

ESAI Postgraduate of the Year 2024 Winner

Jeovan Araujo, Technological University of the Shannon (TUS)

Plastic pollution is one of the most pressing environmental challenges of our time, with millions of tons of plastic waste accumulating in landfills and ecosystems each year. Jeovan's PhD research titled "Towards Circularity for Petroleum- and Bio-Based Plastics: Tailoring Properties and End-of-Life Routes", which was co-funded by [TUS President's Doctoral Scholarship](#) and the [Horizon 2020 BioCEP project](#), addresses this issue by developing innovative biotechnological strategies for plastic degradation and upcycling while enhancing the properties of bioplastics. Using a multidisciplinary approach, Jeovan's PhD work combines polymer engineering, biotechnology, materials science, and environmental sciences to develop more sustainable plastics and advanced recycling and upcycling solutions for plastic waste management.

Focusing on exploring green chemical methods to design innovative bioplastic formulations that can contribute to a more sustainable material lifecycle, Jeovan [reported](#) a new bioplastic material in which the incorporation of food waste-based calcium salt promoted a dual antimicrobial and antioxidant effect on thermoplastic films. This work was succeeded by a new [study](#) published in the *ACS Sustainable Chemistry & Engineering* journal, in which Jeovan developed an environmentally friendly approach to fabricate curcumin-based bioplastic films reinforced with natural hybrid fillers that resulted in significantly better mechanical strength, and barrier properties and a 5-fold enhancement in colour stability, making them more viable as replacements for traditional plastics.

Conventional recycling methods are inadequate for low-quality single and mixed plastic waste streams, which are often inappropriately disposed of in landfills and ecosystems. In response, in a [study](#) published in the *Environmental Technology & Innovation* journal, Jeovan and co-workers demonstrated the successful degradation of lower-grade polyethylene terephthalate (PET) plastic into its monomers through biocatalytic microbial degradation. Jeovan's research also explored a biotechnological route using enzyme catalysis to degrade hard-to-recycle, mixed PET and bio-based plastic waste streams, which were then repurposed into bacterial nanocellulose—a high-value, regenerative eco-polymer with applications in various fields such as packaging and medical devices. This pioneer [study](#) was published in *Journal of Cleaner Production*, for which Jeovan was awarded the Best Overall Impact Submission at [TUS Research Week 2024](#).

The economic and environmental impact of Jeovan's research is substantial. His work contributes to a circular economy for plastics where waste is minimized, and high-performance biodegradable materials are designed. Particularly, these advancements are relevant for industries in packaging, materials manufacturing, and waste management, offering sustainable alternatives to replace environmentally damaging plastic materials. Jeovan's research is timely and relevant due to increasing regulations on plastic waste, such as the new EU Packaging and Packaging Waste Regulation (PPWR), and the growing demand for circular materials. Furthermore, his interdisciplinary approach aligns with UN Sustainable Development Goals (SDGs 9, 11, 12, 13, 14 and 17) and environmental policies by managing plastic waste at end-of-life (EoL) more effectively and creating high-performance, greener bioplastics. Through these efforts, Jeovan's research is contributing to a broader movement toward innovative and environmentally responsible plastic management solutions.

Jeovan carried out his PhD studies at the Centre for Polymer Sustainability (CPS), a research centre led by Dr Margaret Brennan Fournet at the Polymer, Recycling, Industrial, Sustainability and Manufacturing (PRISM) Research Institute in TUS, which also incorporates the Enterprise Ireland funded Technology Gateway centre Applied Polymer Technologies (APT).