PENGEMBANGAN TEMULAWAK (*Curcuma xanthorrhiza* Roxb.) BUBUK TERENKAPSULASI DENGAN VARIASI RASIO SODIUM ALGINAT DAN KALSIUM KLORIDA ($CaCl_2$)

Oleh

Aliya Marsha Hudayanti

21/481072/SV/19730

Diajukan kepada Departemen Teknolgi Hayati dan Veteriner Sekolah Vokasi
Universitas Gadjah Mada pada tanggal 3 Juli 2025
untuk memenuhi sebagian persyaratan untuk memperoleh derajat
Sarjana Terapan Pengembangan Produk Agroindustri

ABSTRAK

Penelitian ini bertujuan mengembangkan sistem hidrogel berbasis temulawak bubuk menggunakan metode *reverse spherification* dengan bahan tambahan *carboxymethyl cellulose* (CMC), sodium alginat, dan kalsium klorida ($CaCl_2$). Sistem enkapsulasi ini dirancang untuk meningkatkan stabilitas senyawa bioaktif temulawak. Tiga formulasi diuji, yaitu SA1-CA5, SA2-CA4, dan SA3-CA3, kemudian dianalisis melalui parameter morfologi, SEM, porositas, tekstur, kapasitas *swelling*, stabilitas, serta uji *in-vitro*. Hasil SEM memperlihatkan perbedaan struktur permukaan gel pada setiap sampel. Secara kuantitatif, peningkatan konsentrasi sodium alginat secara signifikan meningkatkan diameter, ketebalan lapisan, *hardness*, *adhesiveness*, dan *cohesiveness*, sedangkan peningkatan konsentrasi $CaCl_2$ cenderung meningkatkan nilai porositas, *swelling, springiness* dan *chewiness* ($p < 0,05$). Uji korelasi menunjukkan hubungan positif yang sangat kuat antara ketebalan dan *hardness* ($r = 0,888$; $p < 0,001$), serta antara porositas dan *springiness* ($r = 0,719$; $p = 0,015$). Formulasi SA3-CA3 menunjukkan kinerja terbaik, dengan tingkat penurunan kandungan kurkumin paling rendah (~15% dalam 28 hari) dan profil pelepasan zat aktif yang terkontrol pada pH 2 dan pH 7. Jika dibandingkan dengan temulawak tanpa perlakuan enkapsulasi, sistem hidrogel ini terbukti lebih stabil dan efektif dalam mengendalikan pelepasan senyawa aktif ($p < 0,05$). Oleh karena itu, SA3-CA3 direkomendasikan sebagai formulasi paling optimal.

Kata kunci: Enkapsulasi, Hidrogel, Kurkumin, *Reverse spherification,* Temulawak

Pembimbing Utama : Dr. Eng. Annie Mufyda Rahmatika, S. T., M. T.

DEVELOPMENT OF ENCAPSULATED TURMERIC (*Curcuma xanthorrhiza* Roxb.) POWDER WITH VARIATIONS IN THE RATIO OF SODIUM ALGINATE AND CALCIUM CHLORIDE ($CaCl_2$)

by

Aliya Marsha Hudayanti

21/481072/SV/19730

Submitted to the Departement of Bioresources Technology and Veterinary
Vocational School Universitas Gadjah Mada on (*Month Date, year)*
in partial fulfillment of the requirement for the Degree of
Bachelor of Applied Science in Agroindustrial Product Development

ABSTRACT

This research aimed to develop a turmeric powder-based hydrogel system using the reverse spherification method, incorporating carboxymethyl cellulose (CMC), sodium alginate, and calcium chloride ($CaCl_2$). This encapsulation system was designed to enhance the stability of turmeric's bioactive compounds. Three formulations were investigated: SA1-CA5, SA2-CA4, and SA3-CA3. These formulations were subsequently analyzed through various parameters, including morphology, SEM, porosity, texture, swelling capacity, stability, and in-vitro release studies. SEM results revealed distinct differences in the surface structure of the gel for each sample. Quantitatively, an increase in sodium alginate concentration significantly enhanced the diameter, layer thickness, hardness, adhesiveness, and cohesiveness, whereas an increase in $CaCl_2$ concentration tended to improve the porosity, swelling, springiness, and chewiness values ($p < 0.05$). Correlation analysis demonstrated a very strong positive relationship between layer thickness and hardness ($r = 0.888$; $p < 0.001$), as well as between porosity and springiness ($r = 0.719$; $p = 0.015$). The SA3-CA3 formulation exhibited the best performance, showing the lowest reduction in curcumin content (~15% over 28 days) and a controlled active compound release profile at both pH 2 and pH 7. When compared to unencapsulated turmeric, this hydrogel system proved to be significantly more stable and effective in controlling the release of active compounds ($p < 0.05$). Therefore, SA3-CA3 is recommended as the most optimal formulation.

Keywords: Encapsulation, Hydrogel, Curcumin, Reverse spherification, Java turmeric

Supervisor : Dr. Eng. Annie Mufyda Rahmatika, S. T., M. T.