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Physico-Chemical, Techno-Functional and Bioactive Properties of Camel Whey Protein Concentrate as Affected by Spray Drying and Ultrasonication Treatment

by

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Abstract

Whey protein concentrates (WPCs) are gaining importance as a functional ingredient due to their nutritional, techno-functional and bioactive properties. In this study, WPCs were isolated from skimmed camel milk, then either spray-dried (SD) at 170, 185 and 200 °C, or treated by ultrasonication (US) (20 kHz) for 5, 10 and 15 min followed by freeze-drying to obtain powders. The characterization of WPC powders was carried out by Sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) and Reverse-Phase Ultra Performance Liquid Chromatography (RP-UPLC) which showed that the US treatment degraded the proteins in camel whey more than SD. The morphology, particle size, and surface charge of WPC samples were further studied using scanning electron microscopy (SEM) and Zetasizer, and the lowest particle size of 215.1 nm with surface charge of -21.6 mv was achieved with SD-185 powder. Moreover, SD samples revealed whiter color compared to the US-treated samples which were slightly yellowish in color. US-15 sample exhibited high protein solubility (100%), whereas the camel WPC spray dried at a temperature of 200 °C (SD-200) showed reduced solubility (92.7%). Significant improvement in the emulsifying properties of WPC powders was observed after SD and US, with highest emulsifying activity index (EAI) values of 143.75 m^2/g and 143.11 m^2/g reported for SD-185 and US-15 WPC samples, respectively. However, SD and US treatments negatively affected fat absorption capacity (FAC) and foaming capacity (FC) of WPC samples. Overall, SD and US treatments enhanced antioxidant activities of WPC, and the highest 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) (12.12 mmol TE/g) and 2,2-diphenyl-1-picrlthydrazyl (DPPH) radical scavenging activity (6.86 mmol TE/g) were recorded for US-15 and US-5 samples, respectively. Furthermore, US-10 sample exhibited the highest α-amylase, α-glucosidase, and dipeptidyl-peptidase-IV inhibitory activities among all samples with IC_{50} values of 81.18, 130.10, and 67.92 µg/ml, respectively. Whereas SD processing at lower temperature (170 °C) generated WPC samples with higher *in-vitro* antidiabetic activities. In addition, the *in-vitro* anti-obesity activities of WPC samples were evaluated using the pancreatic lipase (PL) and cholesteryl esterase (CE) inhibitory assays, and US-10 and SD-170 powders showed the lowest IC_{50} values (72.83 and 115.16 µg/ml) and (79.12 and 130.34 µg/ml), respectively. To conclude, SD and US processes were found to improve the techno-functional and bioactive properties of camel WPCs, and thus can be utilized as a promising strategy to preserve and enhance techno-functional and bioactive properties of camel WPC.

Keywords: Camel whey protein; Ultrasound; Spray-drying; Techno-functional properties; Bioactive properties