ULTRASONICATION PROCESSING FOR THE PRODUCTION OF PLANT-BASED NANOEMULSIONS

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Plant-derived proteins have been emerging and growing in interest over the past few years, due to their interesting properties and the trend to replace animal-derived proteins [1]. Ultrasonication processing can be used to develop nanoemulsions based on plant proteins that are kinetically stabilized by their small dimension, unlike classic emulsions [2].

In this work, oil-in-water nanoemulsions were produced through high-speed homogenization, followed by ultrasonic homogenization (US), using different plant-derived proteins, including potato (*Solanum tuberosum*), lupin (*Lupinus angustifolius*), pea (*Pisum sativum*), chickpea (*Cicer arietinum*) and faba bean (*Vicia faba*) protein as emulsifiers. A central composite rotatable experimental design was used to evaluate the influence of three independent variables: water/oil ratio (65-75% of water), protein content (1-6%) and US time (1-7 min) on the size average (by intensity) and polydispersity index (PDI) of the nanoemulsions. A total of 17 experiments were performed with 14 three-level experimental points, and 3 replicates at the central point. The effect of the US time (0, 3, 4.5 and 6 min) in the potato and lupin proteins primary and secondary structures were analysed through SDS-PAGE electrophoresis and circular dichroism, respectively.

Results showed that the use of potato, lupin and pea proteins lead to the formation of stable nanoemulsions, while chickpea and faba bean proteins resulted in non-stable nanoemulsions, with phase separation.

The smallest mean droplet size for potato protein was 439.9 nm and PDI value 0.464 [21:73 (w/w) oil/water ratio, 6% of protein and 6 min of US]. The smallest mean droplet size for lupin protein was 505.5 nm and PDI value 0.434, and for pea protein the droplet size was 551.3 nm and PDI value 0.249 [23.6:73 (w/w) oil/water ratio, 3.4% of protein and 6 min of US].

Electrophoresis results show that for native potato and lupin samples the ultrasonication did not induce significant changes in the protein pattern, indicating that the US treatment did not modify the primary structure. Regarding the second structure, US did not change the secondary structure of potato protein but induced a slight increase of α-helix for all US treatments for lupin protein.

Stable nanoemulsions can be developed using plant-derived proteins and ultrasonication, foreseeing different applications in the food industry.

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References

[1] Electrohydrodynamic processing for the production of zein-based microstructures and nanostructures, P. Silva, S. Torres-Giner, A A. Vicente and M. A. Cerqueira, Current Opinion in Colloid & Interface Science, 56:101504, (2021)

[2] Comparison of Different Protein Emulsifiers on Physicochemical Properties of β-Carotene-Loaded Nanoemulsion: Effect on Formation, Stability and In Vitro Digestion, Liu et al., Nanomaterials, 11, 167, (2021).

Palavras-chave : nanoemulsions, plant-based, plant-derived proteins, ultrasonication