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Researchers at Nagaland University develop biodegradable biopolymer to fight microplastic pollution

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Focused on producing a biodegradable bacterial biopolymer called "Polyhydroxybutyrate" (PHB)



A Nagaland University-led multi-institute research team has developed a biodegradable biopolymer that could offer an eco-friendly alternative to conventional plastics and help tackle the growing global crisis of microplastic pollution.

Microplastics are tiny plastic particles that accumulate in the environment. They have emerged as pollutants of global concern due to their widespread presence across ecosystems. Through a process known as 'Biomagnification', the concentration of microplastics increases at each trophic level, eventually reaching humans at the top of the food chain, thereby posing significant risks to human health and ecosystems.

Addressing this challenge, researchers from Nagaland University and partner institutions focused on producing a biodegradable bacterial biopolymer called 'Polyhydroxybutyrate' (PHB).

The polymer was produced from a bacterial strain called 'Bacillus subtilis FW1', which was previously isolated from fish waste disposal sites in Mokokchung district of Nagaland. PHB has attracted growing interest as a potential replacement for petroleum-based plastics because it is biodegradable, biocompatible and derived from biological sources.

The study was conducted in collaboration with scientists and researchers from multiple institutions across India, including Sathyabama Institute of Science and Technology, CSIR-North East Institute of Science and Technology, Tezpur University, Bharathiar University, University of Science and Technology Meghalaya, and Galgotias University.

The study demonstrated several promising findings. The bacterial strain was able to accumulate up to 69.2 per cent PHB biopolyester, indicating strong production potential. Detailed physico-chemical characterisation also showed that the biopolymer possesses high thermostability. Importantly, laboratory testing revealed that the material is biocompatible with human liver hepatocellular carcinoma cell lines (HepG2), indicating its potential safety for biomedical applications.

Dr Pranjal Bharali, Assistant Professor, Department of Environmental Science, Nagaland University, said, "Future research will focus on improving bacterial strain efficiency, optimising metabolic pathways and utilising low-cost waste-based feedstocks to make PHB production economically competitive with conventional plastics."

Further evaluation of the material's environmental behaviour showed encouraging biodegradability results. The PHB film produced during the research degraded by approximately 59.6 per cent within 28 days during soil burial experiments using the open windrow composting method. Researchers note that this level of biodegradability demonstrates the potential of PHB as a sustainable and environmentally friendly biomaterial.