

Scientists Turn Florida's Rotten Tomatoes into Clean Energy

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Tomatoes are useful for a lot of things — mixing into salads, adding nutritional value to cheeseburgers, lobbing at struggling standup comics, and even making plastic for car parts. But a team of scientists at the South Dakota School of Mines & Technology has come up with a powerful new application for the flushed fruit: electricity.

At the recent 251st National Meeting & Exposition of the American Chemical Society (ACS), the team presented their pilot project, which involves a bio-based fuel cell that uses tomato waste left over from harvests in Florida.

“We have found that spoiled and damaged tomatoes left over from harvest can be a particularly powerful source of energy when used in a biological or microbial electrochemical cell,” said Namita Shrestha, a graduate student at the South Dakota School of Mines & Technology who is working on the project. “The process also helps purify the tomato-contaminated solid waste and associated wastewater.”

Tomato waste: no laughing matter

Each year, the state of Florida throws out nearly 400,000 tons of tomato waste, according to the researchers. In addition to imperfect tomatoes not suitable for grocery store shelves, waste also can come from the leftovers of manufacturing processes of sauces, ketchup and other cooking products.

While this might seem to provide fodder for rotten tomato jokes, this is no laughing matter — this tomato waste is difficult to dispose of and usually ends up in landfills where it generates methane. This both exacerbates climate change and creates major water treatment problems.

“We wanted to find a way to treat this waste that, when dumped in landfills, can produce methane — a powerful greenhouse gas — and when dumped in water bodies, can create major

water treatment problems,” Venkataramana Gadhamshetty, the lead researcher on the project, said in a statement.

This sounds like a multiple win scenario for society and the environment alike — generating electricity, reducing landfill waste, cutting a source of greenhouse gas emissions and improving water quality.

But how does it work?

Tapping tomatoes’ latent energy

The oxidation process, triggered by the bacteria interacting with tomato waste, releases electrons that are captured in the fuel cell and become a source of electricity. The natural lycopene pigment in tomatoes, the researchers have found, is an excellent mediator to encourage the generation of electrical charges from the damaged fruits.

In short: The process taps into the chemical energy stored within the tomatoes and transforms it into electrical energy.

“Microbial electrochemical cells use bacteria to break down and oxidize organic material in defective tomatoes,” Shrestha explained.

Typically, biotechnological applications require, or at least perform better, when using pure chemicals, compared to wastes, Gadhamshetty said. However, the researchers found that electrical performance using defective tomatoes was equal or better than using pure substrates.

“These wastes can be a rich source of indigenous redox mediators and carbon, as well as electrons,” he said.

Enough energy to power the happiest place on Earth

But don’t get too excited about the prospect of a tomato-powered home just yet — currently, the power output from their device is quite small: 10 milligrams of tomato waste can result in 0.3 watts of electricity.

The researchers expect that with additional research and scaling up the technology, electrical output could be increased by several orders of magnitude. They plan to improve the cell by determining which of its parts — electrode, electricity-producing bacteria, biological film, wiring — are resisting the flow of electricity. Then they will tweak or replace that part.

Theoretically, there is enough tomato waste generated in Florida each year to meet Disney World’s electricity demand for 90 days, using an optimized biological fuel cell, the researchers calculate.
