

## EFFECT OF PROPYLENE GLYCOL ON THE RELEASE PROFILE OF TEMULAWAK (*Curcuma xanthorrhiza* Roxb.) NADES CREAM

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| Article Info                                                                                                                                                                                                                       | ABSTRAK                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <p><b>Article History:</b><br/> Received 21/08/2026<br/> Revised -<br/> Accepted 02/09/2026</p> <hr/> <p><b>Keywords:</b><br/> Curcuminoids<br/> Cream<br/> Natural Deep Eutectic Solvent<br/> Propylene Glycol<br/> Temulawak</p> | <p>Radiasi ultraviolet dapat menyebabkan stres oksidatif dan mengganggu fungsi sawar kulit. Rimpang temulawak (<i>Curcuma xanthorrhiza</i> Roxb.) mengandung kurkuminoid dan xanthorrhizol yang memiliki aktivitas antioksidan dan fotoprotektif. Namun, kelarutan kurkuminoid yang rendah dalam air dapat membatasi pelepasannya dari sediaan topikal. Penelitian ini bertujuan untuk mengevaluasi pengaruh konsentrasi propilen glikol terhadap karakteristik fisik dan profil pelepasan in vitro krim yang mengandung ekstrak rimpang temulawak berbasis Natural Deep Eutectic Solvent (NADES). Ekstrak rimpang temulawak diperoleh melalui ekstraksi berbantu ultrasonik menggunakan pelarut Natural Deep Eutectic Solvent kolin klorida-gliserol yang mengandung 20% air. Ekstrak dikarakterisasi menggunakan Fourier Transform Infrared Spectroscopy, Gas Chromatography-Mass Spectrometry, dan spektrofotometri ultraviolet-visible. Krim diformulasikan dengan propilen glikol 0%, 15%, dan 20%, kemudian dievaluasi meliputi organoleptik, homogenitas, tipe emulsi, pH, viskositas, serta pelepasan in vitro menggunakan sel difusi Franz dengan membran dialisis sintesis. Semua formula menunjukkan karakteristik fisik yang baik berupa homogenitas yang memadai, tipe emulsi minyak dalam air, dan pH yang sesuai untuk aplikasi kulit. Peningkatan konsentrasi propilen glikol secara signifikan meningkatkan pelepasan kurkuminoid. Formula dengan 20% propilen glikol menghasilkan pelepasan kumulatif tertinggi sebesar <math>146,37 \pm 1,60 \mu\text{g}/\text{cm}^2</math> dan fluks puncak sebesar <math>24,39 \pm 0,27 \mu\text{g}/\text{cm}^2/\text{jam}</math>. Analisis kinetika menunjukkan model pelepasan orde pertama dengan mekanisme transport non-Fickian yang dikendalikan oleh difusi dan erosi matriks. Karakterisasi ekstrak mengonfirmasi keberadaan kurkuminoid dan xanthorrhizol sebagai senyawa bioaktif utama. Propilen glikol efektif meningkatkan pelepasan kurkuminoid dari formulasi krim temulawak berbasis Natural Deep Eutectic Solvent melalui peningkatan solubilisasi dan difusi. Formula yang mengandung 20% propilen glikol menunjukkan profil pelepasan terbaik dan berpotensi dikembangkan sebagai sistem penghantaran topikal untuk aplikasi fotoprotektif.</p> |
|                                                                                                                                                                                                                                    | <p><b>ABSTRACT</b></p> <p>Ultraviolet radiation can induce oxidative stress and impair skin barrier function. Temulawak (<i>Curcuma xanthorrhiza</i> Roxb.) rhizome contains curcuminoids and xanthorrhizol with antioxidant and photoprotective activities. However, the poor aqueous solubility of curcuminoids may limit their release from topical formulations. This study aimed to evaluate the effect of propylene glycol concentration on the physical characteristics and</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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*in vitro* release profile of a cream containing Natural Deep Eutectic Solvent (NADES)-based temulawak rhizome extract. Temulawak rhizome extract was prepared using ultrasound-assisted extraction with a choline chloride-glycerol Natural Deep Eutectic Solvent containing 20% water. The extract was characterized using Fourier Transform Infrared Spectroscopy, Gas Chromatography-Mass Spectrometry, and ultraviolet-visible spectrophotometry. Cream formulations containing 0%, 15%, and 20% propylene glycol were prepared and evaluated for organoleptic properties, homogeneity, emulsion type, pH, viscosity, and *in vitro* release using a Franz diffusion cell equipped with a synthetic dialysis membrane. All formulations exhibited acceptable physical characteristics, including good homogeneity, oil-in-water emulsion type, and skin-compatible pH values. Increasing propylene glycol concentration significantly enhanced the release of curcuminoids. The formulation containing 20% propylene glycol achieved the highest cumulative release ( $146.37 \pm 1.60 \mu\text{g}/\text{cm}^2$ ) and peak flux ( $24.39 \pm 0.27 \mu\text{g}/\text{cm}^2/\text{h}$ ). Release kinetics followed a first-order model with a non-Fickian transport mechanism governed by diffusion and matrix erosion. Characterization of the extract confirmed the presence of curcuminoids and xanthorrhizol as major bioactive constituents. Conclusion: Propylene glycol effectively improved curcuminoid release from Natural Deep Eutectic Solvent-based temulawak cream formulations by enhancing solubilization and diffusion. The formulation containing 20% propylene glycol demonstrated the most favorable release profile and shows potential as a topical delivery system for photoprotective applications.

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