Plastic pollution: Understanding threats to human health & bioremediation strategies

Introduction

Millions of tons of plastic pollution enter the natural environment each year, harming wildlife and potentially harming human health through widespread exposure to micro- and nano-plastics. Plastics and their additives are potentially harmful to human health.

Research Goals

1. Understand how plastic and its chemical additives affect human health and innate immunity
2. Discover plastic-degrading bacterial species and create highly efficient and thermostable plastic degraders in the lab

1. Plastics and their additives are potentially harmful to human health

A. ≥ 150 carcinogens and 2,400 chemicals of unknown carcinogenicity are used in plastics.

B. Liver cells can internalize nanoplastics

C. Macrophages phagocytose nanoplastics

2. Our team is discovering new plastic-degrading bacteria and improving the efficiency & thermostability of existing plastic degraders

A. We identified Pseudomonas stutzeri as a potential plastic degrader.

B. We tested P. stutzeri for the ability to degrade various polymers in the lab.

C. We are developing a thermostable plastic degrader to enable bioremediation at high temperatures.

Future Directions:

- Identify new plastic-degrading bacteria for other plastic types (PS, HDPE, LDPE, PVC, and PP)
- Improve the efficiency of natural plastic degraders

References:

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MHETase-like enzymes. The PETase (left) and MHETase (right) enzymes of P. stutzeri have similar structures. Using bioinformatics, we identified a soil bacterium (P. stutzeri) that contains both PETase-and MHETase-like enzymes. The PETase (left) and MHETase (right) enzymes of I. sakaiensis and P. stutzeri have similar structures. We hypothesized that P. stutzeri is a plastic degrader.

Future Directions:

- Identify new plastic-degrading bacteria for other plastic types (PS, HDPE, LDPE, PVC, and PP)
- Improve the efficiency of natural plastic degraders

Utilize directed evolution to generate novel strains with enhanced ability to degrade plastic

Increase temperature range at which degradation is possible

Hiway

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References:

Antibiotic resistance shows transformation success.