

Microencapsulation of Saffron (*Crocus sativus* L.) Extract in Copolymer Complexes Using Extrusion Method

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ABSTRACT

This study describes the preparation of alginate-chitosan and alginate-gelatin beads containing saffron components to be incorporated as additives in food products. This study evaluated the influence of incorporating hydrophilic natural polymers, alginate-chitosan and alginate-gelatin on preserving saffron components. The alginate beads were coated with chitosan and gelatin as copolymer by extrusion method with a polyelectrolyte complex reaction between two oppositely charged poly-ions. The beads were formulated, optimized and evaluated to obtain high encapsulation efficiency of crocin, safranal and picrocrocin as the main components of saffron. The encapsulation variables were selected in accordance with Central Composite Design and were further optimized via response surface methodology. Alginate concentration significantly influenced particle size and encapsulation efficiency of alginate-chitosan and alginate-gelatin beads ($p \leq 0.05$). Both chitosan and gelatin positively affected encapsulation efficiency. The optimum condition for preparing alginate-chitosan beads was an alginate concentration of 1.97% and chitosan concentration of 0.925%; this yielded an encapsulation efficiency of 66.3 ± 1.5 , 86.2 ± 0.7 and $52.9 \pm 3\%$ for picrocrocin, safranal and crocin, respectively. The optimum condition for preparing alginate-gelatin beads was an alginate concentration of 1.95% and gelatin concentration of 3.65%; this yielded encapsulation efficiency of 39.2 ± 2.9 , 31.9 ± 1.7 and $18.3 \pm 1\%$ for picrocrocin, safranal and crocin, respectively. The results clearly indicated that, in combination with alginate, chitosan was a better copolymer than gelatin for encapsulating saffron components.

Keywords: Saffron, Alginate, Chitosan, Gelatin, Encapsulation

INTRODUCTION

Saffron, a popular spice known for its color, aroma and medicinal properties, belongs to the family *Iridaceae*. It consists of the dried stigmas of *Crocus sativus* L., which is widely cultivated in Iran, Spain, Italy, France and India. Saffron is also known as the most expensive spice in the world (Fernandez, 2004; Khan et al., 2011). Saffron is a valuable and important export product in Iran, playing a significant role in Iran's agricultural economy. The total annual worldwide pro-