Effects of enzymatic liquefaction, drying techniques, and wall materials on the physicochemical properties, bioactivities, and morphologies of zinc-amaranth (Amaranthus viridis L.) powders

ABSTRACT

The demand for vegetable powder has been escalating considerably due to its various health benefits and higher shelf life compared to fresh green leafy vegetables. Thus, much research emphasised manufacturing vegetable powder at a lower operational cost and higher efficiency while preserving the nutritive values of the vegetables. In this study, zinc- (Zn-) amaranth puree was liquefied with three types of cell wall degrading enzymes (i.e., Viscozyme L, Pectinex Ultra SP-L, and Rapidase PAC) with varying concentrations (0–3% v/w) and incubation time (0.5–24 h) at pH 5 and 45°C before the drying process. The results showed that enzymatic liquefaction using 1% (v/w) of Viscozyme L for 3 h was the optimal procedure for the reduction of the viscosity of the puree. The liquefied puree was then microencapsulated through either spray- or freeze-drying with different wall materials, e.g., 10% of maltodextrin (MD) DE 10, resistant maltodextrin (RMD), N-octenyl succinate anhydride (OSA) starches from waxy maize, HI CAP 100 (HICAP), Capsul (CAP), and gum Arabic (GA). The results showed that all freeze-dried powders generally had higher process yield (except for that encapsulated by HICAP), higher moisture content (but similar water activities), higher retention of total Zn-chlorophyll derivatives, lower hygroscopicity with slab-like particles, larger particle size, and lower bulk density than those of spray-dried powders. In contrast, the spray-dried powders exhibited irregular spherical shapes with relatively high encapsulation efficiency and antioxidant activities. Nonetheless, encapsulation using different wall materials and drying methods had no significant effect on the powder's cohesiveness and flowability.