Eat the Wrapper?!

An edible solution for wasteful packaging

By Courtney Bricker-Anthony

FOOD PACKAGING AND CONTAINERS ARE STAPLES OF OUR MODERN LIFESTYLE. When you step into your local grocery store, sturdy fruit boxes, small plastic yogurt cups, shiny plastic bottles of salty nuts, and translucent jugs of milk surround you. Food packaging prevents the spread of disease, makes transporting goods easy, and increases shelf life. The benefit of food packaging, however, comes at a cost. Most of it ends up in landfills and pollutes the environment. So, what can we do to stop throwing away massive amounts of food packaging? Some scientists think we should put our money where our mouths are and eat the packaging instead.

Molecular gastronomy has used insights about the chemical transformations of ingredients that occur when cooking food to make wild new concoctions at avant-garde restaurants. But many food scientists say it could do more than just create new takes on gourmet foods.

Entrepreneurs and scientists want to apply the principles of molecular gastronomy to produce edible food packaging and containers.

Café ArtScience and edible skins

David Edwards, a biomedical engineer at Harvard University, is leading the movement to transform food packaging from trash to food. Edwards's restaurant in Cambridge, Mass., Café ArtScience, showcases several of his contributions to food science, including edible packaging.

Café ArtScience offers frozen yogurt encased in WikiCell. WikiCell is a thin, membrane-like substance composed of a mixture of organic molecules derived from foods such as oranges and chocolate. It uses starch, a carbohydrate, as a bonding agent, which is also used in papermaking and pharmaceuticals. Starches convert into a gel or jelly in the presence of water and heat.

Edwards describes the consistency of WikiCell as similar to the skin on a grape. WikiCell is an attractive alternative to traditional food packaging because it has no known negative environmental impact, shields food from bacterial contamination, and appears to provide extended shelf life for food, much like traditional food packaging.

Some critics, have pointed out that these edible skins are still vulnerable to surface contamination by various bacteria in a grocery

In 2013, 36,720 tons of packaging–glass, steel, aluminum, paper, paperboard, and plastic–ended up in landfills. That's the equivalent of about 600 million 2-liter soda bottles!

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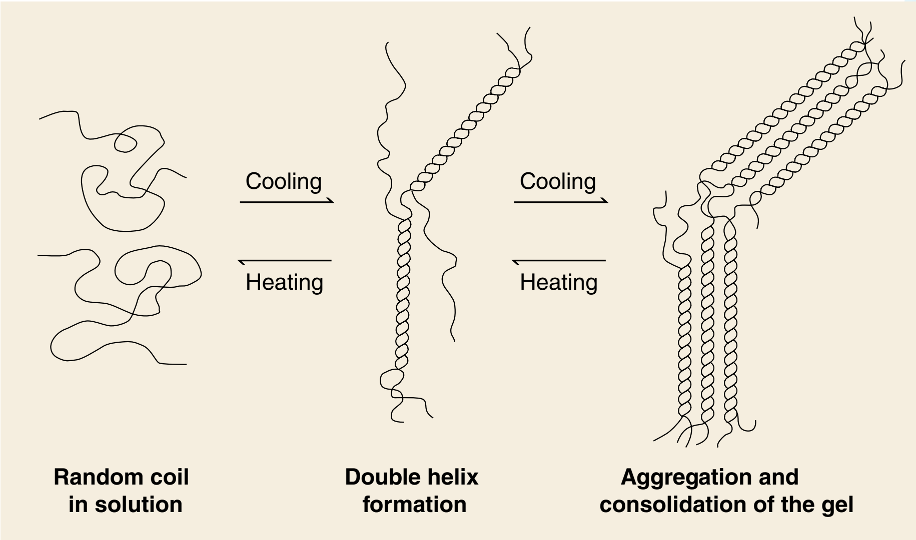

Figure 1. Agar molecules bind together at low temperatures.

store, but this problem can be avoided by placing the skin-wrapped food in biodegradable cellophane. In the future, Edwards hopes to expand the application of WikiCell beyond frozen yogurt to other foods and beverages.

Eating and drinking with LOLIWARE

Disposable cups, bowls, and plates are regularly used at birthday parties, cookouts, and other events. While these items are convenient and help the hosts avoid dealing with piles of dishes, they only add more nonbiodegradable waste to our landfills.

Six years ago, recent college graduates Chelsea Briganti and Leigh Ann Tucker sought to change the way we consume our beverages at parties and other gatherings. “Every year, Americans throw away 25 billion plastic cups that end up in landfills, never to decompose,” Briganti and Tucker said. “We wanted to find a solution.” Thus, LOLIWARE was born. Briganti and Tucker successfully created one of the first edible and compostable cups to replace its plastic and nonbiodegradable counterparts. Compostable materials can be broken down over time by bacteria and fungi.

LOLIWARE cups are made of agar, a substance derived from seaweed that forms a gel in the presence of water. Agar is used in laboratories to cultivate bacterial colonies and in medicine as wound dressing. In molecular gastronomy, agar is used as a jellifying agent for a side dish such as arugula spaghetti.

In hot water, agar forms random coils in solution (Fig.1). In this state, it is easy to put into molds for shaping. As it cools, agar gels because hydrogen bonds cross-link galactan chains (a polysaccharide consisting of galactose monomers). Further cooling consolidates the gel to form a firmer gel that can be dried to create drinking cups.

Because agar is only water soluble at 95–100 °C, LOLIWARE cups are relatively stable and can hold soda until you decide to eat your cup. If you don’t want to eat your cup, it can also be composted to make fertilizer.

Making edible water bottles with spherification

In the United States, plastic water bottles are a huge problem. Every year, we use 50 billion plastic water bottles but only recycle 23% and send the remaining 38 billion water bottles to landfills. This roughly translates to every person in the United States throwing away 119 plastic bottles every year.

Generating new plastic water bottles is also incredibly costly and energy inefficient: The amount of oil consumed to make plastic bottles could fill the gas tanks of 1.3 million cars or power nearly 200,000 homes for an entire year! Last year, the Skipping Rocks Laboratory in the United Kingdom proposed a solution to our costly dependence on bottled water: the Ooho! edible water sphere.

Similar to the LOLIWARE cups, Ooho! edible water spheres use a seaweed derivative called sodium alginate (Fig. 2). However, sodium alginate doesn’t form a gel in response to boiling water. Sodium alginate must undergo a chemical process, called reverse spherification, to form a membrane.

In reverse spherification, calcium lactate (a common salt used in baking agents and dietary supplements) is dissolved in water and added to a cold water bath pre-mixed with

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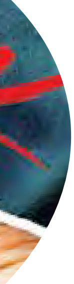
What do the skeptics say?

Many people are skeptical about edible food packaging ever being widely adopted. Sure, the ice cream cones and bread bowls have found their niche, and we eat the skins on apples and grapes, *but come on people!* The plastic isn’t the only reason you don’t eat a water bottle. Think of the filth! The journey from hand to hand. Did everyone (including you) wash their hands properly? Was it stored near or did it ever sit on anything that wasn’t 100% hygienic? Also, if these products are ever sold at grocery stores it will mean selling them with external packaging **(think M&Ms™), completely negating the “package-free” mission.** Why not use biodegradable or reusable packaging and skip the edible packaging?



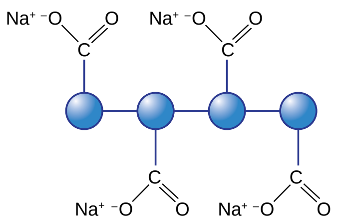


Figure 2. Schematic diagram of sodium alginate

sodium alginate. Calcium ions are divalent and can thus form two bonds. A single calcium ion from calcium lactate can form a bond between two sodium alginate molecules, effectively linking them together (Fig. 3). As calcium ions join the alginate molecules, a solid gel sphere forms around the water in the bath. Since the reaction only occurs in the presence of alginate, you can stop the reaction by simply removing the gel sphere from the solution.

When you want to drink the water from the sphere, all you have to do is pierce the gel with your teeth and pour the water in your mouth. Spherification is a safe-and-easy experiment commonly used by molecular gastronomy chefs, such as Ferran Adria, to make olive oil "caviar" and strawberry sphere.

If these water spheres are widely adopted in the future, we will make a sizable dent in our growing landfill problem.

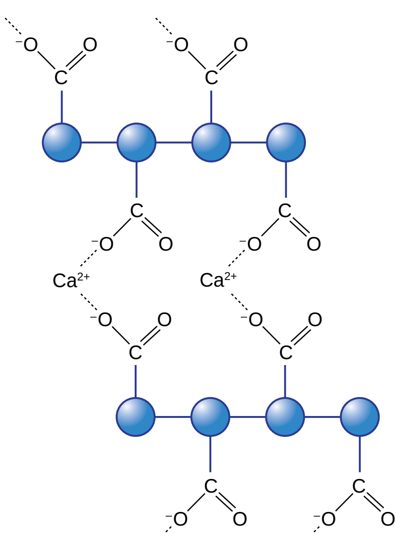


Figure 3. Calcium ions can form multiple bonds with the negative regions of sodium alginate, effectively linking them together and taking the place of the sodium ions.

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Chow down on your cupcake wrapper

Whether your cupcakes are homemade or purchased from a local bakery, they are always wrapped in paper. The paper wrappers from your cupcakes, pastries, chocolates, and other confections always end up in the garbage and contribute to the 9,610 tons of paper packaging and containers entering landfills every year. If you want to stop adding paper waste to our landfills and save some trees, try using edible paper next time you make cupcakes.

Many baking-supply companies have experimented with making edible baking paper as a green alternative to traditional paper. This edible paper is usually produced with rice or tapioca, both of which contain large amounts of starch. Paper is commonly made from plant material, specifically a tough, fibrous material known as cellulose. When chopped up and soaked, the tiny fibers link to each other via weak intermolecular attractions called London Dispersion forces. Both cellulose and starch are natural polymers made of glucose monosaccharides. The main difference is how they are linked to each another. Humans lack enzymes to digest cellulose, but we can digest starch. Starch paper is composed of **amylose** (linear chains of glucose molecules) and **amylopectin** (branched chains of glucose). These can cross-link to form a delicate and edible paper.

You can still take advantage of starch's properties to easily make your own edible paper for cupcakes, spring rolls, or other foods at home.

The future of food packaging

In addition to edible packaging, compostable and biodegradable packaging is also replacing traditional food packaging. Companies such as Eco-Products offer a variety of plates, cups, bowls, and flatware that can be sent to compost facilities where they rapidly degrade into a compost that can be used to enrich soil.

Another company, Ecovative, recently introduced compostable food and materials packaging made from mycelium, the dense, vegetative main body of mushrooms. Cellulose, starches, and polyesters produced by bacteria can also be used to make biodegradable plastic bags and wrappings.

Molecular gastronomy stands to make a substantial contribution to food-packaging waste reduction. If edible water bottles, WikiCell, LOLIWARE, and edible paper become more widely used we might eventually phase out plastic, paper, glass, and aluminum. Reducing landfill mass is important for our future, and perhaps this is one problem we can eat our way out of! CM

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