

**NANOKOMPOSIT KITOSAN-MAGNETIT SEBAGAI ADSORBEN ION
LOGAM Ag(I) DAN UJI AKTIVITASNYA TERHADAP BAKTERI
Escherichia coli DAN *Staphylococcus epidermidis***

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INTISARI

Telah dilakukan sintesis adsorben nanokomposit kitosan-magnetit untuk penghilangan ion logam Ag(I) dalam air dan diuji aktivitas antibakterinya terhadap bakteri *Escherichia coli* dan *Staphylococcus epidermidis*. Adsorben disintesis dengan metode ko-presipitasi *ex-situ* Fe₃O₄ pada kitosan yang menggunakan pengikat silang natrium tripolifosfat dan asam sitrat. Nanokomposit kitosan-magnetit dikarakterisasi dengan menggunakan instrumen FTIR, XRD, SEM-EDX, dan TEM. Kajian adsorpsi ion logam Ag(I) dilakukan melalui optimasi pH, massa adsorben, waktu kontak, dan konsentrasi awal ion logam. Nanokomposit kitosan-magnetit yang telah menyerap ion logam Ag(I), kemudian diuji aktivitasnya untuk penghambatan pertumbuhan bakteri terhadap bakteri Gram negatif *Escherichia coli* dan Gram positif *Staphylococcus epidermidis* melalui metode difusi sumuran.

Hasil karakterisasi menunjukkan bahwa nanokomposit kitosan-magnetit telah berhasil disintesis dengan wujud serbuk dan berwarna hitam. Ukuran nanokomposit yang didapatkan adalah 43,73 nm. Adsorben nanokomposit kitosan-magnetit menghasilkan adsorpsi dengan kapasitas adsorpsi sebesar 7,960 mg g⁻¹. Kondisi optimum adsorpsi ion logam Ag(I) oleh adsorben nanokomposit kitosan-magnetit adalah pada pH 5, massa adsorben 80 mg, waktu kontak selama 90 menit dan konsentrasi awal ion logam 14 mg L⁻¹. Studi kinetika adsorpsi ion logam Ag(I) oleh nanokomposit kitosan-magnetit mengikuti orde dua semu (Ho-McKay) dengan konstanta laju 0,0773 g mg⁻¹ menit⁻¹. Studi isoterm adsorpsi ion logam Ag(I) oleh nanokomposit kitosan-magnetit mengikuti model isoterm Langmuir dengan nilai energi 30,37 kJ mol⁻¹. Nanokomposit kitosan-magnetit setelah proses adsorpsi ion logam Ag(I) memiliki sifat penghambatan pertumbuhan bakteri yang termasuk kategori lemah. Nanokomposit kitosan-magnetit yang telah mengadsorpsi ion logam Ag(I) memiliki kemampuan menghambat bakteri Gram negatif *Escherichia coli* yang lebih kuat, yaitu memiliki diameter zona hambat 1,06 mm daripada penghambatan bakteri Gram positif *Staphylococcus epidermidis* dengan diameter zona hambat 0,8 mm.

Kata kunci : adsorpsi, Ag(I), antibakteri, kitosan, magnetit

CHITOSAN-MAGNETITE NANOCOMPOSITE AS AN Ag(I) METAL IONS ADSORBENT AND ITS ACTIVITY TESTS ON *Escherichia coli* AND *Staphylococcus epidermidis* BACTERIA

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ABSTRACT

Synthesis of chitosan-magnetite nanocomposite adsorbents for removing Ag(I) metal ions in water and testing for its antibacterial activity against *Escherichia coli* and *Staphylococcus epidermidis* has been carried out. The adsorbent was synthesized by the ex-situ co-precipitation method of Fe₃O₄ on chitosan using sodium tripolyphosphate and citric acid cross-linkers. The adsorbent was characterized using FTIR, XRD, SEM, and TEM instruments. Ag(I) adsorption studies were carried out by optimizing pH, adsorbent mass, contact time, and initial concentration of metal ions. The chitosan-magnetite nanocomposite that had absorbed Ag(I) was tested for its activity in inhibiting bacterial growth against Gram-negative *Escherichia coli* and Gram-positive *Staphylococcus epidermidis* using the well-diffusion method.

The characterization results showed that chitosan-magnetite nanocomposite had been successfully synthesized in powder form and had a black color. The size of the nanocomposite obtained was 43.73 nm. The maximum adsorption with an adsorption capacity of 7.960 mg g⁻¹ was obtained. The optimum conditions for the adsorption of Ag(I) metal ions by chitosan-magnetite nanocomposite adsorbent were at pH 5, the mass of the adsorbent was 80 mg, the contact time was 90 minutes, and the initial metal ion concentration was 14 mg L⁻¹. Adsorption kinetics study of Ag(I) by chitosan-magnetite nanocomposite followed a pseudo second order (Ho-McKay) with a rate constant of 0.0773 g mg⁻¹ min⁻¹. The adsorption isotherm study of Ag(I) by chitosan-magnetite nanocomposite follows the Langmuir isotherm model with an energy value of 30.37 kJ mol⁻¹. After the adsorption process of Ag(I) metal ions, chitosan-magnetite nanocomposite inhibited bacterial growth, including in the weak category. Chitosan-magnetite nanocomposite with adsorbed Ag(I) metal has a stronger ability to inhibit Gram-negative bacteria *Escherichia coli*, which an inhibition zone diameter of 1.06 mm, than the inhibition of Gram-positive bacteria *Staphylococcus epidermidis* with an inhibition zone diameter of 0.8 mm.

Keyword: adsorption, Ag(I), antibacterial, chitosan, magnetite