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THE STUDY OF THE EFFECT OF THE CRITICAL PARAMETERS ON THE MANUFACTURING PROCESS OF THE OIL PHYTOEXTRACT WITH THE HEPATOPROTECTIVE ACTION

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Key words: oil extracts; critical parameters; technology; composition of the herbal raw material; hepatoprotector

The experimental studies conducted allow determining the critical parameters and their effect on the manufacturing process of oil extracts of the composition of the herbal raw material with the hepatoprotective action. The influence of the particle size of the raw material, concentration and the amount of ethanol on moistening of the phytocomposition and the temperature of extraction has been studied. As a result of the study the optimal parameters of extraction with the oil extractants providing efficiency of the active substances release from the herbal raw material have been determined. They are grinding of the herbal raw material by a screw shredder, an extractant for moistening is 70% ethanol in the amount of 0.6±0.1 ml per 1.0 of the raw material; the swelling time – 2.0±0.5 h; the temperature of extraction – 55±5ºC. According to the certain critical points of the manufacturing process the flowchart of manufacturing the combined oil herbal medicinal product under the conditional name "Oleosil" has been developed.

Hepatites with the impaired biliary excretion, as well as inflammatory diseases of the liver and gallbladder are the widespread human diseases, first of all among people of the middle and senior age. The timely treatment of the pathologies mentioned prevents development of chronic diseases and improves the quality of the patients' life. Moreover, synthetic and herbal medicines are used [3].

The data obtained in the previous phytochemical studies [7], as well as the data of the systematized literary material [4, 5, 6] have shown the prospects of creating a herbal medicine with the hepatoprotective action on the basis of the phytocomposition (wild carrot seeds, flowers of chamomile and corn silks).

The aim of this research is to study the effect of critical parameters and determine the optimal manufacturing process of oil extracts of the composition of the herbal raw material in order to create the combined oil herbal medicinal product with the hepatoprotective action under the conditional name "Oleosil".

Materials and Methods

The composition of the medicinal herbal raw material containing wild carrot seeds, flowers of chamomile and corn silks in the ratio of (1: 1: 1) was studied. As an extractant the refined corn oil was used [6].

The basic factors affecting the rate and completeness of release of biologically active substances (BAS) were studied. They are the degree of grinding, the type of the extractant and its concentration, the "raw material – extractant" quantitative relationship, the extraction temperature, duration of extraction.

The powdered samples of the herbal raw material were mixed in equal amounts and moistened with ethanol in the concentration from 40 to 96%, stirred to obtain a uniformly moistened mixture of the raw material. To increase the contact surface with the solvent and provide its penetration inside the cell the moistened raw material was placed into a heated infusion cup, covered with a lid and allowed to stand for 2 hours.

Then corn oil heated to 50°C was poured to the moistened raw material to obtain a «mirror» effect and allowed to stand on a water bath for 4 hours. Extraction was conducted at a temperature of 55±5°C. The cooled oil herbal extract was drained off, the raw material was pressed. The extract was clarified by settling for twenty-four hours at a room temperature and further filtration.

The qualitative composition and quantitative content of BAS of the phytocomposition rich in flavonoids, hydroxycinnamic acids, carotenoids, chlorophyll, vitamins, organic and fatty acids was studied by the method of high performance liquid chromatography [7, 10, 12-15].

The studies of factors affecting the yield of BAS were conducted according to the method of quantitative determination of the amount of carotenoids and chlorophylls previously developed [8]. These substances were selected since their content among BAS of the lipophilic nature of the composition of the herbal raw material under research was the greatest [7]. The quantitative content of carotenoids and chlorophylls in oil phytoextracts was determined by the method of UV/VIS absorption spectrophotometry on a "Specord 200" spectrophotometer.

Results and Discussion

During extraction a considerable influence on the speed of the equilibrium achievement in the herbal raw material – solvent system has the degree of the raw material grinding [1, 2]. First of all, the need of grinding is caused by the possibility of improving the extractant penetration

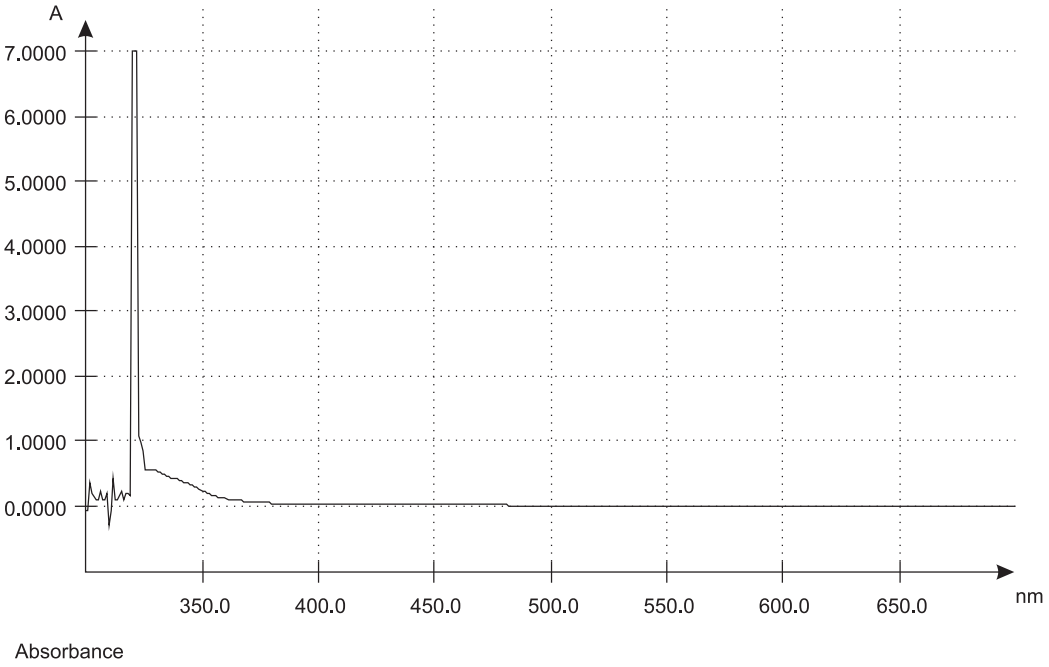

Fig. 1. The absorption spectrum of OE obtained without wetting of the phytocomposition with ethanol.

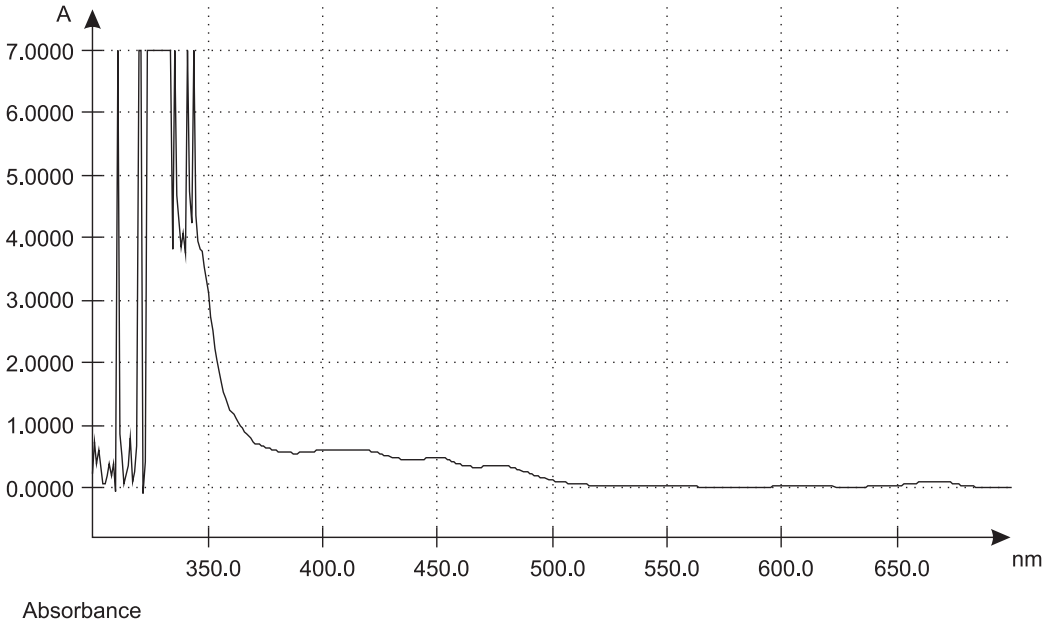

Fig. 2. The absorption spectrum of OE obtained after the preliminary wetting of the phytocomposition with 96% ethanol.

into the layer of the material that has a cellular structure. Cellular coats in seeds are thicker and coarser than in herb, flowers and leaves; therefore, seeds require finer grinding. The best results were achieved while grinding by a screw shredder. Moreover, there was destruction of cells of the raw material with air displacement [1, 2].

It was previously found by us that fat-soluble substances were easily react to form oil extracts, but hydrophilic substances were not practically extracted [4-6]. To transfer BAS with the diphilic nature from the raw material into oil it is reasonable to provide desorption of substances from cells. Intensification of processing of the medicinal herbal raw material is possible when using the system of immiscible solvents [4, 5, 8, 9].

To enrich the oil extract of BAS with the average polarity the preliminary wetting of the composition of the herbal raw material with the water-alcohol solution was proposed. It contributes to weakening of intermolecular bonds, additional hydration of polar groups and hydrophilic compounds. Wetting of the phytocomposition with ethanol improves penetration of the oil solvent inside the cells of the herbal raw material, and it allows to intensify desorption of lipophilic and diphilic BAS. A comparative analysis of absorption spectra of oil extracts (OE) obtained without the preliminary wetting of the raw material and the raw material moistened with ethanol has shown substantial differences in absorption intensity, and it is directly related to the content of biologically active substances (Fig. 1, 2, 3).

It is possible to distinguish three basic absorption maxima in the spectra in Fig. 2 and 3. The first one, at the wavelength of 280-320 nm, can be referred to absorption

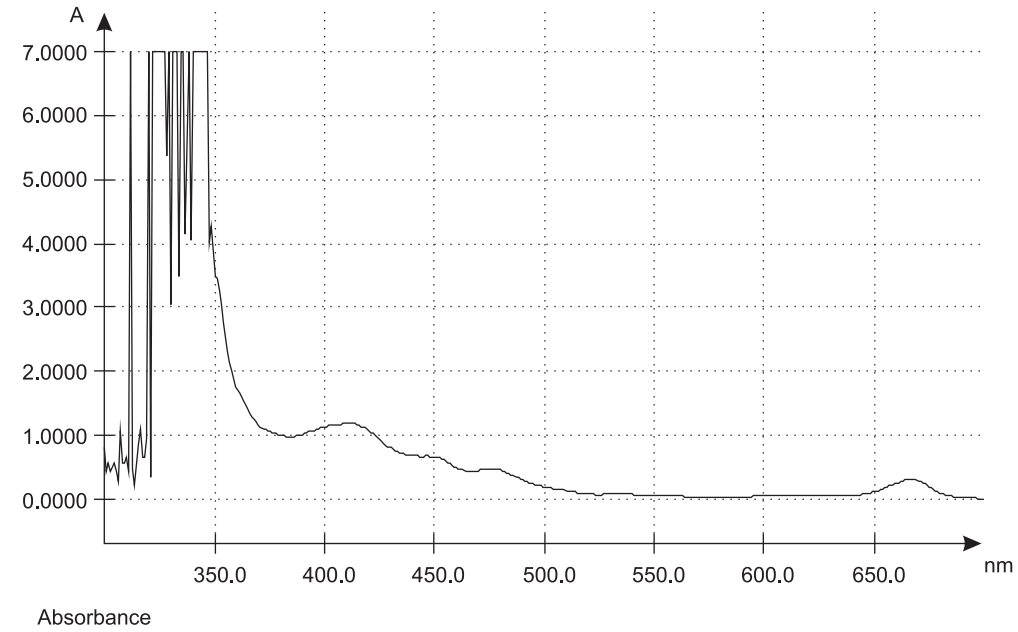

Fig. 3. The absorption spectrum of OE obtained after the preliminary wetting of the phytocomposition with 70% ethanol.

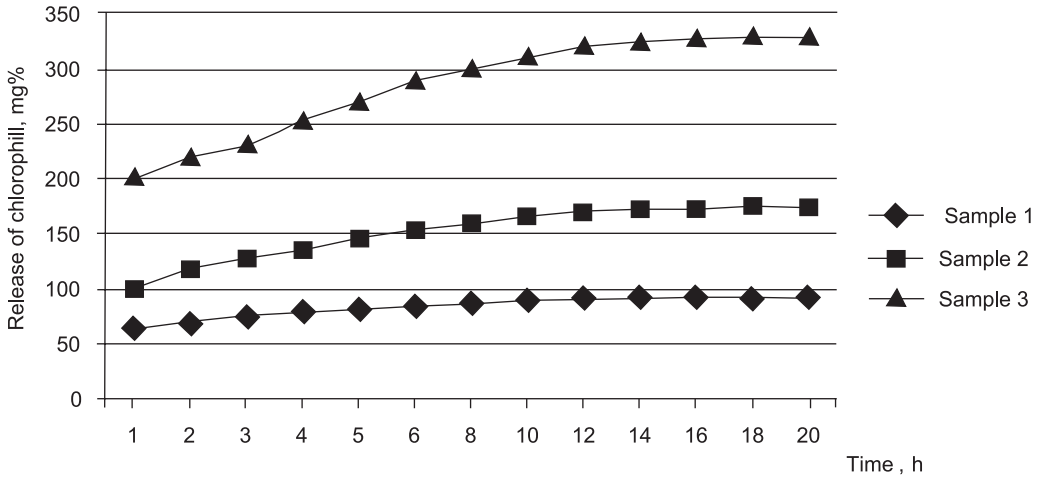

Fig. 4. The content of chlorophyll and its derivatives in oil extracts from the phytocomposition depending on conditions and the time of extraction.

of the hydrophilic complex of BAS of the phytocomposition; the second one, at the wavelength of 450 nm, is typical for carotenoids. The third absorption maximum in the range of 670-685 nm is characteristic for chlorophyll and its derivatives.

Thus, the absorption spectra of the samples of the oil extracts obtained after wetting of the herbal raw material with solutions of ethanol in the concentrations of 40, 70 and 96% evidently demonstrate the possibility of increasing the yield of both diphilic and lipophilic BAS from the phytocomposition containing wild carrot seeds, flowers of chamomile and corn silks. The results of the research indicate that wetting of the phytocomposition with ethanol in the concentration from 40% promotes penetration of the solvent into the raw material cells, its swelling and increase of the desorption degree of not only lipophilic substances (carotenoids, chlorophylls), but polar substances (flavonoids) as well. However, when wetting with 40% ethanol the raw material considerably increases in its volume while swelling and becomes more compact, and it requires more oil for extracting.

Wetting with 96% ethanol promotes better release of lipophilic and hydrophilic compounds (Fig. 2), but the best results were obtained when moistening the phytocomposition with 70% ethanol (Fig. 3).

To determine the dependence of the release of BAS from the phytocomposition on the extraction conditions the lipophilic fraction presented by chlorophyll and its derivatives with the visible absorption maximum at the wavelength of 660-680 nm was chosen.

The quantitative content of lipophilic BAS, in particular chlorophylls and their derivatives, in the samples of the oil extracts obtained depends on the concentration of ethanol used for the preliminary wetting of the phytocomposition (Sample 1 – with 40% ethanol; Sample 2 – with 96% ethanol; Sample 3 – with 70% ethanol), and duration of extraction (Fig. 4). As can be seen from Fig. 3, most BAS react with the extractant for 12-14 hours.

As a result of the research conducted the optimal parameters for extraction with oil extractants providing efficiency of release of active substances from the herbal raw material have been determined. They are grinding

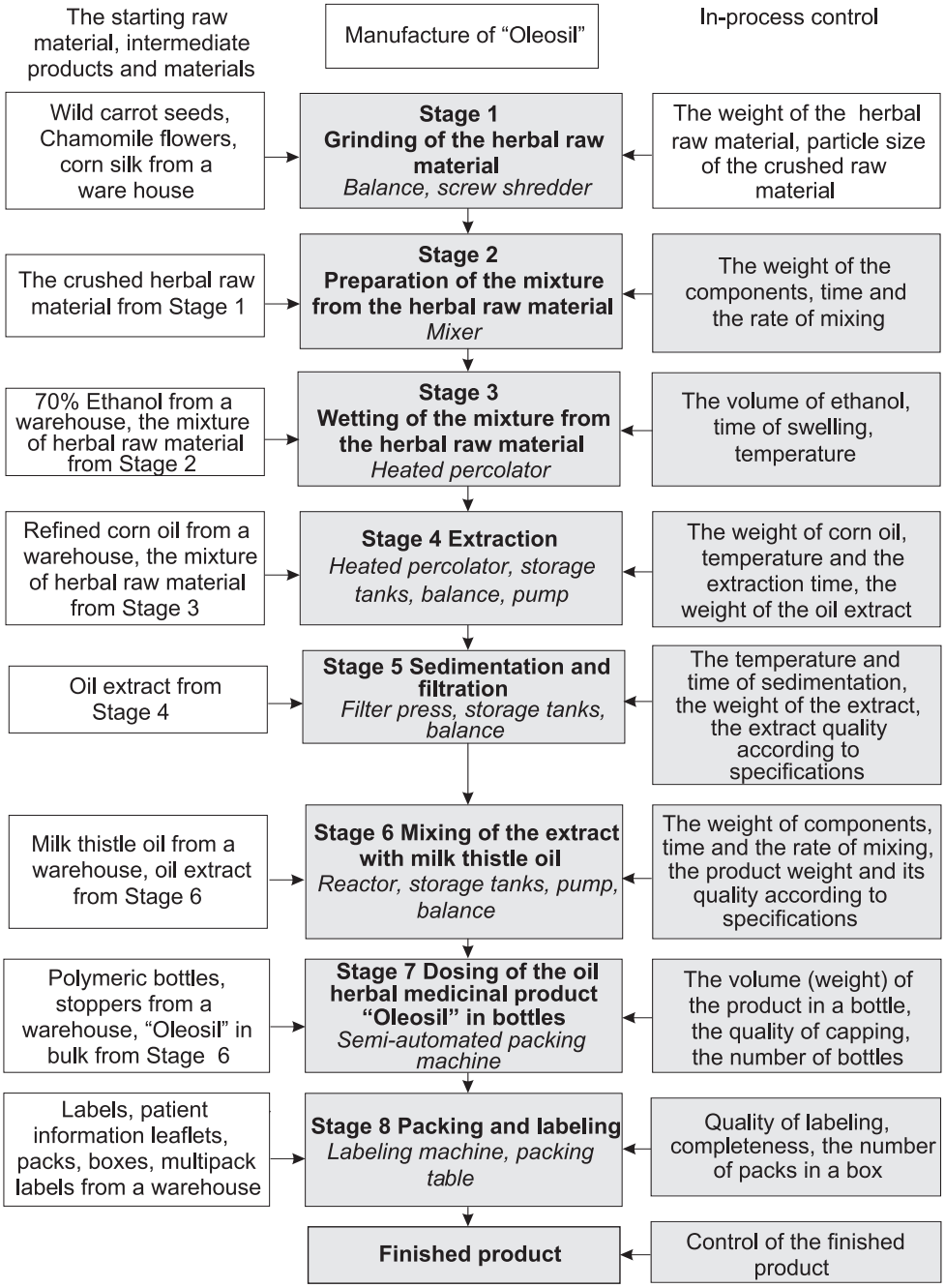

Fig. 5. The flowchart of manufacturing the combined oil herbal medicinal product "Oleosil".

of the herbal raw material by a screw shredder, an extractant for moistening is 70% ethanol in the amount of 0.6±0.1 ml per 1.0 of the raw material; the swelling time – 2.0±0.5 h; the temperature of extraction – 55±5ºC.

In order to increase the therapeutic effect of the product as a medicine with the hepatoprotective action the milk thistle oil obtained from milk thistle (*Silybum marianum*) seeds by direct compression was added to its composition. The milk thistle oil is a classic hepatoprotector – an antioxidant that improves metabolic processes in hepatocytes, increases resistance (stability) of hepatic cells to unfavourable harmful environmental factors.

On the basis of the critical points determined the technology of the complex herbal medicinal product "Oleosil" containing the oil extract from the phytocomposition and milk thistle oil in the ratio of 2:1 and possessing the hepatoprotective action was developed. The flowchart of manufacturing the combined oil herbal medicinal product "Oleosil" is presented in Fig. 5.

CONCLUSIONS

1. The effect of conditions for extraction on release of biologically active substances from the herbal raw material has been studied, and the critical parameters for the technology of the oil herbal extract under the conditional name "Oleosil" have been determined.

2. The optimal conditions for obtaining the oil extract from the phytocomposition that contains wild carrot seeds, chamomile flowers and corn silks in the ratio of (1:1:1) have been substantiated.

3. The flowchart of manufacturing the combined oil herbal medicinal product with the hepatoprotective action under the conditional name "Oleosil" has been developed.

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ВИВЧЕННЯ ВПЛИВУ КРИТИЧНИХ ПАРАМЕТРІВ ВИРОБНИЦТВА НА ТЕХНОЛОГІЧНИЙ ПРОЦЕС ОЛІЙНОГО ФІТОЕКСТРАКТУ ГЕПАТОПРОТЕКТОРНОЇ ДІЇ

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***Ключові слова**: олійні екстракти; критичні параметри; технологія; композиція рослинної сировини; гепатопротектор*

Проведені експериментальні дослідження дали можливість визначити критичні параметри та їх вплив на технологічний процес виробництва олійних екстрактів композиції лікарської рослинної сировини гепатопротекторної дії. Вивчено вплив розміру частинок сировини,концентрації і кількості етанолу на зволожування рослинної композиції і температури екстракції. У результаті досліджень визначені оптимальні параметри екстракції олійними екстрагентами, які забезпечують ефективність вивільнення діючих речовин із рослинної сировини: подрібнення рослинної сировини з використанням шнекового подрібнювача, екстрагент для зволоження – 70% етанол у кількості 0,6±0,1 мл на 1,0 сировини; час зволоження – 2,0±0,5 год; температура екстракції – 55±5ºС. За визначеними критичними точками технологічного процесу розроблена технологічна схема виробництва комбінованого олійного фітопрепарату під умовною назвою «Олеосил».

ИЗУЧЕНИЕ ВЛИЯНИЯ КРИТИЧЕСКИХ ПАРАМЕТРОВ ПРОИЗВОДСТВА НА ТЕХНОЛОГИЧЕСКИЙ ПРОЦЕСС МАСЛЯНОГО ФИТОЭКСТРАКТА ГЕПАТОПРОТЕКТОРНОГО ДЕЙСТВИЯ

О.Ю.Ткачук, Л.И.Вишневская, Т.Н.Зубченко

***Ключевые слова:** масляные экстракты; критические параметры; технология; композиция растительного сырья; гепатопротектор*

Проведенные экспериментальные исследования дают возможность определить критические параметры и их влияние на технологический процесс производства масляных экстрактов композиции лекарственного растительного сырья гепатопротекторного действия. Изучено влияние размера частиц сырья, концентрации и количества этанола на увлажнение растительной композиции и температуры экстракции. В результате исследований определены оптимальные параметры экстракции масляными экстрагентами, которые обеспечивают эффективность высвобождения действующих веществ из растительного сырья: измельчение растительного сырья с использованием шнекового измельчителя, экстрагент для увлажнения – 70% этанол в количестве 0,6±0,2 мл на 1,0 сырья; время набухания – 2,0±0,5 ч; температура экстракции – 55±5°С. По определенным критическими точкам технологического процесса разработана технологическая схема производства комбинированного масляного фитопрепарата под условным названием «Олеосил».