Researcher harnesses energy-efficient pulsed electric fields to preserve milk

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Even though much of the population in developing countries is involved in agriculture, food security is virtually out of reach. Often the only resort is to purchase a cow, buffalo, or sheep, to provide a steady supply of fresh milk, a nutritious staple of a daily diet. But how to preserve it safely? Refrigeration and boiling are costly—and often impossible due to sporadic electricity.

The answers may lie in new Tel Aviv University research published in *Technology*, which finds that short pulsed electric fields can be used to kill milk-contaminating bacteria. Through a process called electroporation, bacterial cell membranes are selectively damaged.

According to lead investigator Dr. Alexander Golberg, of TAU's Porter School of Environmental Studies, applying this process intermittently prevents bacteria proliferation in stored milk, potentially increasing its shelf life.

According to the study, pulsed electric fields, an emerging technology in the food industry that has been shown to effectively kill multiple food-born microorganisms, could provide an alternative, non-thermal pasteurization process. The stored milk is periodically exposed to high-voltage, short pulsed electric fields that kill the bacteria. The energy required can come from conventional sources or from the sun. The technology is three times more energy-efficient than boiling and almost twice as energy efficient as refrigeration.

An alternative for poorer countries

"We are on a constant hunt for new, low-cost, chemical-free technologies for milk preservation, especially for small farmers in low-income countries," said Dr. Golberg. "For 1.5 billion people without adequate access to electricity, refrigeration is simply not a possibility and boiling does not preserve milk's freshness over time."

In developed countries, bacterial growth in milk is managed with refrigeration. But certain pathogens like listeria monocytogenes are less sensitive to low temperature so can proliferate during transportation and in storage. "Refrigeration slows the bacteria's metabolism, but pulsed electric fields kill them," said Dr. Golberg. "They are a fundamentally different approach to controlling microorganisms during storage.

"Our model shows that pulsed electric fields preservation technology does not require a constant electricity supply; it can be powered for only 5.5 hours a day using small, family scale solar panels," said Dr. Golberg. "I believe that this technology can provide a robust, simple, and energy-

efficient milk preservation system that would decrease the amount of wasted milk, thus increasing the income of small farmers in developing countries."

Dr. Golberg is currently exploring partnerships with interested agencies to develop an affordable device to reduce food waste and increase small farmers' incomes.

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