Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu in fulfilment of the requirements for the degree of Master of Science

BIODEGRADATION OF MICROPLASTICS BY BIOFLOCCULANT-PRODUCING BACTERIA ISOLATED FROM BIOFLOC BASED SYSTEM

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AUGUST 2024

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Aquaculture activities are susceptible to introduction of microplastics due to use of water sources. A bioflocculant-producing bacterial strain isolated from a biofloc system demonstrated significant flocculating activity, aiding in removal of microplastic particles from aquatic environments, thereby offering an environmentally friendly approach to enhance the biodegradability of microplastics under laboratory conditions. Eight bioflocculant-producing bacteria candidates have been successfully isolated. The isolated bacteria were first screened using Yeast Peptone Sugar (YPG) agar and enrichment liquid media revealed a highly mucoid and ropy colonies, to identify the bioflocculant-producing strains. The flocculating activity of the bioflocculant-producing bacteria were further analysed using Jar Test. The four highest flocculation activity with 95% was showed by *Microbacterium* sp. BPB5 followed by *Bacillus* sp. BPB1 (93%), *Bacillus* sp. BPB8 (91%), *Microbacterium* sp. BPB6 (91%), while the lowest flocculation activity showed by *Microbacterium* sp. BPB2 with 87%. The bioflocculant-producing bacterial strains BPB1, BPB5, BPB6, and BPB8 were selected for further biodegradation assays with polyethylene, polypropylene, and polystyrene microplastics, and their capability to degrade microplastics was preliminarily screened using zone of clearance method. The microplastics were then incubated separately in shake flask experiment with selected

bacteria in mineral salt media (MSM) at 30^{o}C for 50 days. The biodegradation of microplastics were analyzed using weight loss analysis gravimetrically, Fourier Transform Infrared spectroscopy (FTIR) and Scanning Electron Microscopy (SEM). The results showed that the highest PE microplastics weight loss was 8.9% detected by BPB5, while the lowest was 5.2% detected by BPB8. The maximum degradation of PP microplastics was 9.2% attained by BPB5, while the lowest was 4.6% detected by BPB1. On the treatment with PS microplastics, the maximum degradation was 8.8% by BPB5, while the lowest was 5.2% by BPB8. Fourier-transform infrared (FTIR) spectroscopy analysis further substantiated the biodegradation of microplastics by revealing the presence of new functional groups. Whilst the results were confirmed using SEM analysis which showed morphological changes on the surface of microplastic. Overall, these strains could be useful for removal of microplastics pollution. Conclusively, the significance findings of this study discovered a function of bioflocculant-producing bacteria as a potential strategy to degrade microplastics in aquaculture perspective.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk Ijazah Sarjana Sains

BIODEGRADASI MIKROPLASTIK OLEH BAKTERIA PENGHASIL BIOFLOKULAN YANG DIASINGKAN DARIPADA SISTEM BIOFLOK

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Aktiviti akuakultur terdedah kepada pengenalan mikroplastik akibat penggunaan sumber air. Satu strain bakteria penghasil bioflokulan yang diasingkan daripada sistem bioflok telah menunjukkan aktiviti flokulasi yang ketara, membantu dalam penyingkiran zarah mikroplastik daripada persekitaran akuatik, dengan itu menawarkan pendekatan mesra alam untuk meningkatkan kebolehbiodegradasian mikroplastik dalam keadaan makmal. Lapan calon bakteria penghasil bioflokulan telah berjaya diasingkan. Bakteria yang diasingkan mula-mula disaring menggunakan agar Yeast Peptone Sugar (YPG) dan media cecair pengayaan yang mendedahkan koloni yang sangat mukoid dan likat, untuk mengenal pasti strain penghasil bioflokulan. Aktiviti flokulasi bakteria penghasil bioflokulan dianalisis selanjutnya menggunakan Ujian Jar. Aktiviti flokulasi tertinggi sebanyak 95% ditunjukkan oleh *Microbacterium* sp. BPB5 diikuti oleh *Bacillus* sp. BPB1 (93%), *Bacillus* sp. BPB8 (91%), *Microbacterium* sp. BPB6 (91%), manakala aktiviti flokulasi terendah ditunjukkan oleh *Microbacterium* sp. BPB2 dengan 87%. Strain bakteria penghasil bioflokulan BPB1, BPB5, BPB6, dan BPB8 telah dipilih untuk ujian biodegradasi lanjut dengan mikroplastik polietilena, polipropilena, dan polistirena, dan keupayaan mereka untuk mengurai mikroplastik disaring secara awal menggunakan kaedah zon pembersihan. Mikroplastik tersebut kemudian diinkubasi secara berasingan dalam eksperimen flask

gegar dengan bakteria terpilih dalam media garam mineral (MSM) pada 30°C selama 50 hari. Biodegradasi mikroplastik dianalisis menggunakan analisis kehilangan berat secara gravimetrik, spektroskopi Fourier Transform Infrared (FTIR), dan Mikroskopi Elektron Imbasan (SEM). Keputusan menunjukkan bahawa kehilangan berat mikroplastik PE tertinggi adalah 8.9% yang dikesan oleh BPB5, manakala yang terendah adalah 5.2% yang dikesan oleh BPB8. Degradasi maksimum mikroplastik PP ialah 9.2% yang dicapai oleh BPB5, manakala yang terendah adalah 4.6% yang dikesan oleh BPB1. Dalam rawatan mikroplastik PS, degradasi maksimum adalah 8.8% oleh BPB5, manakala yang terendah adalah 5.2% oleh BPB8. Analisis spektroskopi Fourier Transform Infrared (FTIR) selanjutnya mengesahkan biodegradasi mikroplastik dengan mendedahkan kehadiran kumpulan fungsi baharu. Manakala keputusan disahkan menggunakan analisis SEM yang menunjukkan perubahan morfologi pada permukaan mikroplastik. Secara keseluruhan, strain ini berpotensi digunakan untuk penyingkiran pencemaran mikroplastik. Kesimpulannya, penemuan penting kajian ini mendapati fungsi bakteria penghasil bioflokulan sebagai strategi berpotensi untuk menguraikan mikroplastik dalam perspektif akuakultur.