УДК 615.1.582.683.2.543.456 3.4.2 Фармацевтическая химия, фармакогнозия

DOI: 10.37903/vsgma.2023.1.26 EDN: UHMYHS

STUDY OF ANATOMICAL SIGNS OF *LEPIDIUM DRABA L*.

© Fedotova V.V.

Pyatigorsk Medical and Pharmaceutical Institute, a Branch of Volgograd State Medical University Ministry of Health of Russian Federation, 11, Kalinina, 357532, Pyatigorsk, Russia

Abstract

Objective. *Lepidium draba L.* (syn. *Cardaria draba (L.) Desv.*), family *Brassicaceae* has an interesting and diverse chemical composition, which includes alkaloids, saponins, glucosinolates, flavonoids, tannins, leucoanthocyanins, acids, terpenoids, essential oil. This plant is characterized by pharmacological effects such as anticancer, hypoglycemic, hypocholesterolemic, antibacterial, antifungal antioxidant, carminative, laxative and expectorant. Thus, *L. draba* is promising for pharmaceutical use.

Methods. *L. draba* herb was collected during the flowering period in the vicinity of Pyatigorsk and Mount Mashuk, Stavropol region, Russia in May 2022. The State Pharmacopoeia XIV was the basis of microscopic analysis of *L. draba* as a raw material.

Results. Anatomical signs of *L. draba* are stomata anisocytic type, trichomes unicellular, heavily sinuous walls of cells of the upper and lower epidermis. Mesophyll of two types – palisade and spongy. The bilayer collenchyma is located under the lower epidermis. In the center is a large vascular bundle of ovoid shape. The stem consists of epidermis, collenchyma chlorenchyma, lignified parenchyma, vascular bundles, sclerenchyma. Cells of epidermis of a petal and sepal of a flower polygonal, the sepal has the anisocytic stomata and the petal has outgrowths.

Conclusions. The received findings will provide reference information for standardization, identification and purity for use of herb of *L. draba* as raw materials for pharmacy and medicine.

Keywords: Lepidium draba, collenchyma, cross-section, mesophyll, stomatal anisocytic type, trichomes, vascular bundle

ИЗУЧЕНИЕ АНАТОМИЧЕСКИХ ПРИЗНАКОВ *LEPIDIUM DRABA L.*

Федотова В.В.

Пятигорский медико-фармацевтический институт – филиал Волгоградского государственного медицинского университета, Россия, 357532, Пятигорск, пр-кт Калинина, 11

Резюме

Цель. *Lepidium draba L.* (син. *Cardaria draba (L.) Desv.*), семейство *Brassicaceae* характеризуется богатым разнообразным химическим составом, в который входят алкалоиды, сапонины, глюкозинолаты, флавоноиды, дубильные вещества, лейкоантоцианы, кислоты, терпеноиды, эфирное масло. Это растение обладает такими фармакологическими эффектами, как противоопухолевое, гипогликемическое, гипохолестеринемическое, антибактериальное, противогрибковое, антиоксидантное, ветрогонное, слабительное и отхаркивающее. Таким образом, *L. draba* перспективна для потенциального фармацевтического применения.

Методика. Заготовка травы *L. draba* осуществлялась в период цветения в окрестностях г. Пятигорска и горы Машук Ставропольского края Российской Федерации в мае 2022 г. Микроскопический анализ сырья *L. draba* проводился на основании Государственной Фармакопеи XIV изд.

Результаты. Диагностическими анатомическими признаками *L. draba* являются устьица анизоцитного типа, одноклеточные волоски, сильно извилистые стенки клеток верхнего и нижнего эпидермиса. Мезофилл на поперечном срезе листа двух типов - столбчатый и губчатый. Двухслойная колленхима располагается под нижним эпидермисом. В центре находится крупный

проводящий пучок яйцевидной формы. На поперечном срезе стебля выделяется эпидермис, колленхима, хлоренхима, одревесневшая паренхима, проводящие пучки, склеренхима. Клетки эпидермиса лепестка и чашелистика цветка многоугольные, анизоцитные устьица располагаются на эпидермисе чашелистика, лепесток имеет сосочковидные выросты.

Заключение. Полученные данные являются диагностической информацией для проведения стандартизации и идентификации травы *L. draba* для использования ее в качестве лекарственного сырья для фармацевтических и медицинских целей.

Ключевые слова: Lepidium draba, колленхима, поперечный срез, мезофилл, устьичный аппарат анизоцитного типа, волоски, проводящий пучок

Introduction

Lepidium draba L. (syn. *Cardaria draba (L.) Desv*.) is a perennial plant of the family *Brassicaceae*, which has recently attracted increasing interest among researchers and is promising for introduction into medical practice as a medicinal raw materials [1-3].

The pharmacological effects of *L. draba* are carminative [3], antioxidant [4], laxative [3], anticancer [1], antibacterial [2, 4], antifungal, expectorant, hypoglycemic, hypocholesterolemic [3]. *L. draba* due to its remarkable antioxidant and anti-inflammatory properties can protects the kidney and liver injuries against oxymetholone (anabolic androgenic steroid). These features are attributed to the presence of phenolic and flavonoid components [5, 6]. *L. draba* have considerable antioxidant properties and can help to maintain sexual potency and fertility in patients undergoing chemotherapy [7].

Of the chemical compounds of *L. draba* are detected alkaloids, saponins [8], glucosinolates (glucosinalbin, glucoraphanin [9], lucoerucin [10]), flavonoids (kaempferol, quercetin, isorhamnetin), tannins, leucoanthocyanins8, acids (ellagic, sinapic, p-coumaric and caffeic acids), terpenoids, essential oil [3].

Methods

The research material was herb of *L. draba* (fig. 1). The herb was torn off during blossoming of the plant in May 2022 in Pyatigorsk, Stavropol region.

Fig. 1. *Lepidium draba L.*

For the preparation of micropreparations herb of *L. draba* was fixed in the system ethyl alcohol-glycerol-water in the ratio 1: 1: 1 or used fresh raw materials. The micropreparations were stained with phloroglucin and concentrated sulfuric acid. Micropreparations were studied on a microscope "Biomed", lenses ×4, ×10, eyepiece ×10. Microphotographs were made on a digital camera «3.0 mp cmos microscope eyepiece new». The analysis of *L. draba* was done according to the requirements of the State Pharmacopoeia XIV [11].

Results

Morphological study. Erect stem of *L. draba* pubescent, corymbose-branched at the top 20-50 cm. Basal leaves characterized by sagittate bases. The base of the leaf can wrap around the stem. Phyllotaxy is alternate. Leaf simple with pinnate venation. The margin is dentate. Pubescence is present on the underside of the leaf. The lower stem leaves are sagittate, middle and upper sessile, oblong or lanceolate, up to 6 cm long, light green, up to 3 cm wide. Inflorescence corymb-like. The smell is fragrant. Sepals without pubescence 1.5-2 mm long, white petals 2.5-4 mm long, pistil one, stamens 6. The fruit is silicula oval-cordate, no pubescence.

Microscopic study of the leaf. The upper epidermis has cells with sinuous walls, stomata of numerous anisocytic type, trichomes unicellular with a thick wall and warty surface. Cells of the lower epidermis have more sinuous walls, more stomata than on the upper epidermis (fig. 2A).

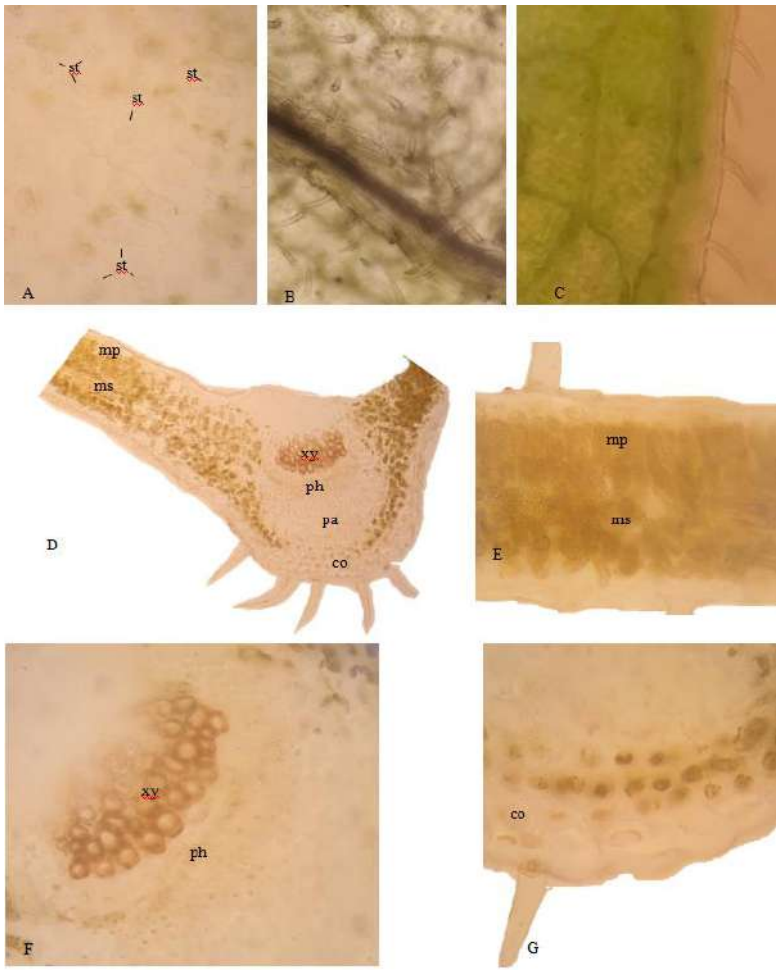

Fig. 2. Leaf of *L. draba:* A – lower epidermis (400×); B – lower epidermis with a fragment of the vein (100×); C – edge of the leaf (100×); D – leaf cross section (100×); E – leaf cross section (400×); F – vascular bundle (400×); E – leaf cross section (400×): st – stomata, co – collenchyma, mp - mesophyll palisade, ms - mesophyll spongy, xy – xylem, ph – phloem, pa – parenchyma

Trichomes are located over the entire surface of the leaf, along the vein (Figure 2B), along the edge of the leaf (fig. 2C). Cross-sections of the leaf. The epidermal cells form one layer, they have a cuticle; square shape of epidermal cells. On the upper and lower epidermis there are stomata and trichomes unicellular (fig. 2D).

The bilayer collenchyma is located under the lower epidermis (fig. 2G). Mesophyll of two types – palisade and spongy. The palisade mesophyll is located on top of two layers of rectangular cells, the cells have thin walls and a large number of chloroplasts. Spongy mesophyll located on the lower side of the leaf in 2-3 layers, round or oval cells with the same number of chloroplasts as in palisade mesophyll cells (fig. 2E). In the center is a large vascular bundle of ovoid shape, collateral type, there is cambium (fig. 2F). The rest of the vein is occupied by a parenchyma with round or multifaceted cells.

Cross-sections of the stem (fig. 3A). The first layer is the epidermis, its cells are square in shape, there is a cuticle. The epidermis is densely located in one row (fig. 3B). Collenchyma is located in 1 layer, along the edges - in several layers. Next is 2-3 layers of chlorenchyma, round-shaped cells of different sizes, cells contain a large number of chloroplasts (fig. 3C). After chlorenchyma is located in several layers of parenchyma.

Vascular bundles are arranged in a circle (fig. 3A). Each vascular bundle is open, collateral, ovoid in shape (fig. 3D). Between the vascular bundles are cells of the lignified parenchyma (fig. 3B). Sclerenchyma is located on the side of the phloem and takes 1-3 layers (fig. 3D). The rest of it consists of parenchyma cells, parenchyma cells of oval or round shape of different sizes. The medulla is empty (fig. 3A).

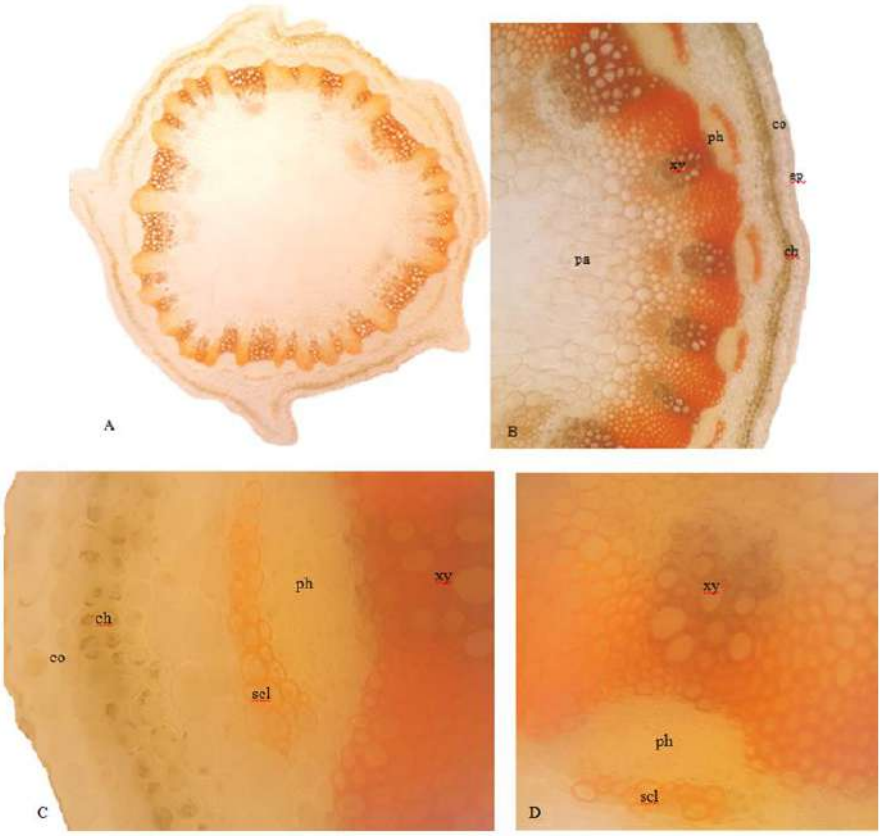

Fig. 3. Cross-sections of the stem (A – ×40; B – ×100; C –400×; D – ×400) of *L. draba:* ep – epidermis, co – collenchyma, xy – xylem, ph – phloem, pa – parenchyma, ch – chlorenchyma, scl – sclerenchyma

The epidermal cells of the sepal are polygonal, the walls are heavily sinuous, the stomata are of anisocytic type (fig. 4A). The cells of the epidermis of the petal are polygonal with straight walls, there are outgrowths along the edge of the petal (fig. 4B).

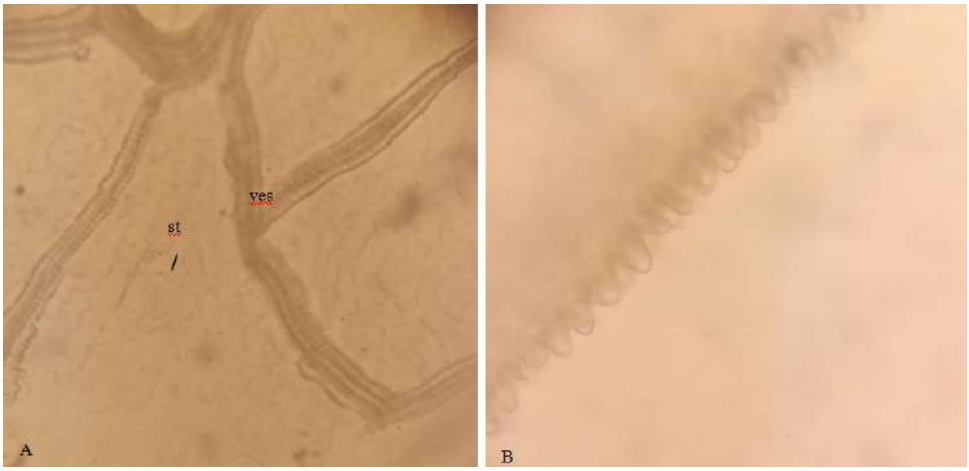

Fig. 4. Flower of *L. draba*: A – epidermis of sepal (×400); B – epidermis of petal (×400): st – stomata, ves – vessels

Discussion

The principal morphological signs of the herb of *L. draba* are the corymbose-branched stem. The base of the leaf can wrap around the stem. The leaves differ in shape, so sagittate are the lower leaves, oblong or lanceolate are the middle and upper leaves. White flowers form an inflorescence corymb. The smell is fragrant.

The main microscopic signs of *L. draba* are: heavily sinuous walls of cells of the upper and lower epidermis, stomata anisocytic type, trichomes unicellular. Mesophyll of two types - palisade and spongy. The bilayer collenchyma is located under the lower epidermis.

In the center is a large vascular bundle of ovoid shape. The stem consists of epidermis, collenchyma chlorenchyma, lignified parenchyma, vascular bundles, sclerenchyma. The flower is characterized by polygonal sepal and petal cells, the sepal has the anomocytic stomata and the petal has outgrowths.

The data obtained are generally similar to the analysis of *L. draba* growing in Iran [12]. The difference in the structure of mesophyll of the leaf. In the plant from Russia, the mesophyll palisade is located under the upper epidermis, mesophyll spongy is located under the lower epidermis. The plant from Iran has the mesophyll palisade under the upper and lower epidermis, a mesophyll spongy in the center of the leaf. Perhaps this is due to the hotter climate of Iran.

Conclusion

Phytotherapy is a treatment characterized by the use of plant medicines in a variety of pharmaceutical products. It is a field of medicine that uses plants either to treat disease or as health-promoting agents. Traditional use of phytotherapies generally preserves the original composition and integrity of the source plant, so that either the whole plant, or a desired percentage of its minimally adulterated components, is used for medicinal purposes. Recently, the worldwide use of herbal medicines has grown profusely. Efficacy, quality, safety are important strategies for improving health and for the social inclusion of phytotherapies. One of the plants, due to which it is possible to increase the arsenal of herbal remedies, is *Lepidium draba L.*

It is rich in a variety of biologically active substances and some pharmacological activity is already known for it. In this work, macro- and microscopic pharmacognostic analysis methods were used. It is useful for the identification, purity and standardization of *L. draba* as a raw material for subsequent use in pharmacy and medicine.

References

1. Amer H.C. Evaluation of anticancer, analgesic and anti-inflammatory activities of the ethanolic extract of *Lepidium draba Linn*. leaves // Advances in Animal and Veterinary Sciences. – 2017. – V. 5,N1. – P. 7-13.
2. Radonić A., Blažević I., Mastelić J., Zekić M., Skočibušić M., Maravić A. Phytochemical analysis and antimicrobial activity of *Cardaria draba (L.) Desv*. volatiles // Chemistry and Biodiversity. – 2011. – V. 8,N6. – P. 1170-1181. doi: 10.1002/cbdv.201000370.
3. Naser E.H., Abo Khthr M.F., Abed S.A. Phytochemistry and therapeutic uses of *Cardaria draba L.*: A review // Plant Archives. – 2019. – V.19,N1. – P. 118-125.
4. Sabrina B., Lotfi B., Nassima B. Compositional study, antibacterial and antioxidant potential of *Lepidium draba L. (Brascicaceae)* // Research Journal of Pharmaceutical, Biological and Chemical Sciences. – 2016. – V.7,N2. – P. 283-287.
5. Feng J., Gao H., Yang L., Xie Y., El-Kenawy A.E., El-Kott A.F. Renoprotective and hepatoprotective activity of *Lepidium draba L*. extracts on oxymetholone-induced oxidative stress in rat // Journal of Food Biochemistry. – 2022 – V.46, N9. – P. 118-126.
6. Wang Y, Bai L, Li H, Yang W, Li M. Protective effects of *Lepidium draba L*. leaves extract on testis histopathology, oxidative stress indicators, serum reproductive hormones and inflammatory signalling in oxymetholone-treated rat // Andrologia. – 2021 – V.11. – P. 18-25.
7. Wang Y, Bai L, Zhang J, Li H, Yang W, Li M. *Lepidium draba L*. leaves extract ameliorated cyclophosphamide-induced testicular toxicity by modulation of ROS-dependent Keap1/Nrf2/HO1, Bax/Bcl2/p53/caspase-3, and inflammatory signaling pathways // Journal of Food Biochemistry. – 2021 – V.12. – P. 11-12.
8. Nebras M., Al-Khafaji S., Al-Marzoqi A.H., Hussein J.H. Influence of the crude Phenolic, Alkaloid and Terpenoid compounds extracts of *Cardaria draba (Lepidium draba L.)* on Human Pathogenic Bacteria // European Journal of Botany, Plant Sciences and Phytology. – 2016. – V. 3,N3. – P. 15-19.
9. Fréchard A., Fabre N., Hannedouche S., Fourasté I. Glucosinolates from *Cardaria draba* // Fitoterapia. – 2002. – V. 73,N2. – P. 177-178.
10. Zekić M., Radonić A. Glucosinolate degradation products of *Aurinia leucadea* (Guss.) K.Koch and *Lepidium draba L*. from Croatia // Natural Product Research. – 2022. – V.1-5.
11. State Pharmacopoeia of the Russian Federation 14th ed. – Ministry of Health RF, 2018.
12. Mousavi S.M., Sharifi-Rad J. Anatomical, palynological and micromorphological study of seed, trichome and stomata of *Cardaria draba L. Desv (Brassicaceae)* in Sistan Iran // International Journal of Biosciences. – 2014. – V.5, N11. – P. 63-69.

Information about the author

Fedotova Victoria V. – Candidate of Pharmaceutical Sciences, Lecturer, Department of Pharmacognosy, Botany and Technology of Phytopreparations of Pyatigorsk Medical and Pharmaceutical Institute, a Branch of Volgograd State Medical University Ministry of Health of Russian Federation. E-mail: bergenya@yandex.ru

Информация об авторе

Федотова Виктория Владимировна – кандидат фармацевтических наук, доцент кафедры фармакогнозии, ботаники и технологии фитопрепаратов Пятигорского медико-фармацевтического института – филиала ФГБОУ ВО «Волгоградский государственный медицинский университет» Минздрава России. E-mail: bergenya@yandex.ru

Конфликт интересов: автор заявляет об отсутствии конфликта интересов.