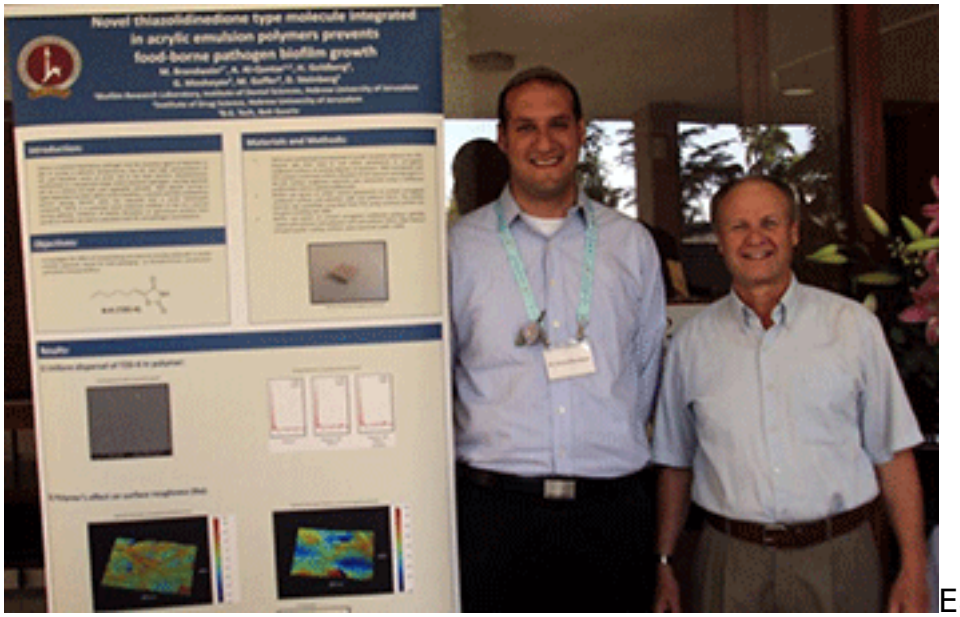
Packaging System Disrupts Produce Biofilm

The Hebrew University of Jerusalem



Eating fruits and vegetables is good for you, but sometimes there's a price to pay: illness caused by bacterial biofilms that adhere to the produce and to the packaging in which it's shipped.

Now a graduate student at the Hebrew University of Jerusalem has discovered a way to attack those bacteria on food packaging. Using a novel packaging system to disrupt those bacteria, his invention has huge commercial potential.

The student, Michael Brandwein, is a researcher under the supervision of Prof. Doron Steinberg from the Biofilm Research Laboratory of the Hebrew University's Dental Faculty. Brandwein was one of two graduate students presented with a Kaye Innovation Award during the 77TH annual meeting of the Hebrew University Board of Governors on June 11.

Bacterial biofilms are an ever-increasing problem in the food industry, especially for fresh produce. The US Centers for Disease Control and Prevention recently reported that food-borne diseases cause an estimated 48 million illnesses each year in the United States alone, of which 45% are caused by bacteria.

Industrialized countries have seen increased demand for fresh produce as awareness of the health benefits of eating fruits and vegetables has grown. But public health concerns about fresh produce are especially acute because many of these products are consumed without cooking. Countless microorganisms, including illness-causing bacteria, attach to food and packaging surfaces and form biofilms in a complex and multifaceted process.

How to get rid of the biofilms? It was recently discovered that bacteria actually talk

to one another, in a process called quorum sensing. This cross-talk is one of the factors that regulate biofilm formation. When certain molecules detect a sufficiently high cell density, they activate a cascade of genetic processes that leads to the bacteria's adhesion. Controlling the production or integration of these molecules can prevent the bacteria from coordinating to create a biofilm.

Along those lines, Brandwein has incorporated a novel molecule synthesized at the Hebrew University, called TZD, into anti-biofilm food packaging. At the Biofilm Research Laboratory the molecule successfully interfered with biofilm formation by bacteria and fungi. It has also been tested successfully to prevent biofilms in recycled water systems.

Brandwein's research has focused specifically on corrugated cardboard boxes, the worldwide medium for transporting the vast majority of fresh agricultural produce. The technology has now been successfully incorporated into industry-specific acrylic polymers, meant to coat the corrugated cardboard used in the fresh produce.

"We have shown that these 'quorum quenching polymers' dramatically reduce the biofilm load on corrugated cardboard, leading to a healthier and more efficient method of transporting today's food," says Brandwein.

The Hebrew University, through its technology transfer company, Yissum, holds granted patents on the process, and has signed an agreement with B.G. Tech of Kibbutz Beit Guvrin for further development and commercialization.

"While millions of dollars have been spent globally to develop antimicrobial polymers, no one has succeeded in developing and marketing anti-quorum sensing/anti-biofilm polymers. We therefore predict that our product will enjoy exclusivity for many years to come," said Brandwein. "We envision our technology being applied to frozen food packaging, poultry and meat packaging and other areas within the food packaging industry."

The researchers predict revenue potential in the many millions of dollars. In addition to addressing health concerns, preventing food contamination has significant economic implications for increasing the shelf life of products.

Growers are also a potential source of income, since bacterial biofilms are also a major source of post-harvest crop loss worldwide, infecting a wide variety of plant tissues and thereby causing bacterial soft rot, rendering the fruit or vegetable unfit for consumption.

The Kaye Innovation Awards at the Hebrew University have been awarded annually since 1994. Isaac Kaye of England, a prominent industrialist in the pharmaceutical industry, established the awards to encourage faculty, staff and students of the Hebrew University to develop innovative methods and inventions with good commercial potential which will benefit the university and society.

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