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ENGINEERING, ENVIRONMENT AND MATERIALS IN PROCESS INDUSTRY

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BOOK OF ABSTRACTS

JAHORINA
MARCH 20-23, 2023

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ULTRASOUND-EMERGING TECHNOLOGY FOR VALORIZATION OF PUMPKIN LEAF BIOMASS: IMPACT OF SONICATION PARAMETERS ON PROTEIN RECOVERY, STRUCTURE, FUNCTIONALITIES, AND BIOACTIVITIES

Jelena R. Mijalković[1],Nataša Ž. Šekuljica[2], Sonja M. Jakovetić Tanasković[1], Predrag M. Petrović[2], Bojana D. Balanč[2],Verica B. Đorđević[1], Zorica D. Knežević-Jugović[1]

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Abstract

The potential of food biodiversity and its production streams to generate additional features for isolating high-value products has been underutilized. Even so, the recovery of valuable nutritional compounds like proteins from waste streams and by-products has been identified as a key strategy for enhancing production sustainability in order to open up new market potential. In accordance with those facts, the primary aim of this research was to utilize a relatively novel extraction technique, high-intensity ultrasound, in order to achieve a reduction in time, energy, and extraction solvent consumption while at the same time improving the extraction yield and nutritional value of extracted leaf proteins.For this purpose, an ultrasound probe system with a low frequency (20±0.2 kHz) was utilized to extract the white proteins from the pumpkin leaf biomass, and the effects of different sonication amplitudes (20, 30, 40, 50, 60 and 70%) and duration periods (0, 1, 3, 5, 7.5, 10, 12.5, 15, 17.5, and 20 min) on the yield, solubility and emulsifying qualities, antioxidant properties, and structural characteristics of proteins were studied. In the functional properties evaluated, leaf proteins isolated using ultrasound outperformed those extracted using the conventional extraction method, maceration. High-intensity ultrasound resulted in a slight but gradual decline in solubility with an increase in amplitude, but a significant increase in solubility in an acidic environment was observed with the decrease of cavitation periods.Ultrasound-extracted proteins exhibit nearly 12, 1.5, and 3-fold greater solubility compared to the maceration-extracted sample at pH 3, 4, and 5, respectively. The emulsifying activity diminishes with increasing sonication amplitude and duration but increases in emulsifying stability as sonication periods are extended.The ultrasound extraction provided pumpkin proteins with high radical scavenging activities (i.e., good electron donors) and chelating activity, with half maximal inhibitory concentrations (IC_{50}) in the range of 0.9 to 1.5 mg/ml, and 0.3 to 0.6, respectively, especially at 20 and 40% amplitude. Raman spectroscopy, surface charge, surface hydrophobicity, and sulfhydryl group contents were employed to characterize the structural changes brought on by ultrasound cavitation, and the achieved changes were more influenced by the treatment periods and amplitudes applied. The experimental findings show that the use of ultrasound-emergingtechnology for protein extraction can significantly increase theyield of pumpkin leaf protein by up to 70%. The utilization of leaf proteins in food products and dietary supplements can be augmented by combining the ultrasound periods and amplitudesto create high-value samples with better capabilities.

Key words: *pumpkin leaf biomass, leaf proteins, ultrasound probe extraction, functionalities, protein structure, bioactivities*

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