

ABSTRAK

Asam kojat merupakan bahan aktif yang banyak digunakan sebagai agen pencerah kulit karena memiliki kemampuan menghambat aktivitas enzim tirosinase sehingga dapat menurunkan pembentukan melanin. Namun sifat hidrofiliknya serta memiliki nilai koefisien partisi log P sebesar -2,45 menyebabkan kemampuan penetrasi melalui stratum korneum rendah sehingga diperlukan sistem penghantaran yang mampu meningkatkan penetrasinya. *Microneedle patch* dikembangkan sebagai sistem penghantaran transdermal karena mampu membentuk mikrokanal pada kulit secara minimal invasif sehingga meningkatkan penghantaran bahan aktif ke lapisan kulit.

Penelitian ini bertujuan untuk memperoleh formulasi microneedle patch asam kojat yang memiliki pelepasan obat yang optimal sebagai pencerah pada area *periorbital*. Formulasi dibuat menggunakan asam kojat dengan konsentrasi 3% dengan variasi kombinasi polimer PVA, PVP, kitosan, HPMC, HEC, dan Na CMC. Pembuatan sediaan dilakukan menggunakan metode micromolding dengan mencetak campuran polimer dan bahan aktif pada cetakan microneedle hingga terbentuk struktur jarum mikro. Evaluasi sediaan meliputi uji organoleptik, pH, kadar air, keseragaman bobot, ketebalan, tinggi jarum, daya tahan lipat, gambaran mikroskopis dan visual bentuk jarum, kandungan asam kojat, uji pelepasan *In-vitro* menggunakan metode dialisis, serta profil pelepasan asam kojat dengan metode difusi. Hasil penelitian menunjukkan seluruh formula memenuhi karakteristik fisik dengan bobot $0,234 \pm 0,009$ g – $0,688 \pm 0,002$ g, ketebalan $1,48 \pm 0,01$ – $2,59 \pm 0,02$ mm, tinggi jarum $1217 \pm 62,36$ μ m – $2433 \pm 23,57$ μ m, kadar air $1,96 \pm 1,13\%$ – $28,63 \pm 0,18\%$, pH $6,09 \pm 0,05$ – $7,31 \pm 0,00$, daya tahan lipat $>300 \pm 0,00$, kandungan asam kojat tertinggi $48,30 \pm 2,80\%$, serta profil penetrasi asam kojat tertinggi pada menit ke-720 yaitu $39,71 \pm 1,15\%$. Analisis kinetika pelepasan menunjukkan model Korsmeyer–Peppas sebagai model yang paling sesuai dengan nilai R^2 sebesar 0,7556, yang menunjukkan mekanisme pelepasan melalui kombinasi difusi dan relaksasi matriks polimer. Berdasarkan hasil penelitian, diketahui bahwa formula yang menggunakan kombinasi polimer PVA 4% dan PVP 6% memiliki persentase pelepasan yang paling baik yaitu $36,58\% \pm 0,11\%$, pada waktu 12 jam.

Kata kunci: Asam kojat, *Microneedle patch*, *Periorbital hyperpigmentation*, pelepasan asam kojat, Korsmeyer–Peppas.

ABSTRACT

Kojic acid is an active ingredient widely used as a skin lightening agent due to its ability to inhibit the activity of the enzyme tyrosinase, thereby reducing melanin formation. However, its hydrophilic nature and log P partition coefficient of -2.45 result in low penetration through the stratum corneum, requiring a delivery system that can enhance its penetration. Microneedle patches were developed as a transdermal delivery system because they can form microchannels in the skin minimally invasively, thereby enhancing the delivery of active ingredients to the dermal layers. This study aimed to obtain a kojic acid microneedle patch formulation with optimal drug release as a lightening agent for the periorbital area. The formulation was made using 3% kojic acid with varying combinations of PVA, PVP, chitosan, HPMC, HEC, and NaCMC polymers. The preparation was made using the micromolding method by printing a mixture of polymer and active ingredients on a microneedle mold to form a microneedle structure. Evaluation of the preparation included organoleptic tests, pH, water content, weight uniformity, thickness, needle height, folding endurance, microscopic and visual images of the needle shape, kojic acid content, in-vitro release test using the dialysis method, and the release profile of kojic acid using the diffusion method. The results showed that all formulas met the physical characteristics with a weight of 0.234 ± 0.009 g – 0.688 ± 0.002 g, thickness of 1.48 ± 0.01 – 2.59 ± 0.02 mm, needle height of 1217 ± 62.36 μ m – 2433 ± 23.57 μ m, water content of $1.96 \pm 1.13\%$ – $28.63 \pm 0.18\%$, pH of 6.09 ± 0.05 – 7.31 ± 0.00 , folding endurance of $>300 \pm 0.00$, the highest kojic acid content of $48.30 \pm 2.80\%$, and the highest kojic acid penetration profile at 720 minutes, namely $39.71 \pm 1.15\%$. The release kinetics analysis showed the Korsmeyer–Peppas model as the most appropriate model with an R^2 value of 0.7556, indicating a release mechanism through a combination of diffusion and polymer matrix relaxation. Based on the results, the formula using a combination of 4% PVA and 6% PVP polymers had the best release percentage, at $36.58\% \pm 0.11\%$, at 12 hours.

Keywords: *Kojic acid, Microneedle patch, Periorbital hyperpigmentation, kojic acid release, Korsmeyer–Peppas.*