



SINTESIS NANOPARTIKEL EMAS TERTUDUNG HISTIDIN UNTUK DETEKSI Hg²⁺

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INTISARI

Dalam penelitian ini telah dikaji sintesis nanopartikel emas (AuNPs) tertudung histidin untuk deteksi kolorimetri Hg²⁺. Sintesis AuNPs tertudung histidin dilakukan dengan 2 cara yaitu sintesis AuNPs menggunakan agen pereduksi natrium sitrat dan agen penudung histidin (AuNPs(st-his)) dan sintesis AuNPs menggunakan agen pereduksi dan agen penudung histidin (AuNPs(his)). AuNPs disintesis dengan menggunakan metode Turkevich.

Hasil penelitian menunjukkan koloid AuNPs memiliki warna merah dengan puncak *surface plasmon resonance* (SPR) pada panjang gelombang (λ) 525 nm. Karakterisasi PSA menunjukkan AuNPs(st) yang memiliki ukuran 1-100 nm sebanyak 82,9% dengan rata-rata ukuran 38,6 nm dan nilai potensial zeta -34,8 mV. Karakterisasi PSA menunjukkan penambahan histidin menyebabkan peningkatan jumlah AuNPs(st-his) berukuran 1-100 nm menjadi 97,5% dengan rata-rata ukuran 32,1 nm. Penambahan histidin pada AuNPs(st) menyebabkan perubahan nilai potensial zeta AuNPs dari -34,8 mV menjadi -64,4 mV. Histidin dapat digunakan sebagai agen pereduksi H₂AuCl₄ pada pH histidin 11. Karakterisasi PSA menunjukkan AuNPs(his) memiliki ukuran 1-100 nm sebanyak 100% dengan rata-rata ukuran 17,9 nm dan nilai potensial zeta -22,4 mV.

Interaksi AuNPs(st-his) dengan Hg²⁺ dibuktikan perubahan warna koloid AuNPs dari merah menjadi biru yang disebabkan turunnya puncak SPR pada λ 525 nm dan terbentuk puncak baru di sekitar λ 650 nm. Interaksi AuNPs(st-his) dan Hg²⁺ terjadi pada pH larutan histidin 12 dan selektif terhadap keberadaan 14 jenis kation selain Hg²⁺ yaitu: K⁺, Co²⁺, Na⁺, Ag⁺, Cu²⁺, Mg²⁺, Zn²⁺, Mn²⁺, Al³⁺, Fe³⁺, Cr³⁺, Ni²⁺, Pb²⁺, dan Cd²⁺. Uji kecermatan pengukuran 7 sampel memperlihatkan nilai *relative standard deviation* (RSD) 1,02%. Batas deteksi (LoD) dan batas kuantifikasi (LoQ) dari AuNPs(st-his) dalam mendeteksi Hg²⁺ masing-masing adalah 1,77 μ M = 0,35 ppm dan 5,89 μ M = 1,18 ppm, nilai perolehan kembali 115% dan 117%. AuNPs(his) interaksinya dengan Hg²⁺ ditandai dengan adanya perubahan warna AuNPs dari merah menjadi ungu, akibat dari bergesernya puncak SPR λ 525 ke 540 nm. Uji pengaruh penambahan kation terhadap AuNPs(his) dilakukan terhadap 14 jenis kation selain Hg²⁺ yaitu: K⁺, Co²⁺, Na⁺, Ag⁺, Cu²⁺, Mg²⁺, Zn²⁺, Mn²⁺, Al³⁺, Fe³⁺, Cr³⁺, Ni²⁺, Pb²⁺, dan Cd²⁺ tidak memberikan gangguan berarti. Pengukuran terhadap 7 sampel berbeda menghasilkan spektra SPR yang berdekatan dengan nilai RSD 0,47%. LoD dan LoQ AuNPs(his) dalam mendeteksi Hg²⁺ masing-masing adalah 55 μ M = 0,31 ppm dan 5,17 μ M = 1,03 ppm. Uji ketepatan menunjukkan nilai perolehan kembali 111% dan 114%.

Kata kunci: nanopartikel emas, natrium sitrat, histidin, Hg²⁺



SYNTHESIS OF HISTIDINE-CAPPED GOLD NANOPARTICLES FOR DETECTION OF Hg²⁺

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ABSTRACT

In this study, the synthesis of histidine-coated gold nanoparticles (AuNPs) for colorimetric detection of Hg²⁺ has been done. Synthesis of AuNPs using histidine as capping agent has been done in 2 ways: synthesis of AuNPs using sodium citrate as reducing agent and histidine as capping agent (AuNPs(st-his)) and synthesis of AuNPs using histidine as reducing and capping agents (AuNPs(his)). AuNPs(st) were synthesized using the Turkevich method.

Results showed that AuNPs(st) colloids had a red color with a surface plasmon resonance (SPR) peak at a wavelength of 525 nm. The PSA characterization results showed 82.9% AuNPs(st) had a size of 1-100 nm, an average size of 38.6 nm, and a zeta potential value of -34.8 mV. The increase in SPR peak intensity indicates that the addition of histidine to AuNPs(st) results in an increase in the efficiency of the formation of AuNPs(st-his). The results of PSA characterization showed that the addition of histidine caused 97.5% AuNPs(st-his) to have a size of 1-100 nm with an average size of 32.1 nm. The addition of histidine to AuNPs(st) caused a change in zeta potential from -34.8 to -64.4 mV. Synthesis of AuNPs(his) was carried out at the pH of histidine solution 11. The results of PSA characterization showed 100% AuNPs(his) have a size of 1-100 nm, the average size of 17.9 nm, and the zeta potential of -22.4 mV.

The interaction between AuNPs(st-his) with Hg²⁺ was known from the colloidal color change from red to blue due to a decrease in the SPR peak at a wavelength of 525 nm and appearance of new peak at around 650 nm. The interaction of AuNPs(st-his) and Hg²⁺ that occurred at the pH of histidine solution 12 was very selective towards interferences from 14 other types of cations: K⁺, Co²⁺, Na⁺, Ag⁺, Cu²⁺, Mg²⁺, Zn²⁺, Mn²⁺, Al³⁺, Fe³⁺, Cr³⁺, Ni²⁺, Pb²⁺, and Cd²⁺. The precision test on the measurement of 7 different samples showed a relative standard deviation (RSD) value of 1.02%. The detection limit (LoD) and the quantification limit (LoQ) of AuNPs(st-his) in detecting Hg²⁺ were 1.77 μM = 0.35 ppm and 5.89 μM = 1.18 ppm, respectively with recovery values were 115% and 117%. In the case AuNPs(his), their interaction with Hg²⁺ could be observed from the color change from colloidal red to purple. This color change was followed by a shift in the SPR peak from 525 to 540 nm. The presence of 14 other types of cations i.e. K⁺, Co²⁺, Na⁺, Ag⁺, Cu²⁺, Mg²⁺, Zn²⁺, Mn²⁺, Al³⁺, Fe³⁺, Cr³⁺, Ni²⁺, Pb²⁺, and Cd²⁺ gave no interference. The precision test on the measurement of 7 different samples produces reproducible SPR spectra with RSD value of 0.47%. LOD and LoQ of AuNPs(his) in detecting Hg²⁺ were 1.55 μM = 0.31 ppm and 5.17 μM = 1.03 ppm, respectively. The accuracy test shows the recovery values were 111% and 114%.

Keywords: gold nanoparticles, sodium citrate, histidine, Hg²⁺