VALORISATION OF ULTRASONATED SEA BUCKTHORN JUICE AS A FUNCTIONAL INGREDIENT IN THE DAIRY INDUSTRY

Amelia BUCULEI[1*], ORCID: 0009-0002-4447-1763
Anca Mihaela GÂTLAN[1], ORCID: 0000-0001-5836-7022
Mircea OROIAN[1], ORCID: 0000-0001-5141-9969
Adriana DABIJA, ORCID: 0000-0002-1877-9142
Ancuţa PETRARU[1], ORCID: 0000-0001-8370-0456
Mădălina IUGA, ORCID: 0000-0003-1314-5957
Florin URSACHI[1], ORCID: 0000-0002-2254-7651
Irina DIANU[3], ORCID: 0000-0001-8632-8987
Artur MACARI[3], ORCID: 0000-0003-4163-3771

[1]Faculty of Food Engineering, University Stefan cel Mare of Suceava, Suceava, Romania
[2]Integrated Center for Research, Development and Innovation in Advanced Materials, Nanotechnologies, and Distributed Systems for Fabrication and Control (MANSiD), Ştefan cel Mare University of Suceava, Suceava, Romania
[3]Department of Food Technology, Technical University of Moldova, Chisinau, Republic of Moldova

*Corresponding author: Amelia Buculei, ameliab@fia.usv.ro

Introduction. Sea buckthorn juice is a valuable functional raw material with high potential as an ingredient in innovative dairy products. However, preserving its temperature-sensitive bioactive compounds, ensuring microbiological safety, and maintaining physical stability remain major technological challenges. This study aimed to optimize laboratory-scale ultrasonic parameters to obtain a microbiologically safe, physico-rheologically stable raw material with enhanced functional properties.

Materials and Methods. The study applied the response surface methodology (RSM) and an experimental D-Optimal design (24 experiments). Four processing factors were evaluated: Amplitude (20–100%), ultrasonic time (10–30 min), temperature (20–50 °C) and frequency (25 and 45 kHz). The changes were monitored by 13 response parameters covering physico-chemical, rheological, bioactive and microbiological properties. The mathematical models obtained were statistically significant ($p < 0.001$), with determination coefficients R^2 between 0.77 and 0.95 and an insignificant lack of matching ($p > 0.05$). The optimal ultrasonic conditions identified by numerical optimization were: Amplitude 97.64%, time 10 min, temperature 50 °C and frequency 45 kHz.

Results and Discussion. Under these conditions, sea buckthorn juice has ideal characteristics for use as a raw material in dairy products: 1. Bioactive enrichment and antioxidant potential: The optimized juice showed high vitamin C (366.52 mg/L), total polyphenols (150.90 mg/100 ml), quercetin (9.21 mg/L), DPPH antioxidant activity (92.34%), and carotenoids (25.28 mg/L), supporting natural fortification of dairy products (clean label). 2. physical stability and phase separation prevention: The sedimentation index decreased from 2.13% (M1) to 1.28%, being comparable to pasteurized M2 (1.30%). High turbidity (119,085 NTU) indicates fine particle dispersion, helping prevent layer separation and deposits in liquid or semi-solid dairy products. 3. Rheological compatibility: The viscosity of the optimized juice maintained at 56.56 Pa·s (similar to 56.83 Pa·s in M1 and 56.22 Pa·s in M2), ensuring compatibility with the structure and consistency of the dairy products. 4. Microbiological biosecurity: The treatment reduced the total number of microorganisms from 24.00 CFU in M1 to 0.63 UFC, approching the efficiency of M2 (0.00 CFU), thus providing a safe ingredient for dairy processing and fermentation. 5. Physico-chemical stability: the pH (3.68), soluble solids (5.68 °Brix) and titratable acidity (1.76 g citric acid/100 g) confirm the maintenance of the physico-chemical balance of the raw materials.

Conclusions. In conclusion, optimized ultrasonic processing transform sea buckthorn juice into a functional, microbiologically safe and physically stable raw material, creating opportunities for innovative and fortified dairy products.

Keywords: *sea buckthorn juice, functional raw material, dairy products, ultrasonication, bioactive compounds, food safety*

Acknowledgments. This work was supported by a grant of the Ministry of Education and Research, CCCDI-UEFISCDI, project number PN-IV-PCB-RO-MD-2024-0214, within PNCD IV. Supported by Premier Agro Concept SRL (Căţineaţa), Botoşani, Romania.