MEATINGPLACE

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Hip to HPP

Photo courtesy of Avure Technologies Inc.

Hormel does it. Cargill too. High-pressure processing's benefits are many, its drawbacks few, and it may have a deeper impact on food safety in meat products than previously realized.

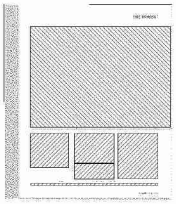
By Michael Fielding, managing editor of technical content

Just a few years into the commercial development of high-pressure processing (HPP) for meat, companies are using it for a host of benefits in making everything from deli meats to hamburgers.

"It's such a simple process," says James Marsden, professor of food safety and security at Kansas State University. "The theory was always there, but to do it in large batches and control the process — it just took time to make it practical." (See sidebar, page 38.)

High-pressure processing (also known as high hydrostatic pressure for its use of pressurized water vessels) offers a variety of benefits: It inactivates pathogens; it allows for higher retail margins in the migration from the frozen case to the fresh case; it's categorized under "natural" and can be labeled as such; and it doubles the product's shelf life. Now come hints from recent research that HPP may even be useful for reducing the effects of allergens — a boon for processors making all kinds of value-added products and meals.

"Most allergens are protein-based, and



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the pressure can denature proteins," explains V.M. Balasubramaniam, associate professor of food safety engineering at The Ohio State University.

NO OVERNIGHT SUCCESSES

The industry didn't get here overnight, though. It's taken years of development to create a practical use for high-pressure meat processing — with whole muscle meat but especially with ground beef.

Hormel, for example, spent about six years developing its own patented HPP. The company now uses HPP for Hormel Natural Choice meat products, which hit retail markets in 2006. "After we identified a consumer trend toward products that contain no preservatives or synthetic or artificial ingredients, we started testing various products that were enhanced with HPP," says Phillip L. Minerich, vice president of research and development at Hormel Foods.

Hormel isn't the only processor to successfully build an in-house HPP system: Cargill uses the technology to treat ground beef, in the first such HPP application in the commercial market. The goal was to extend shelf life while retaining flavor and other attributes.

Cargill's recently commercialized Fressure ground beef products are made in its Columbus, Neb., facility and treated near Milwaukee, says Jan Hood, senior product manager for Cargill's Value-Added Meats – Foodservice business.

Cargill, which had been sending roast beef to a contract HPP processor in Milwaukee since 2004, eventually started experimenting with ground beef. "We know HPP works for other fresh foods, so the key to our success was developing a process that would retain the attributes our customers and consumers expect with fresh ground beef," explains Mike Martin, Cargill's spokesman. "It was not so much hits and misses as it was experimentation and research."

PATHOGENS, CHECK. ALLERGENS?

The meat industry has a remarkable record of reducing pathogens — without HPP in most cases. Yet since most recalls have been associated with allergens, the role of HPP in allergen reduction has begun to turn heads.

"The initial driving factor was food safety, but now retention of nutrients and the reduction of allergens can be other attractions," Balasubramaniam says.

But its role in reducing the allergenic affects of foods hasn't been extensively tested, and some products — such as peanuts — just won't work unless they contain high amounts of water.

Although the study of HPP on allergens is about as old as the use of the technology in the meat industry, research has been limited and in most cases directed at pathogen reduction instead. But the research that does exist offers tantalizing insight into the expanded potential of HPP. Back in 2005, German researchers studied the antigenic response of bovine ß-lactoglobulin (ß-lg, a major cow's milk allergen) to high pressure. They found that HPP changes the protein structure and concluded that it may influence the antigenity of ß-lg.

High pressure may not reduce all allergens, though. Scientists from the Structuring Food for Health Program at the UK's Institute of Food Research reported in the July 2010 edition of *Molecular Nutrition and Food Research* journal that a combination of high pressure and temperature at 20°C did not change the structure of peanut proteins Ara h 2 and Ara h 6 (the two most frequently recognized peanut allergies in children).

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More recently, British researchers at the Institute of Food Research subjected celeriac (a root vegetable whose allergenic properties are associated with some types of pollen allergies) to thermal and high-pressure processing to determine the impact on its immunoreactivity. In May 2011 they reported that the celeriac allergen Api g 1 lost immunoreactivity under a combination of high pressure and temperature. In other words, the treatment reduced the food's ability to cause an allergic reaction.

The technology even has piqued the interest of the USDA, which in April 2011 launched a five-year project to study the effects of a variety of processes (HPP among them) on reducing the allergenic qualities of foods. Although it's too early to tell just how effective HPP is on allergens, the researchers expect to at least reduce the allergenic potency of foods. "It is possible that high-pressure treatment will unfold the allergens," says Soheila J. Maleki, a research chemist with the department's Food Processing and Sensory Quality Research division. "We have preliminary data that suggests unfolding of the allergenic proteins significantly reduces their recognition by allergic antibodies (IgE) obtained from blood of patients."

HPP = HIGH-PRICED PROCESSING?

HPP, however, isn't exactly plug-and-play. The testing and development process, for example, wasn't smooth, Hormel's Minerich reports: "We worked with our packaging suppliers to modify some of the packaging structures so that they could withstand the HPP process. Our meat and food scientists worked together to develop a sliced product that would maintain their peelability attributes after the HPP treatment."

And for the time being, Cargill's Fressure line is limited to foodservice customers. After HPP, raw ground beef is vacuum-packed; deprived of oxygen, the meat does not have the red hue that consumers associate with freshness and taste.

"We expect it to be some time before raw meat is produced using HPP and made available in retail stores on a large-scale basis," Minerich says. After a raw meat product is cooked, however, there is no noticeable difference in the color of the product, "which is why selling the fresh meat concept to foodservice customers will more than likely be the first point of entry into the market."

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Then there's the price. No matter where it's processed — or by whom — the cost difference between thermally processed products and those treated under high pressure typically ranges from 3 cents to 10 cents per pound.

"With the cost of beef to foodservice operators, they have to have the value proposition that warrants the additional cost," Cargill's Hood explains. "Part of it is weighing the spoilage against increased costs. You could more than offset your cost of what you're throwing away by paying a little more for your product for a longer shelf life."

Large processors like Cargill and Hormel seem to be at an advantage over smaller processors by creating their own in-house HPP products, though. The cost of installing an in-house HPP system for most processors is prohibitive at $500,000 to $2.5 million for purchase — not including installation.

For now, contract processors, or toll processors, fill the gap. Although just a handful of toll processors exist in the United States, they've capitalized on the need to treat product and ship it directly to their customers' customers and distributors.

"Operating the equipment is easy; maintaining it is another issue. With lots of seals and tubing, it's maintenance-intensive," explains Ed Wabiszewski, vice president of American Pasteurization Company (APC), a toll processor that operates out of a 25,000-square-foot facility north of Milwaukee.

VALIDATION

APC is the first company in the nation to offer HPP on a commercial tolling basis, treating pre-packaged foods with HPP in addition to labeling, packing and shipping directly to end-users. An important aspect to the relationship, though, is the fact that it's up to the customer — the processor — to validate the process with pressure and hold time specification. That is, the higher the pressure and longer the hold time, the more effective the pathogen inactivation, but the cost also goes up with such processing parameters.

"It's important for the customer to validate the reasons for using high pressure. If it's to increase shelf life, maybe 87,000 psi for a minute is good enough," says Greg Zaja, APC vice president. "But the industry standard to inactivate pathogens is 87,000 psi for three minutes. You do that, and you inactivate listeria at least 4.5 logs."

"It's a large investment for those vessels," Hood adds. "You've got to see if your marketplace will be interested in it, and toll processors are a good way to do that with limited investment."

Some estimates place the payback on capital expenditures for in-house systems at up to 30 years. That's a long time for a processor that doesn't have a full product line dedicated to HPP.

"Cost is relative to risk, and with the number of toll facilities available today, we think using HPP is nearly cost-neutral for all processors who employ this technology," Minerich says.

OTHER APPLICATIONS

Despite interest in other novel applications of HPP (such as whole-carcass processing), "the gold standard without a doubt is post-packaging. Once it's in the package, it can't be re-contaminated again," Wabiszewski says.

Still, the potential for other applications are great. Most processors have used it for RTE meat, but there's a whole market for treating raw meats. It also may help extend the shelf life of microwave meals without the use of salt.

And yet, some experts are urging the industry to take a step back.

"People are seeing the trees and missing the forest," Marsden says. "Up until now we were limited to two types of pasteurization technology: heat and irradiation. Period. This is consumer-friendly, and it doesn't really change the food. Very delicate food products can be treated, and they're not changed. The big picture is that we have a whole new way to pasteurize food products."

'IT'S SUCH A SIMPLE PROCESS. The theory was always there, but to do it in large batches and control the process — it just took time to make it practical.'

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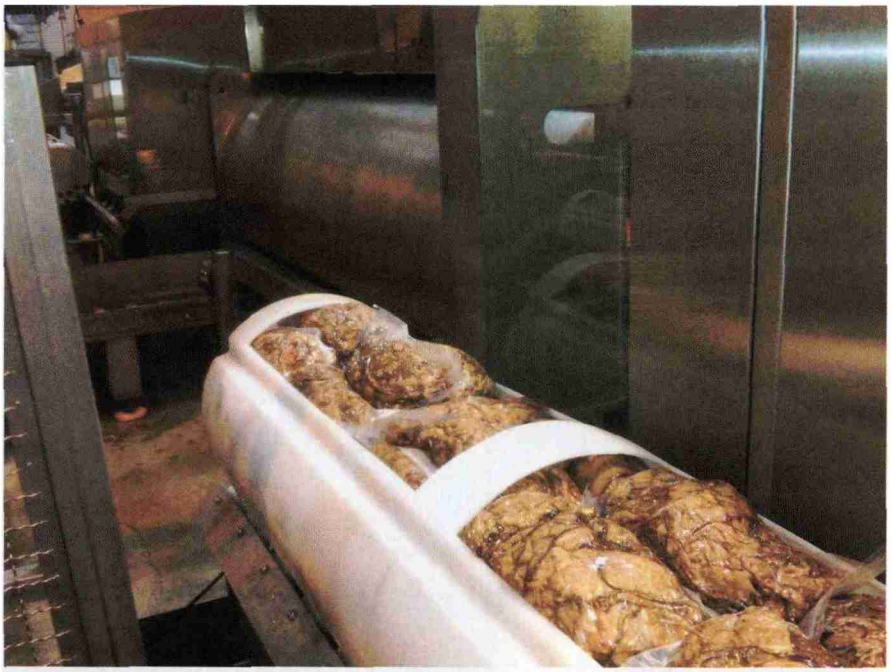
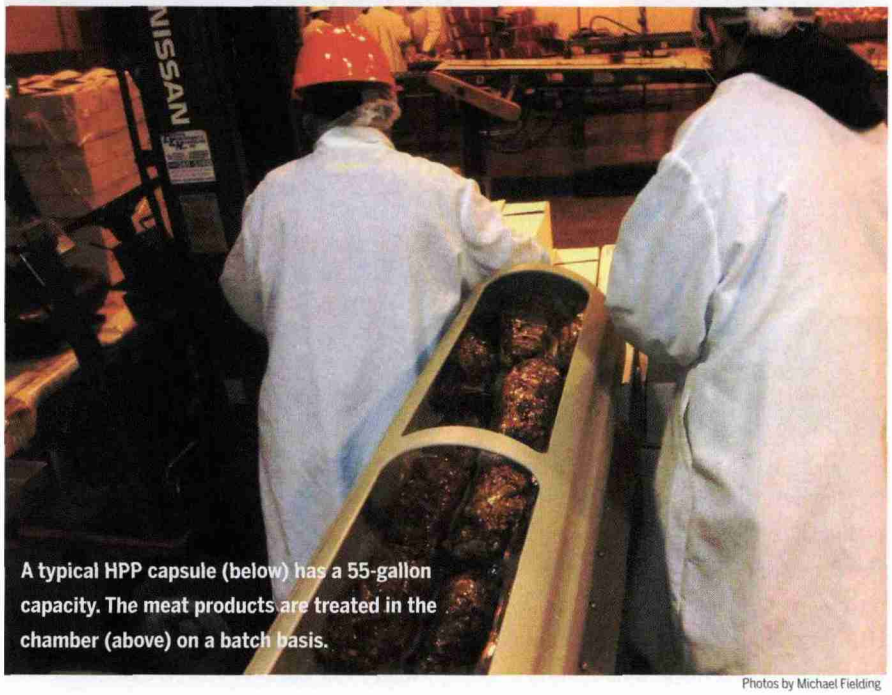
For HPP business strategies, join our webinar in September. Also see our related technical articles at: http://meatm.ag/pqj6W5 and http://meatm.ag/pfmnu1.





A typical HPP capsule (below) has a 55-gallon capacity. The meat products are treated in the chamber (above) on a batch basis.

Photos by Michael Fielding

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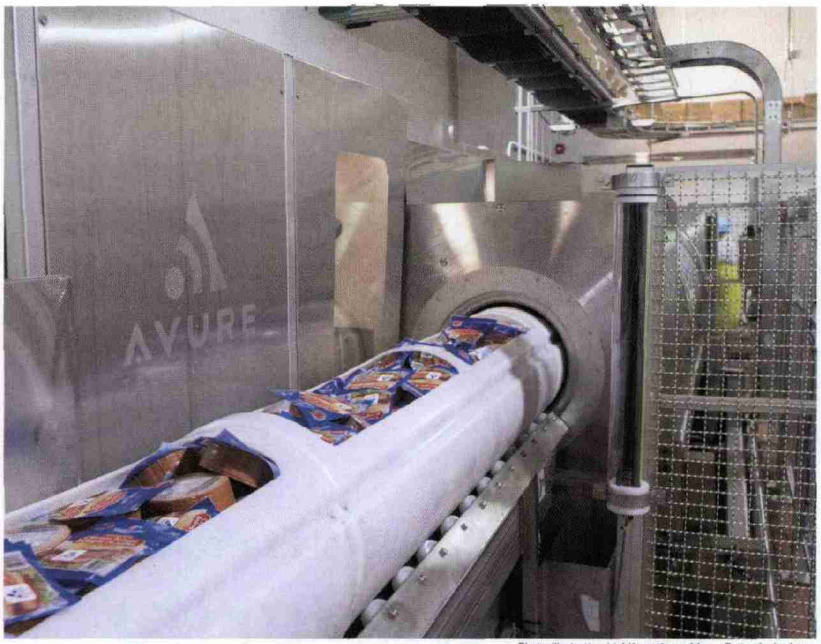
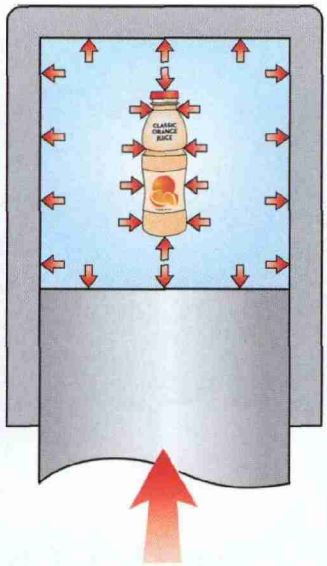


Photo, illustration (right) courtesy of Avure Technologies Inc.



For a closer look at how HPP works, as well as exclusive videos, visit http://www.tk.com.

How it works

High-pressure processing (or high hydrostatic pressure) is a batch process by which food (usually packaged food that's ready for distribution) is placed into a chamber (which typically has a 55-gallon capacity) that is filled with water and pressurized (on average around 87,000 psi) with a pump for a specified amount of time (usually 3 to 5 minutes). Since the pressure is applied uniformly, the food retains its shape.

Sterilization requires a pressure of 101,000 psi at 249°F for 3 to 5 minutes. The specifications are slightly lower for pasteurization, which requires 87,000 psi under ambient temperatures for 3 to 5 minutes or 72,000 psi in addition to mild temperatures not exceeding 122°F.

Not all food is suitable for HPP, though. The food must contain water and not have internal air pockets (such as strawberries). Dry solids that don't have sufficient moisture also aren't suitable, since the pressure will not be effective in microbial destruction.

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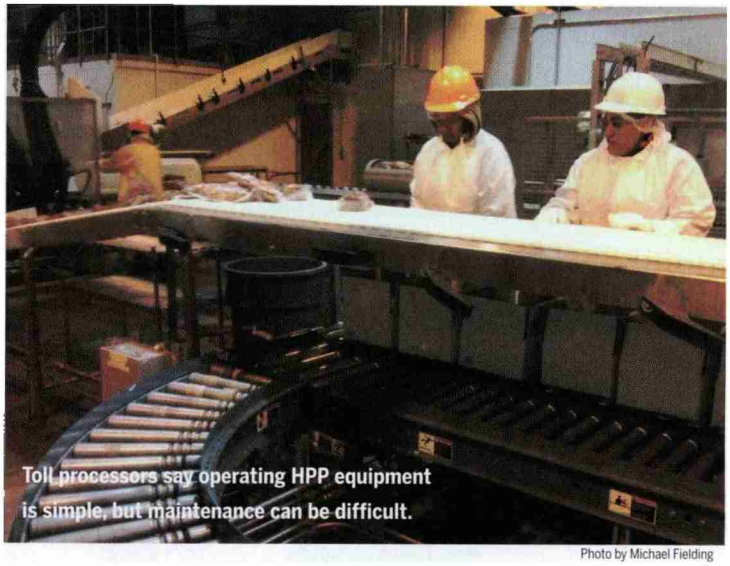

Toll processors say operating HPP equipment is simple, but maintenance can be difficult.

Photo by Michael Fielding

Each batch of HPP-treated products is removed from the vessel (left), unpacked onto a conveyor, and re-packed for shipping.

Photo by Michael Fielding