Fuel from food waste: bacteria provide power

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Researchers have combined the efforts of two kinds of bacteria to produce hydrogen in a bioreactor, with the product from one providing food for the other. According to an article in the August issue of *Microbiology Today,* this technology has an added bonus: leftover enzymes can be used to scavenge precious metals from spent automotive catalysts to help make fuel cells that convert hydrogen into energy.

Hydrogen has three times more potential energy by weight than petrol, making it the highest energy-content fuel available. Research into using bacteria to produce hydrogen has been revived thanks to the rising profile of energy issues.

We throw away a third of our food in the UK, wasting 7 million tonnes a year. The majority of this is currently sent to landfill where it produces gases like methane, which is a greenhouse gas 25 more potent than carbon dioxide. Following some major advances in the technology used to make "biohydrogen", this waste can now be turned into valuable energy.

"There are special and yet prevalent circumstances under which micro-organisms have no better way of gaining energy than to release hydrogen into their environment," said Dr Mark Redwood from the University of Birmingham. "Microbes such as heterotrophs, cyanobacteria, microalgae and purple bacteria all produce biohydrogen in different ways."

When there is no oxygen, fermentative bacteria use carbohydrates like sugar to produce hydrogen and acids. Others, like purple bacteria, use

light to produce energy (photosynthesis) and make hydrogen to help them break down molecules such as acids. These two reactions fit together as the purple bacteria can use the acids produced by the fermentation bacteria. Professor Lynne Macaskie's Unit of Functional Bionanomaterials at the University of Birmingham has created two bioreactors that provide the ideal conditions for these two types of bacteria to produce hydrogen.

"By working together the two types of bacteria can produce much more hydrogen than either could alone," said Dr Mark Redwood. "A significant challenge for the development of this process to a productive scale is to design a kind of photobioreactor that is cheap to construct and able to harvest light from a large area. A second issue is connecting the process with a reliable supply of sugary feedstock."

With a more advanced pre-treatment, biohydrogen can even be produced from the waste from food-crop cultivation, such as corn stalks and husks. Tens of millions of tonnes of this waste is produced every year in the UK. Diverting it from landfill into biohydrogen production addresses both climate change and energy security.

The University of Birmingham has teamed up with Modern Waste Ltd and EKB Technology Ltd to form Biowaste2energy Ltd, which will develop and commercialise this waste to energy technology.

"In a final twist, the hydrogenase enzymes in the leftover bacteria can be used to scavenge precious metals from spent automotive catalysts to help make fuel cell that converts hydrogen into electricity," said Professor Lynne Macaskie. "So nothing is wasted and an important new application can be found for today's waste mountain in tomorrow's non-fossil fuel transport and energy."

Source: Society for General Microbiology