

## ABSTRACT

Skin aging is a natural process that can be delayed with antioxidants such as those found in Tamanu oil. To enhance its stability and effectiveness, Tamanu oil was formulated into a nanoemulsion serum spray using the Self-Nanoemulsifying Drug Delivery System. This study aimed to optimize the excipient composition for Tamanu oil serum spray and assess the impact of nanoemulsion on formulation stability. Optimization was conducted using Simplex Lattice Design in Design-Expert v23.1 by varying Tween 80 and Polyethylene Glycol 400 composition. The optimum formula was evaluated through the responses of Z-average, Polydispersity Index, zeta potential, and nanoemulsion transmittance. The stability test was conducted by freeze-thaw test along with characterization tests, including organoleptic properties, pH, viscosity, and antioxidant activity. Statistical analysis was performed using IBM SPSS v30.0. The optimal formula contained 4.846 g Tween 80 and 1.154 g Polyethylene Glycol 400. Experimental data confirmed model predictions for the responses. Antioxidant activity decreased slightly post-formulation with  $IC_{50}$  value from  $1312.59 \pm 21.87$  to  $1905.99 \pm 53.69$  ppm, suggesting successful encapsulation. The formula remained stable across freeze-thaw test cycles, with only a minor pH difference. In conclusion, the optimum formula of Tamanu oil nanoemulsion serum spray showed good stability and preserved antioxidant activity, supporting its potential as an anti-aging skincare product.

**Keywords:** Antioxidant, encapsulation, freeze-thaw, self-nanoemulsifying drug delivery system, simplex lattice design