Make Whey for Progress

New Uses for Dairy Byproducts

The average American consumes more than 30 pounds of cheese every year. Every pound produced creates an estimated 9 pounds of whey, the liquid byproduct that remains after the curds, or solids, coagulate.

Where does all the whey go? It's used in a range of products such as candy, pasta, baked goods, animal feed—and even pharmaceuticals.

Since its inception, ARS's Dairy Processing and Products Research Unit at the Eastern Regional Research Center (ERRC) in Wyndmoor, Pennsylvania, has investigated uses for whey and other dairy byproducts. Today, thanks in part to ERRC research, cheesemakers have markets for over 1 billion pounds of whey every year.

PEGGY GREB (D793-1)

Food technologist Charles Onwulata inspects molded dairy bioplastic made from surplus whey proteins.

New research shows that whey can also be used to create eco-friendly products. For example, using a process called "reactive extrusion," food technologist Charles Onwulata supplements polyethylene—a common non-biodegradable plastic—with whey proteins.

Reactive extrusion involves forcing plastic material through a heating chamber, where it melts and combines with a chemical agent that strengthens it before it's molded into a new shape. Onwulata showed that by combining dairy proteins with starch during this process, it's possible to create a biodegradable plastic product that can be mixed with polyethylene and molded into utensils.

Working with laboratory chief Seiichiro Isobe, of the Japanese National Food Research Institute, Onwulata created a bioplastic blend by combining whey protein isolate, cornstarch, glycerol, cellulose fiber, acetic acid, and the milk protein casein and molded the material into cups. Onwulata observed that dairy-based bioplastics were more pliable than other bioplastics, making them easier to mold.

Bioplastic blends can replace only about 20 percent of the polyethylene in a product, so resulting materials are only partially biodegradable. But Onwulata and his colleagues are currently applying this process to polylactide (PLA), a biodegradable polymer.

"Blending dairy-based bioplastics with PLA could eventually allow producers to make completely biodegradable materials," he says.

In a separate project, research leader Peggy Tomasula and her colleagues have developed technology to create biodegradable films from byproducts of both dairy processing and biofuels production. Tomasula found that combining casein with water and glycerol—a byproduct of biodiesel production—produces a water-resistant film that can be used as an edible coating for groceries and other products.

"We use carbon dioxide as an environmentally friendly solvent to isolate dairy proteins from milk, instead of harsh chemicals or acids, which can be difficult to dispose of," Tomasula says. Carbon dioxide is a byproduct of the glucose fermentation that is used to make ethanol, and she says it makes the edible film more water resistant.

The resulting food coatings are glossy, transparent, and completely edible. Like traditional food packaging, edible films can extend the shelf life of many foods, protect products from damage, prevent exposure to moisture and oxygen, and improve appearance. By using renewable resources instead of petrochemicals, the scientists can create more biodegradable products and reduce waste.—By **Laura McGinnis,** ARS.

This research is part of Quality and Utilization of Agricultural Products, an ARS National Program (#306) described on the World Wide Web at www.nps.ars.usda.gov.

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