STEREOLITHOGRAPHY (SLA) ASSISTED FABRICATION OF 3D PRINTED POLYMERIC FILM FOR TOPICAL BERBERINE DELIVERY: IN VITRO, EX-VIVO & IN VIVO INVESTIGATIONS

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Background: A 3D printed skin film intended for topical delivery of berberine (BBR) was developed utilizing stereolithography technology to enhance its local concentration. PEGDMA was used as the photopolymerizing oligomer, with PEG 400 as the inert component to facilitate berberine solubilization and film consistency. The system was designed to provide a controlled berberine release profile and a biocompatible matrix for topical applications. The effect of resin composition on the physicochemical properties and drug release profiles was investigated.

Methods: Three batches of topical films were 3D printed by varying the resin composition. Physicochemical characterizations of the films were performed along with microscopy and ex vivo drug permeation study. In vivo skin irritation studies were conducted to assess the skin irritation potential of topical films.

Results: The films were printed as per the CAD design specification with minimal variation. Microscopic analysis confirmed the layer-by-layer 3D printing, while thermal analysis (DSC) and XRD studies revealed the amorphous nature of the drug in the printed film. The FT-IR results confirmed the photo-crosslinking process. The stability data indicated no discernible variations in the physicochemical profile of the 3D printed film over time. Drug permeation study showed effective diffusion of the drug from the film with a higher PEG 400, leading to high ex vivo drug diffusion up to 344.32 ± 61.20 μg/cm^2 after 24 hours through rabbit ear skin. In vivo skin irritation studies have suggested the non-irritant nature of the printed films.

Conclusions: The results indicated the suitability of SLA to fabricate topical film with desired physicochemical properties intended for topical use to treat skin diseases. The presence of PEG 400 in the films facilitated BBR diffusion resulting in an improved flux in the ex-vivo model. The utilization of biocompatible polymers for the additive manufacturing of the films ensured the non-irritant property in vivo.