ABSTRAK

OPTIMASI DSPE BERBASIS *GRAPHENE OXIDE* DARI TANDAN KOSONG KELAPA SAWIT MENGGUNAKAN *RESPONSE SURFACE METHODOLOGY* UNTUK PENENTUAN RESIDU ANTIBIOTIK *CIPROFLOXACIN*

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Kontaminasi air oleh residu antibiotik seperti *ciprofloxacin* (CIP) menjadi masalah serius karena dapat menyebabkan resistensi bakteri dan merusak ekosistem, untuk itu diperlukan metode penentuan residu CIP yang efisien. Tujuan penelitian ini adalah untuk mensintesis *graphene oxide* (GO) dari tandan kosong kelapa sawit (TKKS) sebagai adsorben padat pada teknik *Dispersive Solid Phase Extraction* (DSPE), mengkarakterisasi sifat fisik dan kimia adsorben GO, serta mengoptimasi teknik DSPE berbasis GO menggunakan *Response Surface Methodology* (RSM) untuk penentuan residu CIP. Hasil penelitian menunjukkan bahwa GO berhasil disintesis berdasarkan analisis *Fourier Transform Infrared* (FTIR), *X-ray Diffraction* (XRD), *Scanning Electron Microscopy-Energy Dispersive X-Ray* (SEM-EDX), dan spektrofotometri Ultraviolet-Visibel (UV-Vis). Selanjutnya, optimasi menggunakan RSM menghasilkan kondisi optimum pada pH 3, massa adsorben 22,5 mg, dan waktu kontak selama 35 menit, dengan persentase adsorpsi CIP sebesar 90,592%. Hasil penelitian juga menunjukkan bahwa validasi optimasi menghasilkan nilai yang sangat mendekati prediksi model, yaitu 90,129% dengan nilai persentase *error* relatif kecil sebesar 0,005%, yang membuktikan bahwa model optimasi yang dihasilkan dapat diterapkan secara akurat. Hasil penelitian ini menunjukkan bahwa GO dari TKKS dapat berfungsi efektif sebagai adsorben pada teknik DSPE, sekaligus membuka peluang pemanfaatan limbah TKKS sebagai bahan karbon alternatif dalam aplikasi lingkungan.

Kata kunci: antibiotik *ciprofloxacin*, desain *box bhenken, dispersive solid phase extraction, graphene oxide*, *response surface method*

ABSTRACT

OPTIMIZATION DSPE BASED GRAPHENE OXIDE FROM EMPTY FRUIT BUNCHES USING RESPONSE SURFACE METHODOLOGY FOR DETERMINING CIPROFLOXACIN ANTIBIOTICS RESIDUE

By

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Water contamination by antibiotic residues such as ciprofloxacin (CIP) is a serious problem because it can cause bacterial resistance and damage the ecosystem, therefore an efficient method of determining CIP residues is needed. The objectives of this study were to synthesize graphene oxide (GO) from empty fruit bunches (EFB) as a solid adsorbent in the Dispersive Solid Phase Extraction (DSPE) technique, characterize the physical and chemical properties of GO adsorbents, and optimize the GO-based DSPE technique using Response Surface Methodology (RSM) for the determination of CIP residues. The results showed that GO was successfully synthesized based on Fourier Transform Infrared (FTIR), X-ray Diffraction (XRD), Scanning Electron Microscopy-Energy Dispersive X-Ray (SEM-EDX), and Ultraviolet-Visible (UV-Vis) spectrophotometry analyses. Furthermore, optimization using RSM produced optimum conditions at pH 3, adsorbent mass of 22.5 mg, and contact time for 35 minutes, with a CIP adsorption percentage of 90.592%. The results also showed that the optimization validation produced a value very close to the model prediction, which was 90.129% with a relatively small percentage error value of 0.005%, which proved that the optimization model produced could be applied accurately. The results of this study indicate that GO from EFB can function effectively as an adsorbent in the DSPE technique, while opening up opportunities for the utilization of EFB waste as an alternative carbon material in environmental applications.

Keywords: ciprofloxacin antibiotic, box-behnken design, dispersive solid phase extraction, graphene oxide, response surface methodology.