Clean Eating A Possibility With Food Sterilization System

Washington State University Office of Commercialization

After decades of food trends and practices have made the American diet less nutritious and overly dependent on processed foods, a refreshing new movement is afoot: clean eating.

Consumers are increasingly looking for ways to eat clean by incorporating fresher, more natural foods into their diet and eliminating highly processed foods laden with additives and preservatives. Startup company 915 Labs of Colorado is hoping to play a major role in the clean eating movement by harnessing a new and healthier way to process and package foods developed at Washington State University (WSU).

The new sterilization method, called microwave-assisted thermal sterilization (MATS), is drastically different than conventional food processing, a process that has remained virtually unchanged for more than 100 years. Historically, food has been vacuum packed in a can or pouch and placed in a pressurized cooker at temperatures above 250 degrees for up to an hour.

> *Conventional thermal processing was invented for all the right reasons, so that pathogens would be removed from our food, but it also causes significant damage to the flavor, texture, color and*

> *nutritional content of food.*
>
> Michael Locatis, CEO of 915 Labs

"This forces food companies to use additives to mask that damage," says Locatis, adding, "There are more than 3,000 FDA-approved food additives to compensate for flavor and texture lost during processing."

In contrast, the MATS technology invented by WSU's Juming Tang, Ph.D., eliminates food pathogens and spoilage microorganisms in just 5 to 8 minutes by immersing packaged food in pressurized hot water and simultaneously heating it with microwaves at a frequency of 915 megahertz (MHz), which penetrates food more thoroughly than the 2450 MHz used in home microwave ovens.

"When you shorten cooking time, you retain more nutritional value," says Tang. "You produce a product that is more appealing to the consumer."

Adds Locatis, "MATS has a light touch on the food product. It gives the culinary experts a chance to pull the junk out."

The Problem With Processed Foods

Commercial packaging has become a mainstay of the food industry by facilitating the safe, convenient and cost-effective distribution of produce and other food products while extending their shelf life. Yet despite its contributions to food safety and security, conventional thermal processing has significant downsides.

Highly processed foods — or those processed to such an extent that they offer minimal nutrition along with high levels of oils, sugar, sodium and other additives — are under increasing scrutiny today for the role they play in unhealthy diets and growing rates of obesity and diabetes.

According to a 2014 statement issued by the American Society for Nutrition (ASN), processed foods contribute 52 percent of saturated fat, 75 percent of added sugars and 57 percent of sodium in the American diet. To meet its dietary guidelines, the ASN encourages consumers to limit their intake of fat, sugar and salt and to eat nutrient-dense foods — whether processed or not.

MATS packaging technology enables food packagers to accomplish both objectives: its minimal processing time allows foods to retain their color, texture and flavor while eliminating the need for added preservatives.

Making a Big Impact

Tang didn't set out to revolutionize food processing.

"I fell into food by accident," says Tang, who holds a bachelor's degree in mechanical engineering in addition to master's and doctoral degrees in agricultural engineering. His first job, as an assistant professor in the School of Food Science and Human Nutrition at Acadia University in Canada, brought him into food engineering teaching and research. He joined WSU in 1995.

"When I came to WSU, my department chair told me to start an ambitious project that would have a huge impact," he says.

After attending a meeting of the International Microwave Power Institution, Tang decided to tackle a technical challenge that has long prevented the food industry from exploiting the rapid heating capabilities of microwaves: ensuring uniform and reproducible heat treatment.

“As an engineer, I could design things and I know a lot about math,” he says. “And microwaves require a lot of mathematical computations.”

Making Better MREs and Mac and Cheese

By 1998, Tang’s MATS research attracted funding from the U.S. Army and Kraft Foods, which were looking to improve military rations, or meals ready to eat (MREs) and macaroni and cheese, respectively. He was then selected as a grant recipient of the U.S. Department of Defense Dual Use Science and Technology (DUST) Program, which helped create a consortium of private companies in the food packaging and equipment sectors.

“Our goal was to develop a commercially viable technology to produce military rations and food for the consumer market,” says Tang.

The WSU-led Microwave Sterilization Consortium included U.S. Army Natick Soldier Center and a variety of prominent food and packaging companies, including Kraft Foods, Hormel, Ocean Beauty Seafoods, Rexam Containers and Graphic Packaging. In total, the DUST grant and consortia members contributed millions of dollars in funding and expertise to the development of MATS.

Tang designed the MATS system to use a combination of microwave heat and a hot water tunnel to very rapidly heat packaged food to sterilization temperatures and hold it at the appropriate temperature for a minimum amount of time before very quickly cooling it down. Packaged food sterilized with the MATS prototype system showed minimal heat damage and retained its original quality.

In 2006, WSU patented the design for the 915 MHz single-mode MATS technology for producing prepackaged, low-acid foods. It took another three years to develop a semicontinuous system and collect the engineering data required to file for acceptance from the U.S. Food and Drug Administration (FDA), which was received in 2009 (to MATS-process mashed potatoes). In 2010, the FDA accepted a MATS process for salmon filets in sauce.

“The FDA requires demonstration of engineering and scientific principles and evidence that the technology can produce a safe product,” says Tang. “Before us, no food packager using microwaves for low-acid foods had received FDA acceptance.”

In 2010, WSU licensed the MATS technology — and a companion technology for pasteurizing liquids, microwave-assisted thermal pasteurization (MAPS) — to a startup company called Food Chain Safety, which was purchased by 915 Labs in 2014.

“Juming is one of our most prolific inventors,” says Michael Harpen, J.D., technology licensing associate in WSU’s Office of Commercialization. “There are a small percentage of patents that make more than $1 million in royalties in their lifetime, and this has the potential for that.”

Collaborating for Technology Transfer

Locatis says Tang’s success and the progress made by 915 Labs is a testament to some extraordinary teamwork among academia, government and industry.

“WSU has been a terrific partner,” says Locatis. “There’s a tremendous push to see more GDP activity in the transfer of federally funded research to improve the supply chain of ideas. There are incredible lessons to be learned from tech transfer.That’s why 915 Labs is such a good case study.”

This year, 915 Labs expects to begin building its first full-scale commercial sterilization system, called the MATS-150, for delivery in 2017. Additional orders for the MATS-150 system, which is capable of processing 150 food packages per minute, are pending around the world, and the Australian Department of Defense has specified the technology for the production of its MREs.

To build the MATS system, Locatis says the company has identified world-class providers of the various components in Tang's prototype, including the microwave system, conveyer and automation, pressurization vessel, and control systems. A typical multi-ingredient food product undergoing MATS sterilization is placed in a special container, such as a rigid plastic tray, a meal-divided tray or flexible pouch, all of which are sold by 915 Labs. The food is then mixed or homogenized and sealed. The oxygen-free container is then placed into an automated carrier tray and transported through the microwave system and on to packaging for shipping.

Testing Recipes

915 Labs has also built and placed small versions of the sterilization system, called MATS-B, in two processing and packaging companies: AmeriQual and Wornick Foods, both of which prepare MREs and food products for commercial companies. In addition to conducting their own testing with the MATS-B system, AmeriQual and Wornick are allowing outside food companies to schedule time in their food labs to experiment with the sterilization system.

"Major food companies are anxious to transform existing food brands and to launch new, natural brands with the help of MATS processing," says Locatis. "These MATS-B systems allow chefs and culinary experts to work on recipes and obtaining FDA acceptance [for individual food products]. MATS liberates chefs and culinary experts and enables them to achieve clean labels."

Locatis says more MATS-Bs are on order and food brands and food co-manufacturers around the world have expressed interest in obtaining MATS-B systems for their food labs. 915 Labs also hopes to place a MATS-B system at WSU to support Tang's ongoing research, which currently expands the application of microwave technology to control pathogens in frozen and chilled meals with the help of a $5 million USDA Agriculture and Food Research Initiative grant.

"We appreciate what Dr. Tang has brought to the world and as we become successful, we want to make sure he remains successful," says Locatis.

Wide Range of Applications for MATS

The appeal of food processed with MATS is wide-ranging, from the armed forces and humanitarian agencies to third world countries plagued by famine and food wastage. Here in the United States, Locatis says MATS will help food companies scrambling to respond to consumers' growing distaste for processed foods.

"The big food companies are astute, they are in touch with their customers and they want to do the right thing," says Locatis. "Until now, they couldn't because of processing issues."

Microwave sterilization opens up the possibility of processing a wide range of foods — from tender spears of asparagus to spicy Indian dishes to gourmet foodstuffs. With the help of MATS, modern food processing and packaging — already a cost-effective means of making food readily available — has the potential to provide a greater variety of healthful, additive-free foods.

"In the past, you couldn't have a clean label, quality and convenience," says Locatis. "With MATS, you can have all

three."

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