

SINTESIS DAN APLIKASI NANOKOMPOSIT Cu-ZnO/NANOZEOLIT SEBAGAI AKSELERATOR FOTOSINTESIS TANAMAN BAYAM BRAZIL (*Alternanthera sissoo*)

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INTISARI

Fotosintesis merupakan proses fundamental yang menentukan pertumbuhan dan produktivitas tanaman. Upaya peningkatan efisiensi fotosintesis dapat dilakukan melalui pemanfaatan material fotokatalitik berbasis semikonduktor. Penelitian ini bertujuan untuk mensintesis dan mengkarakterisasi nanokomposit Cu-ZnO/nanozeolit serta mengevaluasi pengaruh aplikasinya terhadap aktivitas fotosintesis tanaman bayam Brazil (*Alternanthera sissoo*). Material ZnO terdoping Cu dan nanozeolit disintesis menggunakan metode kopresipitasi, sedangkan pembentukan nanokomposit Cu-ZnO/nanozeolit dilakukan melalui metode impregnasi. Material yang dihasilkan dikarakterisasi menggunakan FTIR, SR UV-Vis, XRD, analisis luas permukaan spesifik (SAA), AAS, serta TEM-SAED. Aplikasi nanokomposit dilakukan melalui penyemprotan daun selama periode pengamatan lima minggu, dan pengaruhnya dievaluasi berdasarkan parameter fisiologis fotosintesis dan pertumbuhan tanaman.

Fotokatalis Cu-ZnO dengan variasi konsentrasi Cu (0,01-0,75% b/v) berhasil disintesis dan menunjukkan respons terhadap cahaya tampak, yang ditandai dengan penurunan energi celah pita dari 2,95 eV menjadi 2,86 eV serta penurunan ukuran partikel hingga 29,37 nm. Aplikasi nanokomposit Cu-ZnO/Nanozeolit pada tanaman bayam Brazil menunjukkan peningkatan signifikan laju fotosintesis sebesar 1,48-3,76 $\mu\text{mol m}^{-2}/\text{s}$ serta pertumbuhan daun sebesar 2,0-3,5 cm. Respons terbaik diperoleh pada aplikasi Cu-ZnO/Nanozeolit dengan konsentrasi 0,1%. Selain itu, sintesis nanokomposit melalui metode impregnasi mampu meningkatkan luas permukaan spesifik material hingga 72,4 m^2/g . Hasil penelitian ini mengindikasikan bahwa nanokomposit Cu-ZnO/Nanozeolit berpotensi dikembangkan sebagai akselerator fotosintesis berbasis nanomaterial untuk mendukung aplikasi pertanian berkelanjutan.

Kata kunci: akselerator, bayam brazil, doping tembaga, fotosintesis, nanozeolit, ZnO

***SYNTHESIS AND APPLICATION OF CU-ZNO/NANOZEOLITE
NANOCOMPOSITES AS PHOTOSYNTHESIS ACCELERATORS FOR
BRAZIL SPINACH (*alternanthera sissoo*) PLANTS***

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ABSTRACT

Photosynthesis is a fundamental process that determines plant growth and productivity. Improving photosynthetic efficiency can be achieved through the utilization of semiconductor-based photocatalytic materials. This study aimed to synthesize and characterize Cu-doped ZnO/nanozeolite nanocomposites and to evaluate their effects on the photosynthetic activity of Brazilian spinach (*Alternanthera sissoo*). Cu-doped ZnO and nanozeolite were synthesized using the coprecipitation method, while the Cu-ZnO/Nanozeolite nanocomposites were prepared via an impregnation technique. The resulting materials were characterized using FTIR, SR-UV, X-ray diffraction (XRD), specific surface area analysis (SAA), atomic absorption spectroscopy (AAS), and transmission electron microscopy with selected area electron diffraction (TEM-SAED). The nanocomposites were applied to plant leaves through foliar spraying over a five-week observation period, and their effects were evaluated based on physiological parameters of photosynthesis and plant growth.

Cu-ZnO photocatalysts with varying Cu concentrations (0.01-0.75% w/v) were successfully synthesized and exhibited visible-light responsiveness, as indicated by a reduction in band gap energy from 2.95 eV to 2.86 eV and a decrease in particle size to 29.37 nm. Application of the Cu-ZnO/Nanozeolite nanocomposites significantly enhanced the photosynthetic rate of Brazilian spinach by 1.48-3.76 $\mu\text{mol m}^{-2}/\text{s}$ and increased leaf growth by 2.0-3.5 cm. The optimal response was observed at a Cu-ZnO/Nanozeolite concentration of 0.1%. Furthermore, nanocomposite synthesis via the impregnation method increased the specific surface area of the material to 72.4 m^2/g . These results indicate that Cu-ZnO/Nanozeolite nanocomposites have strong potential as nanomaterial-based photosynthesis accelerators to support sustainable agricultural applications.

Keywords: accelerator, Brazilian Spinach, copper doping nanozeolite, photosynthesis, ZnO