

## **Emulsion formulation optimization and characterization of spray-dried $\kappa$ -carrageenan microparticles for the encapsulation of CoQ10**

### **ABSTRACT**

The present study is aimed to prepare  $\kappa$ -carrageenan microparticles for the encapsulation of model drug, coenzyme Q10 (CoQ10). A face-centered central composite design was employed to study the effects of three different formulation variables ( $\kappa$ -carrageenan, emulsifier, and oil). The powder yield was found inversely affected by the  $\kappa$ -carrageenan and oil concentration. The encapsulation efficiency was maximized in the region of the middle level  $\kappa$ -carrageenan concentration, the high level emulsifier concentration, and the low level oil concentration. The emulsifier concentration was the most influential variable on the particle size of powder. The optimal formulation was reported as 0.91% (w/v)  $\kappa$ -carrageenan concentration, 0.64% (w/v) emulsifier, and 1.0% (w/w) oil. Both differential scanning calorimeter and X-ray diffraction analyses proved that incorporation of CoQ10 into  $\kappa$ -carrageenan microcapsules resulted in amorphous powder with significantly ( $p < 0.05$ ) higher water solubility compared to pure CoQ10 and physical mixture in the crystalline form.

**Keyword:**  $\kappa$ -carrageenan; Coenzyme Q10; Spray drying; Emulsion formulation; Water solubility