Microbes Pass Valuable Gas

By Roxanne Khamsi | Also by this reporter

02:00 AM May. 20, 2003 PT

About 10,000 years ago, humans learned how to put yeast to work to brew beer.

Now, as the scientific community struggles to develop a way to produce hydrogen for fuel cells, some researchers are including microorganisms in their recipes for making electricity.

With a reliable source of hydrogen, fuel cells can produce energy with water as the only byproduct.

Here's the problem: While hydrogen is the most abundant element in the universe, it is extremely difficult to capture and store in its pure form. Just as potable water cannot be found in the middle of the ocean, usable hydrogen remains scarce in the sea of organic compounds surrounding us.

The methods of manufacturing and compressing hydrogen gas require great amounts of energy. To overcome these challenges, scientists have been tinkering with the biological powers of everything from common yeast to mysterious bacteria living on the ocean floor.

At the University of California at Berkeley, mechanical engineering professor Liwei Lin is busy developing a microbial fuel cell that runs off the digestive activity of baker's yeast. The yeast feed on glucose, a simple sugar, and digest it in a process called aerobic metabolism.

"We extract electrons from the yeast cells where the aerobic metabolism process happens," Lin explains.

Controlling the movement of electrons to harness a renewable source of fuel remains the target for scientists designing fuel cells, which extract power from electrochemical reactions. The advantage of Lin's mechanism is that it runs on glucose, a naturally abundant resource produced by plants.

One of his small prototypes, measuring 0.7 square centimeters and less than 1 millimeter thick, produces 1 microwatt of power -- approximately enough to power a digital wristwatch.

Lin believes it is only a matter of time before fuel cells in laptop computers will recharge from glucose cartridges. He plans to adapt his prototype to use glucose found in the bloodstream to power implantable devices such as internal pacemakers.

With the help of a $300,000 grant from the National Science Foundation, Lin's lab will expand its work on other types of microbial fuel cells. They hope to refine a new system that extracts power from the photosynthetic activity of algae.

"The prototype we have tested has very poor efficiency -- less than 1 percent," Lin said. "We believe that we can engineer this technology much better to have higher efficiency than gasoline-based combustion engines."

Suellen VanOoteghem, a researcher at the National Energy Technology Laboratory in Morgantown, West Virginia, also believes in the potential of microorganisms to revolutionize our power grid. She and her team study heat-loving bacteria that eat glucose, then pass gas in the process of breaking down their food. But the gas these microorganisms release is more useful than it is offensive.

Under optimal conditions, a 14-liter reactor in her lab produces waste gases that are up to 80 percent hydrogen. VanOoteghem estimates that the activity of bacteria in a 53-cubic-foot reaction chamber would provide enough hydrogen to run a 200-kilowatt fuel cell and supply energy for about 20 houses.

The exact enzymatic pathway by which these bacteria (known scientifically as *T. neapolitana*) produce hydrogen remains unknown, although researchers are working to map the microorganism's genome.

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