



## **NEWS RELEASE**

**Singapore, 8 February 2024**

### **NTU Singapore scientists develop artificial ‘worm gut’ to break down plastics**

A team of scientists from **Nanyang Technological University, Singapore (NTU Singapore)** has developed an artificial ‘worm gut’ to break down plastics, offering hope for a nature-inspired method to tackle the global plastic pollution problem.

By feeding worms with plastics and cultivating microbes found in their guts, researchers from NTU’s **School of Civil and Environmental Engineering (CEE)** and **Singapore Centre for Environmental Life Sciences Engineering (SCELSE)** have demonstrated a new method to accelerate plastic biodegradation.

Previous studies have shown that *Zophobas atratus* worms – the larvae of the darkling beetle commonly sold as pet food and known as ‘superworms’ for their nutritional value – can survive on a diet of plastic because its gut contains bacteria capable of breaking down common types of plastic. However, their use in plastics processing has been impractical due to the slow rate of feeding and worm maintenance.

NTU scientists have now demonstrated a way to overcome these challenges by isolating the worm’s gut bacteria and using them to do the job without the need for large scale worm breeding.

**NTU Associate Professor Cao Bin at the School of CEE and Principal Investigator at SCELSE** said, “A single worm can only consume about a couple of milligrams of plastic in its lifetime, so imagine the number of worms that would be needed if we were to rely on them to process our plastic waste. Our method eliminates this need by removing the worm from the equation. We focus on boosting the useful microbes in the worm gut and building an artificial ‘worm gut’ that can efficiently break down plastics.”

The study, published in *Environment International* in January, is aligned with the University's commitment to fostering innovation and translating research into practical solutions that benefit society under its **NTU2025** five-year strategic plan.

## **Developing an artificial worm gut**

To develop their method, the NTU scientists fed three groups of superworms different plastic diets - **High-density polyethylene (HDPE), Polypropylene (PP) and Polystyrene (PS)** - over 30 days. The control group was fed a diet of oatmeal.

The NTU scientists selected the plastics as they are among the most common plastics in the world, used in everyday items like food boxes and detergent bottles. HDPE is a type of plastic known for its high-impact resistance, making it difficult to break down.

After feeding the worms plastic, scientists extracted the microbiomes from their gut and incubated them in flasks containing synthetic nutrients and different types of plastics, forming an artificial 'worm gut'. Over six weeks, the microbiomes were left to grow in the flasks at room temperature.

## **Increase in plastic-degrading bacteria**

The scientists found that compared to the control group, the flasks which contained the gut microbiomes from the plastic-fed worms showed a significant increase in plastic-degrading bacteria.

Furthermore, the microbial communities colonising the plastics in the flasks were simpler and more tailored to the specific type of plastic than the microbes found on plastics that had been fed directly to the worms . When the microbial communities are simpler and targeted to a specific type of plastic, this translates to potential for more efficient plastic degradation when used in real-life applications.

**First author of the study Dr Liu Yinan, Research Fellow at the School of CEE and SCELSE**, said, "Our study represents the first reported successful attempt to develop plastic-associated bacterial communities from gut microbiomes of plastic-fed worms. Through exposing the gut microbiomes to specific conditions, we were able to boost the abundance of plastic-degrading bacteria present in our artificial 'worm gut,' suggesting that our method is stable and replicable at scale."

The researchers say their proof-of-concept lays the foundation for developing biotechnological approaches that use worms' gut microbiomes to process plastic waste.

For their next steps, the researchers want to understand how the bacteria in the superworm's gut break down the plastics at the molecular level. Understanding the mechanism will help scientists engineer plastic-degrading bacterial communities to break down plastics efficiently in the future.

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**Notes to Editor:**

Paper titled "[Establishment of plastic-associated microbial community from superworm](#)" published in *Environment International*, Volume 183, January 2024  
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***About Nanyang Technological University, Singapore***

A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 33,000 undergraduate and postgraduate students in the Engineering, Business, Science, Medicine, Humanities, Arts, & Social Sciences, and Graduate colleges.

NTU is also home to world-renowned autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies, and Singapore Centre for Environmental Life Sciences Engineering – and various leading research centres such as the Earth Observatory of Singapore, Nanyang Environment & Water Research Institute and Energy Research Institute @ NTU (ERI@N).

Under the NTU Smart Campus vision, the University harnesses the power of digital technology and tech-enabled solutions to support better learning and living experiences, the discovery of new knowledge, and the sustainability of resources.

Ranked amongst the world's top universities, the University's main campus is also frequently listed among the world's most beautiful. Known for its sustainability, NTU has achieved 100% Green Mark Platinum certification for all its eligible building projects. Apart from its main campus, NTU also has a medical campus in Novena, Singapore's healthcare district.

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