Overlooked Environmental Science: A Tiny Solution to a Plastic Planet

Silas Tooth
Lake Forest College
Lake Forest, Illinois 60045

It is more than daunting to consider that plastic is filling our oceans, landfills, and our bodies at ever increasing rates. The inadequacy of waste treatment and a significant lack of a global movement for removing single use plastic from our societies is endangering our world. Microplastics are consumed daily through our food, eventually entering our bodies and posing health risks, including heart problems. Nature too is poisoned by our pollution. There is a desperate need for research and large-scale action into treatment for the mounting waste. However, a research paper (which remained overlooked and unpublished for 15 years until 2016) may have the answer to the environmental disaster humans have bestowed upon themselves.

Over 2 billion tons of municipal waste is produced globally each year (Lama, 2024), 12% of which is produced by the USA alone (Alves, 2024). For reference, if you put 6,000 Empire State Buildings on a rather large set of scales, they would weigh the much as the amount of waste produced each year globally. This has justifiably raised many concerns for the severe environmental impact that the continuous buildup of waste on our planet is causing. Despite being deemed non-toxic, plastics such as polyethylene terephthalate (PET) and other synthetic polymers that take the form of larger particles and micro granules are long-lasting pollutants that can build up in living organisms and can be found everywhere. Despite the mounting scientific research on the decline of the planet's health and the urgency of an environmental reform, there is a gap between what is being done on the scientific and the government levels. Despite these dreary figures, there is hope thanks to a fantastic bacterium found some two decades ago.

In 2001, a group of Japanese microbiologists led by Kohei Oda found a revolutionary strain of bacteria that 'eats' plastic (Buranyi, 2023). Outside the city of Sakai, in a waste management dump, scientists dug up this bacterium which contained enzymes capable of breaking down PET (Buranyi, 2023). Their initial findings were considered to be lacking 'importance' until 2016 when they finallyvpublished the paper 'A bacterium that degrades and assimilates poly (ethylene terephthalate)' (Yoshida). The bacteria, Ideonella sakaiensis 201-F6, has two enzymes PETase and MHETase, which are capable of hydrolyzing PET, as well as its reaction intermediate, MHET. This forms two environmentally friendly molecules: terephthalic acid and ethylene glycol. Since this discovery, research has continued, particularly at the University of Portsmouth with Professor McGeehan. He and his team were able to combine PETase and MHETase which increased their efficiency in breaking down PET to its monomers (Marshall, 2022).

The key question to consider now is: can this be done on an industrial scale to tackle the piling plastic waste continuously being produced? In short, yes it can, but there is still insufficient support for projects researching plastic-degrading bacteria, as well as limited funds to move from research to large-scale application of this strategy. Hence, the main research is being conducted at universities and a handful of biotechnology companies. Carbios, a biotech company based in France, has one of the few pilot plants used to test the recycling of PET (Marshall, 2022). This highlights a significant issue with global environmental initiatives and a lack of support for solutions based on scientific research. Nevertheless, it is important to note that enzymes such as PETase and MHETase alone cannot solve the problem of plastic waste, but they could be a large part of the solution. Thus, an increase in funding and industrial application could lead to further discoveries and decrease global waste production.

The environmental crises created from the excessive amount of single-use plastic waste produced each year demands urgent and innovative solutions. While the discovery of the plastic-degrading bacterium Ideonella sakaiensis offers a promising part of the solution, its potential remains largely undeveloped due to insufficient funding for research and industrial application. There is an opportunity for the global community to invest in projects developing research on scale up enzymatic break-down of PET and other plastics. A culture of sustainability and investing in scientific research would allow the mitigation of devastating environmental and health consequences caused by plastic pollution and contribute towards a healthier planet.

References

Alves, Bruna. "Municipal Solid Waste in the U.S. - statistics & facts." Statista, 29 April 2024,

Buranyi, Stephen. "'We are just getting started': the plastic-eating bacteria that could change the world." The Guardian, 28 September 2023,

Lama, Nuru. "The World has a Waste Problem. Here's How to Fix It." International Finance Corporation, 26 April 2024,

Marshall, Michael. "How 'super-enzymes' that eat plastics could curb our waste problem." The Guardian, 5 Feb 2022,

Shosuke Yoshida et al. 'A bacterium that degrades and assimilates poly (ethylene terephthalate)'. Science 351, 1196-1199 (2016).
"Trends in Solid Waste Management." World Bank, 20 September 2018,