

Using Bacteria to Combat Plastic Pollution

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An issue we have currently is the amount of waste that we produce each year. Annually, humans produce over 380 million tons of plastic, and additionally every piece of plastic ever manufactured still exists today unless it has been burnt. Getting rid of excess plastic is essential to maintain good water quality and minimize microplastic pollution. Single use plastics are essential to daily life, as they are easily sterilized for medical use, personal use for straws, utensils, and much more. Plastic is not something that will disappear on its own. A way to combat plastic pollution would be to burn it, but it lets off harmful and potentially toxic gases. I propose utilizing bacteria, specifically *Pseudomonas aeruginosa*, to combat the excessive plastic issue. In past studies, *P. aeruginosa* has been shown to digest plastics and rubbers.

Bacteria can be used to help biodegrade plastic, which is usually unable to go through this process. Most plastic is made of long chains of polymers that are resistant to passing through membranes because of their high molecular weight. As we have discussed in class, cell membranes are responsible for regulating what can and what cannot enter the cell. Through genetic engineering, like CRISPR-Cas9, it may be possible to create bacteria with the ability to not only allow longer polymers to enter the membrane, but also allow them to break them down quickly. This method would allow us to amplify certain genes, or even knock out ones that are undesirable. Perhaps we could downregulate specific permeability genes while upregulating genes that promote hydrolysis to take place. Also, some preliminary research has displayed the opportunity of utilizing biofilms to cover the surface of the plastic to perform a widespread breakdown of the plastic (Harrison et al., 2011).

Genes needed to break down these bonds are *phaZ1* and *phaZ5*, which allow the *P. aeruginosa* to breakdown the PHA present in most plastics. If we could increase the expression of this gene, we could allow for a more efficient and marketable breakdown of common plastics. If a bacteria can become better at breaking down polymers like in plastic, then we could slowly combat this pollution issue by having the bacteria consume the plastic.

I believe that this would make money because solving the issue of plastic use would allow businesses that rely on plastic to continue operating while also providing a way to healthier

water systems. Perhaps everyone could have their own ‘plastic compost’ that contains the bacteria to speed the process of degrading, like what people do with compost now. A company could sell kits that allow communities to collect plastic and safely use the bacteria to break it down. I think this would be successful, and great for advertising as well. A source I had found discussed the microorganisms that are able to break down specific plastic that is created with biodegradability in mind, which is where this idea stemmed from.

Harrison P, Sapp M, Schratzberger M, Osborn AM. Interactions between microorganisms and marine microplastics: a call for research. *Mar Technol Soc J*. 2011;45(2):12–20.
doi: 10.4031/MTSJ.45.2.2.

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