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Stability and Rheology of Sodium Diclofenac-Loaded and Unloaded Palm Kernel Oil Esters Nanoemulsion Systems

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Abstract : Sodium diclofenac is one of the most commonly used drugs of nonsteroidal anti-inflammatory drugs (NSAIDs). It is especially effective in the controlling the severe conditions of inflammation and pain, musculoskeletal disorders, arthritis, and dysmenorrhea. Formulation as nanoemulsions is one of the nanoscience approaches that have been progressively considered in pharmaceutical science for transdermal delivery of drug. Nanoemulsions are a type of emulsion with particle sizes ranging from 20 nm to 200 nm. An emulsion is formed by the dispersion of one liquid, usually the oil phase in another immiscible liquid, water phase that is stabilized using surfactant. Palm kernel oil esters (PKOEs), in comparison to other oils; contain higher amounts of shorter chain esters, which suitable to be applied in micro and nanoemulsion systems as a carrier for actives, with excellent wetting behavior without the oily feeling. This research was aimed to study the effect of O/S ratio on stability and rheological behavior of sodium diclofenac loaded and unloaded palm kernel oil esters nanoemulsion systems. The effect of different O/S ratio of 0.25, 0.50, 0.75, 1.00 and 1.25 on stability of the drug-loaded and unloaded nanoemulsion formulations was evaluated by centrifugation, freeze-thaw cycle and storage stability tests. Lecithin and cremophor EL were used as surfactant. The stability of the prepared nanoemulsion formulations was assessed based on the change in zeta potential and droplet size as a function of time. Instability mechanisms including coalescence and Ostwald ripening for the nanoemulsion system were discussed. In comparison between drug-loaded and unloaded nanoemulsion formulations, drug-loaded formulations represented smaller particle size and higher stability. In addition, the O/S ratio of 0.5 was found to be the best ratio of oil and surfactant for production of a nanoemulsion with the highest stability. The effect of O/S ratio on rheological properties of drug-loaded and unloaded nanoemulsion systems was studied by plotting the flow curves of shear stress (τ) and viscosity (η) as a function of shear rate (γ). The data were fitted to the Power Law model. The results showed that all nanoemulsion formulations exhibited non-Newtonian flow behaviour by displaying shear thinning behaviour. Viscosity and yield stress were also evaluated. The nanoemulsion formulation with the O/S ratio of 0.5 represented higher viscosity and K values. In addition, the sodium diclofenac loaded formulations had more viscosity and higher yield stress than drug-unloaded formulations.

Keywords : nanoemulsions, palm kernel oil esters, sodium diclofenac, rheoligy, stability
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