EVALUATION OF FRESHWATER CYANOBACTERIA AS A SOURCE OF BIODEGRADABLE PLASTICS

W.A.B.M. Samarajeewa[1], T.K. Bowange[1], J.C. Kasturiarachchi[2], R.R. Ratnayake[1*]
[1] *National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka*
[2] *Sri Lanka Institute of Information Technology, New Kandy Road, Malabe*
renuka.ra@nifs.ac.lk

Conventional fossil-based plastics have become a threat to the environment worldwide due to their persistence in nature. Bioplastics including Polyhydroxybutyrate (PHB), Polyhydroxyalkanoate (PHA), Polylactic acid (PLA), and starch undergo complete degradation by natural microbial action thus present a sustainable alternative to petroleum-based plastics. Commercial production of bioplastics has been achieved using plants from land-based sources; however, the constraints of resource depletion hinder the scalability of crop-dependent bioplastic manufacturing. Cyanobacteria, with their exceptional biodegradable plastic characteristics, could be a more viable solution to address the demand for non-degradable plastics. Selected strains Spirulina subsalsa, Synechocystis sp., Synechococcus sp., and Oscillatoria sp., which were previously isolated from freshwater reservoirs in Sri Lanka, and Spirulina platensis obtained from the culture collection of the National Institute of Fundamental Studies, Sri Lanka were semi-mass cultured in Zarrouk's (pH-10.5), and BG-11 (pH-7.5) media, subjecting to constant illumination at 2000 lux and shaking conditions of 200 rpm. Growth rate of cultures was determined based on the absorbance measured at 680 nm at regular intervals. After 4 weeks, biomass was harvested, oven-dried, and ground into a fine powder for analysis. Total Polyhydroxybutyrate (PHB) content was analyzed using the Law and Slepecky method, while PHB in Synechocystis sp. was qualitatively analyzed using Raman Spectroscopy. Along with the highest growth rate, the highest total PHB content of 8.4% was recorded in Synechocystis sp., exceeding the previously reported PHB contents. Synechococcus sp. displayed the second highest PHB content of 7.4% followed by Spirulina platensis (4.9%) and Spirulina subsalsa (2.6%). Oscillatoria sp. exhibited the lowest PHB content of 0.9%. Raman spectroscopy revealed bands at 1725, 1443, and 1458 cm-1, consistent with criteria, affirming PHB biopolymer crystallinity. Studying native Cyanobacteria as a source of biodegradable plastics holds greater promise for sustainable bioplastic production compared to other alternatives. This is attributed to their rapid growth, efficient resource utilization, regeneration capabilities, and minimal environmental impact. Consequently, these findings indicate their substantial potential in tackling the challenges associated with non-degradable plastics, offering promising prospects for sustainable solutions.

Keywords: *Cyanobacteria, Polyhydroxybutyrate, Plastic pollution, Sustainable.*