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Optimization of nanoemulsion formulations of Piper sarmentosum for topical application in skin cancer

[Therapeutic Delivery](#) • Article • 2026 • DOI: 10.1080/20415990.2026.2696195 [Jawahar, Bassam Mohamed](#)^a; [Shahbuddin, Munira](#)^a; [Raus, Raha Ahmad](#)^a; [Abu Bakar, Mohd Rushdi](#)^{b, c} ; [Ridzwan, Irna Elina](#)^d; [+2 authors](#)^a Department of Chemical Engineering and Sustainability, Faculty of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia[Show all information](#)

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Abstract

Aims: Topical delivery for skin cancer treatment is a better alternative for a highly localized tumor and lower severity of adverse effects associated with oral or parental administration of chemotherapeutic drugs. Topical delivery of drugs requires specific formulation properties to successfully penetrate the interior barriers of skin layers. Our previous in vitro study showed that essential oil (EO) from Piper sarmentosum inhibited both A375 (melanoma) and A431 (non-melanoma) cells, but not HFF1 (human fibroblast) cells. This study aimed to formulate a nanoemulsion incorporating EO from Piper sarmentosum for topical treatment of skin cancer.

Materials and methods: Hydrophilic–lipophilic balance (HLB) was employed to optimize the nano-formulation conditions. Tween 80 and Span 80 were used to adjust the HLB value, and prepared using ultrasonication. Optimization was performed using Response Surface Methodology (RSM) at

varying concentrations of EO (1–10%), surfactant mixture (Smix) (10–20%), and ultrasonic amplitude (20–70%). The three response variables are particle size, polydispersity index (PDI), and zeta potential. Results and Conclusion: Our results revealed an optimal HLB value at 13.83, followed by an optimal formulation comprising 10% EO, 10% Smix, and 33% amplitude yielding 27.69 nm, PDI of 0.245, and –13.1 mV. The optimized nano-formulation exhibited desirable physicochemical characteristics, suggesting its potential suitability for topical delivery. © 2026 Informa UK Limited, trading as Taylor & Francis Group.

Author keywords

chemotherapy; Nanoemulsion; Piper sarmentosum; skin cancer; topical

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