

## **SIFAT FISIKOKIMIA DAN UJI ANTIBAKTERI *WHITE MINERAL TRIOXIDE AGGREGATE* TERHIDRASI LARUTAN KITOSAN DAN METRONIDAZOL**

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### **INTISARI**

Sifat fisikokimia dan uji antibakteri *white mineral trioxide aggregate* (WMTA) yang terhidrasi oleh larutan kitosan dan metronidazol telah dikaji dalam penelitian ini. Tujuan penelitian ini adalah sintesis WMTA menggunakan prekursor kalsium karbonat ( $\text{CaCO}_3$ ), mempelajari pengaruh penggunaan larutan kitosan dan metronidazol sebagai penghidrasi WMTA terhadap sifat mekanik, pelepasan metronidazol dan ion Ca, serta aktivitas antibakteri terhadap *Pseudomonas aeruginosa* (*P. aeruginosa*) dan *Streptococcus mutans* (*S. mutans*) dari WMTA/Kit/Met.

WMTA disintesis menggunakan metode sol-gel dan dikalsinasi pada suhu 1000 °C selama 3 jam. WMTA dihidrasi dengan larutan kitosan 4% dalam asam asetat 1% dan larutan metronidazol, dengan perbandingan berat:volume 2:1. Material WMTA dikarakterisasi menggunakan ATR-IR, XRD, SEM, dan TGA. Sifat mekanik dipelajari dengan melakukan uji kuat tekan, diametral, dan radiopasitas, sedangkan pengujian sifat antibakteri terhadap bakteri *P. aeruginosa* dan *S. mutans* dilakukan terhadap larutan hasil perendaman sampel 12 jam dengan metode cakram.

Hasil menunjukkan bahwa WMTA berhasil disintesis dan hidrasi menggunakan larutan kitosan meningkatkan pelepasan metronidazol hingga mencapai 63,61% pada waktu 12 jam dan pelepasan ion Ca mencapai 44,40 ppm pada waktu sehari. Peningkatan konsentrasi metronidazol pada WMTA/Kit/Met tidak meningkatkan hasil signifikan terhadap sifat mekanik dan antibakteri terhadap bakteri *P. aeruginosa* dan *S. mutans*. Kekuatan tekan dan radiopasitas tertinggi terdapat pada sampel WMTA/Kit/Met2, yaitu masing-masing sebesar 18,27 MPa dan 12,02 mm Al, sedangkan untuk diametral sebesar 6,45 MPa pada sampel WMTA/Kit. Komposit WMTA/Kit/Met5 menunjukkan sifat antibakteri terhadap *P. aeruginosa* dengan zona hambat  $6,44 \pm 0,15$  mm, sedangkan komposit WMTA/Kit/Met4 memiliki zona hambat  $6,44 \pm 0,41$  mm terhadap *S. mutans*. Berdasarkan semua pengujian yang telah dilakukan, dapat disimpulkan bahwa WMTA/Kit/Met2 memiliki potensi untuk diaplikasikan sebagai material pengisi pada saluran akar gigi.

Kata Kunci: antibakteri, kitosan, mekanik, metronidazol, WMTA.

## PHYSICOCHEMICAL PROPERTIES AND ANTIBACTERIAL TEST OF WHITE MINERAL TRIOXIDE AGGREGATE HYDRATED WITH CHITOSAN SOLUTION AND ANTIBIOTICS

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### ABSTRACT

The physicochemical properties and antibacterial testing of white mineral trioxide aggregate (WMTA) hydrated by chitosan and metronidazole solution have been studied in this research. The aim of this research is to synthesize WMTA using a calcium carbonate ( $\text{CaCO}_3$ ) precursor and to investigate the effects of using chitosan and metronidazole solutions as WMTA hydrants on its mechanical properties, the release of metronidazole and calcium ions, as well as the antibacterial activity of WMTA/Chi/Met against *Pseudomonas aeruginosa* (*P. aeruginosa*) and *Streptococcus mutans* (*S. mutans*).

WMTA was synthesized using the sol-gel method and calcined at 1000 °C for 3 hours. WMTA was hydrated with a 4% chitosan solution in 1% acetic acid and metronidazole solution, with a weight:volume ratio of 2:1. WMTA material was characterized using ATR-IR, XRD, SEM, and TGA. The mechanical properties were studied by conducting compressive strength, diametral and radiopacity tests. Meanwhile, the antibacterial properties were tested against *P. aeruginosa* and *S. mutans* using the solution obtained from 12 hours sample immersion, employing the disc diffusion method.

The results showed that WMTA was successfully synthesized and hydration using chitosan solution increased the release of metronidazole up to 63.61% in 12 hours and the release of Ca ions reached 44.40 ppm in one day. Increasing the metronidazole concentration in WMTA/Chi/Met did not significantly increase the mechanical and antibacterial properties against *P. aeruginosa* and *S. mutans* bacteria. The highest compressive strength and radiopacity were found in the WMTA/Chi/Met2 sample, namely 18.27 MPa and 12.02 mm Al respectively, while for the diametral it was 6.45 MPa in the WMTA/Chi sample. The WMTA/Chi/Met5 composite showed antibacterial properties against *P. aeruginosa* with an inhibition zone of  $6.44 \pm 0.15$  mm, while the WMTA/Chi/Met4 composite has an inhibition zone of  $6.44 \pm 0.41$  mm against *S. mutans*. Based on all the tests conducted, it can be concluded that WMTA/Kit/Met2 has the potential to be applied as a filling material for root canals.

Keywords: antibacterial, chitosan, mechanics, metronidazol, WMTA.