Key to Eliminating the Plastic Problem: Degradation of Polyethylene Plastic Using Bacillus sp. YP1 and Enterobacter asburiae YT1 from Wax Worm Gut

Thompson, Grace (School: Oviedo High School)
Um, Taeseung (School: Oviedo High School)
Koenig, Travis (School: Oviedo High School)

Over 300 million tons of plastic waste is produced annually, and over 270 million tons of that waste is sent to landfills. This research hopes to better characterize plastic consumption in Bacillus sp. YP1 and/or Enterobacter asburiae YT1 and to identify subsequent genes involved in the degradation of plastic in the hopes of treating the world's pollution pandemic. Wax worms were cultured with polyethylene plastic as its sole food source to artificially select for polyethylene-degrading bacteria. The bacteria were extracted from the gut, cultured, and incubated with polyethylene samples. Plastic degradation amounts were compared between the polyethylene treatment group and a control fed a normal diet. Bacteria artificially selected for showed a mass degradation amount of 24.1% compared to 3.1% from wax worms not fed plastic. The degradation amounts between the groups was statistically significant ($p = 3.88 \times 10\text{-}39$). Regarding genomic comparisons, a number of partial matches in protein-protein and protein-nucleotide BLAST searches were found between a polyethylene hydrolase enzyme from I. sakaienis and those in the Bacillus sp. YP1. These findings suggest that polyethylene degradation is not caused by a single gene, but by a group of genes and likely evolved as an evolutionary metabolic pathway. Future research paths include further identification of plastic degrading genes, exploring evolutionary relatedness, and targeting genetic engineering to transform innocuous bacteria into plastic degraders. These bacteria can then be used in waste disposal to minimize plastic deposition into landfills.

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