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EDIBLE FILMS WITH SUPERPOWERS
BY KIM SEVERSON/NEW YORK TIMES
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Leave heirloom tomatoes to the organic farmers and pork belly to the chefs. In the chemistry department at Rutgers University and other laboratories like it, the real action is in less trendy ingredients like oregano, crab shells and milk.

In a handful of food science labs around the country, people who talk about food in terms of microbes and polymers have been turning the natural pathogen fighters found in everyday food into edible films and powders.

If their work pans out, thin films woven with a thyme derivative that can kill E. coli could line bags of fresh spinach. The same material in powder form might be sprinkled on packages of chicken to stop salmonella.

Strawberries could be dipped in a soup made from egg proteins and shrimp shells. The resulting film — invisible, edible and, ideally, flavorless — would fight mold, kill pathogens and keep the fruit ripe longer.

For average eaters who are still scratching their heads over trans fat, food coated with invisible films that lure bad microorganisms to their death might as well be nuclear fusion. But food scientists believe the potential for using these everyday ingredients to make a safer food supply is huge.

“These natural films are really a very hot topic these days,” said Michael Chikindas, a food scientist working with the team at Rutgers. “The range of applications is endless, from very delicate foods to Army rations and space missions.”

On the most basic level, the films are something like a plastic wrap made of edible components that dissolves in water. The films can be infused with molecules from cloves, thyme or other foods that can keep unhealthy bacteria from growing. They can even be manipulated to carry flavor.

Of course, what works in the lab doesn’t always translate to the production line. As far as most of the scientists know, these new edible antimicrobial films and powders have yet to coat any food on the market. But their time is near, researchers say. Patents are pending and several large companies, commodity groups and the federal government have invested money in the research.

In any food processing innovation, the timing has to be right for both consumers and manufacturers, and this might be the moment. Reports of food-borne sickness outbreaks have become part of the daily news. Just last week, baby carrots infected with shigella, a bacteria, were recalled in 12 states. In July, 86 brands of canned chili sauce and other meat products were recalled in a botulism scare. In June consumers were advised to throw away bags of the snack called Veggie Booty after salmonella in it made people in 17 states sick.

As shoppers demand safer food, they're also demanding healthier food made with ingredients they can pronounce.

"We're working on consumer-friendly antimicrobials, so people will read the package label and not freak out," said Mark Daeschel, a professor of food science at Oregon State University.

Professor Daeschel teamed up with the food scientist Yanyun Zhao to engineer an edible film made from a fiber found in crab and shrimp shells. They mixed in lysozyme, a protein found in both eggs and human tears that has proven effective against listeria and staphylococcus. "It's why we don't get eye infections," he said.

The result is a film that could coat fruit or meat or even become an edible yogurt lid.

Beyond concerns for safer food and more natural products, the researchers are enjoying another bit of good timing: Consumers are becoming accustomed to thinking about edible film as a product that can deliver mouthwash and cough syrup. Why not food?

"One of the big breakthroughs were those Listerine strips," said Tara McHugh, a food researcher with the Department of Agriculture who makes films from carrots and tomatoes. "Consumers have just become more comfortable eating films."

Many people already eat more films and coatings than they realize. The wax on apples and the coating on aspirin are examples of edible protective layers used to battle oxygen, moisture and mishandling.

Most coatings are made from gluten, cellulose, starch and various proteins approved by the Food and Drug Administration as safe for consumption. They line ice cream cones and coat battered frozen food. A layer of film in some frozen pizzas keeps moisture from the sauce from seeping into the crust. Fresh sliced apples and other produce get coatings of ascorbic acid to keep them from turning brown.

Indeed, many shiny confections like chocolate-covered almonds and raisins are coated with confectioner's glaze, a substance that might make some snackers cringe. It is often made with the secretions of a mite-sized beetle that lives in India and Thailand.

Making confectioner's glaze also requires ethanol, which is regulated by the Environmental Protection Agency, said Dr. John Krochta, a food scientist at the University of California at Davis. The new kinds of edible coatings might eliminate the need for ethanol, he said.

In the mid-1990s, when work on edible films was beginning to take off, Professor Krochta figured out how to turn whey into a film that would be biodegradable. He was interested in the film, but also in finding a way for cheesemakers to use the excess whey they produced. The California government and that state's dairy industry helped pay for the research.

Now he is investigating whether his milk film can fight bacteria. The magic ingredients are milk proteins designed to help protect calves from bacterial infections. He believes they could be manipulated so that edible film wrapped around ready-to-eat turkey or smoked salmon would inhibit salmonella or listeria.

At Rutgers, researchers have just begun to dream about a product that could be used on food.

Ashley Carbone, a graduate student in Dr. Kathryn Uhrich's chemistry lab, got together with Dr. Chikindas from the food science department and started playing with spice derivatives, sometimes filling the chemistry lab with the smell of curry. Ms. Carbone discovered a way to synthesize biodegradable polymers with oils from oregano, cloves or thyme. The polymers can then be turned into films or powders that, when applied to food, can keep communities of bad bacteria from forming.

"We haven't tried eating it yet but I'm sure it's going to be O.K.," said Dr. Uhrich, whose team presented her lab's findings last week at the American Chemical Society's annual meeting in Boston.

"It's a naturally derived polymer," she said. "Even though I am a chemist, I recognize that people are more comfortable with food-derived components."

The films of Ms. McHugh, who works in the U.S.D.A. Agricultural Research Service labs near San Francisco, have a much less scientific beginning. She originally intended to make films as way to get people to eat more fruits and vegetables. People liked the flavor and the novelty and they took off. A company called Origami Foods now wraps sushi in her carrot film instead of nori and sells it at stores like Trader Joe's. Her apple film adds flavor and moisture to a spiral-cut ham.

As is often the case in the food science, one thing led to another.
"The next step is to get additional value out of them by adding some antimicrobials," she said.

She's playing around with cinnamon, which would go nicely with her apple film and could work against listeria or salmonella, and oregano, whose oil contains thymol and carvacrol, which damage E. coli.

And unlike some water-based films that are brushed on in liquid form, her sticky fruit and vegetable films might adhere to food better and provide a longer-lasting attack on bacteria.

Researchers are still noodling over several problems. One is how to control the timing of the release of the natural bug fighters once the film is on the food. Others are the films' excessive sensitivity to humidity, and how they can be applied to food so that the good bacteria touch every surface. Then there are labeling issues. Are the milk and shellfish proteins used in films the same ones that trigger allergic reactions? What about milk films on products a vegan might eat?

And no one knows how much it might cost in additional research and new equipment to actually transfer films from a lab to a food plant.

But scientists say the films might be a more palatable way of killing pathogens than irradiation, a process that has met resistance from food advocacy organizations. And as excited as the scientists are about their new powders and films, they are quick to point out that the products are not cure-alls.

"This is not intended to make up for sloppy growing or handling or cleaning and processing," Professor Krochta said.

Fordras' sponsored researchers determined that both the enhanced antimicrobial activity of the LYSOPAK formulation and the synergistic effect of the two compounds can broaden the anti-microbial effect of Lysozyme to ensure food safety and quality, by protecting those food articles especially vulnerable to deterioration caused by microbial growth, dehydration, and ripening due to respiration, such as cheese, meat products, fruit and vegetables.

In fact, the design of LYSOPAK products is particularly targeted toward inhibiting pathogenic and spoilage bacteria and fungi on food surfaces, such as Escherichia coli, Staphylococcus aureus, Clostridium botulinum, Salmonella spp.,Pseudomonas spp., Apergillus niger, Monoilinia fructicola, Botrytis cinerea, and Rhizopus spp.

The films containing the LYSOPAK formulation can be used to wrap cheese (sliced or brick) and meat products such as ham, chicken and ground beef. Processed meat products such as hotdogs and sausages can be coated using the film-forming LYSOPAK solution. Perishable fruit and vegetables can be sprayed or dipped into the LYSOPAK solution to form a protective coating to enhance microbial safety, and extend the product's shelf-life.

In addition to fighting bacteria, the LYSOPAK products are edible and biodegradable, or can be recycled as animal feed. This would reduce the amount of packaging waste sent to landfills.