SINTESIS KARBON DOT TERDOPING NITROGEN (N-CDs) DARI AIR LEMON (*CITRUS LIMON*), LARUTAN ASAM SITRAT, DAN AMONIUM HIDROKSIDA SEBAGAI SENSOR FLUORESENS UNTUK DETEKSI Fe^{3+} DI LINGKUNGAN PERAIRAN

Muhammad Faiz Akbar Harahap
21/480803/PA/20908

INTISARI

Sintesis karbon dot terdoping nitrogen dari air lemon (L-N-CDs) dan larutan asam sitrat (CA-N-CDs) telah dilakukan dengan metode *microwave-assisted synthesis* yang dapat digunakan sebagai sensor fluoresens untuk mendeteksi ion Fe^{3+} di lingkungan perairan. L-N-CDs disintesis dengan prekursor air lemon dan CA-N-CDs disintesis dengan prekursor larutan asam sitrat sebagai sumber C, kemudian masing-masing CDs ditambahkan amonium hidroksida sebagai sumber dopan N. Sintesis dilakukan dengan menggunakan *microwave* dengan memvariasikan berbagai optimasi kondisi reaksi, seperti waktu dan daya iradiasi serta volume dopan N. Waktu iradiasi divariasi dari 6-18 menit, daya iradiasi divariasi dari 100-800 W, dan volume dopan N divariasi dari 50-300 µL. L-N-CDs dan CA-N-CDs yang telah disintesis pada kondisi optimum dievaluasi stabilitas intensitas fluoresensnya dengan berbagai kondisi lingkungan seperti pH, paparan sinar UV, dan waktu simpan di suhu ±4 °C dan suhu ruang. Selain itu juga dilakukan uji selektivitas dan sensitivitas L-N-CDs dan CA-N-CDs terhadap ion Fe^{3+} serta dievaluasi pengaruh interferensi ion logam lainnya. L-N-CDs dan CA-N-CDs dengan kondisi terbaik diaplikasikan untuk mendeteksi ion Fe^{3+} di perairan.

Hasil penelitian menunjukkan bahwa kondisi optimum sintesis L-N-CDs dan CA-N-CDs masing-masing terjadi pada waktu 8 dan 14 menit dengan daya 600 W dan volume dopan N sebanyak 200 µL. Spektra FTIR-ATR menunjukkan bahwa atom N telah terpasivasi pada permukaan CDs yang ditunjukkan dengan adanya vibrasi ikatan karakteristik seperti N-H dan C=N. Analisis dengan TEM menunjukkan bahwa L-N-CDs dan CA-N-CDs berbentuk kuasi sferis dengan diameter rata-rata 2,25 nm. L-N-CDs dan CA-N-CDs memiliki stabilitas yang masing-masing baik pada rentang pH 4-11 dan 5-11, paparan sinar UV hingga 180 dan 0 menit, serta waktu penyimpanan pada suhu ±4 °C selama 22 dan 43 hari. L-N-CDs dan CA-N-CDs dapat mendeteksi ion Fe^{3+} secara selektif dan sensitif dengan *Limit of Detection* (LoD) sebesar 0,1888 dan 0,1921 ppm dan *Limit of Quantification* (LoQ) sebesar 0,6293 dan 0,6404 ppm. L-N-CDs dan CA-N-CDs telah berhasil diaplikasikan sebagai sensor fluoresens untuk mendeteksi ion Fe^{3+} pada sampel air lingkungan dengan tingkat presisi yang tinggi, ditunjukkan dengan nilai *Relative Standard Deviation* (RSD) <5%.

Kata kunci: CA-N-CDs, Fe^{3+}, fluoresens, karbon dot, L-N-CDs

SYNTHESIS OF NITROGEN-DOPED CARBON DOTS (N-CDs) FROM LEMON JUICE (Citrus limon), CITRIC ACID SOLUTION, AND AMMONIUM HYDROXIDE` AS A FLUORESCENCE SENSOR FOR THE DETECTION Fe^{3+} IONS IN AQUATIC ENVIRONTMENTS

Muhammad Faiz Akbar Harahap
21/480803/PA/20908

ABSTRACT

The synthesis of nitrogen-doped carbon dots from lemon juice (L-N-CDs) and citric acid solution (CA-N-CDs) has been carried out using a microwave-assisted synthesis method that can be used as fluorence sensors to detect Fe^{3+} ions in aquatic environments. L-N-CDs were synthesized with lemon juice precursors and CA-N-CDs were synthesized with citric acid solution precursors as a C source, then ammonium hydroxide was added to each CDs as the N dopant source. The synthesis was carried out using a microwave by varying various optimized reaction conditions, such as irradiation time and power as well as dopant N volume. The irradiation time was varied from 6-18 minutes, the irradiation power was varied from 100-800 W, and the dopant N volume was varied from 50-300 µL. L-N-CDs and CA-N-CDs synthesized under optimal conditions were evaluated for their fluorescence intensity stability under various environmental conditions such as pH, UV exposure, and storage time at ±4 ℃ and room temperature. In addition, the selectivity and sensitivity tests were conducted on L-N-CDs and CA-N-CDs against Fe^{3+} ions and the effect of interference from other metal ions was evaluated. The L-N-CDs and CA-N-CDs with the best condition were applied to detect Fe^{3+} ions in water.

The result showed that the optimum conditions for the synthesis of L-N-CDs and CA-N-CDs occured at 8 and 14 minutes respectively with a power of 600 W and a dopant N volume of 200 µL. The FTIR-ATR spectra showed that N atoms had been passivated on the surface of CDs which was indicated by the presence of characteristic bond vibrations such as N-H and C=N. Analysis with TEM showed that L-N-CDs and CA-N-CDs are quasi-spherical in shape with an average diameter of 2.25 nm. L-N-CDs and CA-N-CDs has good stability at pH ranges of 4-11 and 5-11, UV expore of up to 180 and 0 minutes, and storage time at ±4 ℃ for 22 and 43 days, respectively. L-N-CDs and CA-N-CDs can selectively and sensitively detect Fe^{3+} ions with a Limit of Detection (LoD) of 0.1888 and 0.1921 ppm and a Limit of Quantification (LoQ) of 0.6293 and 0.6404 ppm. L-N-CDs and CA-N-CDs have been succesfully applied as fluorescence sensors to detect Fe^{3+} ions in environmental water samples with a high level of precision, as indicated by a Relative Standard Deviation (RSD) value of <5%.

Keywords: CA-N-CDs, carbon dots, Fe^{3+}, fluorescence, L-N-CDs