Field breeder: the composition of biologically active substances and potential uses in medicine (review)

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Knautia arvensis: composition of biologically active substances and potential opportunity for use in medicine (a review)

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SUMMARY

A review of modern scientific data on the chemical composition, use in folk medicine, and pharmacological properties of the field borer (Knautia arvensis (L.) Coult) of the Teel family (Dipsacaceae Juss.), Widely used in traditional medicine in Russia, is presented. It has been shown that the field borer contains various classes of biologically active substances (including phenolic compounds, polysaccharides, organic acids, macro and microelements), which have a versatile pharmacological effect. The expediency of further study of this species as a promising domestic medicinal plant material for its introduction into official medicine is shown.

Key words: field breeder, Knautia arvensis (L.) Coult, Dipsacaceae, chemical composition, traditional medicine, pharmacological activity.

RESUME

The article presents an overview of modern scientific data on the chemical composition, use in folk medicine and pharmacological properties of Knautia arvensis (L.) Coult family Dipsacaceae, widely used in traditional medicine of Russia. It is shown that of Knautia arvensis (L.) Coult contains different classes of biologically active compounds (including phenolic compounds, polysaccharides, organic acids, macro and microelements), which have diverse pharmacological activity. On the basis of the reviewed information and analytical research, the expediency of further study of this species as a promising domestic medicinal plant raw materials for its introduction into official medicine is shown.

Keywords: Knautia arvensis (L.) Coult, Dipsacaceae, chemical composition, traditional medicine, pharmacological activity.

INTRODUCTION

The historical experience of various countries and peoples in the use of medicinal plants underlies the therapeutic agents of traditional medicine, but for a long time the use of plants had only a purely empirical character. Currently, the principle of using medicinal plants in medical practice has changed radically and is based on a strict scientific basis, taking into account the content of various classes of biologically active substances (BAS) and their pharmacological effects [28]. Into a modern system

health care in many countries of the world have successfully introduced natural medicines [24], while the world's leading developers of standardized phytopreparations are turning to the experience of traditional medicine [34]. Therefore, the search for new sources of herbal preparations among the species of domestic flora remains an urgent direction of modern pharmacy in the context of import substitution.

One of the most popular promising plants of the flora of Russia, which has long been used in traditional medicine, is the field borer (Knautia arvensis (L.) Coult) of the teasel family (Dipsacaceae Juss.) [32, 33].

The purpose of the work is to systematize modern scientific data on chemical composition, pharmacological activity and use in traditional medicine, as well as generalization of the results of our own experimental studies of the field breeder, on the basis of which it is possible to predict the prospects and expediency of further study of this species for its introduction into official medicine.

Historical background

The field borer got its name due to its use in traditional medicine (for the treatment of various skin diseases). The Latin generic name "Knautia" (Korostavnik) is given in honor of the German physician, naturalist and botanist H. Knaut (Dr. Christopher Knaut.) [3]. However, according to other sources, the name is consonant with the Greek verb "κναω", which means "scratch, scrape" and indicates the use of this type for skin diseases. The specific name “arvensis” means “field” [41]. In traditional medicine of various countries of the world, the plant is called bark, scabby grass, dyspnea (chest) grass, bruise, bruise, commotion, umbilical cord, balabolic, field aster, asterisk, honey, Christ's stick, Egyptian rose, gypsy rose, blue button, field scabbard [1, 2, 3, 31, 41].

Botanical description

The field bark is a perennial herb up to 80 cm high, covered with dense small bristly hairs, has a multi-headed rhizome and an erect, branched, grooved stem [22]. The lower leaves are whole, petiolate, located in a basal rosette; upper, stem - pinnately dissected, or lyre-shaped, sessile, located opposite, usually harsh-haired. The color of the leaves is grayish green. [31]. The flowers are small, bisexual, zygomorphic, collected in inflorescences - heads with a diameter of 20–40 mm. Corolla of 5 fused petals, funnel-shaped, with a bend, 9–15 mm long - for external flowers, 6–7 mm - for internal ones; as a rule, bluish-colored, less often - pink or white [5, 26, 29, 35]. There are four stamens, all free [5, 8]. The leaves of the envelope are lanceolate, pointed, two-row, pale green in color [38, 43]. Calyx 3-4 mm long, saucer-shaped, pale green, has 8-10 long spinous teeth. Fruit - achene, oblong ovate, 5–6 mm long,

has dense pubescence, greenish-yellow in color [8, 26, 29] (Fig. 1). Flowering occurs throughout the summer, starting in June, and continues until late autumn [29, 35, 37], fruits are formed from July to October [19, 35, 40].

Rice. 1. Field breeder (Knautia arvensis (L.) Coult). General view of the plant (Photo from site http://travenvrn.livemaster.ru) Medicinal plant raw materials - grass (Photo authors)

Distribution and ecology

The field breeder is a very common and very ecologically sustainable Eurasian perennial [22, 23]. The distribution area covers the forest zone, forest and subalpine belt of Europe, Western Siberia and the Ciscaucasia. It grows up to 1500 m above sea level [11, 32, 45].

In Russia, the field shortworm is a common species for the European part (with the exception of the extreme northern regions of the Arctic and the northern part of the Karelo-Murmansk region) and the North Caucasus; occurs in the southern regions of Western Siberia and some regions of Eastern Siberia, in the Far East (Primorye, Sakhalin) - as an invasive species [11, 30, 43, 45]. This species is widespread in all regions of Central Russia [32, 35, 40, 45]. It grows on the territory of Ukraine, Kazakhstan, Belarus, Lithuania, Iran [26, 37, 38].

The habitat of the field scabbard is dry grass-and-herb meadows, fields, lightand forests, forest edges, steppes, slopes, embankments [22, 23, 26, 27, 32, 35, 40, 41, 43]. It is often found in the steppe and forest-steppe zones as a weed among shrubs, in pastures, wastelands, vegetable gardens, gardens, quarries, near dwellings, along roads [23, 26, 27, 31, 40]. It infests agricultural crops of forage species [22]. Such a wide distribution is due to the ability of the bark plant to easily regenerate both vegetatively and by seeds, of which one plant forms 2.5–3 thousand per summer [40, 47]. In addition, the plant is resistant to mowing and easy trampling. Korostavnik is a typical representative of the melliferous herb; capable of

to form a lot of nectar even in arid conditions [31, 36, 40, 44]. Pollinated by insects (first of all, diurnal butterflies, as well as bumblebees and beetles), forms abundant pollen [5]. The plant is quite demanding to the composition of the substrate, it prefers fertile, humus-rich soils [23, 31, 35, 44]. It is considered an ornamental plant [9, 32, 33].

Component composition

According to the literature, the chemical composition of the field bark was studied differently for different plant organs.

The roots of the plant contain triterpenoids (knautiosides A and B) and steroids (β-sitosterol glucoside) [32, 33, 46], as well as coumarins and flavonoids [33]. The stems contain saponins, coumarins and flavonoids, while the fruits contain iridoids [33]. The seeds are considered as a potential source of fatty oil (the content of which reaches 25%), incl. 33–40% - in the form of saturated nylon and caprylic acids [40, 43]. Leaves of this species are rich in vitamin C (14.58%) [6].

The most studied chemically is the field bark grass.

In the aerial part of the plant, the presence of saponins, bitter and tannins, iridoids, sugars, carotene (up to 140 mg%) and other vitamins [6, 7], glucoluteolin (luteolin7glucoside) [6, 7, 20, 21, 39], 8Cglucoside has been proven. chrysoeriol, swertiaponin [6, 20, 21], micro and macroelements [6, 7].

Chromatographic methods (BC, TLC, HPLC) revealed 21 compounds of phenolic nature, of which 13 were identified, attributed to flavonoids, phenol carboxylic acids and tannins: luteolin 7 glycoside, quercetin, rutin, kaempferol, gallic, okumaric, caffeic, cycoric acids , coumarin, tannin, epicatechin. The predominant flavonoids are luteolin-7glycoside and quercetin (5.39% and 5.09% of the total amount of phenolic compounds in the raw material). Of phenolic acids, gallic acid (17.17%) predominates, and of coumarins, umbelliferone (7.74%) [16]. The quantitative content of the sum of flavonoids in the herb of field bark in terms of quercetin ranges from 0.28% to 0.37% [9].

When studying the carbohydrate composition of the herb of the field bark, it was found that it contains free (arabinose, glucose, galactose, fructose) and bound (in the form of glycosides and polysaccharides) sugars [9]. Polysaccharides are present in the herb of this type in significant quantities: the content of water-soluble polysaccharides (WSPP) is 5.90%, pectin substances (PV) - 7.90%, hemicelluloses A and B (HC A and HC B) - 4.80% and 3.75%, respectively [13.17]. Of the monosaccharides, the composition of VRPS includes neutral (glucose, galactose, arabinose, rhamnose) and acidic (galacturonic and glucuronic acids) sugars; arabinose (8.6%) and glucose (8.1%) predominate. In the composition of PV - acidic (galacturonic acid prevails - 73.7%) and neutral (glucose, galactose, arabinose, xylose) monosaccharides. HC A and HC B contain only neutral monosaccharides (xylose, arabinose,

The quantitative content of free (8.47%) and methoxylated carboxyl groups (4.34%), as well as methoxyl groups (2.99%) has been established. The PV of the field bark beetle herb are low esterified [9].

In the study of amino acids in the herb of the field bark, 15 compounds were found, of which 7 are indispensable (valine, leucine, isoleucine, lysine, methionine, threonine, phenylalanine). The content of the sum of amino acids in the dry residue of the aqueous extract is 4.62% incl. the amount of essential amino acids - 1.60%. Glutamic acid is predominant [14].

When studying the elemental composition, it was found that the grass of the field barker contains 22 macro and microelements, incl. 10 essential and 5 conditionally essential (potassium, sodium, calcium, magnesium, phosphorus, copper, zinc, molybdenum, manganese, iron, silicon, boron, aluminum, nickel, titanium, vanadium, chromium, barium, zirconium, silver, gallium, beryllium) [18].

Other classes of biologically active substances of the field bark grass are represented by tannins of the predominantly hydrolyzable group (4.61%), organic acids (the total content of which is 1.40%, including ascorbic acid - 0.072%), steroid and triterpenic acids (up to 0.008%) saponins, carotenoids (3.21 mg%) [9].

Use in traditional medicine

Field borer is a widely used medicinal plant in folk medicine in many countries of the world.

In traditional medicine in Russia, korostavnik has long been used as an expectorant, astringent, anti-inflammatory, antiseptic agent [11]. The aerial part was used for pulmonary tuberculosis, bronchitis, acute respiratory diseases, cystitis, ascites, as an astringent for diarrhea and rectal prolapse [11, 25, 33]. A syrup was prepared from the flowers, which was used for pulmonary tuberculosis and liver diseases [33]. But the most famous for the treatment of skin diseases. Hence, its name arose (from the word "scab"), tk. Since ancient times, this plant has been used to treat various kinds of skin disorders. Since ancient times, korostavnik in the form of an infusion has been used externally for chronic pustular skin diseases, pyoderma, furunculosis, carbuncles, scabies, eczema of the scalp, rashes, itching of the anus, as well as fistulas of the anus [11, 25, 33]. The roots have been used to treat syphilis [33]. There is information about the use of the plant for snake bites [11]. In other countries of the world, the field bark is also a popular plant of traditional medicine; at the same time, the list of nosologies for which this type is used is similar to that in Russia. So, in Denmark, the scabbard is used externally for itching, rashes, ringworm [41]. In Poland, the plant is used as a remedy for the treatment of wounds, as well as for diarrhea [41]. In Hungary, korostavnik is used for tuberculosis, scabies, as an antihelminthic agent [41]. at the same time, the list of nosologies for which this type is used is similar to that in Russia. So, in Denmark, the scabbard is used externally for itching, rashes, ringworm [41]. In Poland, the plant is used as a remedy for the treatment of wounds, as well as for diarrhea [41]. In Hungary, korostavnik is used for tuberculosis, scabies, as an antihelminthic agent [41]. at the same time, the list of nosologies for which this type is used is similar to that in Russia. So, in Denmark, the scabbard is used externally for itching, rashes, ringworm [41]. In Poland, the plant is used as a remedy for the treatment of wounds, as well as for diarrhea [41]. In Hungary, korostavnik is used for tuberculosis, scabies, as an antihelminthic agent [41].

In the literature, there is information about the use of korostavnik in veterinary medicine as an antiparasitic agent for the extermination of fleas and helminths [11, 33]. Currently, the plant has found its application in homeopathy [35].

Experimental pharmacological studiesThe study of the pharmacological activity of the field breeder was carried out only by experimental preclinical studies. in vitro and in vivo.

Foreign scientists studied the pharmacological properties of the methanol extract of the herb of the field bark. So, in 1999, Kowalczyk A. and Krzyzanowska J. found that a methanol extract of the herb of the field borer exhibits antifungal activity [32, 42]. Later (in 2008) Hoffmann EM, SeljeAssmann N., Becker K. experimentally confirmed the presence of antiproteolytic properties in this extract [32, 42].

In Russia, on the basis of the Research Institute of Experimental Medicine and the Department of Microbiology, Virology, Immunology of the Kursk State Medical University, screening pharmacological studies of water extraction (infusion), as well as individual fractions of biologically active substances (water-soluble polysaccharides and pectin substances) from the herb of field bark were carried out.

The study of acute toxicity showed that when administered intragastrically to mice, the infusion (in doses from 0.2 to 1.0 ml), as well as water-soluble polysaccharides (VRS in doses of 1000-1500 mg / kg) are non-toxic [10].

The expectorant effect of the infusion and VSPR of the grass of the field was carried out on an experimental model using frogs. It was found that the studied drugs have an expectorant effect (the infusion increases the locomotor activity of the cilia of the ciliated epithelium of the frog esophagus by 24.2%, VSP - by 8.5%, respectively). However, these indicators are inferior to those of the comparison drugs - infusion of the herb marshmallow and Mukaltin [15].

Anti-inflammatory effects were studied in two models, taking into account the effect on different stages of the inflammatory process in mice and rats. The antiexudative activity was manifested in the VRPS at a dose of 200 mg / kg and infusion at a dose of 1 ml / kg (edema decreased by 12.3% and 17.0%, respectively, compared with the control), but it is inferior to that of the reference drug - infusion of flowers calendula. The antiproliferative properties were shown by the infusion and VRPS (inhibition of granuloma formation was 14.5% and 45.1%). At the same time, the results of the antiproliferative activity of VRPS are comparable with the reference drug - the infusion of calendula flowers (46.4%) [9].

The study of the effect of infusion and VSP on capillary permeability was carried out on albino rabbits by simulating a local inflammatory reaction. With the introduction of the infusion (1 ml / kg) and VSPC (100 mg / kg), the latent period of the appearance of staining spots increases (by 141.0% and 91.7%, respectively), as well as their diameter decreases (by 21.3% and 23.5%, respectively) [9].

To study the analgesic activity, two models were used - chemical and thermal irritation (models of "vinegar writhing" and "hot plate"). In case of chemical irritation, the infusion (0.2 ml) and VRPS (200 mg / kg) reduce the number of writhing by 21.9% and 22.9%, respectively, but they are inferior to the reference drug (Analgin), which, in comparison with the control group

animals reduced this indicator by 65.1%. In case of local thermal stimulation (0.2 ml) and VRPS (200 mg / kg), the time of calm stay of the animals on the heated plate was significantly increased in comparison with the control by 23.4% and 11.0%, respectively, but they were inferior to the reference drug (Analgin), which increased this indicator by 41.4% compared with control [4].

The diuretic effect of the herb infusion was studied in white rats. The infusion exhibits a diuretic effect (the amount of urine excreted per day increases by 37.3%), but it is less pronounced than in the official species - horsetail and lingonberry [9].

The antimicrobial effect of the infusion and pectin substances (PV) of the field bark beetle grass was determined by the method of serial dilutions. The infusion showed antimicrobial activity against Pseudomonas aeruginosa (in a ratio of 1: 2 and 1: 4) and Proteus vulgaris (1: 2 and 1: 4). The PV solution showed antimicrobial properties against Pseudomonas aeruginosa (1: 2), Proteus vulgaris (1: 2), Bacillus cereus (1: 2 and 1: 4). However, the infusion and solution of PV in the indicated concentrations did not show an antimicrobial effect against Escherichia coli, Staphylococcus aureus and a fungistatic effect against yeast-like fungi of the genus Candida, because did not suppress the growth of these microorganisms [9].

By the method of thin-layer chromatography in infusion, alcoholic extraction and solution of VSPR from the herb of field barker, 4 substances showing antioxidant activity were found. The infusion inhibits the kinetics of Fe2 + induced chemiluminescence, causing a decrease in the luminescence level of the model system compared to the control by 12.9% [12].

CONCLUSIONS

1. Based on generalized and systematized modern scientific the literature data show that the field borer is a widespread species with a significant raw material base; contains a complex of biologically active substances exhibiting various types of pharmacological activity.

2. Data on the use of field barker in traditional medicine different countries of the world and the results of pharmacological studies substantiate the advisability of its further more in-depth study as a promising domestic medicinal plant with the aim of introducing it into official medicine.

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