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Singapore scientists mine butanol from fats in food waste

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Scientists in Singapore have found a green, efficient way to deal with the growing amount of food waste that the country produces.

They have genetically modified a type of yeast so that it can convert fats in food waste to recover half its weight in butanol — a type of alcohol that can be used as fuel or to make cosmetics and textiles — giving a second life to the over 600,000 tonnes of food waste that is incinerated in Singapore yearly.

Last year Singapore produced 785,500 tonnes of food waste, of which only 13 percent was recycled. Since 2010, the amount produced has risen by about 30 percent.

National University of Singapore don Matthew Chang said he thought scientists could "play a part in finding a solution to the growing problem."

Hence the associate professor from the NUS Synthetic Biology for Clinical and Technological Innovation program led a team to investigate how to create a biological process that could convert food waste into something useful.

After three years and US$222,990 from the National Environment Agency, the team has found a way.

They modified the genetic makeup of the yeast Yarrowia lipolytica — which has the natural ability to process fats — by inserting 10 extra genes into its cell. The result? Yeast that can produce close to 300,000 tonnes of butanol from 600,000 tonnes of food waste.

The team's way of recycling food waste produces almost four times less carbon dioxide than incineration and half that compared to anaerobic digestion — in which micro-organisms are used to break down food waste into biogas.

Their method also uses less energy, requiring 33k kilowatt hour (kWh) for a ton of waste, half of that required to incinerate waste to produce energy, and less than half the 81 kWh per ton needed for anaerobic digestion.

The method involves blending the food waste and extracting the fats in it and adding that to the engineered yeast in a bioreactor. The butanol produced is then filtered out.

"Not only can we reduce the amount of food waste that gets burnt, but we can also produce a high-value product that has a global demand of 350 million gallons a year," said Chang.

The method has been proven to work in the laboratory and the next step is to test it on a larger scale. Professor Chang will be seeking more funding for this. The project will be among those showcased at the Clean Enviro Summit starting today.

When contacted for comments, Associate Professor John March from the Department of Biological and Environmental Engineering at Cornell University said past attempts to convert food waste into value-added chemicals through a biological process had taken a more "generalist" approach. The aim was to convert all waste to ethanol, which failed because the methods used more energy than they produced. They were also not financially viable.

In an e-mail interview he said: "Prof. Chang's approach solves these two problems by using two very clever solutions: Focusing on the lipid component of food waste and using an engineered yeast to complete the conversion to the highly energetic and commercially attractive butanol."