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Kyrbassova E.A., Dyuskalieva G., Baitasheva G.U., Imanova E.M.

Kazakh State Women's Teacher Training University,
Kazakhstan, Almaty, e-mail: kyrbasova_elzira@mail.ru

BIOLOGICAL AND PHYTOCHEMICAL FEATURES OF UNDERGROUND ORGANS OF MEDICINAL PLANTS OF THE GENUS AEGOPODIUM L.

Aegopodium L. is a perennial plant of the Apiaceae family, growing in the mountainous regions of Europe, Siberia, the Caucasus, Kazakhstan and Central Asia. The genus Aegopodium L. includes seven species. Two species grow in Kazakhstan: Aegopodium podagraria L. and Aegopodium alpestre Ledeb. Goutweed (Aegopodium podagraria L.) as a medicinal plant for the treatment of podagra and rheumatism has been used since ancient times. But the biological and phytochemical characteristics of Aegopodium podagraria L. and Aegopodium alpestre Ledeb are very little studied.

Our article presents the results of a comparative study of the anatomical and morphological structures of the underground organs of the two above-mentioned medicinal plants, as well as the determination of the moisture, ash and extract content of their raw materials.

Plants were collected during the flowering period (in early July) 2017 in the big Almaty gorge (GPS coordinates of the initial point of the gorge: 43.136976, 76.903267. Height over sea level of 1500 – 2500 m).

As a result of morphological study of underground organs of Aegopodium podagraria L. and Aegopodium alpestre Ledeb. it is revealed that the roots in the form of lobes are formed on horizontal rhizomes. On the cross section of the anatomical root of both plants diarch. In the primary bark, as well as between the xylem rays accumulate starch grains. Biometric measurements of the root showed that, the indicators of Aegopodium podagraria L. are higher than, Aegopodium alpestre Ledeb.

The humidity of underground organs of Aegopodium podagraria L. Aegopodium alpestre Ledeb. does not exceed the values of this indicator for pharmaceutical samples. The ash content of underground organs of Aegopodium podagraria l is 1.5 times lower than that of Aegopodium alpestre Ledeb., and the extractivity of both plants is high (25.37 ± 6.91% and 28.13 ± 4.95%, respectively).

Key words: goutweed (Aegopodium podagraria L.), Aegopodium alpestre Ledeb., medicinal plants, xylem, phloem, ash content, extractivity.

Кырбасова Э.А., Дюскалиева Г., Байташева Г.У., Иманова Э.М.

Қазақ мемлекеттік қыздар педагогикалық университеті,
Қазақстан, Алматы қ., e-mail: kyrbasova_elzira@mail.ru

Aegopodium L. туысына жататын дәрілік өсімдіктердің жерасты мүшелерінің биологиялық және фитохимиялық ерекшеліктері

Aegopodium L. – Еуропа, Сібір, Кавказ, Қазақстан мен Орталық Азияның таулы аймақтарында кездесетін, Apiaceae тұқымдасына жататын көпжылдық шөптесін өсімдік. Бұл туыстың жеті түрі бар, соның ішінде Қазақстанда Aegopodium podagraria L. және Aegopodium alpestre Ledeb. деген екі түрі өседі.

Кәдімгі бежір (Aegopodium podagraria L.) подагра мен ревматизмді емдеуде қолданылатын дәрілік өсімдік ретінде антикалық кезеңнен бері белгілі. Дегенмен, Aegopodium podagraria L. және Aegopodium alpestre Ledeb. өсімдіктерінің биологиялық және фитохимиялық ерекшеліктері туралы зерттеулер жоқтың қасы деуге болады.

Біздің мақаламызда жоғарыда аталған екі дәрілік өсімдіктердің жерасты мүшелерінің салыстырмалы анатомо-морфологиялық зерттеулері, сонымен қатар олардың шикізаттарының

ылғалдылығы, күлділігі және экстрактивтілігі туралы мәліметтер берілген. Өсімдіктер 2017 жылы гүлдеу кезеңінде (шілде айының басында) Үлкен Алматы шатқалында (шатқалдың басталар нүктесінің GPS координаттары: 43.136976, 76.903267. теңіз деңгейінен биіктігі 1500 – 2500 м) жиналған.

Aegopodium podagraria L. және Aegopodium alpestre Ledeb. өсімдіктерінің жерасты мүшелерінің морфологиялық зерттеулері бойынша тамырлары көлденең тамырсабақта түзілген шашақ тәрізді болып келетіні анықталды. Көлденең анатомиялық кесіндісінде екі өсімдіктің де тамыры диархты. Алғашқы қабықта және ксилема сәулелерінің арасындағы жасушаларда крахмал дәндері кездеседі. Биометриялық өлшеулер бойынша Aegopodium podagraria L. тамырының көрсеткіштері Aegopodium alpestre Ledeb. өсімдігіне қарағанда жоғары екені байқалды.

Aegopodium podagraria L. және Aegopodium alpestre Ledeb. өсімдіктерінің жерасты мүшелерінің ылғалдылығы фармакопеялық үлгілердегі берілген көрсеткіштер мәнінен жоғары емес. Aegopodium podagraria L. жерасты мүшелерінің күлділігі Aegopodium alpestre Ledeb. өсімдігіне қарағанда 1,5 есе төмен, ал экстрактивтілігі екі өсімдікте де жоғары болды.

Түйін сөздер: бежір (Aegopodium podagraria L.), Aegopodium alpestre Ledeb., дәрілік өсімдіктер, ксилема, флоэма, күлділік, экстрактивтілік.

Кырбасова Э.А., Дюскалиева Г., Байташева Г.У., Иманова Э.М.

Казахский государственный женский педагогический университет,
Казахстан, г. Алматы, e-mail: kyrbasova_elzira@mail.ru

Биологические и фитохимические особенности подземных органов лекарственных растений рода Aegopodium L.

Aegopodium L. – многолетнее растение семейства Apiaceae, произрастающее в горных регионах Европы, Сибири, Кавказа, Казахстана и Центральной Азии. Род Aegopodium L. включает семь видов. В Казахстане растут два вида: Aegopodium podagraria L. и Aegopodium alpestre Ledeb.

Сныть (Aegopodium podagraria L.) в качестве лекарственного растения для лечения подагры и ревматизма применяется ещё с античных времен. Но тем не менее биологические и фитохимические особенности Aegopodium podagraria L. и Aegopodium alpestre Ledeb. очень мало изучены.

В нашей статье даны результаты сравнительного изучения анатомо-морфологических строений подземных органов двух выше названных лекарственных растений, а также определения влажности, зольности и экстрактивности их сырья. Растения были собраны во время периода его цветения (в начале июля) 2017 г. в большом Алматинском ущелье (GPS координаты начальной точки ущелья: 43.136976, 76.903267. Высота над уровнем моря – 1500 – 2500 м).

В результате морфологического исследования подземных органов Aegopodium podagraria L. и Aegopodium alpestre Ledeb. выявлено, что корни в виде мочек образуются на горизонтальных корневищах. На поперечном анатомическом срезе корень обеих растений диархный. В первичной коре, а также между лучами ксилемы накапливаются зерна крахмала. Биометрические измерения корня показали, что показатели Aegopodium podagraria L. выше, чем у Aegopodium alpestre Ledeb.

Влажность подземных органов Aegopodium podagraria L. и Aegopodium alpestre Ledeb. не превышает значений данного показателя для фармокопейных образцов. Зольность подземных органов Aegopodium podagraria L. 1,5 раза ниже чем Aegopodium alpestre Ledeb., а экстрактивность у обеих растений высокая.

Ключевые слова: сныть (Aegopodium podagraria L.), Aegopodium alpestre Ledeb., лекарственные растения, ксилема, флоэма, зольность, экстрактивность.

Introduction

Plant materials are used throughout the developed and developing world as home remedies, in over-the-counter drug products, and as raw material for the pharmaceutical industry, and they represent a substantial proportion of the global drug market [1]. So for the formation of a stable raw material base of the domestic pharmaceutical industry and the creation of new phytopreparations, priority is given to the study of Pharmacopoeia, vicar (substituting) and promising plant species in the regions of Kazakhstan. One of the most promising medicinal plants are the genus Aegopodium L. On the territory of Kazakhstan the genus Aegopodium represented by two species – *Aegopodium podagraria* L. and *Aegopodium alpestre* Ledeb. [2].

As a medicinal raw material from the field of view of official medicine, the dream fell out more than 150 years ago. Books about medicinal plants, it again began occasionally to appear only since the late 50-yers of the last century. In addition, all

this despite the fact that the excellent taste properties of ordinary goutweed connoisseurs of the green world valued at all times (the first mention of the goutweed is in the manuscript, dating from the XII century.). At the same time, folk medicine has never excluded this plant from its healing agents. But only biochemical and applied research of recent decades have been able to justify the biological effect of edible dreams (as it was called in the middle of the 19th century) [3].

Aegopodium podagraria L. contains many vitamins and microelements, as well as umbelliferosis, glucose, fructose, cyclitol, essential oil, umbelliferone, choline, falcarinolone, falkarinone, falkarinol, falcarindiol, phenolcarboxylic acids and their derivatives, coumarins, higher aliphatic hydrocarbon pentadecane, beta-sitosterol, terextera, flavonoids. The herb contains a lot of vitamin C, especially in autumn (65-100 mg%). [4, 5]. Gas chromatography-mass spectrometry identified more than 20 volatile organic compounds isolated from leaves ans flowers of *Aegopodium podagraria* L. [6].

In studies of Tovchiga O. V. et al. it is shown that the extract and tincture goutweed normalize lipid composition of liver in rats with impaired lipid and carbohydrate metabolism, caused by protamine sulfate and atherogenic diet [7].

In the works of some authors [2] it is mentioned that *Aegopodium podagraria* is a part of drugs for the prevention and treatment of oncological diseases.

Aegopodium podagraria is used as a sedative in traditional medicine. The effect of its aerial part extract and tincture on levels of depression and anxiety, as well as on locomotor activity, exploratory behaviour and memory of male and female mice was investigated. The extract showed dose-dependent and sex specific antidepressive effect (at a dose of 100 mg/kg but not at a dose of 1 g/kg in female mice) with the worsening of the results of the passive avoidance test. The extract at a dose of 100 mg/kg tended to reduce anxiety signs in the animals of both sexes, in male mice such reduction was also seen under the influence of the extract at a dose of 1 g/kg and the tincture at doses of 1 and 5 ml/kg (the latter did not considerably changed the other parameters measured). The results indicate favourable central activity of A. podagraria extract in mice [8].

Ethanol extract of *A. podagraria* L. possesses antibacterial activity and show synergistic and additive effects with antibiotics [9].

The composition of essential oils of leaves and stems of the *Aegopodium podagraria* L. is well studied [10, 11].

The presence of 61 chemical elements and antioxidant activity of total extraction from the above-ground part of *Aegopodium podagraria* L. was found, and 14 amino acids were found [12].

We have proposed a comparative anatomic-morphological and some phytochemical studies of underground organs of *Aegopodium podagraria* L. and *Aegopodium alpestre* Ledeb.

Materials and methods

The object of the study was the underground organs of plants of the genus Aegopodium L. of the umbrella family (Apiaceae, Umbelfereae). Underground parts of the plant Aegopodium podagraria L. and Aegopodium alpestre Ledeb. were collected during its flowering period (early July) 2017 in the Big Almaty gorge (GPS coordinates of the initial point of the gorge: 43.136976, 76.903267. Height above sea level 1500 – 2500 m) and was identified by researchers of the Institute of Botany and MES RK .

The plants were collected in a herbarium for the purpose of structural analysis. Plant samples were determined by the flora of Kazakhstan [13]. Subsurface vegetative organs of the plant Aegopodium podagraria L. and Aegopodium alpestre Ledeb were recorded. Fixation was carried out in 70% alcohol by the method of Strasburger-Flemming (alcohol-glycerin-water 1: 1: 1). Anatomical preparations were prepared by hand and by the electron microtome MZP-01 "Tehnom", sections were closed in glycerin and balsam in accordance with generally accepted methods Barykina R.P. [14], **Yeung** E.C.T. [15]. The thickness of the anatomical sections of 10-15 microns. Prepared more than 100 temporary preparations. Micrographs are made on a video microscope MCX100 Trinocular MICROS (Austria) (magnification x100, x400) [16, 17]. Statistical processing of biometric indicators were processed by the method of GF Lakin [18, 19] using MS Excel.

Determination of moisture, ash and extract content of raw materials was carried out in accordance with the requirements of the State Pharmacopoeia of the USSR XI edition, State Pharmacopoeia RK and the European Pharmacopoeia, as well as in other literature [20-22].

To determine the moisture, the crushed raw materials of 3 g in a bottle were placed in a drying oven heated to 105^0 C. Drying was carried out to constant weight. A constant weight is considered achieved if the difference between two subsequent weighing after 30 minutes of drying and 30 minutes of cooling in desiccators does not exceed 0.01 g. The first

weighing of the raw material was carried out after 3 hours.

The method of determining the ash content is based on the determination of the incombustible residue of inorganic substances remaining after burning and piercing the raw material. To determine the total ash, a weight of 1 g was taken. Raw materials in the crucible were carefully charred over the weak flame of a gas burner. After the raw material was completely charred, the crucible was transferred to a muffle furnace for burning coal and completely calcining the residue at a temperature of 550^0 C. At the end of the calcinations, the crucible was cooled for 2 hours, then put into desiccators, at the bottom of which is anhydrous calcium chloride, cooled and weighed.

To determine the content of extractive substances, an analytical sample of the raw material was ground and sifted through a sieve with holes 1 mm in diameter, after which a weight of 1 g was selected.

A portion of the raw material is placed in a conical flask, 50 cm^3 of 80% ethanol is poured in, the flask is closed with a stopper, weighed with an error of no more than 0.01 g, and left for 1 hour. Then the flask is connected to a reflux condenser, heated to boiling and maintain a weak boil for 2 hours. After cooling, the flask with the contents is again closed with the same stopper, weighed and the weight loss is supplemented with the same solvent (80% ethanol). The contents are thoroughly shaken and filtered through a dry paper filter into a dry wab with a capacity of 150-200 cm^3. 25 cm^3 of the filtrate is pipetted into a porcelain dish with a diameter of 7-9 cm, pre-dried on an analytical balance, evaporated in a water bath to dryness, dried at 105^0 C for 3 hours, then cooled for 30 minutes in a desiccator, at the bottom of which is anhydrous calcium chloride and weighed.

Results and discussion

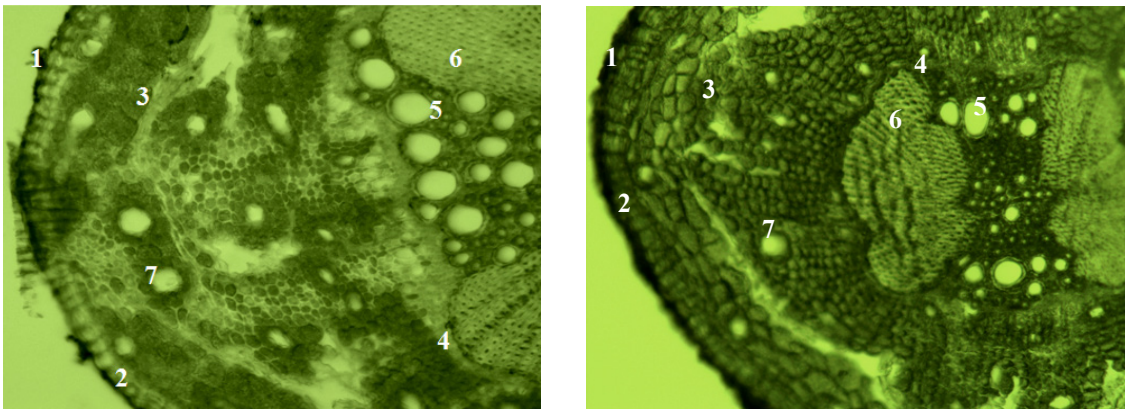
Aegopodium podagraria L. and *Aegopodium alpestre* Ledeb. – perennial herbaceous plants of the Apiaceae family. In Kazakhstan, *Aegopodium podagraria* L. occurs in the middle mountains from Altai to the Western Tien Shan, the *Aegopodium alpestre* Ledeb. occurs along the northern slopes of the Altai Mountains to the Western Tien Shan. Roots formed on a horizontal rhizome as fibrous (1-figure).

Anatomical features of the underground organs of the plant Aegopodium L.

Adhering to the methodical instruction, the transverse sections of the underground organs were carried out in the flowering phase, since it is in this phase that the structural anatomical elements of the plant organs have the greatest integrity.

Figure 1 – *Aegopodium podagraria* L. (A) and *Aegopodium alpestre* Ledeb. (B)

Under the epiblema of the root is the primary cortex, which surrounds the central cylinder in the form of a wide ring. It consists of exoderm, mesoderm and endoderm. Multilayer mesoderm is represented by rounded cells with numerous intercellular spaces. The rounded parenchymal cells with slightly thickened walls are located more or less regular concentric layers. In the cells of Aegopodium podagraria L. a lot of starch grains. The endoderm consists of a single layer of densely closed cells with horseshoe-shaped thickenings. Outside, the central cylinder is surrounded by a pericycle (Figure 2).



A B

1-epiblema, 2-exoderm, 3 mesoderm, 4-endoderm, 5-xylem, 6-phloem, 7-resin passages

Figure 2 – Anatomical structures of the roots of *Aegopodium podagraria* L. (A) and *Aegopodium alpestre* Ledeb. (B)

As can be seen, the anatomical structure of the roots of Aegopodium plants is the same as in dicotyledons.

In dicotyledonous plants, the primary structure is replaced by the secondary. These changes occur as a result of the emergence of two educational tissues: cork cambium and cambium. Cork cambium forms periderm. The primary cortex is exfoliated. Cambium forms a secondary phloem and xylem, therefore the roots of dicotyledonous plants are able to grow in thickness.

As can be seen from the 2-figure, in both species of plants pitch passages are well expressed, their size in *Aegopodium podagraria* L. is larger than *Aegopodium alpestre* Ledeb

As can be seen from table 1, the biometric indicators of the anatomical structure of the root of *Aegopodium podagraria* L. were higher than *Aegopodium alpestre* Ledeb. Thus, the thickness of the anatomical cross section of the root is 1.4 times thicker (1886.71 ± 1.95 μm and 1357.99 ± 4.73 μm, respectively), the diameter of the central cylinder is 1.7 times larger (483.62 ± 1, 40 μm and 287.21 ± 1.56 μm, respectively), the thickness of the first crust is 1.3 times thicker (397.8 ± 1.02 μm and 307.04 ± 0.66 μm, respectively), the thickness of the periderm does not make a big difference observed (28.22 ± 0.22 μm and 26.94 ± 0.39 μm).

To obtain drugs can only be used benign raw materials. On this basis, quality indicators were established for the studied plant materials (table 2).

From the data given in the 2-table, it follows that the humidity of the underground organs of *Aegopodium podagraria* L. (5.36 ± 0.25%) and *Aegopodium alpestre* Ledeb. (5.2 ± 0.14%) does not exceed the values of this indicator for pharmaceutical-based samples, the tolerable limit of which is usually in the range of 12-15%. Humidity is one of the important numerical indicators of raw materials, which is understood as its loss in weight due to the removal of hygroscopic moisture and volatile substances. Determine the moisture content in the raw material by drying it to constant weight. Medicinal plant raw materials should not contain moisture above the permissible norms, since conditions for reducing its quality are created under high humidity during storage.

Table 1 – Biometric indicators of the anatomical structure of the root of plants of the genus Aegopodium L.

Plant species	Root thickness, mkm	Central cylinder, mkm	The thickness of the primary cortex, mkm	Periderm thickness, mkm
Aegopodium podagraria L.	1886,71±1,95	483,62±1,40	397,8±1,02	28,22±0,22
Aegopodium alpestre Ledeb.	1357,99±4,73	287,21±1,56	307,04±0,66	26,94±0,39

Table 2 – Indicators of the chemical properties of raw materials Aegopodium L

№	Indicators	Object	
		Aegopodium podagraria L.	*Aegopodium alpestre* Ledeb.
1	Humidity, %	5,36±0,25	5,2±0,14
2	Ash content, %	8,58±0,18	13,24±0,16
3	Extract, %	25,37±6,91	28,13±4,95

The next important indicator of the raw material is the determination of its ash content. The ashes of plant raw materials is called the residue of inorganic substances, obtained after burning and subsequent piercing of the residue to constant weight. The amount of ash in vegetable raw materials varies within certain limits and depends both on the specifics of the raw material itself, and on the method of its collection and drying conditions. As can be seen from figure 3, the ash content of the underground organs of *Aegopodium podagraria* L. (8.58 ± 0.18%) is 1.5 times lower than *Aegopodium alpestre* Ledeb. (13.24 ± 0.16%).

To carry out the extraction, we took a portion of the crushed raw material weighing 1 g with an accuracy of up to 0.0001 g. 80% ethyl alcohol was used as a solvent. From the analysis presented in table 2 of the data, it can be seen that the extract in the underground organs of *Aegopodium podagraria* L. and *Aegopodium alpestre* Ledeb. high: 25.37 ± 6.91% and 28.13 ± 4.95%, respectively.

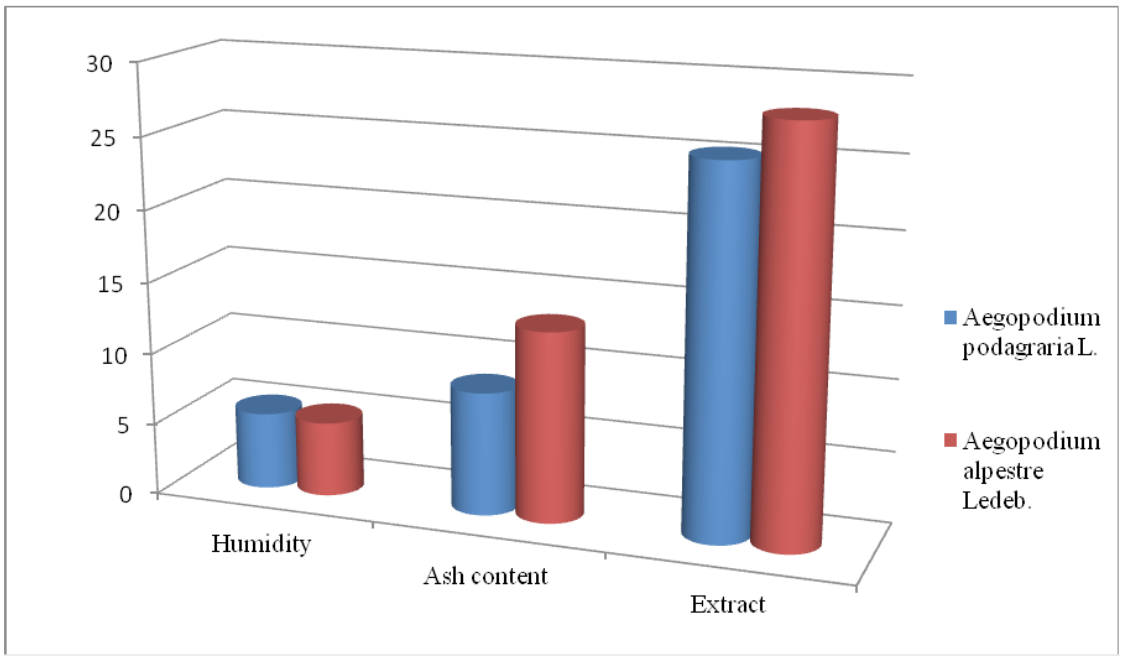


Figure 3 – Comparative content of moisture, ash and extract content of raw materials of Aegopodium podagraria L. and Aegopodium alpestre Ledeb.

Conclusion

The ground elder (Aegopodium podagraria L.) is a perennial plant that has been known and used in folk medicine for centuries. The interest in herbs has increased in recent years [23].

Thus, the obtained results of the study of the underground organs of plants of the genus Aegopodium L. replenishing biological and phytochemical data, makes it possible to determine the pharmacological qualities of plants.

Conflict of interest

All authors have read and are familiar with the content of the article and do not have a conflict of interest.

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Әдебиеттер

1 Kunle, O.F., Egharevba, H.O, Ahmadu, P.O. Standardization of herbal medicines – A review // International Journal of Biodiversity and Conservation Vol. 4(3). – 2012. – P. 101-112. DOI: 10.5897/IJBC11.163. ISSN 2141-243X

2 Грудзинская Л.М., Гемеджиева Н.Г., Нелина Н.В., Каржаубекова Ж.Ж. Аннотированный список лекарственных растений Казахстана: Справочное издание. – Алматы, 2014. – 200 с. ISSN: 978-601-7511-00-5

3 Федотов С. В. Сныть обыкновенная – новое эфиромасличное растение, ее хозяйственное и медицинское значение (обзор) // Аромакоррекция психофизического состояния человека. Ялта. – 2015. – С. 69-79.

4 Лавренова Г.В., Лавренов В.К. Полная энциклопедия лекарственных растений. М.: АСТ; Донецк: Сталкер. – 2008. – 416 с. ISBN 978-985-16-4968-2

5 Prior, RM et al., The polyacetylene falcarindiol with COX-1 activity isolated from Aegopodium podagraria L. // Journal of ethnopharmcology. – 2007. – P. 176-178. DOI: 10.1016/j.jep.2007.05.005

6 Paramonov, EA et al., Identification and biological activity of volatile organic compounds isolated from plants and insects. III. Chromatography-mass spectrometry of volatile compounds of Aegopodium podagraria // Chemistry of natural compounds. 20007 – P. 584-586. DOI: 10.1023/A:1017563708858

7 Товчига О.В., Горбач Т.В., Штрыголь С.Ю., и др. Эффекты препаратов сныти обыкновенной (Aegopodium podagraria L.) и их комбинаций с метформином у крыс с нарушениями липидного и углеводного обмена, вызванными протамина сульфатом // Обзоры по клинической фармакологии и лекарственной терапии. – 2017. – Т. 15. – № 2. – С. 31–41. doi: 10.17816/RCF15231-41

8 Tovchiga, O. The influence of Aegopodium podagraria L. extract and tincture on behavioural reactions of random-bred mice / O. Tovchiga, S. Shtrygol'// Journal of Chemical and Pharmaceutical Research. – 2015. – Vol. 7, № 7. – P. 370–384. ISSN: 0975-7384

9 Stefanovic O., Comic L., Stanojevic D., Solujic-Sukdolak S. Antibacterial Activity of Aegopodium podagraria L. extracts and interaction between extracts and antibiotics //Turk J Biol. –33 (2009). – P.145-150. doi:10.3906/biy-0810-21

10 Orav A., Viitak A., Vaher M. Identification of bioactive compounds in the leaves and stems of Aegopodium podagraria by various analytical techniques. – Vol. – 2 Issue: 1. – P. 152-160// DOI: 10.1016/j.proche.2009.12.022

11 Агеев В.А., Макарова Д.Л., Домрачев Д.В., Родин А.П., Ханина М.А. Изучение химического состава эфирного масла Aegopodium podagraria L. флоры Сибири // Химия растительного сырья. – 2011. – №1. – С.129-132

12 Агеев В.А. Фармакогностическое исследование сныти обыкновенной : Aegopodium podagraria L.: автореферат дис. ... кандидата фармацевтических наук: Самара, 2013.- 25 с.: ил. РГБ ОД, 9 13-1/785

13 Флора Казахстана. Т. 6. (Молочайные, Зонтичные и др.]. Алма-Ата, 1963, 466 с. ISBN: 978-5-4458-5988-8

14 Барыкина Р.П. и др. Справочник по ботанической микротехнике. Основы и методы. – М., Изд-во МГУ. – 2004. – 312 с. ISBN: 5-211-06103-9

15 Yeung, E.C.T., Stasolla, C., Sumner, M.J., Huang, B.Q. Plant Microtechniques and Protocols. Springer, 2015. ISBN 978-3-319-19944-3

16 Rudall P.J. Anatomy of flowering plants: An introduction to structure and development. – 3d ed. // Cambridge University Press, 2007. – 145 p. ISBN: 13: 978-0521692458

17 Clarke A.R., Eberhardt C.N. Microscopy techniques for materials science. Cambridge, England : Woodhead Pub., 2002. – P. 456. ISBN: 9781855737501

18 Лакин Г.Ф. Биометрия. – М.: Высшая школа. – 1990. – 352 с. ISBN 5-06-000471-6

19 Surangi W.P., Selena Y.S. 2014. Bioinformatic and biometric methods in plant morphology. doi: [10.3732/apps.1400071]

20 Государственная Фармокопея СССР. Вып.2: Общие методы анализа. – Лекарственное растительное сырье. – М.: Медицина, 1989. – 400 с.

21 Государственная Фармокопея РК.– 2009. – Т.2. – 803 с. ISBN. 978-601-7152-43-7.

22 Пятигорская Н. В. Самылина И. А. Береговых В. В. Ногаева А. Т. Ковалева Е. К. Смирнов В. Ю. Правила организации производства и контроля качества лекарственных средств из растительного сырья. Учебное пособие. – СПб.: СпецЛит, 2013. – 367 с. ISBN: 9785299004779

23 Dębia K. et. all. Do brewing temperature and the morphological part of the ground elder plant have an influence on the fluoride content of ground elder infusions? Fluoride. 2018, 51(2), pp. 153-163. ISSN: 00154725

References

1 Ageev V.A. (2013) Farmakognosticheskoe issledovanie snyti obyknovennoj: [Pharmacognostic study of goutweed: Aegopodium podagraria L.]: avtoreferat dis. ... kandidata farmacevticheskih nauk: Samara,.- 25 s.: il. RGB OD, 9 13-1/785

2 Ageev V.A., Makarova D.L., Domrachev D.V., Rodin A.P., Hanina M.A. (2011) Izuchenie himicheskogo sostava jefirnogo masla Aegopodium podagraria L. flory Sibiri [The study of the chemical composition of the essential oil Aegopodium podagraria L. flora of Siberia] // Himija rastitel'nogo syr'ja, no 1, pp.129-132.

3 Barykina R.P. i dr. (2004) Spravochnik po botanicheskoj mikrotehnike. Osnovy i metody [Handbook of botanical microtechnique. Basics and methods.]. – M., Izd-vo MGU. 312 p. ISBN: 5-211-06103-9

4 Clarke A.R., Eberhardt C.N. Microscopy techniques for materials science. Cambridge, England : Woodhead Pub., 2002. – P. 456. ISBN: 9781855737501

5 Dębia K. et. all. (2018) Do brewing temperature and the morphological part of the ground elder plant have an influence on the fluoride content of ground elder infusions? Fluoride. 51(2), pp. 153-163. ISSN: 00154725

6 Fedotov S. V. (2015) Snyt' obyknovennaja – novoe jefiromaslichnoe rastenie, ee hozjajstvennoe i medicinskoe znachenie (obzor) [Goutweed – a new aromatic plant, its economic and medical value (review)] // Aromakorrekcija psihofizicheskogo sostojanija cheloveka. Jalta. pp. 69-79.

7 Flora Kazahstana. T. 6. (1963) [Molochajnye, Zontichnye i dr.] [Euphorbia, Umbrella, etc.]. Alma-Ata, 466 p. ISBN: 978-5-4458-5988-8

8 Gosudarstvennaja Farmokopeja RK. (2009) [State Phamocopea RK]. vol. 2, 803 p. ISBN. 978-601-7152-43-7.

9 Gosudarstvennaja Farmokopeja SSSR. Vyp.2: Obshhie metody analiza. – Lekarstvennoe rastitel'noe syr'e [General methods of analysis. – Medicinal plant raw materials.]. –M.: Medicina, 1989. – 400 s.

10 Gosudarstvennaja Farmokopeja RK. (2009). vol. 2, 803 p. ISBN. 978-601-7152-43-7.

11 Grudzinskaja L.M., Gemedzhieva N.G., Nelina N.V., Karzhaubekova Zh.Zh. (2014) Annotirovannyj spisok lekarstvennyh rastenij Kazahstana [Annotated list of medicinal plants of Kazakhstan]: Spravochnoe izdanie. – Almaty, 200 p. ISSN: 978-601-7511-00-5

12 Kunle, O.F., Egharevba, H.O, Ahmadu, P.O. (2012) Standardization of herbal medicines – A review // International Journal of Biodiversity and Conservation, vol. 4(3), pp. 101-112. DOI: 10.5897/IJBC11.163. ISSN 2141-243X

13 Lakin G.F. (1990) Biometrija [Biometrics]. – M.: Vysshaja shkola. 352 p. ISBN 5-06-000471-6

14 Lavrenova G.V., Lavrenov V.K. (2008) Polnaja jenciklopedija lekarstvennyh rastenij [Complete encyclopedia of medicinal plants]. M.: AST; Doneck: Stalker. 416 p. ISBN 978-985-16-4968-2

15 Orav A., Viitak A., Vaher M. (2009) Identification of bioactive compounds in the leaves and stems of Aegopodium podagraria by various analytical techniques. vol. 2 Issue: 1, pp. 152-160// DOI: 10.1016/j.proche.2009.12.022

16 Paramonov, EA et al., (2007) Identification and biological activity of volatile organic compounds isolated from plants and insects. III. Chromatography-mass spectrometry of volatile compounds of Aegopodium podagraria // Chemistry of natural compounds, pp. 584-586. DOI: 10.1023/A:1017563708858

17 Pjatigorskaja N. V. Samylina I. A. Beregovyh V. V. Nogaeva A. T. Kovaleva E. K. Smirnov V. Ju. (2013) Pravila organizacii proizvodstva i kontrolja kachestva lekarstvennyh sredstv iz rastitel'nogo syr'ja. [Rules for the organization of production and quality control of medicinal products from plant materials]. Uchebnoe posobie. – SPb.: SpecLit, 367 p. ISBN: 9785299004779

18 Prior, RM et al., (2007) The polyacetylene falcarindiol with COX-1 activity isolated from Aegopodium podagraria L. // Journal of ethnopharmcology. pp. 176-178. DOI: 10.1016/j.jep.2007.05.005

19 Rudall P.J. (2007) Anatomy of flowering plants: An introduction to structure and development. – 3d ed. // Cambridge University Press, 145 p. ISBN: 13: 978-0521692458

20 Stefanovic O., Comic L., Stanojevic D., Solujic-Sukdolak S. (2009) Antibacterial Activity of Aegopodium podagraria L. extracts and interaction between extracts and antibiotics //Turk J Biol., vol 33, pp.145-150. doi:10.3906/biy-0810-21

21 Surangi W.P., Selena Y.S. (2014) Bioinformatic and biometric methods in plant morphology. doi: [10.3732/apps.1400071]

22 Tovchiga O.V., Gorbach T.V., Shtrygol' S.Ju., i dr. (2017) Jeffekty preparatov snyti obyknovennoj (Aegopodium podagraria L.) i ih kombinacij s metforminom u krys s narushenijami lipidnogo i uglevodnogo obmena, vyzvannymi protamina sul'fatom [Effects preparations of goutweed (Aegopodium podagraria L.) and their combinations with metformin in rats with disorders of lipid and carbohydrate metabolism caused by protamine sulfate] // Obzory po klinicheskoj farmakologii i lekarstvennoj terapii. vol. 15, no. 2, pp. 31–41. doi: 10.17816/RCF15231-41

23 Tovchiga, O. (2015) The influence of Aegopodium podagraria L. extract and tincture on behavioural reactions of randombred mice / O. Tovchiga, S. Shtrygol'// Journal of Chemical and Pharmaceutical Research, vol. 7, no. 7, pp. 370–384. ISSN: 0975-7384

24 Yeung, E.C.T., Stasolla, C., Sumner, M.J., Huang, B.Q. (2015) Plant Microtechniques and Protocols. Springer, ISBN 978-3-319-19944-3