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U.S. University Developing Renewable Energy from Bacteria

New alternative power source could generate electricity in remote areas

Erika Parra, a University of California Berkeley graduate-student researcher, studies the microbial fuel cell.

By Nancy L. Pontius
Special Correspondent

Littleton, Colorado — Researchers at the University of California, Berkeley are investigating a new renewable energy source using living, nonhazardous bacteria to generate electricity.

Known as a microbial fuel cell, "this power source could be used in remote areas that are not on the electrical power grid, such as rural regions of sub-Saharan Africa," Tony Kingsbury, director of the university's Sustainable Products and Solutions Program, told *America.gov*.

The research team hopes one day to use microbial fuel cells as innovative household power generators that look like aquariums but are filled with water and microscopic bacteria instead of fish. When the bacteria inside are fed, the power generator — referred to as a "biogenerator" — would produce electricity.

"A household-size biogenerator may be able to generate enough electricity to power certain medical equipment, cell phones or small appliances such as stoves and refrigerators," Erika Parra, a UC Berkeley graduate-student researcher, told *America.gov*. The new energy source could also power lights for children to use at night when studying for school, Kingsbury said.

"Someday, if we can engineer a cost-effective microbial fuel cell of small enough size, we could potentially improve the quality of life for millions of people," Parra said. Small units also might be developed to power portable devices that currently run on batteries, such as flashlights, cell phones, radios and laptop computers.

MINIATURE POWER SOURCE FROM BACTERIA

Scientists discovered a beneficial trait in certain strains of bacteria commonly found in aquatic environments. "When these bacteria digest food, they break down the food molecules into pieces and give off electrons and protons which contain chemical energy," Parra said.

Microbial fuel cells collect these electrons and protons and convert their chemical energy into electrical energy by recombining these particles with oxygen, which yields electricity and water.

"A biogenerator one liter [in size] could potentially produce one kilowatt of electricity," Parra said. "Larger biogenerators can produce more electricity."

These fuel cells give off electricity similar to batteries, except that the fuel cells do not currently store energy, but instead emit energy when the bacteria are fed. "When power is needed, you just feed the bacteria food, such as sugar," Parra added.

Researchers are studying fuel cells with a single bacterium, which is about 1/100th of the width of a human hair. The micro-scale fuel cells are manufactured with semiconductor fabrication techniques, similar to those used in making a computer chip. Researchers plan to demonstrate larger biogenerators in the future.

Bacterium generates electricity in a

microbial fuel cell.

Microbial fuel cells generate electricity in direct current (DC) form, the same as the power produced by batteries. To produce alternating current (AC) needed by most appliances, AC power inverters could be used. In addition to generating power, the biogenerators produce clean drinking water as a byproduct.

GENERATING MORE ENERGY

To develop a useful, affordable source of power, researchers are working to create as much energy from this process as possible.

“We are looking into what keeps the bacteria healthy and happy, such as the best environmental conditions,” Parra said. Maintaining the bacteria at room temperature or warmer seems to work best.

The bacteria appear to generate more power when fed a diet of vinegar and alcohol, which are produced by fermentation, she noted. The team is considering ways to combine the biogenerator with a fermenting process in a two-stage system, so that food waste could be added and fermented at one end of the system, and then electricity would be collected as the end result.

For the future, the team is looking into how the biogenerator might store converted electrical energy for later use. “Right now, the bacteria are fed shortly before we need them to produce energy,” Parra said.

The energy project is part of UC Berkeley’s Sustainable Products and Solutions Program, which was funded with $2 million from The Dow Chemical Company Foundation in 2008. Dow plans to contribute additional funding over the next three years.

“Dow is providing the funds to establish the Sustainable Products and Solutions Program to encourage the multidisciplinary investigation of new, sustainable technologies that meet societal needs and can benefit the U.S. and other countries, such as the development of renewable energy sources and innovative water-purification technologies,” Bo Miller, president of the Dow Foundation, told *America.gov*.

Other projects include investigating the synthesis of bio-based alternative fuels, low-cost solar-powered charge controllers, arsenic removal from drinking water in Bangladesh and fuel-efficient cook stoves for Africa and China.

More information about the biogenerator project is available on the Sustainable Products and Solutions Program Web site.