

High Pressure Processing of Foods

What is high pressure processing?

High pressure processing (HPP) is also called high hydrostatic pressure processing, ultra high pressure processing, pascalization or cold pasteurisation. It is a food processing technology which applies high pressure to solid or liquid foods to improve their safety and in some cases, organoleptic properties and quality.

How does HPP work?

Foods which receive HPP must be first pre-packed in vacuum-packs or other flexible packaging such as plastic bottles. Harder packaging such as ceramics, glass or metal cannot be used in HPP. The selected packaging must be able to withstand the high pressures used, without losing seal integrity or barrier properties and without leaching undesirable packaging chemicals into the product.

After packaging, the foods are placed into a specially designed pressure chamber which is sealed and completely filled with potable water. A pump connected to the pressure chamber pressurises the water, i.e. hydrostatic pressure, and this pressure is then transmitted, i.e. applied, to the food through its packaging via the water. As the pressure acts instantaneously and is equally distributed, there is no obvious crushing effect on the packaged food. The pressure is then applied for a set time period typically from a few seconds up to 20 minutes. On completion of the time period, the chamber depressurises and the food product can be removed.

In most processing operations HPP is carried out between 400 to 600 Mega Pascal (MPa), at room temperature, although due to the effect of pressure, the temperature of the product in the pressure chamber can rise by 3-6°C for every 100 MPa increase in pressure, depending on the composition of the product.

What is the effect of HPP on microorganisms?

In typical HPP operations, i.e. 400-600 MPa for two minutes or greater, the high pressure applied to foods at room temperature will reduce numbers of most vegetative bacteria by up to 4 log units or greater, and inactivate certain enzymes with only a small change in the organoleptic properties of the food. However, the resistance of bacteria and other microorganisms to HPP is highly variable, e.g. some gram positive bacteria such as *Listeria monocytogenes* can exhibit higher resistance than gram negative bacteria such as *Salmonella*.

Spores of both bacteria and moulds are largely resistant to inactivation by HPP. Viruses have a wide range of pressure resistance, depending on their structural diversity. The effectiveness of HPP treatments will be dependent on the pressure applied, the holding time, temperature, the type of food matrix and the target organism. It is the responsibility of the food business operator to ensure that the HPP treatment applied to the food product is appropriate to achieve the desired result.

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What are the applications of HPP?

There are many foods suitable for HPP, but particularly those with high water contents including fishery products, shellfish, meat and dairy products, fruit and vegetable juices, smoothies, dips, jams and baby food. The decision to use HPP can be driven by a number of requirements:

- **Spoilage control** – by reducing the foods microbial load, HPP may be used to extend shelf-life by increasing the period over which the food can be marketed and sold
- **Pathogen control** – by elimination or reduction to safe levels pathogens of concern such as *Listeria monocytogenes*. It should be noted that HPP does not destroy spores and microorganisms will differ in their responses to pressure, therefore process validation is important
- **Organoleptic preservation/improvement** – as HPP is a non-thermal process it can preserve or improve the organoleptic properties that can be compromised when the food is heat treated. In cheese for example, HPP can decrease the microbial load which slows the ripening process. This can help ensure the organoleptic properties are consistent between batches of cheese and are maintained throughout its shelf-life. HPP can also be used to tenderise and improve the texture of meat products
- **Product reformulation** – the use of HPP for enhancing the characteristics of reformulated products, e.g. low salt meats
- **Product forming** – by subjecting food products such as reformed/restructured meats to the very high pressures used in HPP, the binding or cohesion of many small pieces of meat into one larger piece may be facilitated
- **Shucking of shellfish** – HPP (often at lower pressures and for shorter times than those used for the processes described above) can be used for shucking shellfish and other seafood

Role and Responsibilities of Food Business Operators

All food business operators proposing to use HPP as part of their production processes (even if the HPP step is carried out by another food business operators under contract) must document and implement procedures based on the principles of HACCP covering the use of HPP for all their products as part of their Food Safety Management System.

Food business operators manufacturing food which is to be treated with high pressure, i.e. HPP, should document how the chosen HPP parameters of pressure and holding time were validated and verified to ensure the food safety of all HPP products during a defined product shelf-life.

In this regard, if food business operators are using durability and/or challenge studies to provide information for validation of a HPP process, the design of the study should accurately reflect the processes and conditions under which the products are produced and stored.

It is recommended that food business operators use laboratories that are accredited to a relevant standard, e.g. ISO/IEC 17025:2005, and the relevant microbiological parameters to be examined. It is further recommended that food business operators use laboratories that have experience in carrying out these shelf-life studies. The Food Safety Authority of Ireland (FSAI) provides good practice recommendations for carrying out shelf-life studies in its [GN 18 - Validation of Product Shelf-Life](#).

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Food business operators placing foods on the market that have been treated with HPP should consider whether the particular treated food is a novel food within the terms of Regulation (EC) 258/97.

All stand-alone, i.e. contract or off-site, HPP establishments must be registered as food businesses with the relevant competent authority, i.e. under Regulation (EC) No 852 of 2004 for the purposes of official controls on food safety, and may also be subject to approval, i.e. under Regulation (EC) No 853 of 2004, rather than registration depending on the other processing carried out at the site.

Food business operators considering the use of stand-alone HPP establishments have responsibilities under Articles 17 to 19 of Regulation (EC) No 178/2002 to ensure their foods satisfy the requirements of food law which are relevant to their activities and to verify that such requirements are met at all steps in the process. These responsibilities include:

- Ensuring that foods satisfy the requirements of relevant food law
- Verifying that such requirements are met
- Ensuring that appropriate traceability and recall systems are in place

All food business operators considering the use of HPP, i.e. either on-site or contracted off-site, should contact their supervisory competent authority before beginning use of HPP.

All products which are subjected to HPP must be appropriately labelled and be in compliance with all the requirements of Regulation (EC) No 1169/2011 on the Provision of Food Information to Consumer. If foods treated with HPP are supplied to other food business operators, these food business operators need to be informed that the foods have been treated with HPP so that they can consider any implications for their own HACCP assessments.

Regulation (EC) No 1169/2011 does not include a specific requirement to inform consumers that a food product has been treated with HPP. However, the legislation does require particulars of the specific treatment a food has undergone to be included in or to accompany the name of the food. Therefore, the FSAI recommends that it should be clearly stated on the label of the treated food in a non-abbreviated form, as its absence is potentially misleading to the consumer. Food treated with HPP should not be marketed in such a way as to mislead the consumer, e.g. fruit juice treated with HPP should not be marketed as 'fresh' or 'raw'.

All wrapping and packaging used with HPP food products and relevant processing equipment must conform to the requirements of Regulation (EC) No 1935/2004 on Materials and Articles Intended to come into Contact with Food and of any specific measures applicable to the particular food contact material.