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Sustainability Advantages of High Pressure Food Processing

How HPP cuts waste, lowers emissions and helps build a healthier, safer planet.

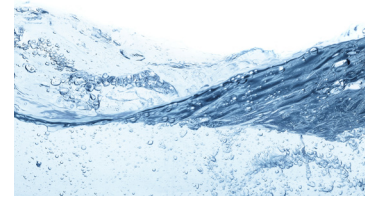


Executive Summary

The growth of high pressure processing (HPP) is driven by consumer demand for fresh taste without chemicals or preservatives. But that's not the only reason why food processors and retailers choose HPP. This white paper outlines the sustainability and cost saving advantages HPP delivers over other processing methods, such as thermal. Sustainability means meeting today's needs without compromising the ability of future generations to meet theirs.

Key findings conclude:

- **HPP prevents costly waste** and food losses with its expanded shelf life capabilities.
- **Healthy, nutrient-rich foods and beverages** help avoid negative health impacts and associated medical costs.
- **Longer expiration dates** give shoppers confidence to purchase and consume products they might otherwise discard.
- **Reduced energy requirements** lessen HPP's global warming potential compared to other methods, such as thermal pasteurization.
- **HPP inactivates foodborne pathogens**, such as Listeria and Salmonella, that could cause illness or death, or trigger an outbreak.
- **Green light for clean labels.** By cutting preservatives, producers eliminate environmental impacts of sourcing those ingredients, and manufacturers health problems linked to common additives.



HPP Defined: Extreme Pressure and Water

Avure's HPP uses ultra-high pressure (up to 87,000 psi or 6,000 bar) and purified, cold water to keep packaged food and beverages pathogen-free, and stay fresh longer without preservatives or chemicals.

Learn more at

Avure-HPP-Foods.com

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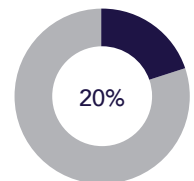
Approach: Investigating HPP's Positive Environmental Effects

Life Cycle Inventories and Analyses (LCI's and LCA's) are useful tools for assessing the environmental impact of products and processes, and offer the ability to quantify the level of impact in a variety of categories. The International Organization for Standardization (ISO) has issued and continues to update standards for performing LCI's and LCA's.

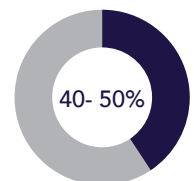
(See ISO standards 14040 and 14044¹)

Estimated Global Yearly Food Losses

Meat & Dairy Products



Fruits & Vegetables



The use of these tools to assess the environmental impact of products produced using HPP is growing. More analyses will yield additional product and process-specific information when available. Where ISO-level LCI or LCA information is readily available, we will reference it. In other cases, we will detail the underlying logic behind concluding that HPP increases sustainability.

Whether you use HPP or you're considering it, we hope you'll find this analysis helpful to evaluate its increase in sustainability.

Areas of HPP Impact and Benefit

Delivering food and beverages to consumers involves complex systems, which include connections, overlaps and reinforcements between broad categories of sustainability measures.

In general, think of a ratio of meaningful product performance (PP) experienced by a user to the environmental impacts (EI) associated with all the activities associated with sourcing, producing, delivering and using the product.

The higher the PP/EI ratio, the greater the value experienced by the user per unit of environmental impact.

In the case of a food or beverage product, meaningful performance to a consumer could include nutritional value, sensory experience, raw material inputs, product safety, and levels of waste.

System changes that deliver equivalent meaningful performance with lower environmental impacts or that deliver improved performance with similar levels of impacts increase the PP/EI ratio and are inherently more sustainable.

3 Ways HPP Prevents Food Losses and Waste

The Food and Agricultural Organization of the United Nations (FAO) defines food losses as "the decrease in quantity or quality of food" and food waste as that part of food losses "which refers to the discarding or alternative (non food) use of food that was fit for human consumption – by choice or after the food has been left to spoil or expire as a result of negligence²."

FAO studies estimate global yearly food losses ranging from 20% for meat and dairy products to 40-50% for fruits and vegetables. Distribution and consumption segment losses are large components of loss rates³.

1. Extend shelf life. Curb food waste.

With HPP's improved shelf life capabilities, manufacturers reach wider markets, and reduce waste volume and the associated costs



A Selection of HPP Products

HPP foods and beverages include ready-to-eat and ready-to-cook meats, fruits and vegetables, salsa and guacamole, juices and smoothies, ready meals, soups and sauces, wet salads and dips, dairy products, seafood and shellfish.

of waste: disposal cost, energy cost, increased resource cost of food production and increased GHG emissions⁴.

Coupled with the reduction of spoilage is the improvement of quality afforded with the longer shelf life. HPP products do not exhibit significant product deterioration as microbiological shelf life nears. This allows manufacturers to reduce the costs associated with distressed products and more importantly, deliver a higher quality product to consumers.

2. Avoid harmful, costly production losses.

The least sustainable outcome is to lose all the material and energy inputs associated with producing and delivering a product because the product is unusable, while all the emissions, releases or other environment impacts occur. At that point, the performance-to

“Longer expiration dates give consumers confidence to consume healthy, safe products they may otherwise discard.”

impact ratio becomes zero because no performance is realized, but all the inputs have been spent and all the impacts incurred.

3. Healthy foods. A healthy population.

Low quality foods provide lower nutritional value to consumers, which can negatively impact health, well-being and productive capability of those consuming such foods. The performance-to-impact ratio becomes lower as nutritional value is lost. HPP helps products retain their natural vitamins and healthy nutrients after prolonged refrigeration.

For example, a University of Leuven, Belgium, study found that Valencia orange juice (made with HPP) retains 90 percent of its vitamin C after 20 weeks of storage. Compare to thermal processing, which loses more than half of its vitamin C over the same timespan ²¹.

As processing and packaging technology has improved, so has the product sustainability from increasing the shelf life of food and beverages. HPP further extends shelf life, especially for products with rapidly declining food quality. This benefits consumers, producers and retailers.

For example, a grocery chain keeps shelves stocked with healthy and safe

products from manufacturers. And longer expiration dates give consumers confidence to consume food they might otherwise purchase and discard.

Waste through negligence has a clear behavioral component. One way to reduce it is to change the typical experience of steadily declining food quality during storage. HPP sustains the quality of the last 1/3 of a package of luncheon meat or other product to be more like the first product removed from the package. This influences consumers to confidently use the entire product they purchased, which translates into cost savings.

While some research suggests longer refrigerated storage harms the environment through increased energy use and associated emissions⁵, it assumes the refrigerator would not be in use if the product in question were consumed more quickly. This is not consistent with the reality of how consumers use refrigerators, and any small incremental impacts associated with more openings of a refrigerator are dwarfed by the impact of wasted food shown in their analyses.



HPP helps orange juice retain 90 percent of its vitamin C even after 20 weeks of refrigeration²¹.

Reduce Energy Consumption

Compared to thermal pasteurization by autoclave of a fish and vegetable ready-to-eat meal with 60-day shelf life, in a comparative limited life cycle assessment, HPP had a global warming potential more than 20% lower, even when HPP processing included a pre-cooking cycle⁶.

Continuing advances in HPP equipment cycle time and productivity are further reducing energy requirements.

The potential for HPP to create longer shelf life refrigerated or chilled foods with high quality, nutrition and safety also opens the door for some popular food items to be moved from frozen to chilled processing and distribution, and reduce energy consumption.

Use Fewer Ingredients. Gain a Clean Label.

HPP allows food processors to reduce or eliminate ingredients added solely for preservative effects, including chemicals that inhibit bacterial growth. Reduced ingredient usage means eliminating the environmental impacts associated with sourcing those ingredients.

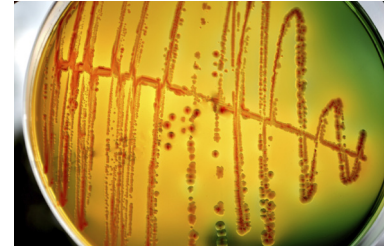
A simpler ingredient list also help food processors achieve “clean label,” which appeals to an increasing segment of the population that seeks healthy, natural choices in convenient foods and beverages.

Finally, while precise benefits are largely unquantified at this point, some

common preservatives are linked to chronic health problems. Improving health reduces the environmental burden associated with treating serious illnesses and diseases. HPP can contribute to a healthier population and reduced environmental impact.

Increase Food Nutritional Value

HPP has been repeatedly shown to result in little or no change to essential nutrients, vitamins^{7, 8, 9, 10} and sensitive health-related bioactive compounds. This yields foods with increased shelf life and better nutritional value. With HPP, less food is required to satisfy nutritional needs and fewer supplements are required to replace vitamins and nutrients lost during thermal processing. These are results that increase the PP/EI ratio and represent advances in sustainability.



HPP inactivates dangerous foodborne pathogens, such as E. coli and Listeria.

Better Food Taste and Texture

Proper choice of HPP processing conditions can result in improvements in taste and texture of food products compared to versions traditional processing methods.

Upgrading lower-grade raw materials creates higher-value products that satisfy consumer quality desires, and avoid more environmentally intensive food production approaches.

“Each year about 48 million Americans experience a foodborne illness.”

(See US Patent Publication 2010/0048116.)

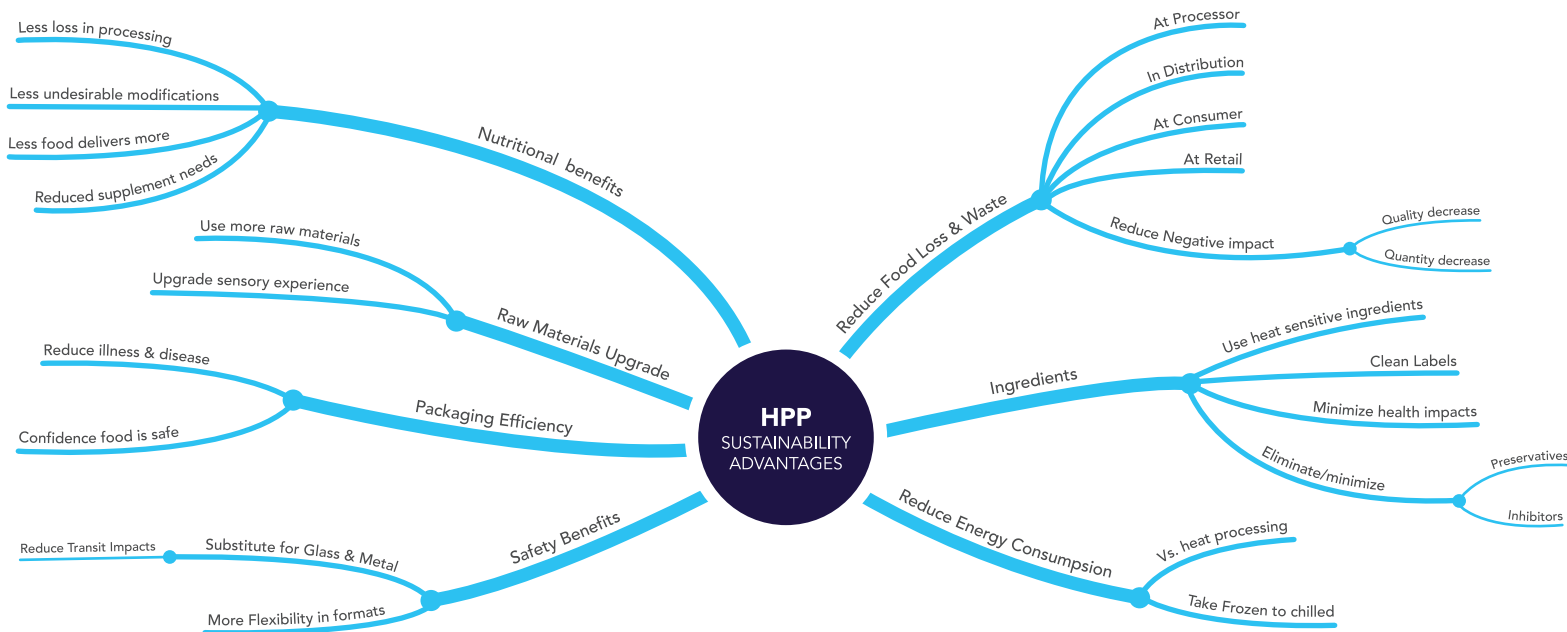
Produce Safer Food. Build a Healthier World.

According to the U.S. National Institutes of Health (NIH), each year about 48 million Americans experience a foodborne illness. Harmful bacteria and viruses^{12, 13} cause the majority.

As discussed earlier, HPP inactivates common foodborne pathogens. Villamonte et al.¹⁴ showed the complete inactivation of *Listeria monocytogenes* in packaged, sliced cooked ham could eliminate negative health impacts to susceptible populations compared to *L. monocytogenes* in the traditionally processed product¹⁴.

In the beverage industry, Salmonella, E. coli O157:H7, L. monocytogenes, and the parasitic pathogen, Cryptosporidium parvum¹⁵ are major etiological agents of food poisoning outbreaks. In the late 1990's following the E. coli O154:H7 outbreak in apple juice, Avure Technologies worked closely with the U.S. FDA to validate and gain approval of HPP as a processing method to achieve the FDA's 5-Log pathogen rule¹⁰.

Inactivate Deadly Foodborne Viruses



Several studies have shown the efficacy of HPP in the inactivation of viruses in food products^{16, 17, 18, 19}. Now, research is underway to understand the dynamics of inactivation of contamination viruses. Human noroviruses (HuNoVs) may cause the majority of U.S. foodborne illness, and 11% and 25% of foodborne deaths and hospitalizations.

As international trade expands from developing countries, Hepatitis A (HAV), the other major food contamination virus of concern, is especially worrisome.

Tests to date indicate that pressure applications toward the higher end of the range employed in commercial HPP treatments can be effective in inactivating HuNoVs and HAV. But direct validation of processing conditions will be required for specific foods. For some applications, those pressures may not be compatible with desired organoleptic properties. More work is required to identify HPP strategies to inactivate all potential foodborne viruses without significantly degrading food quality.

As discussed earlier, reductions in negative health impacts from foodborne illness translate into increased sustainability by avoiding costs associated with treating illness. While difficult to quantify, it is intuitive considering a decrease in illness and disease.

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