

PROCESS FOR OBTAINING HYDRO-ALCOHOLIC EXTRACTS FROM BERRIES BASED ON MATHEMATICAL MODELING

Roman GOLUBI, ORCID ID: 0000-0003-4444-9515

National Institute for Applied Research in Agriculture and Veterinary Medicine, Republic of Moldova

Boris MORARI, ORCID ID: 0000-0002-1583-7474

National Institute for Applied Research in Agriculture and Veterinary Medicine, Republic of Moldova

Silvia NEMȚEANU, ORCID ID: 0000-0002-5075-5378

National Institute for Applied Research in Agriculture and Veterinary Medicine, Republic of Moldova

Maria-Marcela BARBAROȘ, ORCID ID: 0000-0003-0524-148X

National Institute for Applied Research in Agriculture and Veterinary Medicine, Republic of Moldova

Elena ZÎREANOVA, ORCID ID: 0000-0002-7625-175X

National Institute for Applied Research in Agriculture and Veterinary Medicine, Republic of Moldova

*Corresponding author: Roman Golubi, e-mail: romangolubi985@gmail.com

Introduction

Berries are an important source of substances with antioxidant properties, which can be successfully used to increase the nutritional value of new generation foods. The main task for food engineering researchers is to develop the optimal process for extracting these substances. Typically, water-ethanol hydromodules are used, where the parameters vary: sample-solvent ratio, temperature, pH value, and extraction duration.

Material and methods

As samples for research, three types of berries were selected: sea buckthorn, rosehip and black currant. Their content of substances with high antioxidant activity was determined by UV-VIS spectrophotometry: ascorbic acid (vitamin C), α -tocopherol (vitamin E), carotenoids (expressed as β -carotene), vitamins B1, B2, B6 and phenolic substances. The representative index for expressing the general antioxidant effect was the DPPH radical scavenging assay. To optimize the process of obtaining hydro-alcoholic extracts from berries, second-degree mathematical modeling with two factors was applied.

Results

The berries purchased from local farmers were processed according to the technological flow, which included: inspection and washing with a water jet at 1.5 bar, sectioning and separation of seeds (in the case of rosehip), freezing at -18°C . At the time of initiating the experiments, the samples were removed from the freezer and adjusted to $20-22^{\circ}\text{C}$, then they were crushed in a screw juicer and homogenized into a puree structure. For the extraction of substances with antioxidant properties (vitamins, carotenoids, phenolic compounds), a hydroalcoholic solution with a degree of 71.0% (wine distillate) was used in a ratio of 100 mL:10 mg puree. Thirteen experiments were performed, each in 2 repetitions, where the input parameters temperature and treatment duration had maximum, minimum and center values, plus "star" points ($+\alpha$ and $-\alpha$). The hydroalcoholic extracts of berries, obtained according to the planned variants in the mathematical model, were diluted 1:100 and introduced with an automatic pipette in a volume of 100 μL into 1 cm wide cuvette, where initially 3900 μL of 0.2 mM DPPH solutions were added. After 30 min of incubation in the dark, the cuvettes with solutions were read by a spectrophotometer, the wavelength being 517 nm. Using the Microsoft Excel (MS Office 2007), the values of the data field were calculated to obtain regression equations and the optimal combination of temperature and duration for the maximum possible value of the issue parameter, which is directly related to the increased content of substances with antioxidant properties. Based on this mathematical model, the extraction process was optimized for each type of berry and the maximum value of DPPH radical scavenging activity was established: 52.6% and 44.2% for extraction for 60 min at 20°C from rosehip puree and blackcurrant puree, respectively 31.7% for extraction for 45 min at 44°C from sea buckthorn puree.

Conclusions and Implications

The process of obtaining extracts from sea buckthorn, rosehip, black currant, rich in antioxidant substances was optimized by applying mathematical modeling. The efficiency of the process was confirmed by the DPPH test. These results will be useful for fortifying low-alcoholic beverages.

Keywords: *antioxidant activity, berries, DPPH assay, extraction optimization, mathematical modeling*