



KAJIAN PELEPASAN METRONIDAZOL DARI MINERAL TRIOKSIDA AGREGAT TERHIDRASI LARUTAN KITOSAN

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INTISARI

Dalam penelitian ini telah dikaji pelepasan metronidazol dari Mineral Trioksida Agregat (MTA) terhidrasi larutan kitosan. Tujuan penelitian ini yaitu mempelajari sintesis dan karakterisasi MTA, mempelajari kinetika pelepasan metronidazol dari MTA terhidrasi kitosan (MTA/MET-Ch), dan menentukan aktivitas antibakteri larutan hasil perendaman MTA/MET-Ch.

Material mineral trioksida agregat disintesis dengan metode sol-gel menggunakan prekursor TEOS, CaCO_3 , $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, Bi_2O_3 , dan amonia sebagai katalis basa. Material MTA yang terbentuk dihidrasi menggunakan larutan metronidazol dan kitosan. Pelet hasil hidrasi direndam dalam media saliva buatan selama variasi waktu 1-12 jam (interval 1 jam) dan 24 jam. Material dikarakterisasi dengan ATR-IR, XRD, SEM-EDX, dan SAA. Antibiotik dan ion kalsium yang lepas dari material MTA dianalisis dengan spektrofotometer UV-Vis dan AAS. Uji aktivitas antibakteri terhadap bakteri Gram negatif *Pseudomonas aeruginosa* (*P. aeruginosa*) dan bakteri Gram positif *Enterococcus faecalis* (*E. faecalis*) dilakukan terhadap larutan hasil rendaman material MTA/MET dan MTA/MET-Ch dalam waktu 1 dan 12 jam.

Hasil penelitian menunjukkan bahwa hidrasi MTA dengan larutan kitosan menurunkan persen massa hilang 3,22% setelah 12 jam perendaman dan peningkatan pelepasan sebesar 53,97% setelah 1 jam perendaman dengan pelepasan relatif konstan pada 17,65 ppm setelah 12 jam. Pelepasan antibiotik metronidazol pada perendaman 1 dan 12 jam pada MTA/MET adalah 5,53% dan 55,26% (model kinetika orde 0), sedangkan pada MTA/MET-Ch adalah 16,80% dan 59,83% (model kinetika Hixson-Crowell). Penggunaan larutan kitosan dan metronidazol untuk hidrasi MTA meningkatkan aktivitas antibakteri terhadap *Pseudomonas aeruginosa* dan *Enterococcus faecalis* dengan zona hambat $6,89 \pm 0,27$ mm dan $8,11 \pm 0,18$ mm terhadap saliva buatan setelah 12 jam direndam material MTA.

Kata kunci: antibakteri, antibiotik metronidazol, kitosan, pelepasan antibiotik, MTA



STUDY ON THE RELEASE OF METRONIDAZOLE FROM CHITOSAN SOLUTION HYDRATED MINERAL TRIOXIDE AGGREGATE CHITOSAN

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ABSTRACT

In this study, the release of metronidazole from Mineral Trioxide Aggregate (MTA) hydrated chitosan solution was investigated. The objectives of this study were to examine the synthesis and characterization of MTA, to study the kinetics of metronidazole release from MTA hydrated chitosan (MTA/MET-Ch), and to determine the antibacterial activity of the MTA/MET-Ch soaking solution.

Mineral trioxide aggregate material was synthesized by the sol-gel method using TEOS, CaCO_3 , $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, Bi_2O_3 precursors, and ammonia as base catalyst. The formed MTA was hydrated using metronidazole and chitosan solutions. The hydration pellets were soaked in artificial saliva media for 1-12 hours (1-hour intervals) and 24 hours. The material was characterized by ATR-IR, XRD, SEM-EDX, and SAA. Antibiotic and calcium ions released from MTA material were analyzed by UV-Vis spectrophotometer and AAS. Against Gram-negative bacteria *Pseudomonas aeruginosa* and Gram-positive bacteria *Enterococcus faecalis* was carried out on the solution of MTA/MET and MTA/MET-Ch material soaking for 1 and 12 hours.

The results showed that hydration of MTA with chitosan solution decreased the percent mass loss by 3.22% after 12 hours of immersion and increased the release by 53.97% after 1 hour with a relatively constant release at 17.65 ppm after 12 hours. The release of metronidazole antibiotics at 1 and 12 hours of immersion in MTA/MET was 5.53% and 55.26% (0th order kinetic model), while in MTA/MET-Ch it was 16.80% and 59.83% (Hixson-Crowell kinetic model). The use of chitosan and metronidazole solutions for MTA hydration increased the antibacterial activity against *Pseudomonas aeruginosa* and *Enterococcus faecalis* with inhibition zones of 6.89 ± 0.27 mm and 8.11 ± 0.18 mm against artificial saliva after 12 hours of immersion in MTA material.

Keywords: antibacterial, antibiotic release, chitosan, metronidazole antibiotic, MTA