

## PREPARASI NANOPARTIKEL KITOSAN-MAGNETIT-Zn(II) DAN UJI AKTIVITASNYA TERHADAP BAKTERI *ESCHERICHIA COLI* DAN *STAPHYLOCOCCUS EPIDERMIDIS*

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### INTISARI

Penelitian tentang nanopartikel kitosan-magnetit-Zn(II) dan uji aktivitasnya terhadap bakteri *Escherichia coli* dan *Staphylococcus epidermidis* telah dilakukan. Penelitian dilakukan dengan sintesis nanopartikel kitosan-magnetit melalui metode ko-presipitasi *ex-situ* menggunakan pengikat silang natrium tripolifosfat dan asam sitrat. Nanopartikel kitosan-magnetit dikarakterisasi dengan menggunakan FTIR, XRD, SEM-EDX, dan TEM. Kajian adsorpsi ion logam Zn(II) dilakukan melalui penentuan kondisi optimum untuk parameter pH larutan, massa adsorben, waktu kontak, dan konsentrasi awal ion logam. Nanopartikel kitosan-magnetit dan hasil adsorpsi kemudian diuji aktivitasnya terhadap bakteri Gram negatif berupa *Escherichia coli* dan Gram positif berupa *Staphylococcus epidermidis* melalui metode difusi sumuran.

Hasil penelitian menunjukkan bahwa nanopartikel kitosan-magnetit telah berhasil disintesis dengan wujud serbuk padatan kasar dan berwarna hitam, serta keberhasilan sintesis telah terbukti melalui spektra FTIR. Citra SEM menunjukkan bahwa nanopartikel kitosan-magnetit berpori dengan unsur C, N, O, dan Fe yang ditunjukkan dari spektra EDX. Citra TEM menunjukkan rata-rata ukuran nanopartikel kitosan-magnetit adalah sebesar 43,73 nm. Nanopartikel kitosan-magnetit memiliki  $pH_{pzc}$  pada pH 3. Kondisi optimum adsorpsi ion logam Zn(II) oleh nanopartikel kitosan-magnetit didapatkan pada pH 6, massa adsorben 100 mg, waktu kontak selama 90 menit dan konsentrasi awal ion logam 18 ppm. Studi kinetika adsorpsi mengikuti orde dua-semu dengan konstanta laju adsorpsi  $0,1108 \text{ g mg}^{-1} \text{ menit}^{-1}$ . Studi isoterm adsorpsi mengikuti model isoterm Dubinin-Radushkevich dengan energi bebas sebesar  $0,791 \text{ kJ mol}^{-1}$ . Nanopartikel kitosan-magnetit setelah adsorpsi ion logam Zn(II) memiliki kemampuan antibakteri pada kategori lemah dengan zona hambat 1,17 mm terhadap bakteri Gram negatif *Escherichia coli* dan 0,83 mm terhadap bakteri Gram positif *Staphylococcus epidermidis*.

Kata kunci: adsorpsi, antibakteri, kitosan-magnetit, Zn(II)

## PREPARATION OF CHITOSAN-MAGNETITE-Zn(II) NANOPARTICLES AND ITS ACTIVITY TESTS ON A *ESCHERICHIA COLI* AND *STAPHYLOCOCCUS EPIDERMIDIS* BACTERIA

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### ABSTRACT

Research on chitosan-magnetite-Zn(II) nanoparticles and their activity test against *Escherichia coli* and *Staphylococcus epidermidis* bacteria has been carried out. The research was conducted by synthesizing chitosan-magnetite nanoparticles through the ex-situ co-precipitation method using sodium tripolyphosphate and citric acid crosslinkers. The chitosan-magnetite nanoparticles were characterized using FTIR, XRD, SEM-EDX, and TEM. The Zn(II) metal ion adsorption studies were carried out by determining the optimum conditions for the parameters of solution pH, adsorbent mass, contact time, and initial concentrations of metal ion. The chitosan-magnetite nanoparticles and the adsorption results were then tested for their activity against Gram-negative bacteria in the form of *Escherichia coli* and Gram-positive bacteria in the form of *Staphylococcus epidermidis* using the good diffusion method.

The results showed that chitosan-magnetite nanoparticles had been successfully synthesized in the form of black, coarse solid powder, and the success of the synthesis had been proven through FTIR spectra. The SEM image showed that the chitosan-magnetite nanoparticles were porous with elements C, N, O, and Fe as showed from the EDX spectra. TEM images showed that the average size of chitosan-magnetite nanoparticles was 43.73 nm. Chitosan-magnetite nanoparticles had a  $pH_{pzc}$  at pH 3. Optimum conditions for Zn(II) metal ion adsorption by chitosan-magnetite nanoparticles were obtained at pH 6, the mass of the adsorbent was 100 mg, the contact time was 90 minutes and the initial concentration of metal ions was 18 ppm. The adsorption kinetics study followed a pseudo-second order with an adsorption rate constant of  $0.1108 \text{ g mg}^{-1} \text{ min}^{-1}$ . The adsorption isotherm study followed the Dubinin-Radushkevich isotherm model with a free energy of  $0.791 \text{ kJ mol}^{-1}$ . Chitosan-magnetite nanoparticles after adsorption of Zn(II) metal ion had the antibacterial ability in the weak category with an inhibition zone of 1.17 mm against Gram-negative *Escherichia coli* and 0.83 mm against Gram-positive *Staphylococcus epidermidis*.

Keywords: adsorption, antibacterial, chitosan-magnetite, Zn(II)