Formulation and Characterization of *Penaeus monodon*-Derived Glucosamine Liposomal Gel

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Abstract

Liposomes are an effective delivery system to enhance the bioavailability of glucosamine, a bioactive compound essential for maintaining joint health. This study began with the production of glucosamine hydrochloride (GlcN-HCl) from black tiger shrimp (Penaeus monodon) shell waste through chitosan hydrolysis using an ultrasonic extraction method with varying HCl concentrations (4–8%). Treatment with 4% HCl yielded the highest recovery and optimal physicochemical characteristics, including particle size of 26–239 nm and specific crystalline structures at 2θ angles of 9.87° and 28.95°. The selected GlcN-HCl was then formulated into a liposomal gel system using the thin film hydration method with soy lecithin:cholesterol ratios of 40:60, 50:50, and 60:40. The best formula (60:40) exhibited a particle size of 539.3 nm, PDI of 1.6, zeta potential of –3.7 mV, and high encapsulation efficiency (98.61%). Evaluation of the gel's supramolecular structure focused on syneresis, where the best formula showed the lowest value, indicating good matrix cohesion and water retention during storage. The increase in liposome turbidity over four days remained within an acceptable range, demonstrating adequate physical stability. In addition, a swelling test was conducted by gravimetric method to assess the gel's fluid absorption capacity, reflecting its elasticity and structural integrity as a delivery matrix. Overall, the glucosamine liposomal gel exhibited a stable supramolecular structure in terms of both syneresis and swelling capacity, suggesting its potential as an innovative glucosamine delivery system for functional food applications, particularly for the elderly. Nutritional estimation also indicated a high choline contribution (82% RDA) with cholesterol levels remaining within safe limits.

Keywords: Ultrasound-assisted extraction, Encapsulation efficiency, Swelling capacity, Supramolecular gel structure, Choline contribution.