

## **Comparison of process parameter optimization using different designs in nanoemulsion - based formulation for transdermal delivery of fullerene**

### **ABSTRACT**

This research aims to formulate and to optimize a nanoemulsion-based formulation containing fullerene, an antioxidant, stabilized by a low amount of mixed surfactants using high shear and the ultrasonic emulsification method for transdermal delivery. Process parameters optimization of fullerene nanoemulsions was done by employing response surface methodology, which involved statistical multivariate analysis. Optimization of independent variables was investigated using experimental design based on BoxóBehnken design and central composite rotatable design. An investigation on the effect of the homogenization rate (4,000ó5,000 rpm), sonication amplitude (20%ó60%), and sonication time (30ó150 seconds) on the particle size,  $\zeta$ -potential, and viscosity of the colloidal systems was conducted. Under the optimum conditions, the central composite rotatable design model suggested the response variables for particle size,  $\zeta$ -potential, and viscosity of the fullerene nanoemulsion were 152.5 nm, 652.6 mV, and 44.6 pascal seconds, respectively. In contrast, the BoxóBehnken design model proposed that preparation under the optimum condition would produce nanoemulsion with particle size,  $\zeta$ -potential, and viscosity of 148.5 nm, 655.2 mV, and 39.9 pascal seconds, respectively. The suggested process parameters to obtain optimum formulation by both models yielded actual response values similar to the predicted values with residual standard error of <2%. The optimum formulation showed more elastic and solid-like characteristics due to the existence of a large linear viscoelastic region.

**Keyword:** Nanoemulsion; Palm kernel oil ester; Fullerene; Central composite rotatable design; BoxóBehnken design; Response surface methodology