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# The Role of Technology in Food Safety

**High-Pressure Processing, Food Safety,  
Increased Shelf Life and Nutritional Value:  
The Benefits of a New Technology  
in a Changing World**

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While American consumers today have access to food that is - without question - the safest in the world, recent food scares from lettuce, spinach and pet food poisonings along with massive beef recalls have reduced consumer confidence in food safety to an all-time low. According to the latest "US Grocery Shopper Trends" survey from Food Marketing Institute (FMI), Arlington VA., from 1996 to 2006, 82% of consumers reported they were "completely" or "mostly" confident about food safety. One year later in 2007 that number dropped nearly 20% to 66%.

Food-borne pathogens such as *Listeria monocytogenes*, *Salmonella*, and *E. coli* O157:H7 continue to pose a significant threat to public health—at great cost to our nation's food producers and consumers. The cost of managing food-borne disease outbreaks may be as high as \$23 billion yearly, according to recent data from the centers for Disease Control and Prevention (CDC).<sup>1</sup> Consider the impact of the following food contamination outbreaks:

- In 1998, a nationwide outbreak linked to hot dogs contaminated with *Listeria monocytogenes* killed 21 people, and sickened another 100.<sup>2</sup>
- In 1999, unpasteurized orange juice contaminated with *Salmonella* resulted in 423 illnesses;<sup>3</sup> a few years earlier, apple juice contaminated with *E. coli* O157:H7 resulted in the death of a child.
- Between 1990 and 2000, oysters and clams have caused 2,136 illnesses nationwide due to a variety of pathogens, primarily Norwalk virus and the *Vibrio* bacteria.<sup>4</sup>
- In 2002, a record-breaking 27.4 million pounds of ready-to-eat turkey deli products were recalled due to *L. monocytogenes* contamination. The outbreak, traced to a single production facility, caused 7 deaths and 47 illnesses.<sup>5</sup>

In addition to encouraging the implementation of an active intervention method as a step within HACCP plans, industry and government should join forces to educate consumers about food safety—while respecting the right of the consumer to make decisions about the products they purchase and the technologies used to make these products safe.

How can consumers be better protected from food-borne pathogens? How can food producers significantly improve food safety and deliver the highest quality products? Although no single approach will address all of the nation's food safety and security challenges, the technology exists today to make foods safer.

The most time-honored approach to killing bacteria involves the use of high temperatures, or so-called "thermal processes." While heat pasteurization and cooking are very effective in destroying bacteria, the use of high temperatures can also destroy some of the important characteristics of food—including the flavor, texture, color, and nutrition. Other methods of controlling food-borne pathogens involve the use of chemical additives and preservatives. These, however, may have undesirable effects on the quality of food.

## **HPP: a safe and effective technology to combat food-borne pathogens**

Another approach to food quality, safety, and security, which scientists have recognized and studied for the past hundred years, has been commercialized as an effective means to destroy food-borne pathogens such as *E. coli* O157:H7, *Listeria monocytogenes*, and *Salmonella*. This technology, known as high-pressure processing, or HPP, uses physical pressure rather than heat, chemicals, or irradiation to make foods safer while conserving the desirable characteristics of the food. Because it does not involve the use of high temperatures, HPP is frequently described as a "non-thermal" method.

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<sup>1</sup> "HACCP: A View to the Bottom Line," unpublished paper by Larry Keener, April 2002

<sup>2</sup> CDC

<sup>3</sup> CDC

<sup>4</sup> Center of Science in the Public Interest, August 2000

<sup>5</sup> CDC

Over the past 20 years, using advanced engineering methods, domestic and global companies have begun to refine and commercialize high-pressure processing. Today, HPP has clearly demonstrated its ability to destroy harmful food-borne pathogens and extend the quality of a wide range of foods. HPP equipment is now manufactured in the United States and Europe. As a result, food manufacturers are increasingly turning to HPP to make food safer as well as to extend both quality and shelf life and create all-natural, preservative-free products. In fact today the retail market for HPP foods is estimated to be approaching \$2 billion annually.<sup>6</sup>

HPP works by subjecting food to extremely high hydrostatic pressure—up to 87,000 pounds per square inch (psi). While HPP does have its limitations—for example, products high in air content such as bread cannot be processed with HPP—it has significant advantages and works most effectively on foods that are high in liquid content. Ready-to-eat meats (cold cuts), fresh juice, prepared fruits and vegetables, smoked fish, picked crabmeat and oysters are a few examples of products that can benefit from HPP.

Covalent bonds are not broken during HPP, and as a result, no free radicals or chemical by-products are formed. Although no direct evidence exists to show that the free radicals produced by irradiation or high temperature cooking are dangerous, free radicals remain a public concern. In addition, HPP does not “add” anything to food. As a result, neither the U.S. Food and Drug Administration (FDA), nor the U.S. Department of Agriculture’s Food Safety Inspection Service (FSIS) require approval of high-pressure processing.

What makes HPP effective at improving the safety of certain foods? HPP works because uniform high pressure affects microbial cellular integrity and metabolism without affecting the covalent structures of food components responsible for nutrition and flavor. The effectiveness of HPP doesn’t depend on the size or thickness of the food item—its impact is instantaneous and uniform throughout the product, whether it’s a one-pound package of sliced chicken meat or a six-pound prosciutto ham.

As a food safety technology, HPP offers food manufacturers another means of meeting the FDA’s food safety requirements, while still maintaining the highest quality food product possible. For example, when used as an active intervention step within a HACCP plan, HPP can achieve greater than the 5-log reduction of food-borne pathogens as required by the FDA’s new Juice HACCP Rule<sup>7</sup> without heat pasteurization of the juice.

HPP can also be used as an active post-harvest intervention step to increase the safety of raw shellfish from potential *Vibrio* bacteria contamination. As new applications and benefits of HPP are developed, the food industry as well as the FDA and USDA are actively investigating the potential benefits for broad commercial use.

Avure Technologies Incorporated, the global leader in high pressure technology has taken the HPP concept and commercialized it. Today Avure manufactures a wide range of HPP systems for laboratory, pre-production and full production use along with specialized systems available for the seafood industry. The company, through its food laboratory, assists customers with HPP recipe and packaging development as well as regulatory approval. It has also secured a number of HPP process patents. As of April 2008, Avure had supplied over 50% of the world’s HPP commercial capacity, more than all other vendors combined.<sup>8</sup>

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<sup>6</sup> Avure Technologies estimate

<sup>7</sup> DEPARTMENT OF HEALTH AND HUMAN SERVICES Food and Drug Administration 21 CFR Part 120; Hazard Analysis and Critical Control Point (HACCP); Procedures for the Safe and Sanitary Processing and Importing of Juice; Food and Drug Administration, HHS

<sup>8</sup> Avure Technologies internal research

## Consumer acceptance of HPP technology

Proprietary research shows that high-pressure processing ranks higher in consumer acceptance than most other food safety methods, including irradiation. According to several research studies, consumers feel most comfortable with a process that does not add anything to the food they are eating.<sup>9</sup> Consumer acceptance was further tested in June 2000, when the Seattle-based research firm, TRD Frameworks, conducted research designed to measure consumer reactions to high-pressure processing. TRD Frameworks conducted phone interviews with 500 randomly selected primary shoppers across the United States.

Based on these interviews, overall reaction to high-pressure processing was very positive, with more than 70 percent of consumers rating the technology between 6-7 on a 1-7 scale. The most important benefit of the technology, consumers reported, is its ability to keep food safe while maintaining original product quality. Subsequent research, conducted in 2001 by GMA Research Corporation of Bellevue, Washington, indicates that food executives responsible for quality assurance and food safety feel that negative consumer perceptions of irradiation constitute a "barrier to acceptance" of irradiation and open the door to a more consumer-friendly technology.<sup>10</sup>

Nationally recognized companies including Hormel Foods Corporation (prosciutto ham and other RTE meats), Perdue Farms (poultry), Avomex (guacamole, salsa, avocado pieces, juice, ready meals), Calavo (avocado products), Leahy Orchards (applesauce), Winsoms of Walla Walla (chopped onions), Motivatit Seafoods, Nisbet Oyster Company, Joey Oysters (oysters), and others have installed Avure HPP equipment in their manufacturing plants to produce safe, high-quality foods. HPP products are also being produced internationally in Europe, Japan, Australia, New Zealand, and Korea.

HPP has been demonstrated to be successful with the following product categories:

**Ready-to-eat meats and poultry:** HPP is effective in destroying *Listeria* in ready-to-eat meats such as sandwich meat, sausage, and other packaged deli cold cuts. HPP reduces *Listeria* in these products without subjecting the products to post-packaging reheating or ionizing irradiation. HPP does not promote the formation of the free radicals that lead to the loss of desirable sensory qualities such as moisture or flavor. With HPP the product remains fresher and retains its flavor.

**Seafood and molluscan shellfish:** HPP is effective in killing the dangerous *Vibrio* bacteria often found in raw shellfish without destroying texture and taste. HPP offers the added benefit of separating the shellfish or crustacean meat from the shell. This is a significant economic benefit to shellfish processors. HPP also kills *Listeria* and extends the refrigerated shelf life of smoked fish, picked crabmeat and other seafood products.

**Fruit and vegetable products:** HPP can kill potential food-borne pathogens and extend refrigerated shelf life in fresh salsa, dressing, guacamole, and other value-added fruit and vegetable products.<sup>11</sup>

**Juice:** HPP can produce fresh-tasting, safe juice, while also extending its refrigerated shelf life. Scientific data shows that food pathogens such as *Salmonella*, *L. monocytogenes*, and *E. coli* O157:H7 are effectively destroyed by HPP without changing the juice's fresh, natural characteristics. HPP can achieve a greater than 5-log (100,000 times) reduction of the pathogens of concern in fresh juice, and is recognized as a viable technology for the FDA's 5-log pathogen reduction in fruit juice and cut fruits. Similar approvals have been granted in Europe, Canada, and other countries.

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<sup>9</sup> Irradiation Conference Report

<sup>10</sup> "Food Safety Technology Study", conducted by GMA Research Corporation, Bellevue, WA, 2001

<sup>11</sup> Numerous studies have been conducted on HPP bacteria inactivation in foods. For example, Raghubeer, R., Dunne, P., Farkas, D., Ting, E.; "Evaluation of Batch and Semicontinuous Application of High Hydrostatic Pressure on Foodborne Pathogens in Salsa", *Journal of Food Protection*, Vol. 63, No. 12, 2000.

## **Conclusion**

As a food safety and food security technology, HPP offers three basic benefits:

- **Safety**

HPP provides an effective means of combating food-borne pathogens. Nothing is added to the food during the HPP process.

- **Quality**

HPP preserves the quality without impacting the sensory characteristics and nutrition of most food. HPP also reduces food waste by extending the refrigerated shelf life of many perishable products 2X or more. High quality ingredients must be used to achieve high quality final products.

- **Consumer-friendliness**

Research indicates that consumer acceptance of HPP is very high. HPP does not involve the use of irradiation or chemical preservatives, and it is environmentally friendly. Because HPP can dramatically increase shelf life without the use of preservatives, food processors are able to all-natural clean label foods that today's consumers desire.

As a result HPP is being used extensively by processors for manufacturing of all-natural products in the ready-to-eat meat category and shucking and shelling of seafood. There is also global acceptance of HPP for processing preservative free processed fruit and vegetable products and juices/smoothies. Finally there are strong emerging markets for ready-meals and deli salads.

To learn more about HPP technology and equipment please visit [www.avure.com](http://www.avure.com) or contact us at:

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