

Development of Kamala Formula using Nanotechnology

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Abstract

Osteoarthritis is a prevalent degenerative joint disease affecting the elderly population. The traditional Thai Kamala poultice, comprising nine herbal components including *Zingiber cassumunar*, has demonstrated anti-inflammatory efficacy but presents limitations in preparation complexity, active compound consistency, and storage stability. This study aimed to develop an optimized Kamala extract nanoemulsion formulation using nanotechnology to overcome these challenges.

The experimental approach involved systematic screening of oils, surfactants, and co-surfactants using pseudoternary phase diagrams combined with ultrasonication. Physicochemical characterization included particle size analysis, polydispersity index (PDI), pH measurement, and stability evaluation. Coconut oil demonstrated the highest solubility for DMPBD (the main bioactive compound) with a peak area of $7,726,887 \pm 81,547.1$. Tween 80 was identified as the optimal surfactant, while n-butanol provided the widest one-phase region (16.32%).

Formulation K2 (Smix 50%) exhibited superior balanced properties with an average particle size of 77.92 ± 8.35 nm, low PDI (0.199 ± 0.042), skin-compatible pH (6.08 ± 0.07), and maintained stability without phase separation after 72 hours. All formulations showed good short-term stability under centrifugation testing.

The optimized Kamala nanoemulsion (ratio 1:2:50:47 of extract:coconut oil:Smix:water) demonstrated excellent physicochemical properties suitable for topical application. This research successfully bridges traditional Thai medical wisdom with contemporary pharmaceutical technology, offering high potential for development into standardized nanoemulsion-based products for anti-inflammatory therapy. The findings support the modernization of traditional remedies into evidence-based herbal medicines compatible with current healthcare practices.

Keywords

Nanoemulsion, Thai herbal medicine, osteoarthritis.