PENGARUH PENAMBAHAN NANO KALSIUM FOSFAT DAN MAGNESIUM OKSIDA TERHADAP KARAKTERISTIK BIOPLASTIK DARI RUMPUT LAUT *(Eucheuma spinosum)*

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ABSTRAK

Penggunaan plastik sekali pakai secara terus-menerus menjadi penyebab penumpukan sampah plastik yang sulit dihancurkan oleh mikroorganisme, sehingga perlu solusi yang inovatif yaitu menggunakan plastik *biodegradable* yang ditambahkan dengan $Ca_3(PO_4)_2$-NPs dan MgO-NPs. Penelitian ini bertujuan untuk mengetahui pengaruh penambahan $Ca_3(PO_4)_2$-NPs dan MgO-NPs ditinjau dari kuat tarik, daya serap air dan biodegrabilitas bioplastik yang dihasilkan dari tepung rumput laut (*Eucheuma spinosum*). $Ca_3(PO_4)_2$-NPs dan MgO-NPs disintesis, dikarakterisasi menggunakan XRD. Selanjutnya, bioplastik dibuat dengan variasi komposisi penambahan $Ca_3(PO_4)_2$-NPs dan MgO-NPs yang diuji sifat kuat tarik, daya serap air, dan biodegradasinya, serta dianalisis lebih lanjut menggunakan SEM-EDS. Hasil menunjukkan bahwa kombinasi penambahan $Ca_3(PO_4)_2$-NPs dan MgO-NPs menunjukkan interaksi signifikan dimana penambahan $Ca_3(PO_4)_2$-NPs dapat meningkatkan kuat tarik, menurunkan daya serap air serta mempercepat proses degradasi sedangkan penambahan MgO-NPs pada uji daya serap air dan uji biodegradasi, tetapi sedikit meningkatkan kuat tarik. Bioplastik dengan variasi A3 menunjukkan hasil terbaik, memenuhi standar SNI untuk uji kuat tarik dengan nilai rata-rata sebesar 18,22 MPa, uji daya serap air dengan nilai < 18,96 %, mampu terdegradasi sempurna dalam waktu kurang dari 60 hari dan permukaan tidak homogen. Temuan ini menunjukkan potensi besar pengembangan bioplastik berbasis rumput laut dengan penambahan nanopartikel sebagai alternatif kemasan ramah lingkungan yang mendukung upaya pengurangan limbah plastik secara berkelanjutan.

Kata-kata kunci: bioplastik, Eucheuma spinosum, nanopartikel, kuat tarik, daya serap air, biodegradasi.

THE EFFECT OF ADDITION OF NANO CALCIUM PHOSPHATE AND MAGNESIUM OXIDE ON THE CHARACTERISTICS OF BIOPLASTICS FROM SEAWEED (Eucheuma spinosum).

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ABSTRACT

The continuous use of single-use plastics has contributed significantly to the accumulation of plastic waste, which is difficult to degrade by microorganisms. Therefore, an innovative solution is needed, such as the use of biodegradable plastics reinforced with $Ca_3(PO_4)_2$-NPs and MgO-NPs. This study aims to investigate the effect of adding $Ca_3(PO_4)_2$-NPs and MgO-NPs on the tensile strength, water absorption, and biodegradability of bioplastics derived from seaweed flour (Eucheuma spinosum). The $Ca_3(PO_4)_2$-NPs and MgO-NPs were synthesized and characterized using X-ray diffraction (XRD). Subsequently, bioplastics were fabricated with various compositions of $Ca_3(PO_4)_2$-NPs and MgO-NPs, and tested for their tensile strength, water absorption, and biodegradation properties, followed by further analysis using scanning electron microscopy and energy-dispersive X-ray spectroscopy (SEM-EDS). The results showed that the combination of $Ca_3(PO_4)_2$-NPs and MgO-NPs had a significant interaction effect, where the addition of $Ca_3(PO_4)_2$-NPs increased tensile strength, reduced water absorption, and accelerated the degradation process. Meanwhile, the addition of MgO-NPs influenced water absorption and biodegradability, while slightly improving tensile strength. The bioplastic formulation labeled A3 yielded the best performance, meeting the Indonesian National Standard (SNI) for tensile strength with an average value of 18.22 MPa, water absorption below 18.96%, complete degradation within less than 60 days, and a non-homogeneous surface morphology.These findings demonstrate the strong potential of seaweed-based bioplastics enhanced with nanoparticles as an environmentally friendly packaging alternative, supporting efforts to reduce plastic waste sustainably.

Keywords: bioplastic, Eucheuma spinosum, nanoparticles, tensile strength, water absorption, biodegradation.