Growth Performance and Biomass of Haematococcus lacustris (Girod-Chantrans) Rostafinski Cultivated
in Liquid Digestate of POME at Various Concentrations
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GROWTH PERFORMANCE AND BIOMASS OF *Haematococcus lacustris* (Girod-Chantrans) Rostafinski CULTIVATED IN LIQUID DIGESTATE OF POME AT VARIOUS CONCENTRATIONS

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ABSTRACT

Palm Oil Mill Effluent (POME) is a high-strength agro-industrial wastewater that poses environmental challenges due to its high organic and nutrient content. Its treated derivative, Liquid Digestate of POME (LDP), has potential as an alternative nutrient source for microalgal cultivation. This study evaluated the effects of various LDP concentrations on the growth performance, biomass production, nutrient utilization, and morphological responses of *Haematococcus lacustris*. Cultures were cultivated for 20 days in AF6 based and distilled water-based media supplemented with 10%, 20%, and 30% LDP, with cultures cultivated in AF6 medium alone and distilled water alone served as positive and negative controls, respectively. Cell density was determined using a hemocytometer, biomass production was measured using the gravimetric method, nitrogen and phosphorus concentrations were quantified using colorimetric test kits, and morphology was observed using light microscopy. Increasing LDP concentration improved cell density and biomass production, with the 30% treatment showing the best performance among digestate-based cultures. AF6 based cultures generally supported higher growth than distilled water-based treatments, however, *H. lacustris* remained viable in all LDP treatments, indicating that digestate nutrients could sustain cultivation even without synthetic supplementation. Nitrogen and phosphorus concentrations decreased throughout cultivation, with nitrogen removal ranging from 71.5–86.1% and phosphorus removal ranging from 65.7–90.6%, confirming active nutrient assimilation. Nitrogen consumption showed a stronger relationship with growth performance than phosphorus utilization. Morphological analysis revealed a predominance of palmella cells and the presence of immature aplanospores and aplanospores in higher LDP treatments, indicating adaptive responses to cultivation-induced stress. These findings demonstrate the potential of LDP as a low-cost alternative nutrient source for sustainable *H. lacustris* cultivation while supporting wastewater valorisation.

KEY WORDS: *Haematococcus lacustris*, microalgae cultivation, palm oil mill effluent digestate, sustainable medium

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PERFORMA PERTUMBUHAN DAN PRODUKSI BIOMASSA *Haematococcus lacustris* (Girod-Chantrans) Rostafinski YANG DIKULTIVASI DALAM *LIQUID DIGESTATE OF POME* PADA BERBAGAI KONSENTRASI

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ABSTRAK

Palm Oil Mill Effluent (POME) merupakan limbah agroindustri berkekuatan tinggi yang berpotensi menimbulkan permasalahan lingkungan akibat kandungan bahan organik dan nutrien yang tinggi. Produk turunannya yang telah melalui proses pengolahan, yaitu *Liquid Digestate of POME* (LDP), berpotensi dimanfaatkan sebagai sumber nutrien alternatif untuk kultivasi mikroalga. Penelitian ini bertujuan untuk mengevaluasi pengaruh berbagai konsentrasi LDP terhadap pertumbuhan, produksi biomassa, utilisasi nutrien, dan respons morfologi *Haematococcus lacustris*. Kultur dipelihara selama 20 hari pada media berbasis AF6 dan air distilasi yang disuplementasi dengan LDP 10%, 20%, dan 30%, dengan media AF6 dan air distilasi tanpa LDP sebagai kontrol. Kepadatan sel ditentukan menggunakan hemositometer, biomassa diukur secara gravimetri, konsentrasi nitrogen dan fosfor dianalisis menggunakan kit uji kolorimetri, serta morfologi diamati menggunakan mikroskop cahaya. Peningkatan konsentrasi LDP meningkatkan kepadatan sel dan produksi biomassa, dengan perlakuan 30% menunjukkan performa terbaik di antara kultur berbasis digestat. Kultur berbasis AF6 umumnya menghasilkan pertumbuhan yang lebih tinggi dibandingkan kultur berbasis air distilasi, namun *H. lacustris* tetap mampu tumbuh pada seluruh perlakuan LDP. Konsentrasi nitrogen dan fosfor menurun selama kultivasi, dengan efisiensi penggunaan nitrogen sebesar 71,5–86,1% dan fosfor sebesar 65,7–90,6%, menunjukkan terjadinya asimilasi nutrien secara aktif. Analisis morfologi menunjukkan dominasi sel palmela serta munculnya aplanospora imatur dan aplanospora pada perlakuan LDP yang lebih tinggi. Hasil penelitian ini menunjukkan bahwa LDP berpotensi dimanfaatkan sebagai sumber nutrien berbiaya rendah untuk kultivasi *H. lacustris* yang berkelanjutan sekaligus mendukung pemanfaatan limbah dan pemulihan nutrien.

KATA KUNCI: *Haematococcus lacustris,* kultivasi mikroalga, palm oil mill effluent digestate, media terbarukan