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Ultrasound-Assisted Extraction of Bioactive Compounds from Cocoa Shell and Their Encapsulation in Gum Arabic and Maltodextrin: A Technology to Produce Functional Food Ingredients

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Abstract : In this study, the extraction of cocoa shell powder (CSP) was optimized, and the optimized extracts were spray-dried for encapsulation purposes. Temperature (45-65 ◦C), extraction time (30–60 min), and ethanol concentration (60–100%) were the extraction parameters. The response surface methodology analysis revealed that the model was significant ($p \leq 0.05$) in interactions between all variables (total phenolic compound, total flavonoid content, and antioxidant activity as measured by 2,2-Diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP assays), with a lack of fit test for the model being insignificant ($p > 0.05$). Temperature (55 ◦C), time (45 min), and ethanol concentration (60%) were found to be the optimal extraction conditions. For spray-drying encapsulation, some quality metrics (e.g., water solubility, water activity) were insignificant ($p > 0.05$). The microcapsules were found to be spherical in shape using a scanning electron microscope. Thermogravimetric and differential thermogravimetric measurements of the microcapsules revealed nearly identical results. The gum arabic + maltodextrin microcapsule (GMM) showed potential antibacterial (zone of inhibition: 11.50 mm; lower minimum inhibitory concentration: 1.50 mg/mL) and antioxidant (DPPH: 1063 mM trolox/100g dry wt.) activities ($p \leq 0.05$). In conclusion, the microcapsules in this study, particularly GMM, are promising antioxidant and antibacterial agents to be fortified as functional food ingredients for the production of nutraceutical foods with health-promoting properties.

Keywords : functional foods, coco shell powder, antioxidant activity, encapsulation, extraction
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