Optimization of Zein Microneedle loaded with Curcumin for the Treatment of Melanoma

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Abstract:

Zein a protein from corn was used to optimize zein-based microneedles for efficient transdermal drug delivery of curcumin (Cur)for the treatment of melanoma. PVP K30 and PEG were used at different ratios as plasticizers to improve the microneedles' strength and membrane penetration. A quality-by-design approach was adopted using design expert software to optimize the mechanical strength and membrane insertion of the microneedles. The zein concentration from 50 to 60% and PVP K30/PEG of concentration of 10% to 20% were used for the optimization. The modified micro molding technique was employed to prepare the microneedle. The incorporation of 50% zein with 20% PVP K30 resulted in good mechanical strength for membrane insertion. After the optimization different loading of Cur was employed from 1 to 0.125 %. Loading curcumin at 0.5% had the highest membrane penetration (61.07%), least needle height reduction (5.77%). Curcumin release resulted in an initial fast release up to 60.1± 4.6 % in the first 4 hours, followed by a prolonged release up to 76.2±SD % over 24 hours. The ex vivo permeation of curcumin from the cur MNs resulted in a higher permeation rate (1.9 mg/cm².min) compared to free curcumin (0.35 mg/cm².min) over 24 hours. The developed zein Cur microneedles have the potential to overcome curcumin solubility and transdermal delivery challenges for the treatment of melanoma.