The Fresh Food & Beverage Advantage
A High Pressure Processing & Packaging Reference Guide
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Insight</td>
<td>2</td>
</tr>
<tr>
<td>What is HPP?</td>
<td>3</td>
</tr>
<tr>
<td>How HPP Works</td>
<td>4</td>
</tr>
<tr>
<td>The Benefits of HPP</td>
<td>5-6</td>
</tr>
<tr>
<td>HPP Product Applications</td>
<td>7</td>
</tr>
<tr>
<td>Packaging Requirements</td>
<td>8</td>
</tr>
<tr>
<td>Selecting the Right Package</td>
<td>9</td>
</tr>
<tr>
<td>HPP Decoration Solutions</td>
<td>10</td>
</tr>
<tr>
<td>Sealing Best Practices</td>
<td>11</td>
</tr>
</tbody>
</table>
Research shows the global high pressure processing food market to be worth $14 billion in 2018. By 2023, the market will reach an estimated $27.4 billion and will grow to $51.1 billion by 2027 (16.5% CAGR). This growth is a result of many factors and trends, including consumer, food safety, and food industry demands.

The clean label movement is on the rise. Consumers are becoming educated shoppers who demand more from fresh food than ever before. 73% of US consumers agree it is important that ingredients on a food label are familiar and would be used at home. There is an explosive interest in fresh, convenient, and less processed foods and beverages. Shoppers are willing to spend more money to receive better-for-you products, and they are also more willing to research production methods before making purchases.

Due to an increasing concern over food safety and the rise in foodborne illness, food producers and retailers are seeking reliable food safety measures that will provide the best product quality. Not only do they wish to keep their customers safe, they also want to ensure their brand is protected.

The food and beverage industry’s demand for longer shelf life and superior sustainability also contributes to growth within the market. Food waste is a huge issue – environmentally, ethically, and financially. Companies want to be responsible and make sure good food does not go to waste. Longer shelf life decreases a product’s chance of ending up in a landfill. Additionally, the longer a product lasts, the further it can be distributed and sold.
What is HPP?

**High pressure processing (HPP)** ironically isn’t really processing at all. HPP is a unique food preservation method that utilizes cold water and extreme pressure (up to 87,000 psi) to inactivate food-borne pathogens and spoilage organisms.

The effectiveness of the HPP process depends on the amount of pressure applied, vessel holding time, temperature, product type, and targeted pathogens and spoilage organisms.

Unlike chemical and thermal treatments that can compromise flavor, vitamins, and nutrients, HPP is a non-thermal process non-chemical process. Without the use of heat, the product’s original qualities remain intact. Also, because water pressure is applied uniformly in all directions, HPP foods retain their original shape.

HPP enhances food safety, extends product shelf life, helps protects brand equity and company reputation, and enables the sale of cleaner label products.
How HPP Works

- Products, already sealed within their final packaging (e.g. rigid plastic containers, bags, pouches, plastic bottles, chubs, trays), are loaded into HPP carrier baskets.

- The baskets are then inserted into the HPP vessel. The basket enters the HPP machine and is sealed by plugs.

- Potable water is pumped into the HPP vessel, which applies isostatic pressure (equal pressure all sides) on the packages.

- The product is held at a pressure between 45,000 and 87,000 psi (310 to 600 MPa) for 1 to 6 minutes, depending on the HPP process recipe.

- Pressure is transmitted uniformly and instantaneously throughout the products.

- Pressure disrupts microbial biochemistry of bacteria and spoilage microorganisms.
The Benefits of HPP

**Improved Food Safety**
By disrupting foodborne pathogens within their final sealed packaging, the process reduces the risk of recontamination before the product is sold. Pathogenic vegetative bacteria types disrupted by HPP:

- Salmonella
- E. coli 0157:H7
- Listeria monocytogenes
- (Lm)Campylobacter
- Vibrio in shellfish

**Shelf Life Extension**
Because HPP disrupts the growth of bacterial and spoilage organisms (yeasts and mold), HPP typically doubles refrigerated product shelf life.

**Cleaner Label Products**
Since HPP uses only water and pressure, there is no need for the use of harsh chemicals to kill bacteria or added sodium to preserve freshness. HPP helps simplify the ingredient list.

**Food Waste Reduction**
HPP reduces food waste by extending product shelf life. This increases the period of time in which the food can be marketed and sold, which reduces grocery shrinkage. Consumers will also be pleased with the products staying fresh longer.
The Benefits of HPP

**Brand Protection**
HPP provides a level of defense against product recalls due to pathogen contamination, thus reducing the risk of foodborne illness cases.

**Competitive Differentiation**
Due to increased shelf life, cleaner labels, and product innovation, HPP helps facilitates a competitive advantage for manufacturers and retailers. For instance, HPP enables manufacturers to transition from frozen foods to fresh, ready-to-eat products.

**Logistical Advantages**
With a longer shelf life, manufacturers may gain wider distribution ranges, and both retailers and consumers may be able to reduce the amount of food wasted from spoilage.

**Better Organoleptics (Taste, Texture, Color)**
Because HPP uses water and pressure, many natural qualities of HPP products may be preserved longer. The absence of heat treatment allows foods and beverages to remain at their peak taste, texture, and color for a longer period of time.

**Innovative New Products**
The use of HPP can preserve the characteristics of reformulated products, such as low sodium meats. It can also improve the creaminess of yogurt-based products, all while keeping foods fresh.
HPP works on a wide variety of product types, depending on their physical attributes, water content, and packaging type. The main product categories that work well with HPP include:

- Juices and beverages
- Meat and poultry
- Seafood
- Salsa and guacamole
- Fruits and vegetables
- Ready-to-eat soups and meals
- Wet salads and dips
- Dairy
- Pet food
- Baby food

New product types are continually being tested for viability through HPP. The HPP product application categories will continue to expand to meet consumer demands for fresh, better-for-you foods and beverages.
Packaging Requirements

Three main requirements for HPP packaging

**Durable**
Plastics are one of the best choices for packaging due to their ability to survive extreme pressure and rigorous handling. The intense pressure squeezes the package, so it must be able to bounce back without cracking or breaking. The container can be made from a variety of plastics including polypropylene (PP), high density polyethylene (HDPE), and polyethylene terephthalate (PET) and can be any color. PP containers are very durable, can withstand microwaving and dishwashing, and can be easily recycled. An oxygen barrier layer can be added to a PP container if even longer shelf life is desired, although this may effect the recyclability of the PP container. PET has oxygen barrier properties and is recyclable.

**Strong Seal**
The film used in HPP must maintain a high burst strength, yet still be peelable for the consumer. Films can be made out of many types of plastic; one of the most important factors is to be compatible with the container material. For example, a PP film must be paired with a PP container. The container must be able to accept a film seal and should not have any types of coating on it that hinder that sealing process. The bond between the film and container should be strong and secure.

**Minimal Head Space**
Minimizing head space in the container is important for HPP. A general rule is to fill the container at least 90% or higher to head space inside the container. If there is too much air in a container, it could cause excess stress on the container and result in bursting or cracking.

It is important to test any container and film with your specific product before using.
Selecting the Right Package

Five considerations

**Material:** PP containers are an ideal package to use in HPP. The resins Berry uses for food contact products are compliant with FDA rules. Berry containers are blended with a special formula to make them even stronger during the HPP process. PP containers performed slightly better in drop tests than comparable PET containers.* An oxygen barrier layer can be added to a PP container if even longer shelf life is desired. Berry has a stock line of containers with a full barrier wrap.

**Manufacturing Process:** Plastic containers are typically made using two methods - injection molding and thermoforming. Injection molding means injecting plastic into a mold and thermoforming means stretching plastic into a cavity and punching or trimming it. Both types of manufacturing processes are compatible with HPP; however, injection-molded containers are created to a closer spec, enabling an easy sealing and wider processing window.

**Color:** More than half of shoppers (54%) agree it’s important to see a product through its packaging, which is one reason why clear containers are gaining popularity.** Consumers buy with their eyes - they want to be able to see what they are eating. Consumers typically categorize containers into being clear or not and do not often distinguish levels of clarity.***

**Decoration:** There are five ways to decorate a rigid PP container, which include dry-offset print, Iconic™ print, pressure sensitive labels, in-mold labels, and shrink sleeve. Berry offers all of these methods, with each one offering an advantage based on your priorities. An important consideration is to determine what your decoration is trying to communicate to the intended consumer along with quantity and SKUs.

**Lidding Film:** Plastic lidding films come in many materials and varieties. Lidding film is typically white or clear and can be printed or plain. It must be thick and tough enough to resist puncture damage during post processing. The material and sealant is designed to adhere to the cup material (PP, PET, HDPE, etc). Certain films, such as Clear-seal™ is compatible with PP and designed to be strong, yet peelable and can be printed with photographic images up to ten colors – which helps processing as well as the consumer experience.
Decoration plays an important role in HPP packaging

Once the product has completed the HPP process, it is up to the consumer whether they want to purchase it. How you decorate the container says a lot about your brand and the product inside. 64% of consumers try a new product because the package catches their eye.*

Decoration Solutions

Printing
If you have large quantities and minimal SKUs of flavors, direct printing is a great option. With direct print, the ink goes directly on the container and is cured with a UV light. It is bonded to the plastic and will stay on the container during the HPP process. Iconic™ printing is an option that combines high quality printing with a competitive cost, great for round and non-round shapes.

In-mold Labeling
Use in-mold labeling for a big impact with any quantity in a stock or custom shape. In-mold labeling is a pre-printed plastic label and is permanently bonded to the container surface. A variety of finishes are available including matte, glossy, and metallic. This premium decoration cannot be removed and is highly scratch resistant.

Pressure Sensitive Labeling
For smaller quantities or many SKUs, a pressure sensitive label is a good decorating solution. A pressure sensitive label is a thin plastic label with printing on it. It can be hand-applied or machine-applied. It is important to ensure the adhesive is strong and compatible with HPP because it must survive being submerged into the water chamber. Work with your packaging partner to find an optimal label type.

Shrink Sleeving
Shrink sleeves provide a good option for nontraditional products and also offer a full-length, 360 degree decoration. Shrink sleeves are normally glossy, but they can be matte or textured. High-definition graphics are available in special metallic and thermochromatic inks to suit your needs. Shrink sleeves must be applied after the HPP process to avoid getting water in-between the container and label.

*AC Nielsen report
Sealing Best Practices

Introduction
HPP requires a film seal strength sufficient for the package to survive the process and avoid costly product and package loss. At the same time, many consumers demand a peelable film seal to easily access the product after purchase. It is usually easy to achieve either a strong or peelable seal, but making a strong and peelable seal requires extra attention to material selection and machine setup.

Material selection for sealing
All lidding films vary a great deal. Lidding film that could be perfectly acceptable for a fill and ship application may not be well suited for HPP. Berry offers Clear-seal™ lidding film specifically designed for HPP PP containers, generating a very strong yet peelable seal with a wide process window - and capable of color printing up to ten colors.

Equipment considerations
It is important to ensure the cup is supported in a support plate specifically designed for its geometry. Berry can provide recommendations for cup support plate geometry. Even a small discrepancy can result in weak or imperfect seals that can fail in HPP.

Prior to processing, ensure the seal machine heater head is specifically designed for the cup that it is sealing. During regular production, the heater head must be clean and free of contaminants that would cause weak seals.

The container brim should be clean and free of contaminants. Products and their ingredients affect seal strength by vastly different magnitudes. Some lidding films are more capable of sealing through contamination than others. Contamination can also be partially overcome with seal parameter adjustment, but a contaminated brim may not produce a seal as strong as a clean brim.

To achieve a strong, yet peelable seal, the seal parameters are critical. Some key parameters to consider for the machine set up are heater head surface temperature, heater head contact time, and the force applied by the seal head. Each and every cup, film, and machine combination are unique, and there is no one size fits all list of parameters. To establish the optimum seal parameters, a seal optimization study should be conducted to find the peak seal strength, while still maintaining a peelable film. A Design of Experiments may be the most efficient tool to use for a seal optimization study.

Part of the experiment should be designed to understand the process window that the configuration can achieve. Parameters will wander during production and the process window needs to be sufficiently wide to achieve continuous running without the need for constant adjustment. Berry can assist with the design, set up and testing to help determine the optimum seal parameters for a specific application.

The fill site should have equipment to measure the seal strength prior to HPP, such as a vacuum chamber or pressure burst tester. It is critical to measure seal strength and verify whether it is in control during the fill process for a quality control plan and to avoid seal loss during HPP.

The seal strength and peel force should be measured again after HPP to help ensure results are acceptable to consumers, as it is possible for these values to change as a result of the post processing.
Have a question about HPP or packaging requirements? Contact a member of the Berry Global or Universal Pure team using the contact information below:

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