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DEVELOPMENT OF THE PLANT COLLECTION PRESCRIPTION AND THE OBTAINING A LIQUID EXTRACT TECHNOLOGY ON ITS BASIS FOR PREVENTION AND TREATMENT OF MUSCULOSKELETAL SYSTEM DISEASES

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Purpose. *Development of the composition of the plant collection "Opornofit" and the technology of obtaining a liquid extract on its basis for the prevention and treatment of diseases of the musculoskeletal system, with the determination of quality indicators and stability during their storage.*

Materials and methods. *Plant raw materials for obtaining the collection and liquid extract from it were harvested in Vinnytsia and Kharkiv regions. The numerical parameters of the collection were determined according to the methods of the State Pharmacopoeia of Ukraine 2.0.*

Results. *A screening of the range of medicinal plant raw materials, which in the form of mono- and polycomponent plant collections are used in phytotherapy of diseases of the musculoskeletal system, was carried out and the most promising types of plant raw materials were selected for creating the collection "Opornofit": Arctium root (Arctium lappa L., Arctium minus (Hill) Bernh., Arctium tomentosum Mill.), Rose root (Rosa majalis Herrm., Rosa canina L.), rhizomes with roots of Sanguisorba officinalis L., rhizomes with roots of Rumex confertus Willd., and herb of Bidens tripartita L. with an equal ratio of components in the collection. Taking into account the conditions of military service and the frequent lack of conditions for preparing a decoction from the collection, we developed a technology for obtaining a liquid extract based on its components. For the developed collection and liquid extract, stability during storage during the year was studied.*

Conclusions. *The composition of the herbal collection "Opornofit" and the technology for obtaining a liquid extract based on it for the prevention and treatment of diseases of the musculoskeletal system have been developed, with the determination of quality indicators and stability during their storage. The developed original herbal collection and liquid extract based on it are predicted to have anti-inflammatory, uricosuric, detoxifying, desensitizing, and immunostimulating effects.*

Keywords: *arctium, rosa, sanguisorba, rumex, bidens, herbal collection, musculoskeletal system.*

РОЗРОБКА ПРОПИСУ РОСЛИННОГО ЗБОРУ ТА ТЕХНОЛОГІЇ ОТРИМАННЯ РІДКОГО ЕКСТРАКТУ НА ЙОГО ОСНОВІ ДЛЯ ПРОФІЛАКТИКИ ТА ЛІКУВАННЯ ЗАХВОРЮВАНЬ ОПОРНО-РУХОВОЇ СИСТЕМИ

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Мета. *Розробка складу рослинного збору «Опорнофіт» та технології отримання рідкого екстракту на його основі для профілактики і лікування захворювань опорно-рухової системи, з визначенням показників якості та стабільності у процесі їх зберігання.*

Матеріали та методи. *Сировину для отримання збору та рідкого екстракту з нього заготовляли у Вінницькій та Харківській областях. Числові параметри збору визначали за методиками ДФУ 2.0.*

Результати. *Проведено скринінг асортименту ЛРС, яка у вигляді моно-, полікомпонентних зборів застосовуються у фітотерапії захворювань опроно-рухової системи та обрано найбільш перспективні види сировини для створення збору «Опорнофіт»: корінь лопуха, корінь шипшини, кореневища з коренями родовика лікарського, кореневища з коренями щавлю кінського, трава череди трироздільної при рівному співвідношенні компонентів у зборі. Зважаючи на умови ведення військової служби та частої відсутності умов для приготування відвару зі збору, нами розроблена технологія отримання рідкого екстракту на основі його складників. Для розроблених збору та рідкого екстракту вивчено стабільність в процесі зберігання протягом року.*

Висновки. *Розроблено склад рослинного збору «Опорнофіт» та технологію отримання рідкого екстракту на його основі для профілактики і лікування захворювань опорно-рухової системи, з визначенням показників якості та стабільності у процесі їх зберігання. Для розробленого оригінального*

рослинного збору та рідкого екстракту на його основі прогнозовано протизапальну, урикозурічну, детоксикуючу, десенсибілізуючу, імуностимулювальну дію.

Ключові слова: *лопух, шипшина, родовик, щавель, череда, рослинний збір, опорно-рухова система.*

Introduction. Given the current course of events in the country, the most common health problems of military personnel are known. These problems are in the fields of dentistry, dermatology, gastroenterology, phlebology, and cardiology, and are also associated with impaired musculoskeletal functions. The specificity of the military profession leads to severe physical exertion on the musculoskeletal system, and frequent hypothermia, malnutrition, and prolonged exposure to adverse conditions lead to exacerbation of its diseases, the course of which is accompanied by severe pain and edema [2, 11]. Trench foot, lumbosciatica, arthritis, osteochondrosis etc occupy a special place among the diseases of the musculoskeletal system of military personnel. Military surgeons note that back pain ranks first among the diseases of military personnel, and in such cases it is very difficult to help the patient and overcome it [1, 6].

Taking into account the prevalence of musculoskeletal diseases in the military and the specifics of their treatment, the creation of new budget medicines for long-term use with a comprehensive effect for the prevention and treatment of these pathologies is actually for military pharmacy.

Aim. Development of the composition of the plant collection "Opornofit" and the technology of obtaining a liquid extract on its basis for the prevention and treatment of diseases of the musculoskeletal system, with the determination of quality indicators and stability during their storage.

Materials and methods of research. Plan raw materials for obtaining the collection and liquid extract from it were prepared in Vinnytsia and Kharkiv regions. The numerical parameters of the collection were determined according to the following methods of the State Pharmacopoeia of Ukraine (SPhU) 2.0: loss on drying [5], total ash [14], quantitative content of total polyphenols in terms of pyrogallol according to the monograph "Tree grass" [4], the total hydroxycitric acids in terms of chlorogenic acid according to the monograph "Nettle leaves" [4].

In the liquid extract, the following were determined: ethanol content, dry residue and quantitative content of total polyphenols and total hydroxycitric acids according to the methods which were used for standardization of the collection and described above.

Results and their discussion. Medicinal plant raw materials (MPRM), including in the form of collections, and medicinal products of plant origin have long and reliably taken their place in the systemic complex treatment of arthritis, arthrosis, bursitis, gout, normalization of metabolism, increased immunity, etc [9].

We have screened the range of MPRM, which is in the form of mono- and multicomponent collections used in these areas of phytotherapy, and have selected the most promising types of plant raw materials for creating the collection "Opornofit": Arctium root, Rose root, rhizomes with roots of Sanguisorba officinalis L., rhizomes with roots of Rumex confertus Willd., and herb of Bidens tripartita L. with an equal ratio of components in the collection. Based on the brief characteristics of the types of MPRM we have selected below, the feasibility of their use is justified.

Arctium root (Arctium lappa L., Arctium minus (Hill) Bernh., Arctium tomentosum Mill.) – the chemical composition is represented by sesquiterpenoids, sterols, organic, including hydroxycinnamic, acids, inulin, vitamins (C, group B), micro- and macroelements (zinc, selenium, magnesium, potassium, calcium). Extracts have mild choleretic, diuretic, anti-inflammatory, diaphoretic, antimicrobial and hypoglycemic properties, are used as a general tonic, contribute to the normalization of metabolism, primarily carbohydrate and mineral; improve the functional state of the respiratory organs, liver, gastrointestinal tract, including the functions of the pancreas [18, 17]. The pharmaceutical market presents liquid and solid dosage forms of dietary supplements (DD): "Lympholight", "Burdock Root Extract (Juice)", "Burdock Root Extract".

Rose root (Rosa majalis Herrm., Rosa canina L.) – the chemical composition is represented mainly by compounds of phenolic nature (flavone derivatives: quercetin, isoquercitrin, hyperoside, astragalin; and flavan derivatives - catechins), organic acids, carotenoids, ascorbic acid, salts of calcium, magnesium, iron, manganese, etc. The plant raw material exhibits a wide spectrum of activity, of which the most important is the litholytic effect, accompanied by anti-inflammatory and diuretic. It also has a P-vitamin, astringent, antioxidant, general strengthening and bacteriostatic effect. It is indicated for use in urolithiasis and gallstone disease (softens and grinds urinary and gallbladder stones), cystitis,

diseases of the stomach, intestines, liver, kidneys, gout, polyarthritis, rheumatism, atherosclerosis etc. [12]. The market has DD – "Rosehip Root Tincture" and "Artofit".

Rhizomes with roots of Sanguisorba officinalis – contains compounds of phenolic nature: tannins of the pyrogallic group 25-40% (halo- and ellagotannins), phenolcarboxylic acids, flavonoids, saponins (sanguisorbin, poterin, gentriacontan), ascorbic acid, etc. In medicine it is used as an anti-inflammatory, antimicrobial, hemostatic and astringent. Polyphenols cause P-vitamin and antihypoxic activity, coronary dilating effect, as well as a pronounced stimulating effect on the heart, improving the contractile ability of the myocardium, exhibits angiospastic, spasmolytic and analgesic effects [13, 19]. From the underground organs of the Sanguisorba officinalis, the following medicinal products are obtained: "Rhododendron drops", "Alcohol tincture of the rhododendron officinalis".

Rhizome with roots of Rumex confertus – accumulates tannins of both pyrogallic and pyrocatechin groups (up to 12%), atrachinones of the emodin group (up to 4%). In addition to antibacterial activity, the plant raw material exhibits antiviral, anti-inflammatory, antispasmodic, mucolytic, vasoconstrictive, capillary strengthening, and antitumor activity. Traditionally, extracts are used to treat gastrointestinal diseases – diarrhea, spastic and chronic colitis, in large doses as a laxative (with caution), with inflammation of the mucous membranes, bleeding. They are also offered for the treatment of kidney stones, gout, tuberculosis, cough, and rheumatism [14]. DD – "Horse sorrel root tincture".

The herb Bidens tripartita accumulates diverse groups of compounds: carotenoids, ascorbic acid, glycoproteins, specific polysaccharides, compounds of phenolic nature (flavones, chalcones, aurones, tannins). Due to the diversity of the composition, the plant raw material corrects metabolic processes in the body, activates hematopoiesis, regulates the work of the endocrine glands, exhibits immunomodulatory, antibacterial, anti-inflammatory properties, improves digestive processes and stimulates the work of the adrenal glands. It also exhibits sedative, hypotensive, hemostatic, diaphoretic, reparative, pain-relieving, hepatoprotective and mild diuretic effects. Immunostimulating effect (activates the humoral link of immunity), intensification of phagocytosis and the level of neutrophils in peripheral blood, together with detoxifying and desensitizing action are especially important for autoimmune conditions that accompany a number of diseases of the musculoskeletal system. Hypotensive, sedative, capillary strengthening and reparative effects are additional positive features. Traditionally used for allergic manifestations. As well as for gout, arthritis, joint pain [1, 15]. On the pharmaceutical market there are DD – "Tablets Bidens", liquid "Bidens", "Liquid extract Bidens".

Thus, the harmonious combination of anti-inflammatory, anti-edematous and antimicrobial effects inherent in varying degrees to all selected types of MPRM with powerful antioxidant properties (rhizomes with roots of Sanguisorba officinalis, rhizomes with roots of Rumex confertus, Rose root), soluretic effect (Rose root), the ability to normalize metabolism and the activity of endocrine glands (herb of Bidens tripartite and Arctium root), in particular, the thyroid gland and adrenal glands – predictably leads to a reduction in inflammatory processes and edema, which most often accompany diseases of the musculoskeletal system.

Appropriate additions to the main therapeutic effect are the capillarystrengthening and immunostimulating effects of polyphenols rhizomes with roots of Sanguisorba officinalis, rhizomes with roots of Rumex confertus, Rose rootand herb of Bidens tripartite.

There are no analogues of the above-mentioned medicinal herbal collection "Opornofit" for the complex treatment of diseases of the musculoskeletal system, taking into account the normalization of all metabolic processes, with anti-inflammatory, membrane-stabilizing, desensitizing, immunostimulating, detoxifying, mild choleretic, diuretic and litholytic effects on the pharmaceutical market of Ukraine.

Given the conditions of military service and the frequent lack of conditions for preparing a decoction from the collection, we have developed a technology for obtaining a liquid extract based on its components. The technology for simultaneous production of the collection and liquid extract from it is shown in Fig. 1. In our previous studies, the optimal extractant and extraction time were established [7]. Therefore, to obtain the liquid extract "Opornophyte" we used extraction with a 50% water-ethanol mixture at room temperature for 48 hours. The plant raw material-extract ratio was 1:1 in accordance with the requirements of the SPhU 2.0 [3].

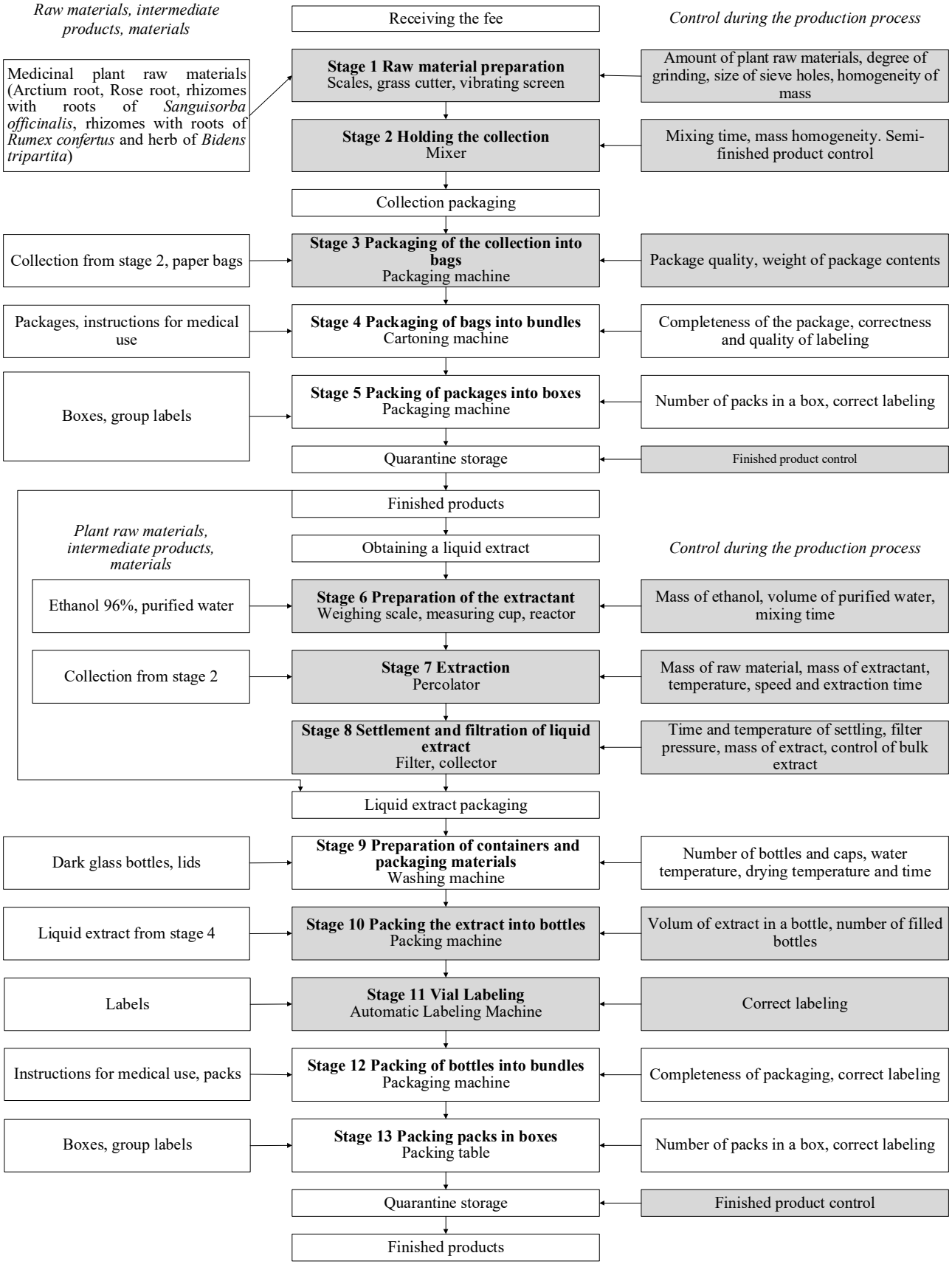

Figure 1. Flow chart of the production of the collection "Opornophyte" with the subsequent preparation of a liquid extract based on the components of the MPRM included in the collection

The next stage of the work was to establish the quality indicators of the collection and study its stability during storage. When developing quality control methods (QCM) projects for the collection and liquid extract according to the requirements of the SPhU 2.0, V.3, identification, testing (determination of total ash, extractable substances, loss on drying etc.) and quantitative determination of the main active substances are carried out. In previous studies, we established the following parameters of quality control of the collection as the content of total ash (not more than 7%, loss on drying (not more than 12.5%), the quantitative content of total polyphenols in terms of pyrogallol - not less than 4.4±0.17%, the quantitative content of total hydroxycinnamic acids in terms of chlorogenic acid - not less than 1.5±0.05% [8]. Therefore, when developing QCM for the liquid extract, the quantitative content of total polyphenols and total hydroxycinnamic acids was determined.

So, the liquid extract "Opornofit" is a dark brown liquid with a slight specific odor. A small precipitate may form during storage. The ethanol content is from 45% (v/v) to 50% (v/v), the dry residue is not less than 1.0%. The quantitative content of total polyphenols contains not less than 0.15 mg/ml in terms of pyrogallol, the content of total hydroxycinnamic acids is not less than 0.01 mg/ml in terms of chlorogenic acid.

The study of the stability of the collection and liquid extract during storage in different types of packaging was carried out in accordance with the requirements of Guideline 42-3.3:2004 in a dry place, protected from light, at a temperature of 25 ± 2 °C for 12 months. Quality control was carried out every 3 months according to the following indicators: description, total ash and loss on drying (for collection), ethanol content and dry residue (for liquid extract), quantitative content of total polyphenols and total hydroxycinnamic acids, weight (volume) of the package contents. The results are given in Tables 1, 2. Thus, the results obtained indicate that the studied samples of the "Opornophyte" collection and the "Opornophyte" liquid extract did not lose their quality indicators during storage for one year and met the requirements of the QCM projects "Collection "Opornophyte" and "Liquid extract "Opornophyte"".

Table 1

Results of the study of the stability of the collection "Opornofit", which is stored in polyethylene bags placed in cardboard packs and filter bags of 1.5 in cardboard packs

Quality indicator	Type of packaging	Shelf life				
		0 month	3 month	6 month	9 month	12 month
Description	Container 1	a mixture of pieces of various shapes in brown, light brown and green colors	corresponds	corresponds	corresponds	corresponds
	Container 2		corresponds	corresponds	corresponds	corresponds
Total ash	Container 1	6,12 %	corresponds	corresponds	corresponds	corresponds
	Container 2	5,68 %	corresponds	corresponds	corresponds	corresponds
Loss on drying, %	Container 1	11,54 %	corresponds	corresponds	corresponds	corresponds
	Container 2	10,42 %	corresponds	corresponds	corresponds	corresponds
Quantitative determination of total polyphenols in %, in terms of pyrogallol	Container 1	4,8 %	corresponds	corresponds	corresponds	corresponds
	Container 2	5,01 %	corresponds	corresponds	corresponds	corresponds
Quantitative determination of total hydroxycinnamic acids in %, in terms of chlorogenic acid	Container 1	1,57 %	corresponds	corresponds	corresponds	corresponds
	Container 2	1,56 %	corresponds	corresponds	corresponds	corresponds
Weight of package contents, gr	Container 1	100 gr	corresponds	corresponds	corresponds	corresponds
	Container 2	1,49 gr	corresponds	corresponds	corresponds	corresponds

Note: container 1 – plastic bag placed in cardboard packs, container 2 – filter bags of 1.5 g in cardboard packs.

Table 2

Results of stability study of liquid extract "Opornophyte", which is stored in glass containers and polyethylene terephthalate containers

Quality indicator	Type of packaging	Shelf life				
		0 month	3 month	6 month	9 month	12 month
Description	Container 1	dark brown liquid with a slight specific odor	corresponds	corresponds	corresponds	corresponds
	Container 2		corresponds	corresponds	corresponds	corresponds
Ethanol content	Container 1	50 %	corresponds	corresponds	corresponds	corresponds
	Container 2	50 %	corresponds	corresponds	corresponds	corresponds
Dry residue, %	Container 1	1,12 %	corresponds	corresponds	corresponds	corresponds
	Container 2	1,12 %	corresponds	corresponds	corresponds	corresponds
Quantitative determination of total polyphenols in %, in terms of pyrogallol	Container 1	0,18 mg/ml	corresponds	corresponds	corresponds	corresponds
	Container 2	0,19 mg/ml	corresponds	corresponds	corresponds	corresponds
Quantitative determination of total hydroxycinnamic acids in %, in terms of chlorogenic acid	Container 1	0,013 mg/ml	corresponds	corresponds	corresponds	corresponds
	Container 2	0,014 mg/ml	corresponds	corresponds	corresponds	corresponds
Volume of package contents, ml	Container 1	50 ml	corresponds	corresponds	corresponds	corresponds
	Container 2	50 ml	corresponds	corresponds	corresponds	corresponds

Notes: * container 1 – is a glass container, container 2 – is a polyethylene terephthalate container

Conclusions

1. Screening of MPRM types included in mono- and multi-component collections for the treatment of musculoskeletal diseases was carried out with the selection of the most promising ones for further research.

2. The composition of the herbal collection "Opornofit" and the technology for obtaining a liquid extract based on it for the prevention and treatment of musculoskeletal diseases were developed, with the determination of quality and stability indicators during their storage. A general technological flow-chart for the manufacture of the herbal collection "Opornofit" and the liquid extract of the same name based on its MPRM components was proposed.

3. Criteria for quality indicators for the specifications for the liquid extract "Opornofit" were determined in the sections "Description", "Ethanol content", "Dry residue", "Quantitative content", "Package content volume".

4. The stability of the developed collection and liquid extract in 2 variants during storage at a temperature of 25 ± 2 °C for 12 months has been experimentally proven. The project of the QCM "Liquid extract "Opornofit" has been developed.

5. The anti-inflammatory, uricosuric, detoxifying, desensitizing, immunostimulating effect of the original herbal collection and liquid extract based on it has been predicted.

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