

Evaluation of the Nomenclature of Herbal Expectorants on Russian Pharmaceutical Market: Current Status and Future Prospects

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ABSTRACT

This review focuses on current data sources on medicinal plants possessing expectorant effects. The component characterization of biologically active compounds determining the specified pharmacological effect of herbal medicines was also described and analyzed. The nomenclature of expectorant drugs presented on the Russian pharmaceutical market was studied and trends have been identified. It is known that herbal preparations, as a rule, are multicomponent. Combined expectorant drugs that simultaneously affect various mechanisms of inflammation and cough are becoming increasingly popular in medical practice. It seems relevant to assess the proportion of the most commonly used components (as well as biologically active substances) that are currently used for the production of expectorant drugs. Expectorant herbal preparations may contain such groups of biologically active substances as

polysaccharides, saponins, essential oils, alkaloids. Medicinal plant material with an expectorant effect is used to obtain liquid dosage forms: syrups, tinctures, infusions, decoctions, elixirs, drops, and oral solutions, as well as solid – tablets, capsules, granules, troches, powders. These drugs occupy their important niche in the pharmaceutical market of the Russian Federation.

Keywords: herbal drugs, herbal expectorants, herbal teas

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INTRODUCTION

Coughing is one of the most common symptoms of respiratory diseases. The main function of a cough is to restore airway patency by removing foreign bodies and/or pathologically altered tracheobronchial secretions from them. Cough therapy is especially relevant in pediatric practice. According to various sources, more than 50% of children under the age of 1 year, as well as more than 30% of children of preschool and school age, suffer from various diseases accompanied by cough. The difficulty in selecting the optimal drug lies in the wide range of antitussive drugs on the market and the features of their effect on physiological processes in the body [1-4]. Traditionally, antitussive drugs are divided into agents that suppress a dry cough, and agents that eliminate a wet (productive) cough. The former inhibits the cough reflex by reducing the sensitivity of the receptors of the efferent endings of the vagus nerve located in the respiratory organs, or by inhibiting the cough center in the medulla oblongata. This group of drugs includes drugs of the central (narcotic and non-narcotic antitussive drugs) and peripheral effects. Expectorants help eliminate excess sputum and restore airway patency. According to the action mechanism, this group of drugs is divided into two subgroups: drugs that stimulate expectoration (secretory), and mucolytic drugs (secretolytics). Secretory preparations enhance bronchioles peristalsis and promotion of sputum from the lower parts of the respiratory system to the upper and its excretion; these drugs reduce secret viscosity by increasing secretion. By the action the drugs of this group can be divided into reflex and

resorptive. Resorptive drugs, absorbed in the gastrointestinal tract, are then secreted by the mucous membrane of the respiratory tract, stimulating the bronchial glands and causing direct liquefaction (hydration) of sputum. Reflex drugs, main derivatives of medicinal plants and their extracts, have a moderate irritating effect on the receptors of the gastric mucosa, as a result of which the vomiting center in the medulla oblongata is excited. As a result, the secretion of salivary glands and mucous glands of the bronchi is enhanced. Secretolytic drugs thin the sputum by splitting the polymers (mucins) contained in it, which leads to a decrease in its viscosity and easier evacuation from the respiratory tract. Mucolytics are indicated for clinical conditions accompanied by cough with thick, viscous, difficult to separate sputum [5].

Many medicinal plants have mucolytic properties, for example, thyme (common thyme, *Thymus vulgaris* L.; wild thyme, *Thymus serpyllum* L.), plantain (common plantain, *Plantago major* L.), primula (*Primula veris* L.), anise (aniseed, *Pimpinella anisum* L.), oregano (*Origanum vulgare* L.), marsh-mallow (marshmallow, marshmallow, *Althaea officinalis* L.) and Armenian marshmallow (*Althaea armeniaca* Ten.), licorice (liquorice, *Glycyrrhiza glabra* L.) and Chinese liquorice (*Glycyrrhiza uralensis* Fisch. ex DC.), siberian milkwort (*Polygala sibirica* L.), Jacob's ladder (*Polemonium caeruleum* L.), common ivy (*Hedera helix* L.), lanceolate thermopsis (Golden Banner, *Thermopsis lanceolata* R. Br.), marsh rosemary (*Ledum palustre* L.), common fennel (*Foeniculum vulgare* Mill.), scots pine

(*Pinus sylvestris* L.), elecampane (horse-heal, elfdock, *Inula helenium* L.), coltsfoot (*Tussilago farfara* L.), wild pansy (*Viola tricolor* L.) and field pansy (*Viola arvensis* Murray). Mucolytics effectively dilute sputum, affecting the gel phase of bronchial secretion, while not significantly increasing its amount, which contributes to rapid cleansing the respiratory tract from accumulated thick bronchial secretions. This leads to a quick resolution of the pathological process as a result. It should be noted that some mucolytic drugs have several dosage forms (inhalation, oral, endobronchial, etc.), therefore, they can provide various methods of drug delivery, which is extremely important for complex treatment of cough in children and adults [6]. The choice of certain antitussive agents depends on the clinical manifestations of the disease, and their rational use significantly affects the effectiveness of treatment. Now, for the treatment of respiratory diseases, a wide range of synthetic drugs is prescribed.

However, their use in clinical practice is often accompanied by the development of side effects and complications. Therefore, there is currently an increased interest in herbal drugs. The advantage of herbal drugs is their mild action, low toxicity and the rare induction of allergic reactions, which is especially important for diseases requiring long-term treatment. Therapy with medicinal plants is one of the oldest methods in medicine that is relevant to date. Despite the availability of highly effective synthetic drugs, herbal medicine retains its position. Through centuries-old empirical selection, groups of medicinal plants used for one or another pathology have been formed. Medicinal plants, unlike drugs, contain many components, as a result of which one plant can have a versatile effect on the body, for example, expectorant, antimicrobial, anti-inflammatory, diuretic. Medicinal plants can be used in form of mixture herbal products (herbal teas) [7]. Another interesting difference between herbal medicinal products from synthetic analogues is the possibility of the simultaneous combined use of different medicinal plants. With the right selection of phytocombinations, the complementarity and strengthening of the therapeutic effects of the components included in the species occur, while undesirable reactions can be smoothed out or eliminated [8]. Herbal drugs use normalizes metabolic processes disturbed as a result of the disease, enhances the elimination of toxic metabolites from the body, and also helps to restore the protective functions of the body [9].

MATERIALS AND METHODS

We searched for the necessary data in various sources of scientific literature – electronic databases: PubMed, Google Scholar, Scopus, Web of Science, e-Library, normative documentation.

RESULTS AND DISCUSSION

3.1. Medicinal plants with expectorant action

The State Pharmacopoeia of the Russian Federation the XIV edition includes medicinal plants that have an expectorant effect; most of them are used for the production of drugs included in the “State Register of Medicines Allowed for Medical Use in the Russian Federation” [10, 11]. The crude

herbal drugs of these, as well as other non-pharmacopoeia medicinal plants, are used to produce drugs. The expectorant effect of herbal drugs is due to the content of certain groups of biologically active compounds (BAS): triterpene saponins, essential oils, polysaccharides (mucus), and some alkaloids.

3.2. Medicinal plants containing saponins

Plants with a predominant content of saponins include licorice, primula, Siberian milkwort, common ivy. Due to the action on the lining of the stomach, the triterpene saponins of these plants reflexively increase the secretion of mucus by the bronchial glands, increase bronchial motility and increase the activity of cilia of the ciliated epithelium of the bronchial mucosa. In addition, saponins have anti-inflammatory and emollient effects. Siberian milkwort – *Polygala sibirica* L., a perennial herbaceous plant of the istode family – *Polygalaceae*. Siberian milkwort herb is rich in triterpene saponins (up to 10%); there are also flavonoids, tannins, essential oil, and ascorbic acid. Siberian milkwort roots contain up to 1% of saponins [12]. Jacob's ladder – *Polemonium caeruleum* L., a perennial herb of the phlox family – *Polemoniaceae*. A clinical study of Jacob's ladder as an expectorant was first carried out at the Tomsk Medical Institute (D.D. Yablokov and A.K. Sibirtseva) in patients with tuberculosis, acute and chronic bronchitis, lung abscess, and pneumonia in the resolution stage. The content of saponins in Jacob's ladder rhizomes with roots reaches 20% (96% of acidic and 4% of neutral saponins), flavonoids, resinous substances, and organic acids are also detected [10, 13]. Currently, herbal drugs based on Siberian milkwort and Jacob's ladder CHD are not available. Common ivy – *Hedera helix* L., evergreen climbing shrub of the ginseng family – *Araliaceae*. Its leaves contain about 5% (up to 10%) of triterpene saponins, mainly bisdesmoside, derivatives of hederogenin, oleanolic acid and baioegenin. In addition to saponins, ivy leaves contain flavonoids, essential oil, vitamins, tannins, etc. [14]. Licorice (liquorice) – *Glycyrrhiza glabra* L. and Chinese liquorice – *Glycyrrhiza uralensis* Fisch. ex DC., a perennial herbaceous plants in the legumes family – *Fabaceae*. The plant's roots contain saponin glycyrrhizin, that is an ammonium and calcium salt of glycyrrhizic acid. The amount of glycyrrhizin, according to various sources, ranges from 7.5 to 25%. Licorice roots also contain flavonoids (3-4%), mono- and disaccharides (up to 20%), pectin, tar, bitter substances and lipids. Thick and dry licorice extracts are dosage forms that allow to maximally preserve all the healing properties of the plant [10, 15, 16]. Primula (cowslip or cowslip primrose) – *Primula veris* L., a perennial herbaceous plant of the primrose family – *Primulaceae*. Primula rhizomes with roots contain 5-10% saponins; a small amount of essential oil and glycosides are also present. Primula herb contains saponins (~3.3%), flavonoids (~5.5%), polysaccharides (~3.3%), tannins, free organic acids, and ascorbic acid [17].

3.3. Medicinal plants containing alkaloids

An expectorant effect is exerted by some plants containing alkaloids, in particular, Ipecacuan (emetic root) and

thermopsis lanceolate. In low concentrations and low doses, the preparations of these plants cause increased secretion of bronchial glands, liquefaction of sputum and excitation of ciliated epithelium of the respiratory tract. Lanceolate thermopsis (Golden Banner) – *Thermopsis lanceolata* R. Br, perennial herbaceous plant of the legume family – *Fabaceae*. The use of thermopsis herb was recommended by M.N. Varlakov (1933) as an expectorant, replacing imported Ipecac CHD. The alkaloid thermopsin contained in the thermopsis causes a pronounced expectorant effect. The total content of alkaloids in terms of thermopsin reaches 3.6% (according to SPRF XIV edition – at least 1.5%). Saponins, tannins and tarry substances, mucus and small amounts of essential oil were also found in the thermopsis herb. In medical practice, thermopsis herb infusion, thermopsis herb powder, and dry thermopsis extract are used [10, 18, 19].

3.4. Medicinal plants containing essential oils

The group of plants with a predominant content of essential oil includes common thyme herb, wild thyme, oregano, fennel fruits, anise, rosemary shoots, pine buds, elecampane rhizomes and roots. Essential oil, secreted through the bronchi, has a local irritant effect, resulting in increased secretion of the bronchial glands and liquefaction of sputum. Essential oil plants, in addition to expectorant action, also have high phytoncide and anti-inflammatory activity, as well as have pronounced antispasmodic and moderate sedative effects. Common thyme – *Thymus vulgaris* L., and wild thyme – *Thymus serpyllum* L., are perennial plants of the mint family – *Lamiaceae*. The chemical composition of both types of thyme is almost the same: essential oil (the main component is thymol), flavonoids, tannins, a small amount of saponins, as well as coffee and rosmarinic acids. In the flowering herb of common thyme, the content of essential oil ranges from 0.8-1.2% (according to SPRF XIV edition – at least 1%), and in the wild thyme herb the content of essential oil does not exceed 1% [10, 20]. Oregano – *Origanum vulgare* L., a perennial herbaceous plant of the mint family – *Lamiaceae*. Its aerial parts contain up to 1.2% of essential oil, which contains phenols (up to 44%) – thymol and carvacrol, bi- and tricyclic sesquiterpenes, as well as free alcohols and geranyl acetate. The leaves are also rich in ascorbic acid; tannins were found [10, 21]. Anise – *Pimpinella anisum* L., an annual herbaceous plant of the celery family – *Apiaceae*. The content of essential oil in anise fruits ranges from 1.2 to 3.2%, less often – up to 6% (according to SPRF XIV edition – at least 1.5%); the main components are transanetol (80–90%) and metholchavicol (about 10%). Fruits are also rich in fatty oil (10–25%) [10, 22]. Common fennel – *Foeniculum vulgare* Mill., Plant of the celery family – *Apiaceae*. Its fruits contain 2–6.5% (according to SPRF XIV – at least 3%) of essential oil, the main components are anethole (up to 60%) and enhol (up to 12%). Fruits are also rich in fatty oil (up to 18%) [10, 23, 24]. Marsh rosemary – *Ledum palustre* L., the evergreen shrub of the heather family – *Ericaceae*. In its shoots, the content of essential oil varies widely from 0.1 to 7.5% and even up to 14% (according to SPRF XIV edition –

not less than 0.1%), which is explained by the influence of geographical and environmental factors. The main components are icebreaker and palustrol. In addition to essential oil, tannins, flavonoids, and arbutin were found in ledum [10, 25]. Scots pine – *Pinus sylvestris* L., pine family – *Pinaceae*. Pine buds contain 0.36% of essential oil (according to SPRF XIV edition – at least 0.3%), and it contains α -pinene, limonene, borneol, bornyl acetate etc. In addition, the buds contain ascorbic acid, bitter and tannins [10, 26]. Elecampane, horse-heal, elfdock – *Inula helenium* L., a perennial herb of the aster family – *Asteraceae*. Rhizomes and roots contain up to 40% of polysaccharides (according to SPRF XIV edition – at least 25%), the main component of which is inulin, and essential oil – up to 3%. Elecampane essential oil – a mixture of sesquiterpene lactones: alantolactone, isoalantolactone, dihydroalantolactone and proazulene. The expectorant effect of elecampane is due to the content of polysaccharides, saponins and essential oil [10, 27-31].

3.5. Medicinal plants containing polysaccharides

Plants with a predominant content of polysaccharides (mucus) include coltsfoot, common plantain, violet, marshmallow. The expectorant effect of these plants is based on the reflex mechanism of action. After ingestion, polysaccharides irritate the gastric receptors, which reflexively, by activating the vagus nerve center in the medulla oblongata, increases the function of the secretory cells of the respiratory tract. This leads to the fact that more mucus is secreted, it becomes less viscous (the amount of the liquid component of the mucus increases) and it clears its throat more easily. Reducing the viscosity of sputum restores the motor function of the ciliary epithelium, and, accordingly, the evacuation of sputum from the respiratory tract. Polysaccharide-containing plants also have an enveloping, emollient, reparative and anti-inflammatory effect. Coltsfoot – *Tussilago farfara* L., a perennial herb of the aster family – *Asteraceae*. Coltsfoot leaves contain polysaccharides, causing an expectorant effect, about 7-8% of mucus (glucose, galactose, pentoses and uronic acids are formed during its hydrolysis), saponins, bitter glycosides, carotenoids, flavonoids, hydroxycinnamic acids, tannins, ascorbic acid [10, 32, 33]. Common plantain – *Plantago major* L., a perennial herb of the plantain family – *Plantaginaceae*. It has an expectorant effect due to the high content of polysaccharides (SPRF XIV edition – at least 12%). The content of mucus in the leaves reaches 12%, and in the seeds reaches 46%; mucus mainly consists of xylose and galacturonic acid. Ascorbic acid, tannins, and vitamin K are also present [10, 34, 35]. Wild pansy – *Viola tricolor* L., and field pansy – *Viola arvensis* Murray, herbaceous annual or biennial (occasionally perennial) plants of the violet family – *Violaceae*. The expectorant effect of the violet herb is due to the content of polysaccharides (up to 9.5% of mucus, which includes arabinose, galactose and glucose, standardization by the total content of polysaccharides (SPRF XIV – at least 8%) and saponins. Violet is also rich in carotenoids, flavonoids, ascorbic acid; there is a small amount of essential oil [10, 36]. Marshmallow (medicinal

marshmallow, mallow, marsh-mallow, marsh mallow) – *Althaea officinalis* L. and Armenian marshmallow – *Althaea armeniaca* Ten., are perennial herbaceous plants in the mallow family – *Malvaceae*. Due to its high polysaccharide content, this plant has an expectorant effect. The mucus content in marshmallow roots reaches 35%, and in the herb – up to 15%; the main components of mucus are polysaccharides (pentosans and hexosans), which give pentose, galactose and dextrose during hydrolysis; 37% starch, 2% asparagine, 8% free sugars, 11-16% pectin are present. The roots are used in the form of powder, infusion, **dry extract and syrup**, and the preparation “Mukaltin” is obtained from the herb [10, 37].

3.6. Dosage forms

Most often, crude herbal drugs with an expectorant effect are used to obtain liquid dosage forms: syrups, infusions, decoctions, elixirs, extracts. The syrup is considered the most preferred form of oral administration for children. In

the syrup, it is possible to balance the necessary pharmacokinetic and organoleptic properties. The advantages of this form are ease of administration, a standardized amount of active ingredients, the ability to correct taste and smell, which is essential in pediatric practice, as well as the possibility of longer storage and ease of transportation.

3.7. The Russian Federation expectorants range

The range of expectorants used in Russia is presented in Table 1. Herbal drugs are produced by manufacturers from Russia, Germany, Poland, India, Croatia, etc. The development of domestic herbal drugs for expectorant action is a priority and noteworthy area of pharmacy in many countries. The interest in herbal medicine is currently reviving. This is facilitated by an in-depth study of biologically active compounds that make up medicinal plants, as well as the emergence of new methods for their study and improvement of existing [38].

Table 1: Russian pharmaceutical market of herbal drugs and mixed herbal products

No	Trade name	Dosage form	Composition	Company (Country)
<i>Monocomponent drugs</i>				
1.	Althea syrup	Syrup	Marshmallow root extract	JADRAN-GALENSKI LABORATORIJ d.d. (Croatia)
2.	Bronchicum C	Syrup	Common thyme herb liquid extract	A.NATTERMANN and Cie., GmbH (Germany)
3.	Bronchicum C	Lozenges	Common thyme herb liquid extract	Sanofi-Aventis Sp. z o.o. (Poland)
4.	Hedelix	Syrup, drops	Common ivy leaf extract	Krewel Meuselbach GmbH (Germany)
5.	Herbion ivy syrup	Syrup	Common ivy leaf extract	KRKA, dd, Novo mesto (Slovenia)
6.	Pectoral Elixir	Elixir	Licorice root extract	JSC “Tatchempharmpreparaty” (Russia)
7.	Dr. Theiss Anis oil	Capsules	Anise oil	Dr. Theiss Naturwaren GmbH (Germany)
8.	Dr. Theiss Plantain syrup	Syrup	Rowleaf plantain leaf extract	Dr. Theiss Naturwaren GmbH (Germany)
9.	Mukaltin; Mukaltin-LekT, Mukaltin Medisorb	Tablets	Marshmallow herb extract	AVVA RUS (Russia); OJSC ThFZ (Russia); JSC Medisorb (Russia) and 12 more manufacturers
10.	Plantain tincture	Tincture	Common plantain leaves	OJSC Tver Pharmaceutical Factory (Russia), JSC “Murom apparatus producing plant” (Russia)
11.	Prospan	Syrup	Common ivy leaf extract	Engelhard Artsnaymittel GmbH & Co.KG (Germany)
12.	Licorice Syrup	Syrup	Licorice root extract	OJSC Tver Pharmaceutical Factory (Russia), LLC Tula Pharmaceutical Factory (Russia), JSC “Tatchempharmpreparaty” (Russia) and 12 more manufacturers
13.	Licorice Root Syrup	Syrup	Licorice root extract	JSC Moscow Pharmaceutical Factory (Russia)
14.	Tuspan	Syrup	Common ivy leaf extract	Sopharma AD. (Bulgaria)
15.	Tussamag	Syrup	Common thyme herb extract	Ratiopharm GmbH (Germany)
16.	Coltsfoot leaves	Crushed leaves,	Coltsfoot leaves	JSC St. MEDIFARM (Russia), LLC Health (Russia), NPO MIKROGEN (Russia), JSC Krasnogorsklexredstva

		leaves powder		(Russia), SMPP MAGNOLIA (Russia), VALERIA (Russia), FITO-EM agro-industrial company (Russia), LLC "Fito-Bot" (Russia), Fitofarm PKF (Russia), "Lek C+" (Russia)
17.	Thyme herb	Crushed herb, pressed herb, powder herb	Wild thyme herb	FITO-EM agro-industrial company (Russia), MAGNOLIA SMFP (Russia), FITOFARM PKF (Russia), LLC "Health" (Russia), St.-MEDIFARM (Russia), LLC "Lek C+" (Russia), LLC "Fito-Bot"(Russia), JSC "Krasnogorsklexredstva" (Russia), IVAN-CHAI (Russia)
18.	Marsh rosemary shoots	Crushed shoots, powder shoots	Marsh rosemary shoots	JSC "Krasnogorsklexredstva" (Russia), LENMEDSNAB (Russia), FAROS-21 (Russia), Federal State Unitary Enterprise NPO Mikrogen of the Ministry of Health of Russia (Russia), St. MEDIFARM (Russia), LLC "Health" (Russia)
19.	Marshmallow roots	Crushed roots	Marshmallow roots	JSC "Krasnogorsklexredstva" (Russia), LLC "Health" (Russia), Federal State Unitary Enterprise NPO Mikrogen of the Ministry of Health of Russia (Russia), LLC PKF Fitofarm (Russia)
20.	Common Pine buds	Whole buds	Common Pine buds	LLC "Lek C+"(Russia), LLC PKF Fitofarm (Russia), LLC "Health" (Russia)
21.	Elecampane rhizomes and roots	Crushed, powder rhizomes and roots	Elecampane rhizomes and roots	JSC "Krasnogorsklexredstva" (Russia), LLC "Health" (Russia), FITO-EM agro-industrial company (Russia), FITO-EM agro-industrial company (Russia), LLC "Fito-Bot"(Russia)
22.	Licorice roots	Crushed roots, roots powder	Licorice roots	FITO-EM agro-industrial company (Russia), MAGNOLIA SMFP (Russia), FITOFARM PKF (Russia), LLC "Health" (Russia), St.-MEDIFARM (Russia), LLC "Lek C+" (Russia), LLC "Fito-Bot"(Russia), JSC "Krasnogorsklexredstva" (Russia), IVAN-CHAI (Russia)
23.	Plantain leaves	Crushed leaves, powder	Plantain leaves	JSC "Krasnogorsklexredstva" (Russia), LLC "Health" (Russia), LLC "Lek C+" (Russia) and 25 more manufacturers
24.	Violet herb	Crushed herb, herb powder	Violet herb	JSC "Krasnogorsklexredstva" (Russia), LLC "Health" (Russia), LLC PKF Fitofarm (Russia), FITO-EM agro-industrial company (Russia), Federal State Unitary Enterprise NPO Mikrogen of the Ministry of Health of Russia (Russia)
25.	Anise fruits	Whole fruits	Anise fruits	LLC "Health" (Russia), LLC "Lek C+" (Russia), IVAN-CHAI (Russia)
26.	Oregano herb	Crushed herba, powder	Oregano herb	JSC "Krasnogorsklexredstva" (Russia), LLC "Health" (Russia), LLC "Lek C+" (Russia).
27.	Fennel fruits	Whole fruits	Fennel fruits	LLC "Health" (Russia), IVAN-CHAI (Russia), LLC PKF Fitofarm (Russia)
<i>Complex drugs, mixed herbal products</i>				
28.	Bronchicum TP	Elixir	Primula root extract + common thyme herb extract	A.NATTERMANN and Cie., GmbH (Germany)
29.	Bronchinol	Syrup	Coltsfoot leaf extract + peppermint leaf oil + lanceolate plantain leaf extract + manna gum leaves oil	Bausch Health (Canada)/ Valeant (Russia)
30.	Bronchipret	Oral drops	Ivy leaf tincture + thyme liquid extract	Bionorica SE (Germany)
31.	Bronchipret TP	Coated tablets	Primula root extract + common thyme herb extract	Rottendorf Pharma GmbH/Bionorica SE (Germany)
32.	Herbifors	Syrup	Primula root extract + common thyme herb extract	LLC Tula Pharmaceutical Factory (Russia)
33.	Herbilesil	Syrup	Ascorbic acid + (wild mallow flower +	LLC Tula Pharmaceutical Factory (Russia)

			lanceolate plantain leaves) extract	
34.	Pectoral species No 1 (Phytopectol No 1)	Mixed herbal product in the form of powder, Crushed mixed herbal product	Althea officinalis roots + oregano herb + coltsfoot leaves	JSC "Krasnogorsklexredstva" (Russia), LLC "Health" (Russia), LLC «Lek C+»(Russia), Federal State Unitary Enterprise NPO Mikrogen of the Ministry of Health of Russia (Russia), LLC "Fito-Bot" (Russia)
35.	Pectoral species No 2 (Phytopectol No 2)	Mixed herbal product in the form of powder, Crushed mixed herbal product	Coltsfoot leaves + common plantain leaves + licorice roots	JSC "Krasnogorsklexredstva" (Russia), LLC "Health" (Russia), and 4 more manufacturers
36.	Pectoral species No 3	Crushed mixed herbal product	Althea officinalis roots + anise fruit + licorice roots + Scots pine bud + sage leaves	LLC "Health" (Russia), LLC "Lek C+" (Russia)
37.	Pectoral species No 4	Crushed mixed herbal product, mixed herbal product in the form of powder	Marsh rosemary shoots + calendula flowers + peppermint leaves + wild chamomile flowers + licorice roots + viola herb	LLC "Health" (Russia), JSC St. Medifarm (Russia), JSC "Krasnogorsklexredstva" (Russia), Federal State Unitary Enterprise NPO Mikrogen of the Ministry of Health of Russia (Russia), LLC PKF Fitofarm (Russia)
38.	Pectoral Elixir	Oral solution, elixir	Ammonia + anise seed oil + licorice root extract	CJSC "VIFITEKH" (Russia), JSC "Tatchempharmpreparaty" (Russia) and 7 more manufacturers
39.	Doctor Theiss Bronchosept	Oral drops	Anise oil + thyme liquid extract	Dr. Theiss Naturwaren GmbH (Germany)
40.	Codelanov	Tablets	Codeine + sodium bicarbonate + licorice roots + lanceolate thermopsis herb	OTCPharm JSC (Russia)
41.	Codelanov phyto	Oral solution	Codeine + licorice root extract + lanceolate thermopsis herb extract + wild thyme herb extract	OTCPharm JSC (Russia)
42.	Linkus BSS	Syrup	Malabar nut leaf extract + marshmallow flower extract + great galangal rhizome extract + jujube tree fruit extract + hyssop extract + cordia broadleaf extract + onosma flowering leaf and flower extract + long red pepper and root extract + licorice root extract + sweet violet flower extract	Herbion Pakistan Pvt. Ltd. (Pakistan)
43.	Linkus LOR	Lozenges	Malabar nut leaf extract + great galangal rhizome extract + hyssop extract + levomenthol + long red pepper and root extract + licorice root extract + sweet violet extract	Herbion Pakistan Pvt. Ltd. (Pakistan)
44.	Linkus ORVI	Granules for oral suspensio	Malabar nut leaves + valerian rhizome with roots + willow bark + licorice roots + common fennel + violet + Chinese tea	Herbion Pakistan Pvt. Ltd. (Pakistan)

		n	leaves + common blue gum leaves	
45.	Mixture conta tussis for adults siccum	Powder for oral solution	Ammonium chloride + sodium benzoate + sodium bicarbonate + licorice root extract + lanceolate thermopsis herb extract	CJSC "VIFITEKH" (Russia), LLC Tula Pharmaceutical Factory (Russia), LLC "LUMI" (Russia), JSC Moscow Pharmaceutical Factory (Russia)
46.	Mixture conta tussis for children siccum	Powder for oral solution	Marshmallow root extract + ammonium chloride + sodium benzoate + sodium bicarbonate + licorice root extract	LLC "Atoll" (Russia), CJSC "VIFITEKH" (Russia), LLC Tula Pharmaceutical Factory (Russia), LLC "LUMI" (Russia), JSC Moscow Pharmaceutical Factory (Russia)
47.	Liquor ammonii anisatus	Oral solution	Ammonia + anise seed oil	JSC "Kirov Pharmaceutical Factory" (Russia), OJSC Tver Pharmaceutical Factory (Russia)
48.	Expectorant species	Crushed mixed herbal product	Marsh rosemary shoots + elecampane rhizomes with roots + calendula flowers + coltsfoot leaves + peppermint leaves + common plantain leaves + wild chamomile flowers + licorice roots	LLC "Lek C+" (Russia), Federal State Unitary Enterprise NPO Microgen of the Ministry of Health of Russia (Russia)
49.	Stoptussin-phyto	Syrup	Lanceolate plantain leaf extract + common thyme herb extract + wild thyme herb extract	Teva Pharmaceutical Industries (Israel)
50.	Antitussive tablets	Tablets	Lanceolate thermopsis herb + sodium hydrogen carbonate	CJSC "VIFITEKH" (Russia), JSC Moscow Pharmaceutical Factory (Russia); OJSC "Pharmstandard-Tomskkhimfarm" (Russia) and 6 more manufacturers
51.	Thermopsis syrup with licorice	Syrup	Ammonium chloride + potassium bromide + sodium benzoate + licorice root thick extract + lanceolate thermopsis herb extract	CJSC "VIFITEKH" (Russia)
52.	Eucabal	Syrup	Plantain liquid extract + thyme liquid extract	Aristo Pharma GmbH (Germany)
53.	Eucabal Balm S	Emulsion for inhalation and external use	Scots pine needles oil + eucalyptus leaf oil	Aristo Pharma GmbH (Germany)

Thus, 51 drugs are sold on the Russian market. The most common CHD for herbal drugs manufacture are licorice roots, thyme herb and plantain leaves. The data are presented in table 2.

Table 2: CHD prevalence in the Russian pharmaceutical market

CHD	The number of drugs on the market
Licorice roots	17
Thyme herb	12
Plantain leaves	9
Anise fruits	6
Ivy leaves	5
Thermopsis herb	5
Marshmallow roots	5
Coltsfoot leaves	5
Violet herb	4
Primula herb/root	3
Other CHD	7

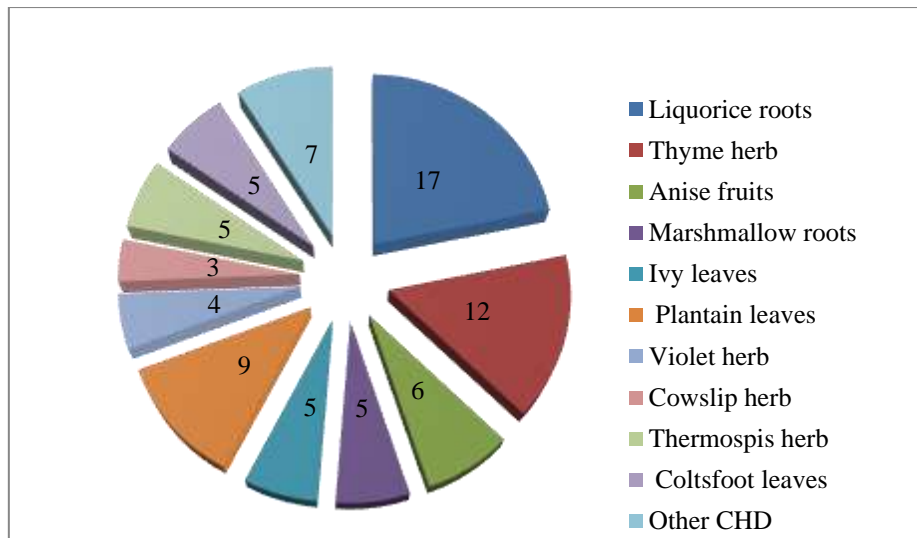


Figure 1: CHD prevalence in the Russian pharmaceutical market

Based on the data in the table, we see that the most common medicinal plants on the market are licorice, thyme, plantain, ivy, anise, thermopsis, primula, marshmallow, violet, coltsfoot. In four of these plants the main group of BAS are

polysaccharides, in three – saponins, in seven – essential oils, and in one – alkaloids. The data are presented in Table 3.

Table 3: The main BAS groups of the expectorant CHD in Russian pharmaceutical market

The main BAS group	CHD
Alkaloids	Thermopsis herb
Polysaccharides	Marshmallow roots, violet herb, coltsfoot leaves, plantain leaves
Saponins	Licorice roots, ivy leaves, primula herb
Essential oils	Thyme herb, anise fruits, fennel fruits, oregano herb, common pine buds, elecampane rhizomes and roots, marsh rosemary shoots

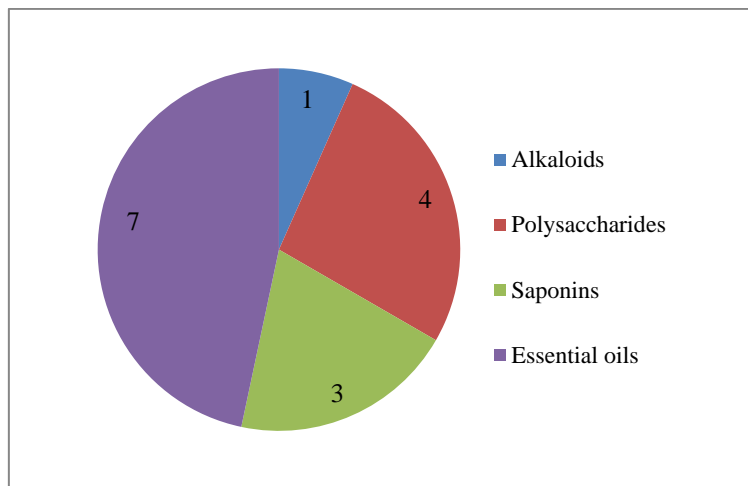


Figure 2: The main BAS groups in the most common CHD in Russian pharmaceutical market

CONCLUSION

Medicinal plants are actively used in modern medicine. Herbal drugs are often prescribed as components of the various diseases complex therapy, including coughing. Currently, 53 drugs made from crude herbal drugs are being sold on the Russian market. The most common CHD for herbal drugs manufacture are licorice roots, thyme herb and plantain leaves. Such phenomena as the expansion of the CHD base, the manufacture of new herbal drugs, the

improvement of standardization methods, do not lose their relevance to this day [39].

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CONFLICTS OF INTEREST

None.

REFERENCES

1. Hanson C. Cough mixtures-an overview. SA Pharmaceutical Journal. 2016; 83 (5): 14-17.
2. Carvalho ACB, Lana TN, Perfeito JPS, Silveira D. The Brazilian market of herbal medicinal products and the impacts of the new legislation on traditional medicines. Journal of ethnopharmacology. 2018; 212: 29-35.
3. Kuang Y, Li B, Fan J, Qiao X, Ye M. Antitussive and expectorant activities of licorice and its major compounds. Bioorganic & medicinal chemistry. 2018; 26 (1): 278-284.
4. Allaert FA, Villet S, Vincent S, Sauve L. Observational study on the dispensing of cough syrups to children with acute cough by community pharmacists in France. Minerva pediatrica. 2018; 70 (2): 117-126.
5. Cazzola M, Calzetta L, Page C, Rogliani P, Matera MG. Thiol-based drugs in pulmonary medicine: Much more than mucolytics. Trends in pharmacological sciences. 2019.
6. Wopker PM, Schwermer M, Sommer S, Längler A, Fetz K, Ostermann T, Zuzak TJ. Complementary and alternative medicine in the treatment of acute bronchitis in children: A systematic review. Complementary Therapies in Medicine. 2020; 49: 102217.
7. Smyslova OA, Bokov DO, Potanina OG, Litvinova TM, Samylina IA. Development and validation of spectrophotometric procedure for quantitative determination of flavonoid content used to control the quality of mixture herbal product. Journal of Advanced Pharmaceutical Technology and Research. 2019; 10 (4):155-162.
8. Vázquez-Fresno R, Rosana ARR, Sajed T, Onookome-Okome T, Wishart NA, Wishart DS. Herbs and Spices-Biomarkers of Intake Based on Human Intervention Studies—A Systematic Review. Genes & nutrition. 2019; 14 (1): 18.
9. Ody, P. The complete medicinal herbal: a practical guide to the healing properties of herbs. Simon and Schuster. 2017.
10. State Pharmacopoeia of Russian Federation, XIV ed., Vol. IV. Federal electronic medical library. <http://femb.ru/femb/pharmacopea.php> [homepage on the Internet]. The Russian Federation Ministry of Health [Official site in Russian].
11. State Register of Medicines. The Russian Federation Ministry of Health [Official site]. URL: <https://grls.rosminzdrav.ru/GRLS.aspx> [in Russian].
12. Lacaille-Dubois MA, Delaude C, Mitaine-Offer AC. A review on the phytopharmacological studies of the genus Polygala. Journal of ethnopharmacology. 2019; 112417.
13. Łaska G, Sieniawska E, Świątek Ł, Zjawiony J, Khan S, Boguszewska A, Polz-Daciewicz M. Phytochemistry and biological activities of *Polemonium caeruleum* L. Phytochemistry Letters. 2019; 30: 314-323.
14. Al-Snafi AE. Pharmacological and therapeutic activities of *Hedera helix*-A review. IOSR Journal of Pharmacy. 2018; 8: 41-53.
15. Brovchenko BV, Ermakova VA, Bokov DO, Samylina IA, Demina NB, Chernova SV. Validation of an HPLC-UV procedure for determining the glycyrrhizic acid content in licorice roots. Pharmaceutical Chemistry Journal. 2020; 53(12): 1168-1173.
16. Dastagir G, Rizvi MA. *Glycyrrhiza glabra* L.(Licorice). Pakistan journal of pharmaceutical sciences. 2016; 29 (5): 1727-1733.
17. Colombo PS, Flamini G, Rodondi G, Giuliani C, Santagostini L, Fico G. Phytochemistry of European Primula species. Phytochemistry. 2017; 143: 132-144.
18. Yong L, Yinyan L, Shenghu H, Yongkang Z. Studies of bacteriostatic and anti-inflammatory activities of alkaloids from *Thermopsis lanceolata* [J]. Journal of Agricultural Sciences. 2007; 2: 34-35.
19. Yong L, Xiangyang C, Yongkang Z. Research progress of *Thermopsis lanceolata* [J]. Journal of Agricultural Sciences. 2007; 1: 80-84.
20. Dauqan EM, Abdullah A. Medicinal and functional values of thyme (*Thymus vulgaris* L.) herb. Journal of Applied Biology & Biotechnology. 2017; 5 (2): 17-22.
21. Timothy CN, Priya VV, Gayathri R. Phytochemical analysis and total phenolic content of *Origanum vulgare* (oregano). Drug Invention Today. 2018; 10 (10):1903-1905.
22. Asadollahpoor A, Abdollahi M, Rahimi R. *Pimpinella anisum* L. fruit: Chemical composition and effect on rat model of nonalcoholic fatty liver disease. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences. 2017; 22: 37.
23. Yaldiz G, Camlica M. Variation in the fruit phytochemical and mineral composition, and phenolic content and antioxidant activity of the fruit extracts of different fennel (*Foeniculum vulgare* L.) genotypes. Industrial Crops and Products. 2019; 142: 111852.
24. Rather MA, Dar BA, Sofi SN, Bhat BA, Qurishi MA. *Foeniculum vulgare*: A comprehensive review of its traditional use, phytochemistry, pharmacology, and safety. Arabian Journal of Chemistry. 2016; 9: 1574-1583.
25. Dampc A, Luczkiewicz M. Rhododendron tomentosum (*Ledum palustre*). A review of traditional use based on current research. Fitoterapia. 2013; 85: 130-143.
26. Metsämuuronen S, Sirén H. Bioactive phenolic compounds, metabolism and properties: a review on valuable chemical compounds in Scots pine and Norway spruce. Phytochemistry Reviews. 2019; 18 (3): 623-664.
27. Bokov DO, Karabeshkin DI, Samylina IA, Potanina OG, Krasnyuk II (junior), Malinkin AD, Sergunova EV, Kovaleva TYu, Bobkova NV, Antsyshkina AM, Bondar AA, Evgrafov AA, Galiakhmetova EK, Moiseev DV, Bessonov VV. Pharmacopoeial analysis of inulin-containing medicinal plant raw materials

- and drugs. Pharmacognosy Journal. 2020; 12(2): 415-421.
28. Petkova N, Ognyanov M, Todorova M, Denev P. Ultrasound-assisted extraction and characterisation of inulin-type fructan from roots of elecampane (*Inula helenium* L.). Acta Scientifica Naturalis. 2015; 1(1): 225-235.
 29. Petkova N, Vrancheva R, Mihaylova D, Ivanov I, Pavlov A, Denev P. Antioxidant activity and fructan content in root extracts from elecampane (*Inula helenium* L.). Journal of BioScience & Biotechnology. 2015, 4(1): 101-107.
 30. Gao S, Wang Q, Tian XH, Li HL, Shen YH, Xu XK, Zhang WD. Total sesquiterpene lactones prepared from *Inula helenium* L. has potentials in prevention and therapy of rheumatoid arthritis. Journal of ethnopharmacology. 2017; 196: 39-46.
 31. Cai YS, Wu Z, Zheng XQ, Wang C, Wang JR, Zhang XX, Yu J. Spiroalanpyrroids A and B, sesquiterpene alkaloids with a unique spiro-eudesmanolide-pyrrolizidine skeleton from *Inula helenium*. Organic Chemistry Frontiers. 2020; 7: 303-309.
 32. Chanaj-Kaczmarek J, Wojcinska M, Matlawska I. Phenolics in the *Tussilago farfara* leaves. Herba polonica. 2013; 59(1): 35-43.
 33. Kovaleva AM, Osmachko AP, Kryvenok MV. Phytochemical research of *Tussilago farfara* L. leaves. Conference proceedings. 2016; 79-80.
 34. Behbahani BA, Yazdi FT, Shahidi F, Hesarinejad MA, Mortazavi SA, Mohebbi M. *Plantago major* seed mucilage: Optimization of extraction and some physicochemical and rheological aspects. Carbohydrate polymers. 2017; 155: 68-77.
 35. Yernazarova KB, Abdrassulova ZT, Tuleuhanov ST, Tussupbekova GA, Salybekova NN, Isayev G, Basim H. Biological features of the medicinal plant *Plantago major* L. International Journal of Biology and Chemistry. 2019; 12 (1): 86-93.
 36. Batiha GES, Beshbishy AM, Alkazmi L, Adeyemi OS, Nadwa E, Rashwan E, Igarashi I. Gas chromatography-mass spectrometry analysis, phytochemical screening and antiprotozoal effects of the methanolic *Viola tricolor* and acetonetic *Laurus nobilis* extracts. BMC complementary medicine and therapies. 2020; 20 (1): 1-14.
 37. Kianitalaei A, Feyzabadi Z, Hamedi S, Qaraaty M. *Althaea officinalis* in traditional medicine and modern phytotherapy. Journal of Advanced Pharmacy Education & Research. 2019; 9 (S2): 154-161.
 38. Shaheen S, Ramzan S, Khan F, Ahmad M. Why Study Herbal Plants? In: Adulteration in Herbal Drugs: A Burning Issue. Springer, Cham. 2019; 17-33.
 39. Bokov DO, Smyslova OA, Litvinova TM, Samylina IA, Potanina OG. Development and approval of quality standards for pharmaceutical substances of plant origin in the Russian Federation. Journal of Pharmaceutical Sciences and Research. 2018; 10(7): 1818-1819.