Pak & Jung Sung Kim (2017) The complete plastid genome sequence of Rheum wittrockii (Polygonaceae), endangered species of Kazakhstan, Mitochondrial DNA Part B, 2:2, 516-517, DOI: 10.1080/23802359.2017.1361359

13 Pandith, S.A., Dar, R.A., Lattoo, S.K. et al. Rheum australe, an endangered high-value medicinal herb of North Western Himalayas: a review of its botany, ethnomedical uses, phytochemistry and pharmacology. Phytochem Rev 17, 573–609 (2018). https://doi.org/10.1007/s11101-018-9551-7

14 Li YX, Gong XH, Li Y, et al. The Influence of Aconitum carmichaelii Debx. on the Pharmacokinetic Characteristics of Main Components in Rheum palmatum L. Phytother Res. 2015;29(8):1259-1264. doi:10.1002/ptr.5369

15 Diaz-Muñoz G, Miranda IL, Sartori SK, de Rezende DC, Alves Nogueira Diaz M. Use of chiral auxiliaries in the asymmetric synthesis of biologically active compounds: A review. Chirality. 2019;31(10):776-812. doi:10.1002/chir.23103

16 Thomford NE, Senthebane DA, Rowe A, et al. Natural Products for Drug Discovery in the 21st Century: Innovations for Novel Drug Discovery. Int J Mol Sci. 2018;19(6):1578. Published 2018 May 25. doi:10.3390/ijms19061578

17 The State Pharmacopoeia of the Republic of Kazakhstan. 2008, No. 1, 591 p.

18 Prozina M.N. Botanical microtechnics. - M., 1960 .-- 208 p.

19 Permyakov A.I. Mikrotehnika - M., 1988. - S. 11-18, 28-29. ISBN 5-211-00683-6: 10 к

20 Barykina R.P., Veselova T.D., Devyatov A.G. et al. Handbook of Botanical Microtechnology (Fundamentals and Methods). - M., Moscow State University, 2004. - 312s. ISBN 5-211-06103-9.

21 G.G. Fourst. Methods of anatomical and histochemical studies of plant tissues. Moscow: Nauka, 1979. - 154 p.

22 Vekhov V.N., Lotova L.I., Filin V.R. Workshop on the anatomy and morphology of higher plants. - Moscow: Moscow State University, 1980. - 560 s.

23 The State Pharmacopoeia of the Russian Federation of the XIII edition. 2016 (Order of the Ministry of Health of Russia no. 771, 2015). FS.2.1.0034.15 Sucrose.

24 Bacik JP, Klesmith JR, Whitehead TA, et al. Producing glucose 6-phosphate from cellulosic biomass: structural insights into levoglucosan bioconversion. J Biol Chem. 2015;290(44):26638-26648. doi:10.1074/jbc.M115.674614

25 Jeong HJ, Kim HY, Kim HM. Molecular mechanisms of anti-inflammatory effect of chrysophanol, an active component of AST2017-01 on atopic dermatitis in vitro models. Int Immunopharmacol. 2018;54:238-244. doi:10.1016/j.intimp.2017.11.019

26 Matsuda H, Morikawa T, Toguchida I, Park JY, Harima S, Yoshikawa M. Antioxidant constituents from rhubarb: structural requirements of stilbenes for the activity and structures of two new anthraquinone glucosides. Bioorg Med Chem. 2001;9(1):41-50. doi:10.1016/s0968-0896(00)00215-7

27 Onoda T, Li W, Sasaki T, Miyake M, Higai K, Koike K. Identification and evaluation of magnolol and chrysophanol as the principle protein tyrosine phosphatase-1B inhibitory compounds in a Kampo medicine, Masiningan. J Ethnopharmacol. 2016;186:84-90. doi:10.1016/j.jep.2016.03.063

28 Choi JS. Chrysophanic Acid Induces Necrosis but not Necroptosis in Human Renal Cell Carcinoma Caki-2 Cells. J Cancer Prev. 2016;21(2):81-87. doi:10.15430/JCP.2016.21.2.81

29 Fei Y, Wang J, Peng B, et al. Phenolic constituents from Rheum nobile and their antioxidant activity. Nat Prod Res. 2017;31(24):2842-2849. doi:10.1080/14786419.2017.1303691

30 Vysocina (Vysocina) G. (Galina) I. (Ivanovna). Antrakhinones and biological activity of species of the genus Rheum L. (Poligonatseva) (Review) // Chemistry of plant raw materials, 2018. No. 4. P. 29-41. URL: http://journal.asu.ru/cw/article/view/3785

31 Huang Q, Shen HM, Ong CN. Inhibitory effect of emodin on tumor invasion through suppression of activator protein-1 and nuclear factor-kappaB. Biochem Pharmacol. 2004;68(2):361-371. doi:10.1016/j.bcp.2004.03.032

32 Huang Q, Shen HM, Ong CN. Emodin inhibits tumor cell migration through suppression of the phosphatidylinositol 3-kinase-Cdc42/Rac1 pathway. Cell Mol Life Sci. 2005;62(10):1167-1175. doi:10.1007/s00018-005-5050-2

33 Tikhomirov AS, Shtil AA, Shchekotikhin AE. Advances in the Discovery of Anthraquinone-Based Anticancer Agents. Recent Pat Anticancer Drug Discov. 2018;13(2):159-183. doi:10.2174/1574892813666171206123114

34 Tutin, F., Clewer HWB. The constituents of rhubarb. J. Chem. Soc., Trans. 1911,99 , 946-967. https://doi.org/10.1039/CT9119900946

35 Ramana L.V., Apparato K.S., Rao B.N., Rao M.S. New phenolic constituents from the bark of Valsurian tripholyate. J. Pharmacogn. Phytochem. 2017; 6: 1314–1316

36 Fuyo M., Venkatachalam M., Girard-Valenciennes E., Caro J., Dufos L. Antraquinones and their derivatives from fungi of marine origin: structural diversity and individual biological activities. Mar. Drugs. 2016; 14: 64. https://doi.org/10.3390 / md14040064

37 Malik EM, Müller CE. Anthraquinones As Pharmacological Tools and Drugs. Med Res Rev. 2016;36(4):705-748. doi:10.1002/med.21391

38 Zhang B, Ji J, Liu X, et al. Rapid adsorption and enhanced removal of emodin and physcion by nano zirconium carbide. Sci Total Environ. 2019;647:57-65. doi:10.1016/j.scitotenv.2018.07.422

39 Sanders B, Ray AM, Goldberg S, et al. Anti-cancer effects of aloe-emodin: a systematic review. J Clin Transl Res. 2017;3(3):283-296. Published 2017 Sep 7.

40 Huang D, Ou B, Prior RL. The chemistry behind antioxidant capacity assays. J Agric Food Chem. 2005;53(6):1841-1856. doi:10.1021/jf030723c

41 Rajkumar V, Guha G, Ashok Kumar R. Antioxidant and Anti-Cancer Potentials of Rheum emodi Rhizome Extracts. Evid Based Complement Alternat Med. 2011;2011: 697986. doi:10.1093/ecam/neq048

42 Li Y, Jiang JG. Health functions and structure-activity relationships of natural anthraquinones from plants. Food Funct. 2018;9(12):6063-6080. doi:10.1039/c8fo01569d