ATLANTIS PRESS

Advances in Biological Sciences Research, volume 7

1st International Symposium Innovations in Life Sciences (ISILS 2019)

Methods of Extraction of Medicinal Vegetable Raw Materials in Phytosubstances Technology

Irina Kaukhova
Saint-Petersburg State Chemical-Pharmaceutical University
Saint-Petersburg, Russia
irina.kaukhova@pharminnotech.com

Victor Weinstein
Saint-Petersburg State Chemical-Pharmaceutical University
Saint-Petersburg, Russia
victor.vainshtein@pharminnotech.com

Marina Burakova
Saint-Petersburg State Chemical-Pharmaceutical University
Saint-Petersburg, Russia
marina.burakova@pharminnotech.com

Mariya Aroyan
Saint-Petersburg State Chemical-Pharmaceutical University
Saint-Petersburg, Russia
mariya.aroyan@pharminnotech.com

Ekaterina Novikova
Saint-Petersburg State Chemical-Pharmaceutical University
Saint-Petersburg, Russia
ekaterina.krasova@pharminnotech.com

***Abstract*—The article discusses the technology of obtaining phytosubstances using modern methods of extraction of medicinal plant materials: ultrasonic extraction, two-phase extraction. On the example of various types of plant materials, a comparative analysis was carried out and the advantages and disadvantages of the considered extraction methods were identified.**

Keywords—phytosubstances, extraction, ultrasonic extraction, two-phase extraction, iris lactea, melilotus officinalis, ginkgo bilobate, bidens tripartita, flavonoids.

I. INTRODUCTION

Analysis of scientific papers published over the past decade, showing a clear trend in the development of the pharmaceutical industry: an increasing number of studies are devoted to natural objects, as sources of potentially active pharmaceutical substances. Various groups of substances of natural origin, such as polyphenols, flavonoids, alkaloids, polysaccharides, coumarins and essential oils, have received increased attention due to their high biological activity [1]. Data based on epidemiological studies have shown that natural biologically active compounds play an important role in the prevention and treatment of common diseases such as cancer, diabetes, Alzheimer's disease, immunodependent and cardiovascular diseases. Moreover, the relatively low incidence of side effects and the possibility of prolonged use of plant origin substances based medicine contributes not only to the search for new sources, but also to the improvement of methods for extraction of biologically active substances from plant materials. [2,3]. The efficiency of the extraction process is influenced by various factors common to the extraction processes as a whole: the nature of the plant material, temperature, the degree of grinding of the plant material, the nature of mixing, the time of extraction, the renewal of the extractant during the extraction process [4].

Along with traditional extraction methods, the method of ultrasonic extraction was widely used. When using this extraction method, not only a significant reduction in the time of the production process is observed, but also an increase, in comparison with traditional extraction methods (maceration, percolation), of the extraction of active substances.

The intensification of the extraction process is achieved due to a number of factors:

1. ultrasonic waves contribute to the acceleration of wetting of various materials having a capillary structure;

2. when creating a sound-capillary effect, air dejection is accelerated and conditions are created for dissolving it in the extractor. There is a sponge effect, as a result, the time of soaking the raw materials under the action of ultrasound is significantly reduced;

3. turbulent (vortex) flows are formed in the extractant layer;

4. molecular diffusion inside the raw material and in the diffusion layer assumes the minimum value, convective diffusion sharply increases [5, 6].

However, as a rule, during ultrasonic extraction, one extractant with a certain polarity is used to extract biologically active substances, which is associated with the limited completeness of extraction. For a more complete extraction of the natural complex of biologically active substances, extraction of medicinal plant raw materials (MPRM) is used with a system of immiscible solvents of different polarity — a two-phase system of extractants (TSE). The most important feature of two-phase extraction (TE), which distinguishes it from other extraction methods used, is that extracts containing both hydrophilic and lipophilic biologically active substances can be obtained in one stage. Two-phase extraction allows you to control the composition and amount of biologically active substances in the extracts, as well as to obtain extracts suitable for direct incorporation into the composition of medical agent. [7,8]. The rationality of using TSE was examined using the leaves of ginkgo biloba as an example. Ginkgo biloba contains flavonoids (quercetin, kaempferol, isorhamnetin, ginkgetin, rutin), complex carbohydrates, organic acids, B vitamins, vitamin C, carotenoids and chlorophylls, i.e. lipophilic and hydrophilic biologically active substances.

Phytosubstances obtained by modern methods have found wide application in medicine, cosmetology. Of particular interest are extracts enriched with biologically active substances, as well as preparations based on them.

The growing demand for products with environmentally friendly causes the need to modernize traditional and

develop new technologies for the extraction of biologically active substances from plant materials, which are used in the pharmaceutical industry

The purpose of this study was to confirm the theoretical data on possible ways of intensifying the process of extraction of biologically active substances, such as ultrasonic extraction and two-phase extraction from plant objects using phytosubstance technology.

II. Experimental

In this work, the intensification of the extraction process of biologically active substances using ultrasonic was studied on the grass of Melilotus officinalis, Bidens tripartita and Iris lactea. The influence of the ultrasonic extraction mode on the extraction of active substances was evaluated by the content of biologically active flavonoid substances. The extraction process was carried out using extractants and extraction modules, which were previously established experimentally using an ultrasonic bath with a frequency of 35 Hz [9,10,11]. The process time was selected in the range from 3 minutes to 25 minutes with an interval of 3 and 5 minutes. The temperature regime was maintained in the range from 40ºC to 90ºC, since this temperature accelerates the process of extracting biologically active substances. As a control, the classical extraction method, maceration, was used. Quantitative determination of flavonoids in the obtained extracts was carried out by differential spectrophotometry [12].

To isolate the main groups of biologically active substances from Ginkgo biloba, ethanol of 70% with the addition of propylene glycol in an amount of 20% (flavonoids) as the polar phase and false flax oil as the non-polar phase were used. The ratio of ingredients: raw materials: non-polar phase: polar phase (70% ethanol - 70% propylene glycol) -1: 5: 8: 2. Two-phase extraction was carried out according to the following methodology: 1 g of raw material was placed in a flask with a capacity of 50 ml. The polar phase was added - the polar phase consisted of 80% alcohol and 20% GHG and non-polar phases, was evacuated. Was heated to a boil in a water bath, then stirred for 90 minutes at a temperature of 70° C. After this time, samples were taken for further studies. To assess the effectiveness of the TE process, certain groups of biologically active substances specific to GBL — flavonoids and chlorophylls — were selected as markers. As the main indicators of the completeness of extraction, the yield of the target products and the concentration of extractable substances in the extracts were taken.

III. Results And Discussion

Ultrasonic treatment enable to increase the efficiency of extraction of flavonoids in comparison to maceration. The results of the study are presented in figure 1.

The obtained extract was used as a phytosubstance in the development of a transdermal therapeutic system [13].

The results presented in figure 2 show, that ultrasound treatment increases the efficiency of flavonoid extraction from Melilotus officinalis herb.

Under the developed conditions, a dry extract was obtained, which was included in the composition of a soft dosage form, a gel, as a phytosubstantiation [14].

When using ultrasonic extraction to extract flavonoids from the Bidens tripartita, the yield of biologically active substances increases by 13.80 % in comparison with the classical method-maceration. The results presented in table I.

From the enriched extraction, a dry extract was obtained, which was included in the composition of the dry extracts in the dosage form - granules in hard gelatin capsules [15].

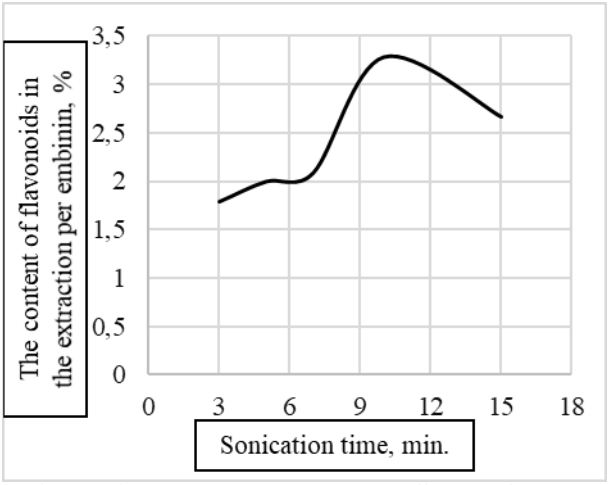

Fig.1. Influence of ultrasonic treatment time on the efficiency of extraction of flavonoids from Iris lactea

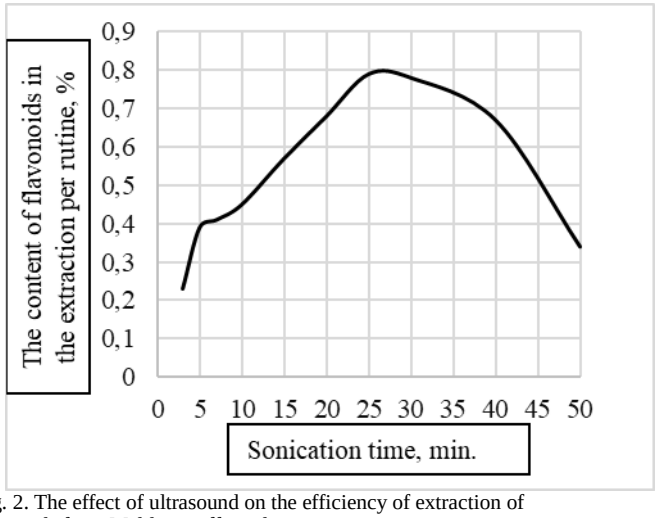

Fig. 2. The effect of ultrasound on the efficiency of extraction of flavonoids from Melilotus officinalis

TABLE I. The Influence Of The Extraction Method On The Extraction Of Biologically Active Substances In A Bidens Tripartita

Baseline raw material	**The extraction of biologically active substances when using ultrasonic, %**	**The extraction of biologically active substances during maceration in a boiling water bath,%**	**The increase in the extraction of biologically active substances, %**
Bidens tripartita	33,30 ± 0,85	19,50 ±0,25	13,80

Thus, for all types of raw materials, the pattern of increasing the extraction of active substances using ultrasonic extraction was established.

The use of TSE made it possible to obtain two extracts with different pharmacological activity in one operation cycle for further inclusion in the composition of emulsion cream for the treatment and prevention of disorders of fat metabolism. [16,17]. The results of the study are presented in table II.

TABLE II. THE CONCENTRATION OF FLAVONOIDS AND CHLOROPHYLLS IN THE POLAR AND OIL PHASE, RESPECTIVELY

Marker for assessing the process of two-phase extraction	**Value**
The concentration of flavonoids in the polar phase, %	0,3450 ±0,0011
The concentration of chlorophyll in oil phase, mg %	25,37±0,36

IV. CONCLUSION

When analyzing the data obtained on ultrasonic extraction, we can conclude that the extraction of biologically active substances when using ultrasound is significantly higher than when using classical methods of extraction, maceration, for all studied types of raw materials. Using the leaves of ginkgo biloba as an example, the advantages of the TSE method for the extraction of active substances with affinity for extractants with different polarity are shown. The obtained extracts enriched with biologically active substances are promising phytosubstances in the technology of medicines.

REFERENCES

[1] V. Lanzotti, “Drugs based on natural compounds: recent achievements and future perspectives”, Phytochem Rev., № 13, p.725, 2014.

[2] M.I. Georgiev, “Natural products utilization”, Phytochem Rev, №13, p. 339, 2014.

[3] M.I. Georgiev, “Coming back to nature: plants as a vital source of pharmaceutically important metabolites—Part II”, A. Curr Med Chem, № 20, p.851, 2013.

[4] E. Mabruki, Development of the composition and technology of medicines based on dry extracts of herniaria glabra, SPKhFA.:St. Petersburg, 2015, 412 p

[5] E.T. Zhilyakova, Z.E. Tsvetkova, D.I. Pisarev, N.N. Boyko, E.Yu. Timoshenko, “Intensification of the production process of a thick extract of silybum marianum using ultrasonic processing of raw materials”, Pharmacy & Pharmacology, vol. 6, № 5, p. 475-483, 2018.

[6] I.V. Kalinina, “Application of the effects of ultrasonic cavitation as a factor in the intensification of the extraction of functional ingredients”, Food Technologies and Biotechnologies, №4, p. 64-70, 2016.

[7] V.A. Weinstein, “The main factors and kinetics of biphasic extraction of plant materials”, Development and registration of medicines, № 10, p.64-70, 2015.

[8] V.A. Weinstein, I.E. Kaukhova, “Extraction of medicinal plant materials by a two-phase system of extractants”, Development and registration of medicines, №3(8), p. 82-87, 2014.

[9] M.V. Aroyan, S.B Goncharova, I.E. Kaukhova, “Influence of technological factors on the efficiency of extraction of flavonoids from iris lacteal”, Proceedings of the VIII All-Russian Scientific Conference of Students and Graduate Students with International Participation "Young Pharmacy - Potential of the Future "April 23-24, 2018, pp. 366–369.

[10] A.O. Irtegova, “The study of the extraction of flavonoids from the melilotus officinalis”, Collection of materials of the IX All-Russian scientific conference of students and graduate students with international participation "Young pharmacy - the potential of the future" April 22-23, 2019, pp. 254-256.

[11] E.K. Novikova, “Development of the composition and technology of a medicinal product based on the composition of dry extracts of a bidens tripartita, solidago canadensis, agrimonia eupatoria” [Text]: author. dis. for a job. scientist step. Cand. farm. Sciences (04.14.01) / Novikova Ekaterina Konstantinovna; St. Petersburg chemical chemist. un - St. Petersburg, 2019, 24 p.

[12] State Pharmacopoeia of the Russian Federation. - XIV ed. - M., 2018. In 4 p. [State Pharmacopoeia of the Russian Federation. XIV ed. T. 1. Ministry of Health of the Russian Federation. M., 2018, 1814 p.

[13] M.V. Aroyan Development of the technology and composition of the transdermal therapeutic system with the extraction of iris lacteal, Pharmacy, 2019, №1, p. 27–32.

[14] M.V. Aroyan, Research into the basis for gel-based dry extract of melilotus officinalis, Collection of materials of the II international scientific conference "The role of metabolomics in improving biotechnological means of production» June 6 – 7, 2019, p. 558-563.

[15] E.K. Novikova, “Development and standardization of granules in hard gelatin capsules based on the composition of dry extracts of a bidens tripartita, solidago canadensis, agrimonia eupatoria”, Development and registration of medicines, № 4(25), p. 6–10, 2018.

[16] I.E. Kaukhova, V.A. Weinstein, Herbal medicines, Technology, Compositions, Standardization. Moscow: KnoRus, 2019, 396 p.

[17] A.S. Moiseeva, “Development of the composition and technology of cosmetics based on the extract of ginkgo biloba leaves for the prevention of cellulite”, Proceedings of the VIII All-Russian scientific conference of students and graduate students with international participation "Young Pharmacy - The Potential of the Future" April 23-24, 2018, p. 465-467.