HPP READY-TO-EAT MEALS

INTRODUCTION

High Pressure Processing (HPP) is a non-thermal food process technology that allows for ready-to-eat (RTE) meals made with meat, seafood, fish, vegetables or carbohydrates to obtain longer a safer shelf-life while preserving the homemade taste and avoiding overcooking. On this sector, the pressure range used it is between 500 MPa (72,500 psi) and 600 MPa (87,000 psi) and is typically applied for few minutes at refrigerated temperature.

High pressure is applied in the final pack, so recontamination after processing is avoided.

Regarding to a physicochemical concept, the HPP technology is softer than a thermal treatment. Product maintains taste and juiciness, with an increase on shelf life. High pressure processing destroys microorganism without any changes in taste or flavor comparing to the original product.

There are four main reasons that make the HPP technology beneficial for RTE meals:

- Safer food products with a longer shelf-life, inactivating spoiling vegetative microorganisms (bacteria, yeasts and molds) and pathogens.
- Sensorial food quality is maintained.
- Possibility of manufacturing preservative free or low sodium products.
- Cooking time can be reduced: overcooking is avoided.

FOOD SAFETY AND SHELF-LIFE

There has been an increased consumer demand for food that is minimally processed, additive free and with extended shelf life (Hicks *et al.*, 2009), so there is a huge interest in non-thermal technologies for preservation such as high pressure processing. HPP can improve shelf life of ready to eat meals three or four times initial shelf life, depending on processing conditions.

Influence of processing parameters and product characteristics

Microbial inactivation levels depend on the pressure and process time (cycle) as well as other factors such as water activity (a_w) or the product pH.

The pH of a product a key factor to consider, working in synergy with the HPP: the lower pH a product has, the more effective microbial inactivation by HPP is reached.

HPP does not control for bacterial spores (known as endospores), so high pressure processing cannot be included In HACCP as a method to control *Clostridium botulinum* or other bacterial spores.

Usually RTE meals has a pH > 4.6 so there exist a risk for spore germination and therefore they must be kept refrigerated for the entire life of the product or added some chemicals or naturals preservatives to avoid spore germination.

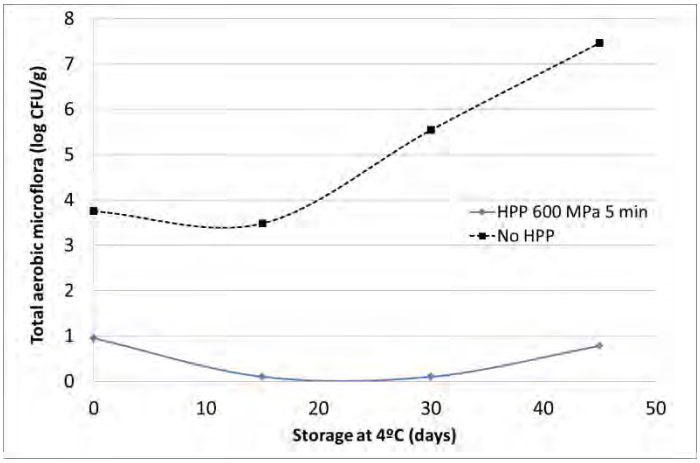

Figure 1: Total aerobic counts of HPP (600 MPa during 5 min) and No HPP cooked RTE rice with mushrooms *versus* storage time at 4 ºC. (Rovere *et al*. 2006)

Shelf- life information

Shelf life increase without changing sensorial quality is the aim of many food manufacturers. Chemical preservatives and thermal treatments (overcooking) are used to be the main methods to preserve ready to eat meals. Microorganism inactivation achieved by HPP avoids overcooking and its consequent losses on juiciness and texture on the product. Also, high pressure allows the manufacturer to reach an all-natural or additive free product safer and with longer shelf life.

Cooked RTE rice with mushrooms: With regard to the studies performed by Rovere *et al.* 2006, HPP helps the producer to reach more than 45 days shelf-life for a typical Italian dish made of cooked rice and mushrooms called risotto ai fungi (pH: 5.82 & Aw: 0.98) stored at 4ºC (39ºF). **Figure 1** shows the evolution of total aerobic counts during storage at 4ºC (39ºF). Day 45 after HPP (600 MPa; 87,000 psi; during 5 min) the total microflora count stays below 1 log cfu/g. According to these data, we can expect longer shelf life than 45 days for rice with mushrooms.

Typical tomato and pepper Italian dish: Rovere *et al.* (2006) performed some trials with this typical Italian dish called peperonata (pH: 4.34 & Aw 0.93).

In this study, process conditions of 600 MPa (87,000 psi) during 5 min, in synergy with low pH, were enough to increase shelf-life of peperonata for more than 45 days. Microflora counts remained under the limit of detection for the HPP sample during storage time (45 days) as seen on **figure 2.**

Salted tarts: Tonello and Voignier (1999) performed some trials regarding the shelf-life of quiches Lorraines, a typical French dish made of eggs, sour cream, onion, bacon strips and cheese on top of a pastry. Vacuum-packaged tarts extended their shelf life from 21 to more than 100 days when subjected to 600 MPa (87,000 psi) for 5 min, **(Figure 3).**

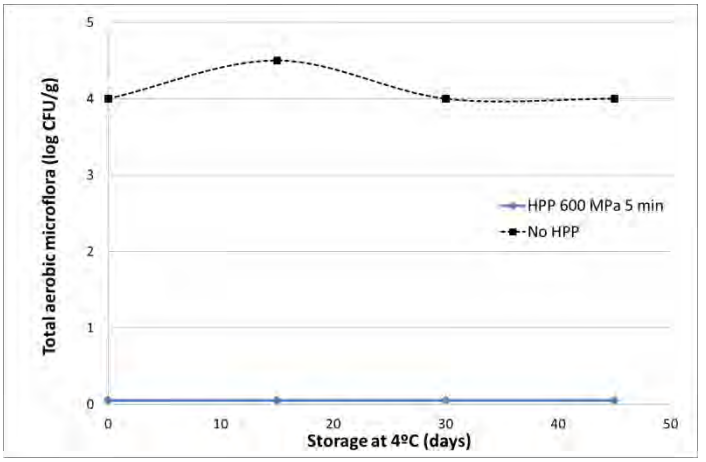

Figure 2: Total aerobic counts of HPP (600 MPa during 5 min) and No HPP peperonata *versus* storage time at 4ºC. (Rovere *et al*. 2006)

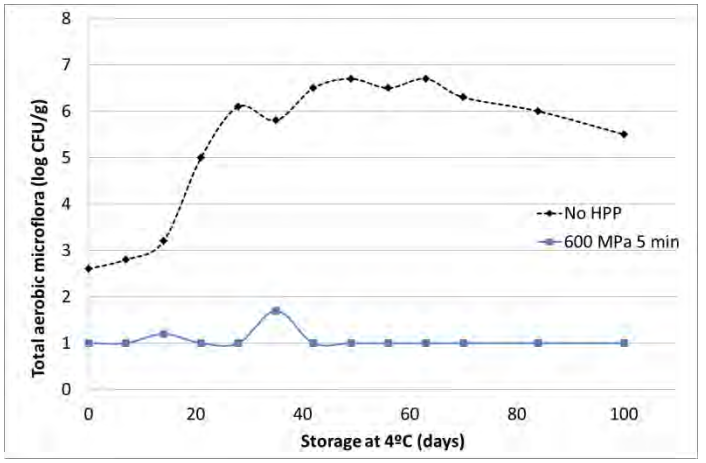

Figure 3: Total aerobic microflora of HPP in typical French-salted tarts *versus* storage time at 4ºC (600 MPa for 5 min), (Tonello et al. 1999)

Challenge tests

For the purpose of validation high pressure processed ready-to-eat meals, challenge test are usually performed. Inoculation of cocktails of pathogenic microorganism such as *Listeria monocytogenes*, *Escherichia coli,* and several strains of different Salmonella *(enteritidis, typhimurium*) are the most common among challenge test for this type of products.

Spanish omelette: The effect of HPP on a cocktail of four *Salmonella enteritidis* strains inoculated in Spanish omelette (typical Spanish dish made of eggs, potatoes and onions) was studied in 2012 by *Toledo et al*. . In this study, they evaluated immediate effect of HPP at different pressure conditions.

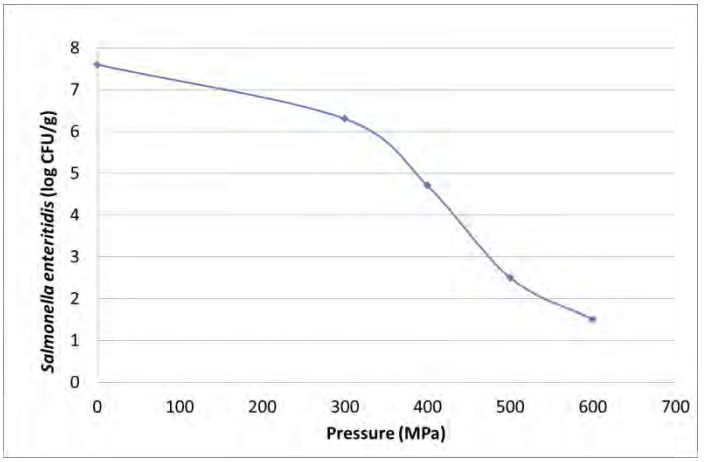

Figure 4: *Salmonella enteritidis* counts *versus* pressure in Spanish omelette (holding time: 5 min). (Toledo et *al*. 2012)

Processing at 600 MPa (87,000 psi) for 5 min reduced *Salmonella enteritidis* counts on selective medium to around 6 log cfu/g. **(Figure 4)**

Spanish omelette samples inoculated and high pressure processed were stored at 6 ºC (43 ºF) for 15 days in order to assess the possible recovery of *Salmonella* under these conditions. **Figure 5** represents *Salmonella* count along the storage time. With a process of 500 MPa (72500 psi) for 5 min, a 5-log reduction was achieved and *Salmonella* count was stable at 3 log cycles during storage at 6 ºC (43 ºF) for 15 days.

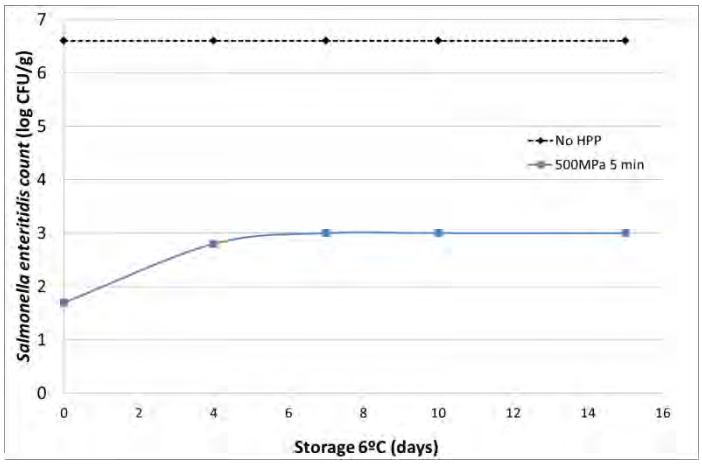

Figure 5: Evolution of *Salmonella enteritidis* counts after HPP process (500 MPa during 5 min) *versus* storage time at 6ºC, (Toledo et al. 2012)

CONCLUSIONS

Since first high pressure processed ready-to-eat meal was launched in Canada in 2007, a large number of companies have implemented HPP as a key step in their process. HPP constitutes a technical solution in the case where industry desires a premium or all natural ready to eat meal with an extended shelf life and high sensorial quality. Microorganism inactivation increases shelf life and food safety of the products avoiding overcooking and losses in texture or juiciness during manufacture.

A reflection of this is the growth of the number of our customers as such as this link shows: http://www.hiperbaric.com/en/customers

You can get more information about Hiperbaric and high pressure processing of foods on the next links:

http://www.hiperbaric.com

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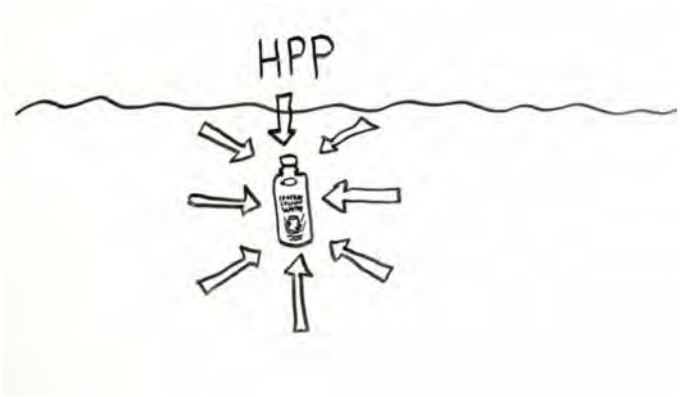
Would you have questions please contact: info@hiperbaric.com



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