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DETERMINATION OF THE COEFFICIENT OF DIFFUSION OF EXTRACTS FROM GOJI BERRY (*LYCIUM BARBARUM*) FRUITS

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Abstract

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The effect of some technological parameters – type and concentration of the solvent, temperature, hydromodule and extraction duration on the coefficient of diffusion was studied by the extraction of goji berry (*Lycium barbarum*) fruit. The highest diffusuion coefficient ($4.86x10^{-6}$ cm^2/s) was observed by water extraction of the fruits. Temperature 60ºC and hydromodule 1:20. On the basis of the coefficient of diffusion, deductions can be made about the diffusion properties of the extracted material and, hence, the properties of the extracts obtained.

Key words: diffusion coefficients; goji berry; tannins

Introduction

Fruits and vegetables are rich in antioxidants which prevent the development of degenerative diseases like cancer, arthritis, arteriosclerosis, cardiovascular diseases, inflammations, acceleration of the ageing processes, etc.

The fruits of goji berry (*Lycium barbarum*) became popular recently due to its useful nutritious and health protection properties (Qian et al., 2004).

Some important active compounds present in *Lycium barbarum* (goji berry) are; polyphenols - 351 mg GAE/100g; flavonoids – 53.06 mg QE/100g; carbohydrates – 42.56 g/100g; proteins – 7.88 g/100g ; lipids – 4.5 g/100g (Peng et al., 2005; Istraty et al., 2013).

Some of the scientific findings reported about goji proved that its fruits contain 19 kinds of amino acids, proteins, wide variety of antioxidants, carotenoids, vitamins, essential amino acids, etc. (Mindell et al., 2003)

The addition of fruits and vegetables to food is most often done in the form of juices while extracts are mainly used for the production of enriched and combined food products. Extracts are active substances drawn out of vegetables in small volumes.

The extracts from fruits, herbs and other plant materials a rich in antioxidants because they decelerate the oxidative degradation of the lipids by improving the quality and nutritious value of the foods.

Polysaccharides are one of the most important components of the *Lycium barbarum* fruits and can be isolated by extraction with hot water. The analysis of the extracts shows that the contents of carbohydrates in them is up to 97.54% and the main components are D-rhamnose, D-xylose, D-arabinose, D-fucose, D-glucose and D-galactose (Lia et al., 2007).

It was proved that the extracts obtained have high antioxidant activity due to the high content of phenols and flavonoids – from 100 to 377.

The essential parameter of the process of extraction which gives an idea of the diffusion properties of the extracted material is the coefficient of molecular diffusion (D). Its value depends on a number of factors: structure of the raw material, type of solvent used, ratio raw material/solvent, temperature of extraction, process duration, etc.

The values of the diffusion coefficients by extraction from different morphologic parts of the plants were deter-

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mined with both polar and non-polar solvents and leaves of gingko biloba, basil, paulownia, fruits of hawthorn (Stoyanova et al., 2010).

There are no data in the available literature about the effects of different factors: type and concentration of the solvent, temperature, hydromodule and extraction duration on the value of the diffusion coefficient by preparation of extract of goji fruits which *is the aim of the present paper.*

Material and Methods

The objects of the study were dried fruits of goji purchased on the market.

The moisture content of the fruits was determined by drying at 105°C until constant weight (BNS EN 12145:2000; Stoyanova et al., 2000).

The coefficient of molecular diffusion was determined under the following technological conditions: average size of the particles – 4 mm; solvents – 70% ethyl alcohol and water, at hydromodule 1:20; temperature 20, 40 and 60°C; duration 1 h, with miscella obtained being removed by filtration every 10 min and a new portion of fresh solvent was added to continue the extraction.

For the extracts obtained, the content of tanning substances was determined and the diffusion coefficient was determined for them. The removal of the solvent from the miscelles obtained carried out by evaporation in a rotary vacuum evaporation apparatus. (Stoyanova et al., 2000; Khasnabis et al., 2015)

The coefficient of diffusion was calculated by the formula of Minosyan (Beloborodov et al., 1971; Matveenko et al., 2014).

$$D = \frac{l^2.2,3.(\lg E_1 - \lg E_2)}{\pi^2(\tau_1 - \tau_2)} \quad (1)$$

where: D is the coefficient of diffusion, m^2/s; – average size of the material particles, m; E_1, E_2 – contents of tanning substances at moments τ_1, τ_2, %; τ_1, τ – the moments selected during the extraction, s.

All the experiments were carried out three times and the average values were calculated, as well as the error (Batuner, 1971).

The data shown in the figures were processed with Statistica 7 Software Informer.

Results and Discussion

The change of the contents of tanning substances during the extraction process is presented in Figure 1. the data indicated that he amount of tanning substances decreased in the course of the process and the highest content was observed in the first 20 min. it can be seen from Figure 1 also that the concentration of tanning substances by water extraction of goji fruits increase with temperature and the highest values were measured at 60°C (1.34 % for the first 20 min or a total of 96.95 % vs the exhausting extraction).

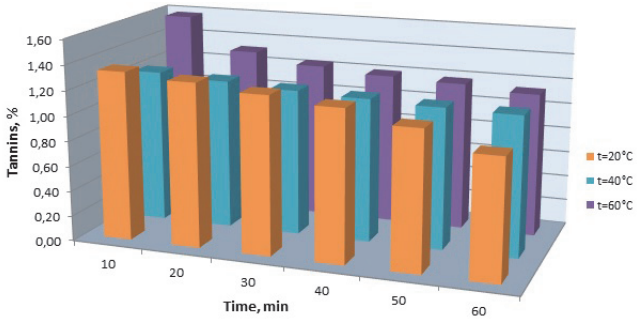

Fig. 1. Change of the content of tanning substances in water extracts, in %

By extraction with 70% ethyl alcohol, the content of tanning substances was higher during the first 20 min of the process for all the temperatures studied (20, 40 and 60°C).

Based on the results illustrated in Figures 1 and 2, the cefficient of diffusion was calculated and its change is presented in Figures 3 and 4.

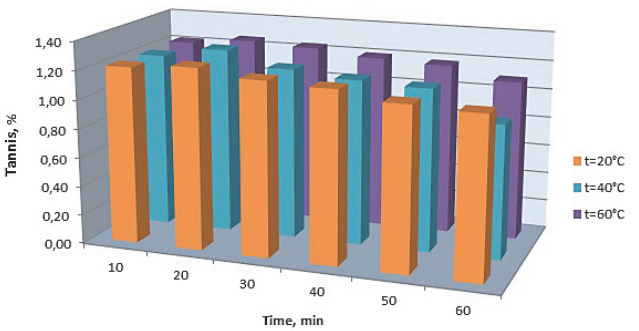

Fig. 2. Change of the tanning substances content in 70% ethyl alcohol, in %

It can be seen from the data that the value of the diffusion coefficient increased with temperature. The highest values were observed at 60°C for water extracts ($4.86x10^{-6}$ cm^2/min) and at 20°C for extracts with 70% ethanol ($3.16x10^{-6}$ cm^2/min) which can be easily explained by the facilitated diffusion. The difference of the diffusion coefficient values for the two goji extracts was due to the type of the solvent used.

Comparing the data obtained with these for other materials, in can be seen that the diffusion coefficient values were

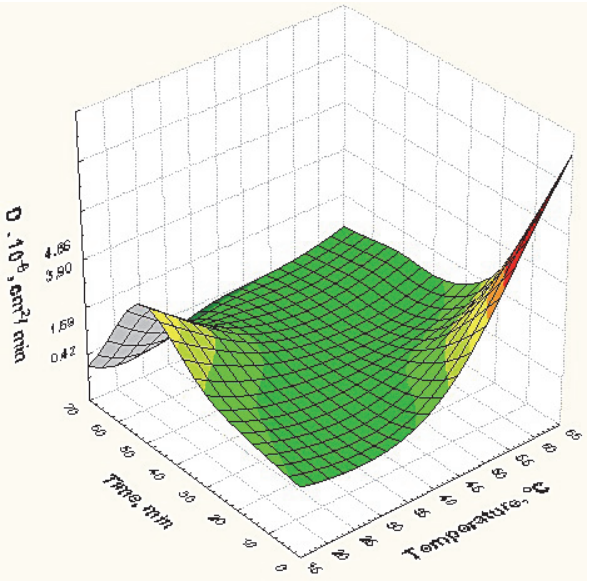

Fig. 3. Change of the coefficient of diffusion (D) in water extracts of goji

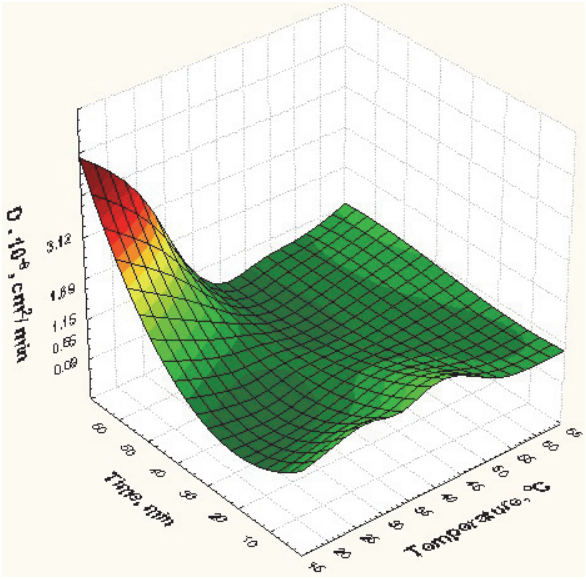

Fig. 4. Change of the diffusion coefficient (D) goji extraction with 70% ethanol

close to these for water extracts of briar ($2.22.10^{-7}$ cm^2/min) but higher than these for lavender raceme ($42.7 – 82.6x10^{-9}$ cm^2/min) (Balinova-Tsvetkova, 1980), amorpha fruit ($18.83 – 44.27x10^{-9}$ cm^2/min) (Damyanov et al., 1981). This was explained with the structure of the vegetation material. Its size and process conditions – type of the solvent used and temperature of the process.

Conclusion

The boosted interest of the consumers to health and the role of food for the improvement of the quality of life stipulated the food industry to offer new and traditional products with improved properties and characteristics which have positive effect on human health. This can be made by introduction of various extracts as additives in food.

Knowing the exact parameters of the process of extraction (type and concentration of the solvent, temperature, hydromodule and duration of the process) is an important prerequisite for the proper proceeding of the process and extracting the valuable components from fruits.

For the water extracts of goji, the yield of tanning substances increased by 1.34% with the increase of the temperature to 60°C and the values of the diffusion coefficient were the highest – $4.86x10^{-6}$ cm^2/min.

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