COEFFIICIENT OF DIFFUSION OF AROMATIC PRODUCTS FROM ANATOLIAN HAWTHORN (*Crataegus Orientalis* Pall. Ex. Bieb.)

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Abstract. The coefficient of diffusion (D) of aromatic products – concrete and resinoid, obtained through extraction of leaves and fruits from hawthorn (Crataegus orientalis Pall. ex Bieb.) have been determined. The highest values of D with respect to resinoid extraction from leaves and fruits are calculated at 70 ºC ($9{,}65.10^{-9}$ cm^2/s and $8{,}61.10^{-7}$ cm^2/s), respectively and with respect to concrete extraction from leaves and fruits – at 40 ºC ($9{,}86.10^{-9}$ cm^2/s and $8{,}33.10^{-7}$ cm^2/s).
Keywords: Crataegus orientalis, coefficient of diffusion, aromatic products.

Introduction

The genus *Crataegus* from fam. *Rosaceae* consists of nearly 21 species in Turkey, which have many hybrids and populations [12, 15]. It has been reported that the fruits and leaves from the species *C. orientalis* Pall. ex. Bieb. are a rich source of flavonoids, vitamin C, glycoside, saponins, tannins and have found application in traditional and official medicine [5, 13]. The fruits extracts are widely used for the treatment of various cardiovascular diseases [6].

In our previous work we have obtained extracts from fruits and leaves of two species of the hawthorn - *C. monogyna* Jaqc. from Bulgaria and *C. orientalis* Pall. ex. Bieb. from Turkey, with the ethanol, aiming at their application in cosmetics [9, 10]. The extracts have been characterized in terms of tannin content and their diffusion have been estimated [4, 11, 14].

There is no data on obtaining of this products from the fruits and leaves from – concrete and resinoid, from hawthorn, as well as on the determination of extracts` molecular diffusion coefficients, which is the aim of the current work.

Experimental

Plant material: Fruits and leaves of hawthorn (*C. orientalis*) from the market from Turkey were used in the investigation. The raw material was characterized in terms of: moisture content by drying it up to constant weight, at 105 ºC [3].

Determination of the diffusion coefficients: Extraction was carried out as a batch static process by maceration in the solvent at a ratio of raw material to solvent = 1:10 under the following conditions: for concrete: solvent – petroleum ether; temperature - 20, 30 and 40 °C; for resinoid: solvent – 96 vol. % ethyl alcohol; temperature - 20, 40, 60 and 70 °C. For both aromatic products - size of material particles - 0,04 cm (fruits) and 0,11 cm (leaves); duration of extraction 1 h, with the solvent replaced and analyzed for extracted tannins after each 10 min interval. As a criterion for effectiveness of the process the quantity of concrete and resinoid was determined.

The diffusion coefficients were estimated by Minosian's equation [1]:

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

where: l - size of the material, cm;

τ_1, τ_2 – duration of extraction, s;

E_1, E_2 – initial and final concentration of concrete or resinoid, %.

All experiments were carried out in threefold repetition and mean values with the respective error are presented in the figures below.

Data presented on the figures are processed with Microcal Origin Micro Soft tool.

Results and discussion

The analyzed hawthorn leaves and fruits were with 11.1 % and 12.4 % moisture level, respectively.

Figures 1, 2, 3 and 4 present the schemes of the experiments that have been carried out and the obtained results. Data reveal that with the increase in extraction duration the quantity of the obtained aromatic products decreases. Regardless of the plant material – leaves or fruit, maximum amount of concrete is extracted at temperature 40°C, and respectively, maximum amount of resinoid – at temperature 70°C, which finding is attributed to the influence of temperature on the extractive potential of the solvent.

On the basis of the experimental results from figures 1 – 4 the diffusion coefficients of concrete and resinoid are calculated, and their variations are presented on figures 5 - 8. With the increase in the temperature of extraction the values of the diffusion coefficients also increase.

The highest values for resinoid from leaves and fruits are calculated at 70ºC ($9{,}65.10^{-9}$ cm^2/s and $8{,}61.10^{-9}$ cm^2/s), respectively, and for concrete extraction from leaves and fruits – at 40 ºC ($9{,}86.10^{-9}$ cm^2/s and $8{,}33.10^{-9}$ cm^2/s), which could be explained by the facilitated diffusion. The differences in the values of the diffusion coefficients for the two studied aromatic products are due to the different structure of the plant organs and the applied solvent.

In our previous work we have obtained the different values of diffusion coefficients for the aromatic products from leaves and fruits from hawthorn (*C. monogyna*), for example resinoid - at 70 ºC ($9{,}02.10^{-8}$ cm^2/s) and 60 ºC ($17{,}77.10^{-8}$ cm^2/s), respectively and concrete – at 30 ºC ($8{,}93.10^{-8}$ cm^2/s) and 40 ºC ($9{,}49.10^{-8}$ cm^2/s) [11].

Compared to the values of diffusion coefficients cited in the literature for other plant materials, our results appear to be lower by one order, for example – concrete from lavender (*L. angustifolia*) flowers ($42{,}7 – 82{,}6.10^{-9}$ cm^2/s), pine (*P. sylvestris*) needles ($33{,}9 – 50{,}8. 10^{-9}$ cm^2/s), etc. [2, 6, 7].

These results are connected to the nature and the size of the raw material, the included aromatic substances and the specific conditions of the extraction process – solvent and temperature.

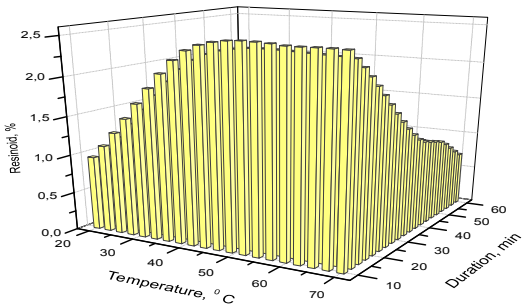

Fig. 1. Content of resinoid from leaves.

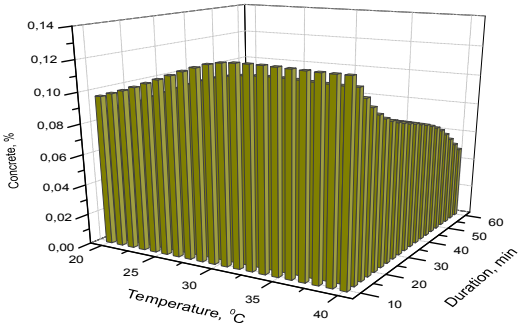

Fig. 2. Content of concrete from leaves

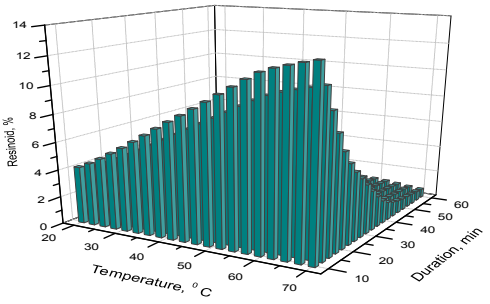

Fig. 3. Content of resinoid from fruits.

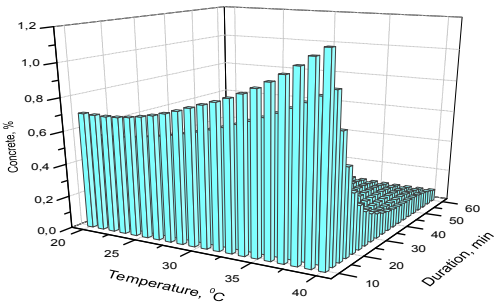

Fig. 4. Content of concrete from fruits.

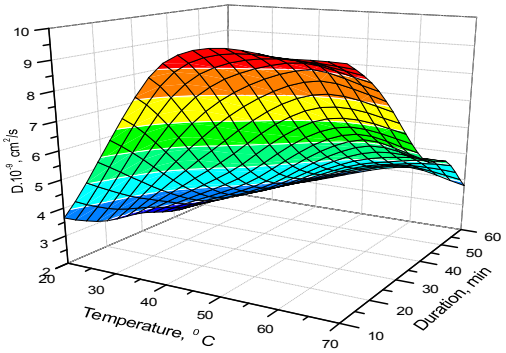

Fig. 5. Diffusion coefficients of resinoid from leaves.

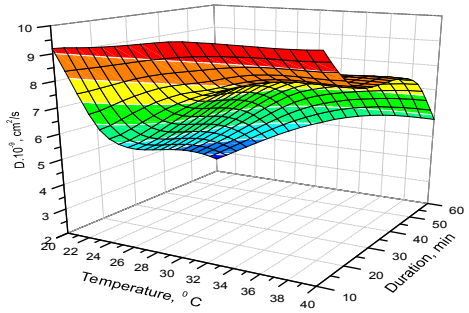

Fig. 6. Diffusion coefficients of concrete from leaves.

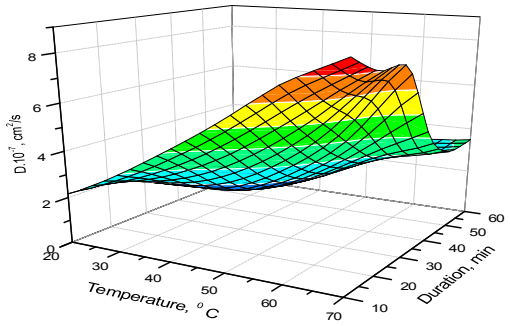

Fig. 7. Diffusion coefficients of resinoid from fruits.

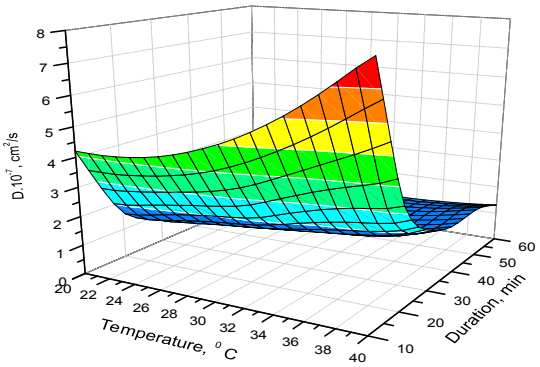

Fig. 8. Diffusion coefficients of concrete from fruits.

Conclusion:

The highest values of coefficient of diffusion with respect to resinoid extraction from leaves and fruits from hawthorn (*C. orientalis*) are calculated at 70ºC ($9{,}65.10^{-9}$ cm^2/s and $8{,}61.10^{-7}$ cm^2/s), respectively and with respect to concrete extraction from leaves and fruits – at 40 ºC ($9{,}86.10^{-9}$ cm^2/s and $8{,}33.10^{-7}$ cm^2/s).

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