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## PULSATILLA ALBA: ANALYTICAL REVIEW OF SPREAD, CHEMICAL COMPOSITION, BIOLOGICAL ACTIVITY AND MEDICAL APPLICATION

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*The object of analytical study is the medicinal plant Pulsatilla alba. This species is rare, the stocks of herbal raw materials are limited, and there are no Pulsatilla alba-based medicines on the Ukrainian market.*

*The aim of study was to analyze and summarize data on the range, content of biologically active compounds and the spectrum of use in pharmacy and medicine Pulsatilla alba.*

*Materials and methods.* Literary and electronic sources of information on the distribution, chemical composition and pharmacological activity of Pulsatilla alba.

*Results.* Pulsatilla alba is a plant of the Ranunculaceae family, characterized by a high content of biologically active organic compounds, namely organic acids, traces of alkaloids, vitamins, resinous and tannins, about 20 different macro- and micronutrients, essential oils,  $\gamma$ -lactones, triterpenoids, sterols, chelidonic acid, coumarins, as well as giving it protection status make it an interesting object for research.

*Analysis of scientific publications revealed that plants of the family Ranunculaceae, in particular, Pulsatilla alba contain a significant amount of biologically active substances, have numerous pharmacological activities, have long been used in folk medicine, and is a promising raw material for the production of phytopreparations. The volume of processing of medicinal plant raw materials in Ukraine in one year is from 5 to 6 thousand tons, the amount of raw materials for export reaches more than 3 thousand tons per year. About 1,000 tons of raw materials consumed in Ukraine are imported and 1,500 tons are domestically produced.*

*Conclusions.* Therefore, as populations of rare low-competitive species of the Ranunculaceae family are particularly endangered, displaced by tree, shrub and highly competitive trivial violent herbaceous species due to the widespread use of Pulsatilla alba in folk medicine as an antitumor, hypnotic, hypnotic, antifungal, antifungal research which should be continued

**Keywords:** Pulsatilla alba, biologically active plants, endangered species, in vitro reproduction, pharmacological activity

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### 1. Introduction

There is a trend towards the use of natural ingredients of plant origin in the pharmaceutical industry. A large number of medicines around the world contain natural herbal ingredients. That is why the search for new sources of biologically active compounds is a topical issue in modern pharmacy [1].

One of these plants, which contain a number of biologically active compounds and can be used as medicinal raw materials, are members of the family Ranunculaceae. Many of these plants are threatened with extinction and are listed in the Red List [2]. It is possible to solve the problems of replenishment of medicinal plant resources with the use of biotechnological methods. Biotechnology uses cells, living organisms and biological processes to produce highly efficient products with programmed properties. Therefore, it is currently relevant to

grow plant biomass in vitro under aseptic conditions on artificial nutrient media [3, 4].

A striking representative of this family can be considered *Pulsatilla alba* (alpine anemona), which has long been used in folk medicine in different countries and has a wide range of medicinal properties [5].

Among the foreign drugs that contain *Pulsatilla* is the homeopathic drug Heel *Pulsatilla compositum*. *Pulsatilla* is also used in the form of supplements, as an anticold and in veterinary medicine [6].

A characteristic component of most species of Ranunculaceae is the glycoside protoanemonin, which has antimicrobial and fungicidal properties, has antimutagenic, sedative effects, activates macrophages in the body [7]. The complex use of the compound, pharmacological properties and viability are important, but data and studies of *Pulsatilla alba* are not available.

The aim of the research is to present data from a review of the scientific literature on the area of distribution, content of biologically active substances and the spectrum of use in pharmacy *Pulsatilla alba*.

## 2. Materials and methods

Literary and electronic sources of information, bibliometric database Google Scholar, ScienceDirect, Scopus, which contain information about the plant *Pulsatilla alba* (distribution problems, botanical description, chemical composition and pharmacological activity) were used for the study.

## 3. Research results and their discussion

*Pulsatilla alba* (Fig. 1) is a plant of the family *Ranunculaceae* [8].

**Synonymous names.** Alpine pasqueflower, alpine anemone, *Pulsatilla scherfelii*, windflower, sheep grass.

**Distribution area.** The genus *Pulsatilla* has, according to various authors, from 35 to 45 species. The species *Pulsatilla alba* has become widespread in meadows and rocky areas of the subalpine and alpine zones. The range extends from northern Spain to Serbia and the Carpathians. Today, habitats are known in Chyvhynny, Marmaros Massif, Chornohora, Svydovka, Gorgany, in the Blue Oaks Reserve in Kyiv Region.



Fig. 1. *Pulsatilla alba*

**Protection status.** Due to a significant decrease in the number, the species *Pulsatilla alba* is listed in the Red List of Ukraine as an alpine rare species, and the manufacture of medicines from raw materials of this plant species (unofficial plant) is prohibited. The distribution map of this plant is shown in Fig. 2.

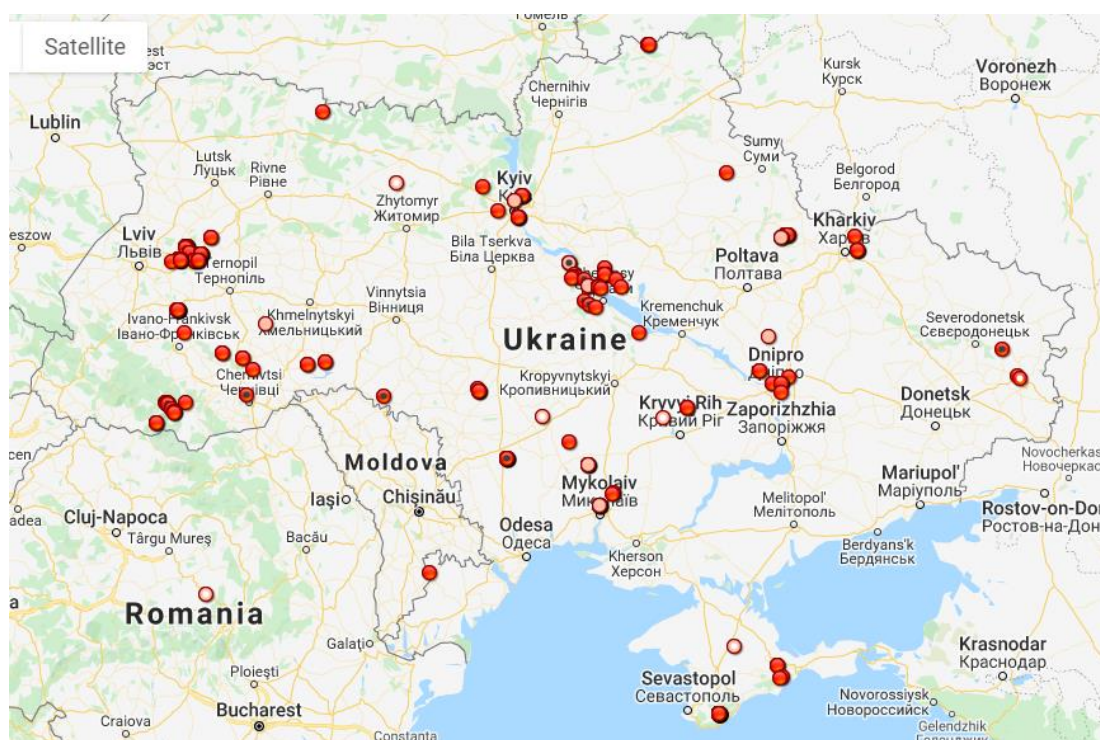


Fig.2. Distribution of *Pulsatilla alba* in Ukraine

The decline in the number of plants is due to excessive visits to the Carpathians over the past decade, which has damaged the grass cover of the mountains and disrupted the structure of apical populations, including white sleep.

Today this plant is protected in the Carpathian NR and NPP "Synevir". Harvesting of plants and violation of places of growth (grazing of cattle) is prohibited. Monitoring of species in Hoverla and Bliznitsa could be an appropriate measure.

**Botanical description.** This plant is a hemicytopyte, i. e., a plant in which at the time of adverse conditions (drought, low temperature) the buds of recovery are at ground level. *Pulsatilla alba* is a perennial primrose plant that develops a strong taproot and numerous branches of the caudex, from which divergent underground shoots diverge [9].

Generative shoots are creeping and reach 25 cm. The leaves appear at the end of flowering, on long peti-

oles and with deeply 2-lobed pointed lobes, basal leaves long-petiolate with three times trifoliate plates. A striking feature of this species are the flowers - with bell-shaped perianth, white, have a yellow center, petals 2–2.5 cm long. Leaves, shoots densely pubescent, as well as petals on the outside. They have the fruit of nutlet [10].

Propagated mainly by seeds, but not uncommon is the vegetative propagation by stolons. *Pulsatilla alba* blooms mainly in April and May. It grows best in places with light shading, although it feels good in the open. Untreated plants can be affected by aphids, powdery mildew.

**Chemical composition of the plant.** Studies of the chemical composition of plants of the genus *Pulsatilla* are devoted mainly to species such as *Pulsatilla nigricans*, *P. ambigua*, *P. chinensis*, *P. dahurica*, *P. koreana*,

*P. turczaninovi*. This can be explained by the fact that *Pulsatilla alba* is rare and research is aimed at species conservation, cultivation, synthesis of analogues of biologically active substances contained in the plant, as well as biotechnological methods of obtaining biomass from *Pulsatilla alba* [11].

*Pulsatilla alba* contains a significant amount of biologically active compounds, which makes it a pharmacologically valuable raw material. Organic acids, traces of alkaloids, vitamins, in particular vitamin C, resins and tannins, about 20 different macro- and microelements were found in the leaves of this plant. The seeds contain fatty oils [12].

The herb contains essential oils,  $\gamma$ -lactones, triterpenoids (p-amyrin acetate), sterols (sitosterol), chelidonic acid, coumarins (Fig. 3).

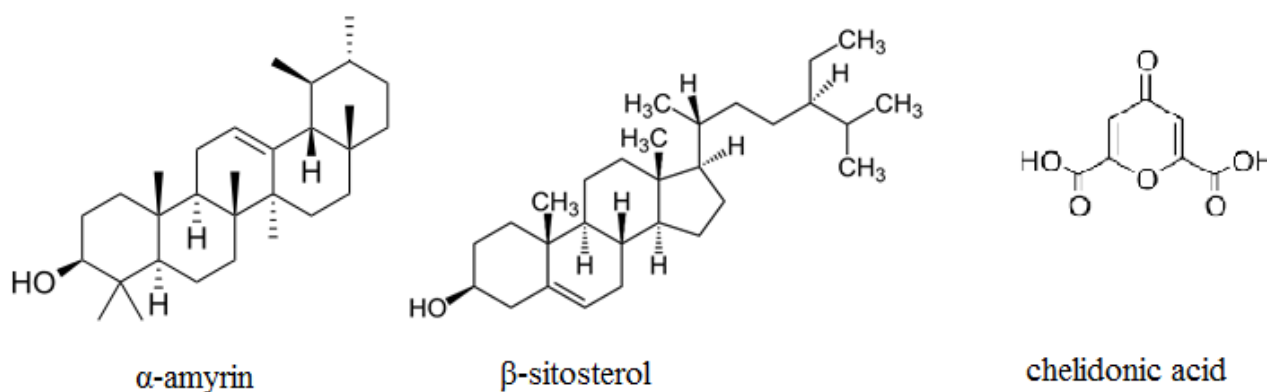


Fig. 3. Chemical composition of the *Pulsatilla alba* herb

The plant is also rich in the glycoside ranunculin, which can be broken down into glucose, and protoanemonin, which in turn decomposes into anemone (anemone camphor) and then inactive anemone acid. It should also be noted a significant amount of tannins, volatile acids, saponins (gederagenin, patensin) and flavonoids in the plant [13–15].

Numerous studies have shown that the dominant class of compounds in *Pulsatilla* species are fatty acids (78.2–96.5 %), protoanemonin (Fig. 4) (48.4 %) [16], and pentadecane.

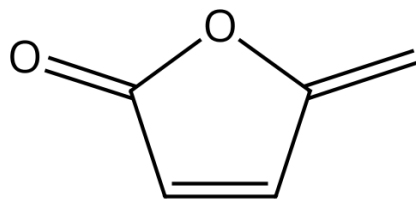


Fig. 4. Protoanemonin

**Pharmacological action:** This plant is used internally as an antitumor, hypnotic, antimicrobial, antifungal agent [17]. Alcoholic extracts of the herb *Pulsatilla alba* show anti-inflammatory activity in the carrageenan model of inflammatory edema of the paw of white rats. 70 % alcohol extract has the best antiexudative activity (1:20). The rate of suppression of the inflammatory reaction of alcohol extract is 27 %, which is slightly lower than the

reference drugs (lower by 10 and 17 % relative to ketorolac tromethamine and diclofenac sodium, respectively). However, this figure is sufficient for herbal anti-inflammatory drugs [18]. The plant is used as a biologically active supplement [19].

**Usage in folk medicine.** *Pulsatilla alba* is a strong antitumor agent and is used to treat cancer of various localizations (cancer of the uterus, breast, gastrointestinal tract, prostate, lung) [20].

In folk medicine it was used as a hypnotic, antimicrobial and antifungal agent. Decoctions of herbs or roots have been used in the treatment of neuralgia, migraine, insomnia, cataracts, glaucoma, inflammation of the inner ear. Alcohol tincture is used for eczema, fungal skin lesions. In addition, tinctures of *Pulsatilla alba* have become widely used in the treatment of bronchitis, asthma, gout, rheumatism.

As a cosmetic, this plant is used to make masks for skin inflammation and acne. These masks smooth, soothe the skin, remove redness. Decoctions are used to rinse hair, which helps to keep them clean and shiny longer.

In veterinary medicine, it is used as a tincture, which has fungicidal and bactericidal properties.

In the East, dysentery, edema of renal and cardiac origin were treated with *Pulsatilla alba* decoction. It was also used for pulmonary tuberculosis, toothache, sexually transmitted diseases. It was believed that the decoction of this plant facilitates childbirth. However, this plant should be used with caution, as it has a number of contraindications.

**Contraindications and toxicity.** It is important to remember that *Pulsatilla alba* is a poisonous plant. Uncontrolled use and self-medication could lead to overdose and acute poisoning. Even inhaling fresh grass vapors could be dangerous to your health.

Caution should be exercised when ingested, as fresh plant abuse could cause inflammation of the intestinal mucosa, kidneys or even paralysis. At glomerulonephritis it is contraindicated to use broths or tinctures of this plant.

A number of studies have also been performed to determine the acute toxicity of 40 % ethanolic extract of callus mass *Pulsatilla alba* [19]. The results of this study indicate the absence of any toxic manifestations when administered intragastrically at doses of 5000, 10,000 and 15,000 mg / kg in white rats, which allows to include extracts of callus mass *Pulsatilla alba* to class VI toxicity (relatively harmless substances). Such data makes it possible to use this drug in medicine.

#### 4. Conclusions

*Pulsatilla alba* is a valuable pharmacological raw material, the study of which should be continued. Discovering new possibilities of *Pulsatilla alba* is a possible breakthrough in medicine and opening new opportunities for its use in various fields, including medicine, medical cosmetology and veterinary pharmacy. *Pulsatilla alba* is not included in any drug in the domestic pharmaceutical market but has long been used in folk medicine in the treatment of many diseases, which is of interest.

#### Conflicts of interest

The authors declare that they have no conflicts of interest.

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