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STATE OF CARTHAMIN IN WATER AND STEAM EXTRACTS OF SAFFLOWER (*CARTHAMUS TINCTORIUS* L.) PETALS

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The chemical structure and high polarity of carthamin, a red dye from Safflower, was reliably proven by numerous investigations using thin-layer and HPLC chromatography, H-NMR, and C-NMR. At the same time, some reputable sources indicate a very low solubility of carthamin in water.

The aim of this study was to identify the truth in this matter, to find out the cause of the discrepancies, to establish the relationship between the form of these dyes in aqueous media and their applicability in various food products.

Safflower air-dry petals served as raw materials for carthamin obtaining. Microscopic examination showed that the dye is in the petals in the form of grains of 30±5 microns in size. Hot steam with a temperature of 98–99 °C was passed through a loose layer of petals at a speed of 1 g/min. The condensate was collected in individual portions, then electron spectra were recorded in the range of 200–800 nm for each portion collected. The spectra are characterized by two peaks at 330 and at 395 nm. Despite the fact that the peak at 330 nm is higher, the peak at 395 nm is more suitable for the quantitative characterization of the content of dyes in steam extracts, since it is more distinct. It is important, that all UV-Vis spectra integrals of extracts obtained by hot steam are proportional to the values of the main optical densities at 395 nm. This correlation is a simple proof of the constancy of the composition of the various parts of the extract (in relation to substances active in the spectra) during extraction.

We have found that aqueous dye extracts contain unidentified biopolymers that behave like electrically charged oligosaccharides. The separation of the solid phase of these oligosaccharides takes place in a range of 3–7 pH-units. We managed to separate the white alcohol-insoluble precipitate of biopolymers from a high water- and alcohol-soluble dye. Thus, carthamin in aqueous extracts loses in solubility precisely due to the formation of complexes with biopolymers.

At the same time, in case of steam extraction, a completely water-soluble dye is obtained. To extract 30, 60, 95 and 99 % of the coloring matter, you need to skip about 12, 25, 40 and 50 g of hot steam through 1 g of petals, respectively. Low velocity of extraction can be explained with the natural state of carthamin in form of solid grains in Safflower petals, which extend the time of diffusion and elution of dye.

From our point of view, differences between the state of carthamin in petals, hot-water and steam extracts explain the discrepancies between the polar structure and the seemingly low solubility of carthamin in water. To verify this hypothesis, we initiated an electrochemical study, the results of which will be presented later.

The temperature resistance and confirmed high solubility of carthamin in water (in the condition of its separation from accompanying substances) makes this dye suitable to various technological operations and contribute to increasing the economic feasibility of Safflower growing. Carthamin is an excellent natural alternative to synthetic azo dyes, which, unfortunately, are still used in food products. Steam-extraction of Safflower petals provides sterilized water-soluble red natural dye with a wide range of uses.

Keywords: carthamin, solubility in water, steam extraction, bio-polymers, UV-spectra.