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BOOK OF ABSTRACTS

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Fish waste extract microencapsulated via spray drying as a valuable source of bioactive lipids and vitamin D_3

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Fishing sector activities generate significant fish waste daily, which strongly affects the environment [1]. Seafood waste could be an exceptional source of innovative bioactive compounds, such as omega-3 fatty acids and vitamin D_3, that can be extracted and used in the formulation of nutraceutical or pharmaceutical products. Therefore, the need for techniques to extract and repurpose these compounds is essential. In this work, an innovative extraction approach using supercritical CO_2 was applied, and the resulting fish waste extract was loaded into spray-dried microparticles that are useful as nutraceutical ingredients [2]. Fish waste from *Sardina pilchardus* species, collected by CNR-IRBIM in collaboration with fishing associations from the Mediterranean Sea (Adriatic Sea), was homogenized and freeze-dried by ENEA. A sustainable supercritical fluid extraction (SFE) was conducted to identify the optimal conditions using a two-variable experimental design (temperature and pressure). The best conditions were replicated three times on a pilot scale, and the extract was characterized for vitamin D_3 and its precursor 7-dehydrocholesterol content (via HPLC-DAD) as well as fatty acid profile (via GC-MS) [3]. Next, the extract was formulated with an aqueous solution (maltodextrin, arabic gum, and pea protein hydrolysate) to produce a stable emulsion through stirring (1100 rpm for 5 minutes), followed by ultrasound (US) treatment (constant power 219 Watts for 3 minutes, 75% amplitude). The emulsion was subsequently subjected to spray drying (T_{in} 160 °C, aspirator 100%, atomizing pressure 1.75 bar, feed rate 9.6 g/min), and the resulting microparticles were characterized for particle size distribution, flowability, residual moisture, and antioxidant activity. SFE optimal conditions were 90 minutes, 350 bar, and 40 °C. The oil extraction yield on the pilot scale was 18.1% w/w DM. The oil contained vitamin D_3 (6.18 ± 0.54 µg/g EXT) and its precursor (789.77 ± 95.02 µg/g EXT). Fatty acids were identified and quantified: ω3-polyunsaturated fatty acids represented the largest proportion (> 43%), followed by saturated fatty acids (~29%) and monounsaturated fatty acids (~19%). The ω3 DHA is the most abundant compound (19.5%). Finally, sardine SFE oil served as the oily phase of the O/W emulsion used as feeding material to be treated via spray drying. The oily droplets of the emulsion obtained after US were very small in size (< 10 µm). The spray drying yield was high (> 87%). The resulting microparticles exhibited good flowability (angle of repose of 33 °), an average diameter of 18.75 µm, SPAN 2.30, 3.63% of residual moisture, and antioxidant activity of 9.25 µg TE/mL.This work adds another building block to the reuse of daily output from the fishing sector, serving as a source of high-value extracts rich in bioactive compounds for pharmaceutical and nutraceutical applications.

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References

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