Development of Polyhydroxyalkanoate-Based Nanocapsule through Phase Inversion Composition (PIC) Method

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Abstract

There is increasing interest within the food and pharmaceutical industries in the invention of delivery system that can encapsulate, protect and release lipophilic bioactive compounds such as omega-3 fatty acids, fat-soluble vitamins, flavonoids, carotenoids and drugs. However, the major challenge for food and pharmaceutical industries is the engineering of nanostructures that can efficiently encapsulate bioactive compounds with enhanced physical and chemical stability, high loading capacity and non-toxic. In this work, new polyhydroxyalkanoate-based nano-capsule was invented without using any organic solvents to accommodate the essential aforementioned needs. Polyhydroxyalkanoates (PHAs) are biodegradable polymers that can be synthesized by microorganism under stress condition i.e. high carbon source and limited source of other nutrients. The invention began with the formulation of nano-emulsion, which will then be the template for preparing PHA-based nano-capsule, by mixing two nonionic stabilizers (Span 80 and Cremophor EL) with jojoba oil as organic medium. All nano-emulsion samples were prepared by low energy emulsification method (phase inversion composition) consisting of stepwise addition of water to the mixture (stabilizers and oil). Response surface methodology (RSM) was applied to obtain the right ratio of those materials. The size and stability of the nano-capsule were studied by using the Malvern Zetasizer Nano ZS and TURBISCAN MA 2000 Stability Analyser. β-carotene was used as bioactive model to study the encapsulation efficiency and protectability of the nano-capsule. From the result, PHA-based nano-capsule with 1.5 – 2.0 % of PHA shows better stability and protection to the β-carotene. Based on the preparation method (without using any organic solvent), good stability and non-toxic, this type of nano-capsule has a good potential to be used in pharmaceutical and nutraceutical industries.

Keywords: Nano-capsule, Biodegradable polymer, Nonionic surfactant, Bioactive encapsulation

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