

**Encapsulation properties, release behavior and physicochemical characteristics of water-in-oil-in-water (W/O/W) emulsion stabilized with pectin–pea protein isolate conjugate and Tween 80**

ABSTRACT

Water-in-oil-in-water ( $W_1/O/W_2$ ) double emulsion is one of the most efficient drug delivery systems. In the double emulsion, the release of a target compound from one phase to another can be controlled by the emulsion composition, emulsification and preparation condition. Tween 80 is mainly used as a high HLB emulsifier; while it may cause many side effects on the human health. The main goal of the present study was to investigate the efficiency of a new hybrid polymer (pectin–pea protein isolate conjugate) as a potential alternative for Tween 80. In this study, the efficiency of different types and concentrations of hydrophilic emulsifier (i.e. Tween 80, native pectin and pectin–PPI conjugate) and hydrophobic emulsifier (i.e. PGPR) on the release behavior of Tartrazine as a marker and other characteristics of  $W_1/O/W_2$  double emulsion were investigated. The double emulsion containing 2% pectin–PPI conjugate and 2% PGPR had proper encapsulation stability (37.05%). Conversely, the sample stabilized with Tween 80 (2%) and PGPR (either 2% or 5%) had relatively poor encapsulation stability after one-month storage (8.97% and 6.35%, respectively). In most cases, the double emulsion stabilized with pectin–PPI conjugate provided stronger encapsulation properties, smaller droplets, and higher zeta potential than other emulsions containing the native pectin and Tween 80. The current study reveals that the pectin–PPI conjugate (3:1) can be used a proper replacer for Tween 80 in stabilizing the double emulsion. The application of pectin–PPI conjugate in the double emulsion led to reduce the percentage of PGPR in the formulation, providing safer product.

**Keyword:** Encapsulation properties; Double emulsion; Pectin–pea protein isolate conjugate; Recovery yield; Stability; Release