Nano-encapsulation of saffron extract through double-layered multiple emulsions of pectin and whey protein concentrate

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1. Introduction

Saffron has been used in a wide variety of industries, including food, pharmaceutical and, cosmetics due to its natural colorant, antioxidant and therapeutic properties. Crocin, picrocrocin, and saffranal are the major compounds of saffron responsible for its color, aroma, and flavor, respectively (Basker and Negbi, 1983; Sampathu et al., 1984; Zeng et al., 2003). These compounds are rather unstable and influenced by the final processing temperature, storage temperature, pH, light, oxygen, enzymes, proteins and metallic ions (Patras et al., 2010).

Microencapsulation is a technique for coating of bioactive materials (like crocin, picrocrocin, and saffranal) in the form of micro- and nano-particles and, providing protection or controlling the release of the entrapped ingredients. There are different methods for encapsulation in the food industry and spray drying is a common and affordable way to do this (Gouin, 2004; Jafari et al., 2008a; Bhandari, 2004).

Improving the encapsulation efficiency during spray drying, which is preventing volatile losses and extending the shelf-life of the products by minimizing the amount of unencapsulated material at the surface of powder particles, is the major emphasis for microencapsulation of food flavors and oils (Jafari et al., 2008b).

Indeed model food systems (water, carrier, and flavor) play a key role in optimising the encapsulation efficiency. These systems can be prepared by different models including maltodextrins, proteins or polysaccharide based systems, and emulsion systems.

The W/O/W multiple emulsion stabilized by biopolymers is a major food system for creating spherical spray dried powder particles in which hydrophilic ingredients are encapsulated in the inner aqueous phase (Rodríguez-Huezot et al., 2004; Mlalila et al., 2014).

The choice of resistant wall materials can affect the encapsulation efficiency of entrapped compounds within W/O/W multiple emulsions. Therefore, applying double-layer techniques (oil droplets coated by double-layered interfacial membranes) for producing W/O/W multiple emulsions, can efficiently coat oil particles during emulsification and result in improved stability to environmental stresses of encapsulated ingredients (Bouver et al., 2012; Giroux et al., 2013).

Rodríguez-Huezot et al. (2004) revealed powders obtained by spray-drying of double-layer W/O/W multiple emulsions showed the best morphology, highest microencapsulation efficiency, and highest total carotenoids retention and a high biopolymer blend (gum Arabic, mesquite gum and maltodextrin) to primary emulsion ratio also produced a high microencapsulation efficiency.

Rajabi et al. (2015) working on saffron extract microencapsulation observed that a mixture with 40% TS consisting of