

INTISARI

SINTESIS DAN KARAKTERISASI GEL KARBONAT HIDROKSIAPATIT BERBASIS CANGKANG KERANG JAGOAN (*Cerastoderma edule*)/MINYAK CENGKIH (*Syzygium aromaticum*) DAN EFIKASINYA SEBAGAI AGEN REMINERALISASI ENAMEL GIGI

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Penelitian ini bertujuan mengembangkan gel komposit berbasis Karbonat Hidroksiapatit (CHA) dari cangkang kerang jagoan (*Cerastoderma edule*) dan minyak cengkih (*Syzygium aromaticum*) sebagai agen remineralisasi enamel dan antibakteri. CHA disintesis melalui metode presipitasi dan diformulasikan ke dalam basis gel dengan variasi konsentrasi CHA (0, 10, 20, 30, 40 wt%) serta penambahan minyak cengkih 2 wt%. Karakterisasi material meliputi *Scanning Electron Microscopy-Energy Dispersive X-ray* (SEM-EDX), *Fourier Transform Infrared* (FTIR), dan *X-Ray Diffraction* (XRD). Efikasi remineralisasi dievaluasi melalui uji kekerasan mikro Vickers, sedangkan aktivitas antibakteri diuji terhadap *Streptococcus mutans* dan *Streptococcus sanguinis* menggunakan metode difusi cakram. Hasil karakterisasi mengonfirmasi pembentukan CHA tipe B dengan ukuran kristalit nanometrik (12 ± 2 nm). Uji kekerasan menunjukkan peningkatan kekerasan pada enamel pasca-perlakuan. Uji antibakteri menunjukkan bahwa penambahan minyak cengkih secara signifikan memperluas zona hambat hingga kategori sangat kuat, dengan diameter terbesar $20,0 \pm 0,2$ mm pada Gel-CHA 20 dengan minyak cengkih terhadap *S. mutans*. Sinergi antara ion CHA dan eugenol terbukti efektif menghambat bakteri kariogenik sekaligus memulihkan kekerasan enamel, menjadikan formulasi ini kandidat potensial untuk manajemen karies gigi.

Kata kunci: gel, karbonat hidroksiapatit, minyak cengkih, remineralisasi enamel, antibakteri

ABSTRACT

SYNTHESIS AND CHARACTERIZATION OF A COMMON COCKLE SHELL (*Cerastoderma edule*)-DERIVED CARBONATED HYDROXYAPATITE/CLOVE OIL (*Syzygium aromaticum*) GEL AND ITS EFFICACY AS A DENTAL ENAMEL REMINERALIZING AGENT

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This study aims to develop a composite gel based on Carbonated Hydroxyapatite (CHA) from common cockle shells (*Cerastoderma edule*) and clove oil (*Syzygium aromaticum*) as an enamel remineralizing and antibacterial agent. CHA was synthesized via precipitation and formulated into a gel base with varying CHA concentrations (0, 10, 20, 30, 40 wt%) and 2 wt% clove oil. Material characterization included Scanning Electron Microscopy-Energy Dispersive X-ray (SEM-EDX), Fourier Transform Infrared (FTIR), and X-Ray Diffraction (XRD). Remineralization efficacy was evaluated via Vickers microhardness test, while antibacterial activity was tested against *Streptococcus mutans* and *Streptococcus sanguinis* using the disk diffusion method. Characterization results confirmed the formation of B-type CHA with nanometric crystallite size (12 ± 2 nm). Hardness tests showed an increase in post-treatment enamel. Antibacterial tests demonstrated that the addition of clove oil significantly expanded the inhibition zone to the very strong category, with the largest diameter of 20.0 ± 0.2 mm in Gel-CHA 20 with clove oil against *S. mutans*. The synergy between CHA ions and eugenol proved effective in inhibiting cariogenic bacteria while restoring enamel hardness, making this formulation a potential candidate for dental caries management.

Keywords: gel, carbonated hydroxyapatite, clove oil, enamel remineralization, antibacterial