



ISSN: 2277- 7695

TPI 2016; 5(2): 12-14

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www.thepharmajournal.com

Received: 07-12-2015

Accepted: 09-01-2016

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Influence of polar extractants on optimization of bas release from herbal raw material

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Abstract

Investigations have been conducted on the extraction of raw materials composition of wild carrot seeds, chamomile flowers, corn columns with stigmas, corn oil after humidification of raw by various concentrations of ethyl alcohol 40, 70, 90, 96. The role of a polar extractant has been studied for optimization of release process of initial biological active substances of hydrophilic and lipophilic nature. Increase of yield of biological active substances has been reached while humidification of herbal raw by aqueous-alcoholic extractants.

Keywords: herbal raw material, oil extract, biologically active substances, carotenoids, chlorophylls, optical absorbance.

1. Introduction

As of today, search of new high effective and safe hepatoprotectors remains of topical interest, which promotes expanding the range of products nomenclature on a basis of herbal raw. The medicinal herbal raw consists of biological active substances (BAS) of different polarity. Extraction of BAS by using classic methods, by hydrophilic aqueous- alcoholic or hydrophobic oil extractants don't lead to receipt the powerful complex pharmacological effect. The oil extractant let to produce only fat-soluble substances from herbal raw materials. Therefore, a great number of valuable compounds remain in shrot often. In this regard, there is a need of rational using of plants with development of new complex technologies which provide maximum extraction of BAS.

2. Materials and Methods: The research was carried out on an oil extracts obtained by extraction of composition of medicinal herbal raw from seeds of wild carrot, chamomile flowers, corn columns with stigmas in the ratio (1 : 1 : 1) by corn oil. As polar solvents for humidification of composition of herbal raw materials, the aqueous-ethanol solutions were selected of different mass fraction of alcohol in the hydroalcoholic solution (HAS). For this purpose, the HAS of 40%, 70%, 90%, 96% have been prepared. The composition of herbal raw has been chopped by a screw device to a size of particles sieved through holes with diameter of 1-3,0 mm. The raw materials have been transferred to a porcelain cup and wetted while stirring until homogenous humidification by minimum amount of aqueous-ethanol mixture. The humidified raw material was removed to a warm infundo cup, then covered with a lid and set aside till swelling. The research of raw swelling has been conducted interactively. Swelling time did not exceed 120 minutes.

Swelling degree of examples of herbal raw material's composition has been calculated to a formula:

$$W(\%) = \frac{m - m_0}{m_0} 100 ,$$

where W– degree of swelling of raw composition

m and m₀- mass of swell and initial raw examples relatively, g.

Upon the swelling, the moistened raw have been poured by corn oil warmed to 50 °C in a ratio (1: 3) and set up on a hot water-bath to infuse for 4 ± 0.5 hours. The extraction temperature was kept up at 55 ± 5 °C by warming the water-bath up, from time to time. Content of BAS (carotenoids, chlorophylls, flavonoids) in oil extracts has been studied by the spectrometric method. To determine carotenoids in terms of β-carotene, the measurement of optical absorbance of oil extracts in hexane has been performed at the wavelength 450 ± 2 nm. As a comparison solution, the corn oil solution in hexane has been applied.

The content of chlorophylls has determined at the spectrometer Spégard 200 by measurement of oil extracts' optical absorbance in acetone at the wave length 663 ± 3 nm. As a comparison solution, the corn oil solution in acetone has been used. The content of flavonoids amount in terms of luteolin-7 glucoside has evaluated in accordance with the methodique by SPhU 2.0, V. 3, p. 207, i.e. by measurement of optical absorbance at the wave length 410 nm.

3. Results of Research and Discussion. The examined composition of herbal raw material contains a wide range of hydrophilic and lipophilic compounds. It is rich in flavonoids, hydroxycinnamic acids, carotenoids, chlorophylls, vitamins, organic and fatty acids. In prior studies, it has been established that liposoluble substances move easily to oil extractions, whereas the hydrophilic substances are hardly extracted. To facilitate the transition of BAS of medium polarity from raw material to oil it is reasonable to ensure desorption of substances from cell. For optimization of the process of BAS extraction of hydrophilic and lipophilic nature from initial raw, the role of hydrophilic extractant was studied. To ensure the necessary desorption of BAS from herbal cell, the prior watering of raw in polar extractant was applied. The literature data analysis [2-5] has shown that intensification of medicinal herbal raw processing is possible while applying the system of immiscible solvents. To optimize mass transfer when removing the hydrophilic and lipophilic components, it is necessary to provide a sufficient degree of the raw material's swelling in a polar extractant. *In vitro*, an impact of the ratio water-ethanol in the HAC onto the degree of raw material's swelling. In the first stage, the herbal raw is subjected to swelling on coming in contact with the extractant. Mainly, duration of swelling depends on histological structure and grinding degree of herbal raw, as well as on the solvent's nature.

On the Fig. 1 the lines are presented which characterize the increase of swelling degree of the examples of such compositions as: wild carrot seeds, chamomile flowers and corn columns with stigmas (1: 1: 1) while absorption of polar solvent's molecules (HAS) by raw material. The results of research have shown that the highest value of the swelling degree (60%) is achieved by using 70% aqueous- alcoholic solution.

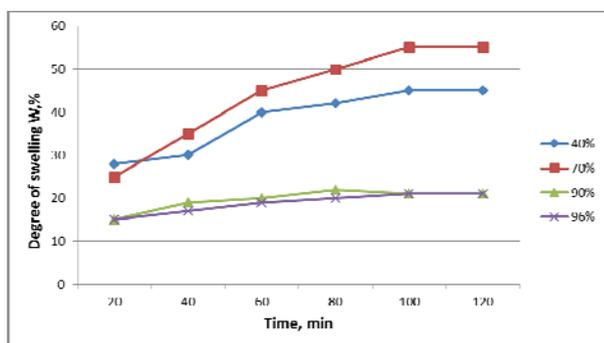


Fig 1: Graphic dependence of swelling degree of the examples of herbal raw composition in aqueous- alcoholic solutions with different concentration

It has been empirically found that preliminary humidification of raw in a polar solvent (HAS) for 2 hours at room temperature is sufficient. The presence of water in a polar solvent (50-30%), as part of the polar extractant, assures hydration processing and facilitates the weakening of

intermolecular links, additional hydration of polar groups and hydrophilic compounds. Moreover, the 70% ethanol enables the solvent to penetrate into the cells of herbal raw compositions that let to strengthening desorption of lipophilic and hydrophilic BAS from cell structures at the surface.

An analysis of the literature has shown that in many respects the value of medicinal raw material is determined by the presence of flavonoids of various nature in its content [1-3]. Due to the wide range of pharmacological activity, flavonoids are applied in medicine as choleric, hepatoprotective, anti-ulcer, capillary strengthening means. Successful combination of low toxicity and high pharmacological activity makes them extremely promising for the preventive medicine and for the treatment of serious diseases [2-5]. The examined composition of herbal raw consisted of the wild carrot seeds, chamomile flowers, corn columns with stigma contains significant fractions of both lipophilic (carotenoids, chlorophylls) and hydrophilic polar and low-polar biological active compounds. The degree of release of flavonoids amount to the oil phase from the extraction conditions has been examined by spectrophotometric method at the wave length 410 nm [1]. Study of extraction regularity while humidification of the herbal raw composition by aqueous-alcoholic solutions, which contain different amount of alcohol and without HAS humidification has shown that in oil fractions of examples significant differences are recorded in intensity of the absorption of UV radiation (Fig. 2) depending on the concentration of polar humidifier and the extraction temperature.

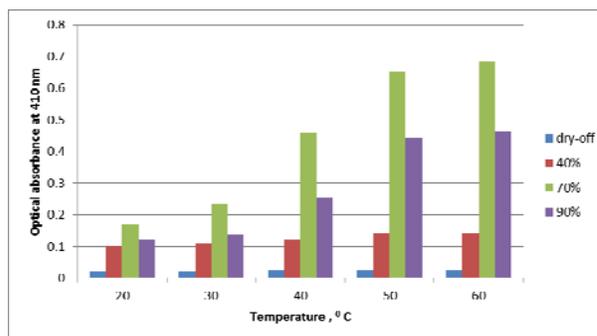


Fig 2: Dependence of optical absorbance of herbal raw material's oil extract at 410 nm on a temperature of extraction and concentration of polar humidifier.

The degree of release of carotenoids' amount in the oil phase from the extraction conditions has examined spectrophotometrically at the wave length 450 nm (Fig. 3).

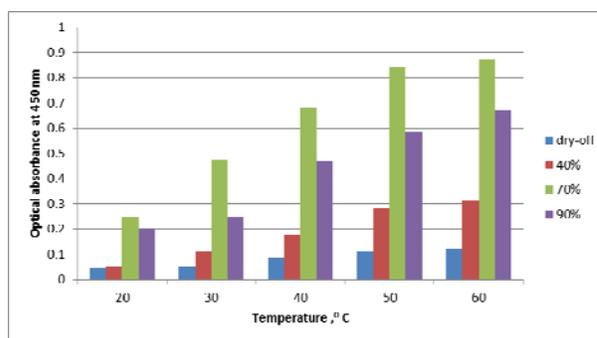


Fig 3: Dependence of optical absorbance of herbal raw material's oil extract at 450 nm on a temperature of extraction and concentration of polar humidifier.

The degree of release of carotenoids' amount in the oil phase from the extraction conditions has examined spectrophotometrically at the wave length 666 nm (Fig. 4).

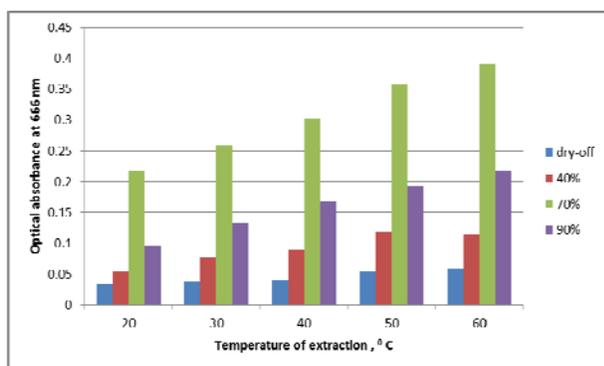


Fig 4: Dependence of optical absorbance of herbal raw material's oil extract at 666 nm on a temperature of extraction and concentration of polar humidifier.

The research allowed to determine the optimal conditions for composition extraction of herbal raw by the corn oil: the maximum extraction of biologically active substances (amount of flavonoids, carotenoids and chlorophylls) has achieved almost in full amount at preliminary humidifying of herbal raw material by 70% aqueous-alcohol solution and raw swelling for 2 hours at a temperature 25 ± 5 °C. Comparison of the results of BAS release depending on extraction conditions has shown that the most efficient extraction of low-polar and lipophilic BAS of the herbal raw composition in the oil phase occurs while using the polar humidifier hydro-alcoholic solution of 70% concentration as compared with extraction by pure corn oil without preliminary humidification (Fig. 2, 3, 4). Such difference can be explained by the important role of polar hydroalcoholic phase as a factor which ensures the necessary degree of swelling of dry herbal raw material, as well as the intermediate solvent and BAS-carrier from cells of the raw to the oil phase. That is, the use of an aqueous ethanol solution facilitates penetration of the more heavy molecules – triacylglycerols of fatty acids of herbal oil into cell membranes of the raw material for flavonoids extraction, as well as general and neutral lipids. The best results of BAS release have been achieved at a temperature 55 ± 5 °C. Furthermore, due to the fact that the amount of polar phase is quite a little, and it is rather rapidly evaporates, we have obtained oil extracts saturated with different biochemical classes of compounds that provide multifunctional therapeutic and prophylactic effects on organism.

4. Outcomes

1. In the result of conducted research, the reasonability has been established of using the polar extractants for preliminary wetting of herbal raw material for further swelling.
2. The impact of polar solvents has been studied on optimization of hydrophilic and lipophilic compounds release in oil extractants.
3. It is shown that the most efficient extraction of low-polar and lipophilic BAS of composition of herbal raw composition of wild carrot seeds, chamomile flowers, corn columns with stigmas in the oil phase occurs after humidification of the herbal composition by 70% aqueous- alcoholic solution at a temperature of extraction of 55 ± 5 °C.

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