SINTESIS FILM NANOKOMPOSIT KITOSAN/PVA/CuONPs TERKAPING SISTEIN DAN APLIKASINYA SEBAGAI FILM ANTIBAKTERI

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INTISARI

Nanopartikel tembaga oksida (CuONPs) telah disintesis menggunakan prekursor tembaga(II) klorida, agen pereduksi asam askorbat, dan agen pengkaping L-sistein. CuONPs hasil sintesis digunakan sebagai komponen dalam pembuatan film nanokomposit kitosan/PVA/CuONPs. Film nanokomposit kitosan/PVA/CuONPs yang telah dibuat diaplikasikan sebagai film pengemas makanan yang bersifat antibakteri. CuONPs disintesis menggunakan metode reduksi kimia dengan bantuan iradiasi *microwave* pada daya 800 watt. Beberapa parameter sintesis berupa pH, konsentrasi agen pereduksi, konsentrasi agen pengkaping, dan waktu reaksi dioptimasi selama sintesis. CuONPs dikarakterisasi dengan spektrofotometer UV-Vis, TEM, PSA, FTIR, dan XRD. Film nanokomposit dibuat dari kitosan, PVA, dan CuONPs menggunakan metode *casting.* Film nanokomposit kitosan/PVA/CuONPs dikarakterisasi menggunakan FTIR, XRD, dan SEM-EDX. Kekuatan mekanik film nanokomposit kitosan/PVA/CuONPs diuji melalui uji kuat tarik dengan *tensile strength* dan uji *swelling*. Aktivitas antibakteri CuONPs dan film nanokomposit kitosan/PVA/CuONPs dievaluasi terhadap bakteri Gram-negatif *Escherichia coli* dan Gram-positif *Staphylococcus aureus.* Efektivitas film nanokomposit sebagai bahan pengemas makanan diuji pada buah stroberi.

Hasil penelitian menunjukkan bahwa puncak absorbansi koloid CuONPs berkisar pada panjang gelombang 290-298 nm. Sintesis CuONPs terbentuk pada kondisi optimum menggunakan prekursor tembaga(II) klorida 1 mM, asam askorbat 10 mM dan L-sistein 2 mM pada pH 9 dengan iradiasi *microwave* selama 7 menit. CuONPs yang diperoleh memiliki bentuk bulat dengan ukuran partikel sebesar 12,72 nm. Film nanokomposit kitosan/PVA/CuONPs memperoleh nilai kuat tarik dan elongasi masing-masing sebesar 33,44 Mpa dan 67,84%. Film nanokomposit kitosan/PVA/CuONPs berpotensi memberikan aktivitas antibakteri yang ditandai dengan terbentuknya zona hambat. Zona hambat pada bakteri *Escherichia coli* adalah 3,4 mm, sedangkan pada bakteri *Staphylococcus aureus* sebesar 3,8 mm. Uji pada buah stroberi menunjukkan bahwa film nanokomposit kitosan/PVA/CuONPs dapat menghambat laju pembusukan pada buah. Film nanokomposit menunjukkan laju degradasi sebesar 3,05% pada uji penimbunan di dalam tanah selama 12 hari.

Kata kunci: antibakteri, CuONPs, film nanokomposit, kitosan, PVA, sistein

SYNTHESIS OF CHITOSAN/PVA/CYSTEINE-CAPPED CuONPs NANOCOMPOSITE FILM AND ITS APPLICATION AS AN ANTIBACTERIAL FILM

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ABSTRACT

Copper oxide nanoparticles (CuONPs) have been synthesized using copper (II) chloride as a precursor, ascorbic acid as a reducing agent, and L-cysteine as a capping agent. The synthesized CuONPs were used as a component of chitosan/PVA/CuONPs nanocomposite film. The produced nanocomposite film applied as an antibacterial food packaging film. CuONPs were synthesized through chemical reduction under microwave irradiation at 800 watts power. Different parameters such as pH, reducing agent concentration, capping agent concentration, and reaction time were optimized during the synthesis. CuONPs were characterized by ultraviolet-visible (UV-Vis) spectroscopy, transmission electron microscopy (TEM), particle size analyzer (PSA), fourier-transformed infrared (FTIR) spectroscopy, and X-Ray diffraction (XRD). The nanocomposite film was made from chitosan, PVA, and CuONPs by using a casting methode. Chitosan/PVA/CuONPs nanocomposite film was characterized by FTIR, XRD, and scanning electron microscope with energy dispersive X-Ray (SEM-EDX). The mechanical strength of chitosan/PVA/CuONPs was tested by tensile strength and swelling test. The antibacterial effects of chitosan/PVA/CuONPs were tested against *Escherichia coli* (Gram-negative bacteria) and *Staphylococcus aureus* (Gram-positive bacteria). The nanocomposite film was applied to strowberry to evaluate its efectivity as an antibacterial food packaging.

The resulted CuONPs colloids exhibited maximum absorption peaks at wavelengths of about 290-298 nm. The synthesize of CuONPs was optimum at 1 mM $CuCl_2$, while the concentrations of ascorbic acid, L-cysteine, pH, and reaction time were 10 mM, 2 mM, 9, and 7 minutes respectively. The obtained CuONPs have spherical shape with the average size 12.72 nm. The tensile strength and elongation of chitosan/PVA/CuONPs nanocomposite film were 33.44 Mpa and 67.84% respectively. The nanocomposite film has potential to employ as antibacterial agents in food packaging. It showed antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* with inhibition zone 3.4 and 3.8 mm respectively. The application of nancomposite film as a food packaging was examined by using strawberry. The results showed that the film can reduce the decay rates of strawberry. Moreover, chitosan/PVA/CuONPs nanocomposite film showed more than 3.05% of degradation after 12-day soil burial test.

Keywords: antibacterial, chitosan, CuONPs, cysteine, nanocomposite film, PVA