



Contribution ID : 16

Type : Oral

Comparison of Ultrasound- and Pulsed Electric Field-Assisted Protein Extraction from fresh *Lemna minor*: Process Evaluation and Functional Characterization

giovedì 1 ottobre 2026 11:45 (15)

Efficient extraction methods are required to maximize protein recovery from duckweed (*L. minor*) while preserving nutritional quality and functionality. The Institute of Food Technology at Weihenstephan-Triesdorf University of Applied Sciences compared ultrasound-assisted extraction (UAE) and pulsed electric field-assisted extraction (PEF) with conventional alkaline–acidic extraction. Fresh greenhouse-grown *L. minor* was processed immediately after harvest. UAE parameters were optimized, while PEF conditions were adopted from previous work. Protein concentrates were characterized for protein content and yield, chlorophyll, antioxidant capacity, and techno-functional properties. UAE achieved the highest protein extraction efficiency at 100% amplitude and 2 min sonication, whereas the investigated PEF treatment (5 min homogenization prior to 5kV/cm) comparatively enhanced cell permeabilization. UAE and PEF yielded protein concentrates containing 60.81% and 65.24% protein, with protein yields of 55.02% and 34.70%, respectively. Conventional extraction produced the lowest protein yield (30.78%) but the highest protein content (66.19%), which did not differ significantly from PEF. Extraction technology also influenced pigment recovery, antioxidant capacity, and techno-functional properties. UAE achieved the highest chlorophyll extraction by ~64% and preferentially recovered hydrophilic antioxidants, consistent with previous findings [1], whereas PEF favored hydrophobic antioxidants. The PEF-derived protein concentrate showed the highest protein solubility and superior foaming and emulsifying capacities, while UAE improved foam and emulsion stability. These findings demonstrate that UAE and PEF are promising alternatives to conventional extraction, enabling the production of duckweed protein concentrates with tailored compositional and techno-functional properties for diverse food applications.

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Scientific Session

Applications

Keywords

non-thermal technologies, protein recovery, functionality

References

Maag, P.; Cutroneo, S.; Tedeschi, T.; Grüner-Lempar, S.; Rauh, C.; Karslioglu, Ö.Ö. Optimization of Protein

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Session Classification : Applications I b — food, feed & nutrition