KEMAMPUAN MIKROALGA LOKAL DANAU SINGKARAK (DIATOM : *Synedra ulna*) DALAM MENDEGRADASI PLASTIK POLIPROPILENA (PP) MELALUI PEMBENTUKAN BIOFILM FOTOTROFIK

TESIS

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ABSTRAK

Pencemaran plastik polipropilena (PP) di ekosistem perairan menjadi permasalahan lingkungan karena sifatnya yang sulit terdegradasi secara alami. Potensi mikroalga, khususnya diatom air tawar sebagai agen awal biodegradasi plastik masih sangat terbatas. *Synedra ulna*, diatom lokal yang dominan pada biofilm plastik di Danau Singkarak, memiliki potensi sebagai kandidat agen biodegradasi, namun belum pernah dievaluasi secara eksperimental dan terukur. Penelitian ini dilakukan pada Januari sampai Juli 2026 yang bertujuan menganalisis perubahan morfologi permukaan, komposisi unsur, gugus fungsi, serta pengaruh kepadatan awal *Synedra ulna* terhadap degradasi plastik PP melalui pembentukan biofilm fototrofik. Penelitian menggunakan Rancangan Acak Lengkap (RAL) dengan empat perlakuan, yaitu kontrol tanpa *S. ulna* serta kepadatan awal 1×10^4, 1×10^5, dan 1×10^6 sel/mL selama 30 hari inkubasi. Analisis dilakukan menggunakan *Scanning Electron Microscope* (SEM), *Energy Dispersive X-ray* (EDX), *Fourier Transform Infrared* (FTIR), *Carbonyl Index* (CI), *Hydroxyl Index* (HI), serta pengukuran *weight loss* yang dianalisis menggunakan uji *One-way* ANOVA dan *Duncan's Multiple Range Test* (DMRT). Hasil penelitian menunjukkan bahwa inkubasi dengan *S. ulna* menyebabkan peningkatan kekasaran permukaan, retakan mikro, perubahan komposisi unsur, serta perubahan gugus fungsi yang mengindikasikan terjadinya biodeteriorasi pada plastik PP. Persentase *weight loss* meningkat seiring meningkatnya kepadatan awal *S. ulna*, yaitu 0,42%, 1,29%, dan 2,60%, serta berbeda nyata antarperlakuan ($p < 0,05$). Kepadatan awal 1×10^6 sel/mL memberikan efektivitas tertinggi dalam mendukung proses biodegradasi plastik PP melalui pembentukan biofilm fototrofik. Seluruh hasil tersebut mengindikasikan telah terjadinya tahap awal biodegradasi (biodeteriorasi) pada plastik polipropilena.

Kata kunci: biodegradasi, biofilm fototrofik, polipropilena (PP), *Synedra ulna*, *weight loss*.

ABSTRACT

Polypropylene (PP) plastic pollution in aquatic ecosystems has become a major environmental concern due to its resistance to natural degradation. The potential of microalgae, particularly freshwater diatoms, as early-stage agents of plastic biodegradation remains largely unexplored. *Synedra ulna*, a local diatom that predominates in plastic-associated biofilms in Lake Singkarak, has the potential to serve as a biodegradation agent. This study was conducted from January to July 2026 and aimed to analyze changes in surface morphology, elemental composition, and functional groups, and to assess the effect of the initial density of *Synedra ulna* on PP biodegradation via phototrophic biofilm formation. A Completely Randomized Design (CRD) was employed with four treatments: a control without *S. ulna* and initial cell densities of 1×10^4, 1×10^5, and 1×10^6 cells/mL, incubated for 30 days. Analyses were conducted using Scanning Electron Microscopy (SEM), Energy Dispersive X-ray (EDX), Fourier Transform Infrared Spectroscopy (FTIR), Carbonyl Index (CI), Hydroxyl Index (HI), and weight loss measurements, followed by One-way ANOVA and Duncan's Multiple Range Test (DMRT). The results showed that incubation with *S. ulna* increased surface roughness, induced microcracks, altered elemental composition, and modified functional groups, indicating biodeterioration of PP plastic. Weight loss increased with higher initial cell densities of *S. ulna*, reaching 0.42%, 1.29%, and 2.60%, with significant differences among treatments ($p < 0.05$). The highest initial density (1×10^6 cells/mL) demonstrated the greatest potential to enhance polypropylene biodegradation through phototrophic biofilm formation. Collectively, these findings suggest that polypropylene plastic has undergone the initial stage of biodegradation (biodeterioration).

Keywords: biodegradation, phototrophic biofilm, polypropylene (PP), *Synedra ulna*, weight loss.