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**ANALISIS POTENSI *ECO-ENZYME* DARI LIMBAH KULIT
BUAH DALAM PENYISIHAN BOD DAN COD PADA AIR
KANDUNGAN ORGANIK RENDAH SECARA BATCH**



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TESIS

OLEH :

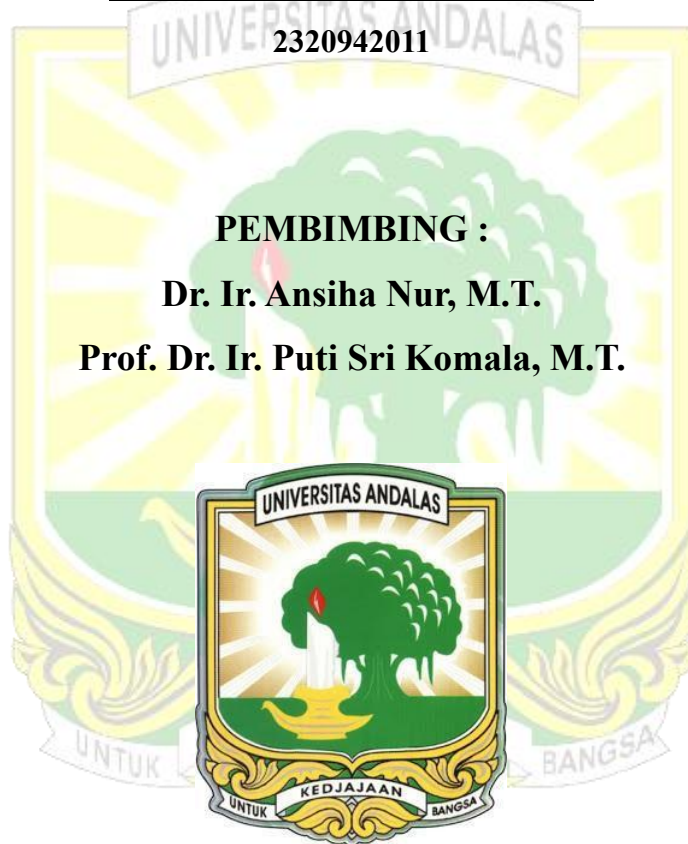
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ABSTRAK

Pencemaran air akibat meningkatnya kandungan bahan organik ditandai dengan tingginya nilai Biochemical Oxygen Demand (BOD) dan Chemical Oxygen Demand (COD) sehingga diperlukan teknologi pengolahan yang ramah lingkungan. Penelitian ini bertujuan menganalisis potensi eco-enzyme dari limbah kulit buah dalam penyisihan BOD dan COD pada air yang memiliki kandungan organik rendah secara batch, menentukan konsentrasi optimum, membandingkan hasil dengan baku mutu Peraturan Pemerintah Nomor 22 Tahun 2021, serta menganalisis model kinetika penyisihan. Media uji berupa air artifisial disusun menggunakan glukosa sebagai sumber karbon organik dengan konsentrasi awal BOD 8,51 mg/L dan COD 35,2 mg/L. Eco-enzyme dibuat dari limbah kulit pisang, jeruk, semangka, pepaya, nenas, dan campuran limbah kulit buah melalui fermentasi anaerob selama tiga bulan. Pengujian dilakukan menggunakan reaktor batch 10 mL dengan variasi konsentrasi 5%, 10%, dan 15% (v/v) selama 12 hari. Hasil penelitian menunjukkan bahwa eco-enzyme kulit pisang dan kulit jeruk memiliki aktivitas enzim tertinggi. Variasi konsentrasi memberikan pengaruh signifikan terhadap penyisihan BOD ($p = 0,004$) dan COD ($p = 0,018$), dengan konsentrasi optimum 5% (v/v) yang menghasilkan efisiensi penyisihan COD sebesar 36,08% dan BOD sebesar 81,92%. Analisis kinetika menunjukkan bahwa penyisihan COD umumnya mengikuti model orde pertama dengan R^2 tertinggi 0,9658, sedangkan penyisihan BOD mengikuti model orde pertama pada dosis 5% dan orde dua pada dosis 10% dan 15% dengan R^2 tertinggi 0,9325. Perlakuan terbaik menghasilkan BOD 1,54 mg/L dan COD 22,5 mg/L yang memenuhi baku mutu PP Nomor 22 Tahun 2021. Penelitian ini menunjukkan bahwa eco-enzyme berpotensi sebagai alternatif pengolahan air artifisial berkandungan organik rendah yang ramah lingkungan.

Kata kunci: air artifisial berkandungan organik rendah, BOD, COD, eco-enzyme, limbah kulit buah, kinetika.



ABSTRACT

Water pollution caused by increasing organic matter is indicated by elevated Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) levels, highlighting the need for environmentally friendly and sustainable treatment technologies. This study aimed to analyze the potential of eco-enzyme produced from fruit peel waste for the removal of BOD and COD from low-organic-content artificial water under batch conditions, determine the optimum eco-enzyme concentration, compare the treatment performance with the Indonesian Government Regulation No. 22 of 2021 water quality standards, and evaluate the removal kinetics. The artificial water used as the test medium was prepared using glucose as the carbon source with initial concentrations of 8.51 mg/L BOD and 35.2 mg/L COD. Eco-enzymes were produced from banana, orange, watermelon, papaya, pineapple, and mixed fruit peels using a fruit peel, molasses, and water ratio of 3:1:10 through anaerobic fermentation for three months. Batch experiments were conducted in 10 mL reactors with eco-enzyme concentrations of 5%, 10%, and 15% (v/v) for 12 days. The evaluated parameters included BOD, COD, pH, temperature, dissolved oxygen (DO), enzyme bioactivity, one-way ANOVA, and zero-, first-, and second-order kinetic models. The results showed that eco-enzymes derived from banana and orange peels exhibited the highest enzymatic activities. Eco-enzyme concentration significantly affected BOD ($p = 0.004$) and COD ($p = 0.018$) removal, with the optimum performance achieved at 5% (v/v), resulting in the highest COD and BOD removal efficiencies of 36.08% and 81.92%, respectively. COD removal generally followed a first-order kinetic model with the highest coefficient of determination ($R^2 = 0.9658$), whereas BOD removal followed a first-order model at the 5% dosage and a second-order model at the 10% and 15% dosages, with the highest R^2 of 0.9325. The optimum treatment reduced BOD and COD concentrations to 1.54 mg/L and 22.5 mg/L, respectively, meeting the water quality standards specified in Government Regulation No. 22 of 2021. These findings demonstrate that fruit peel-derived eco-enzymes have considerable potential as an environmentally friendly and sustainable technology for treating low-organic-content artificial water.

Keywords: batch system, BOD, COD, eco-enzyme, fruit peel waste, kinetics, low-organic-content artificial water.