PETFOOD FORUM

Where the GLOBAL PET FOOD INDUSTRY does business

#petfoodforum

Optimizing microbial control in pet food:

Understanding traditional and innovative methods

Daniela Soto; HPP Food Specialist

April 2025

Hiperbaric

April 28-30, 2025, Kansas City, Missouri, USA

HPP SPECIALIZED TEAM

Applications team

Interested in speaking with the Applications Team?

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LETHAL INTERVENTIONS

Why use a control method against pathogens?

FDA | FDA FOOD SAFETY MODERNIZATION ACT

Foodborne Pathogens Associated with Pet Food:

Salmonella spp., *Listeria monocytogenes, Escherichia coli* and *C. botulinum.*

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Hazard Analysis and Risk-Based Preventive Controls for Food for Animals. Guidance for Industry. July 2022

Microbial control interventions - Limitations

Thermal Technologies		Non-thermal Technologies			
Retort	**High Pressure Thermal Processing (HPTP)**	**UV**	**Bacteriophage**	**Fermentation**	**HPP**
High termal load: long exposure times to high temperatures	Packaging validation	Only effective on surface area	Limited to a 2-3 log reduction	Alters smell and taste	Color change in raw meat
Nutrient loss	Formula adjustments to meet quality and sensory attributes		Low movility of phages, they must be in contact with the bacteria to lyse them	Limited to a 2-3 log reduction. Difficult to standardize.	Requires cold chain
Formation of food contaminants	Testing (validation, heat penetration analysis etc.)	Requires refrigeration	Sensitive to physicochemical stresses (such as pH)		

(Steve´s Real Pet food, 2020)

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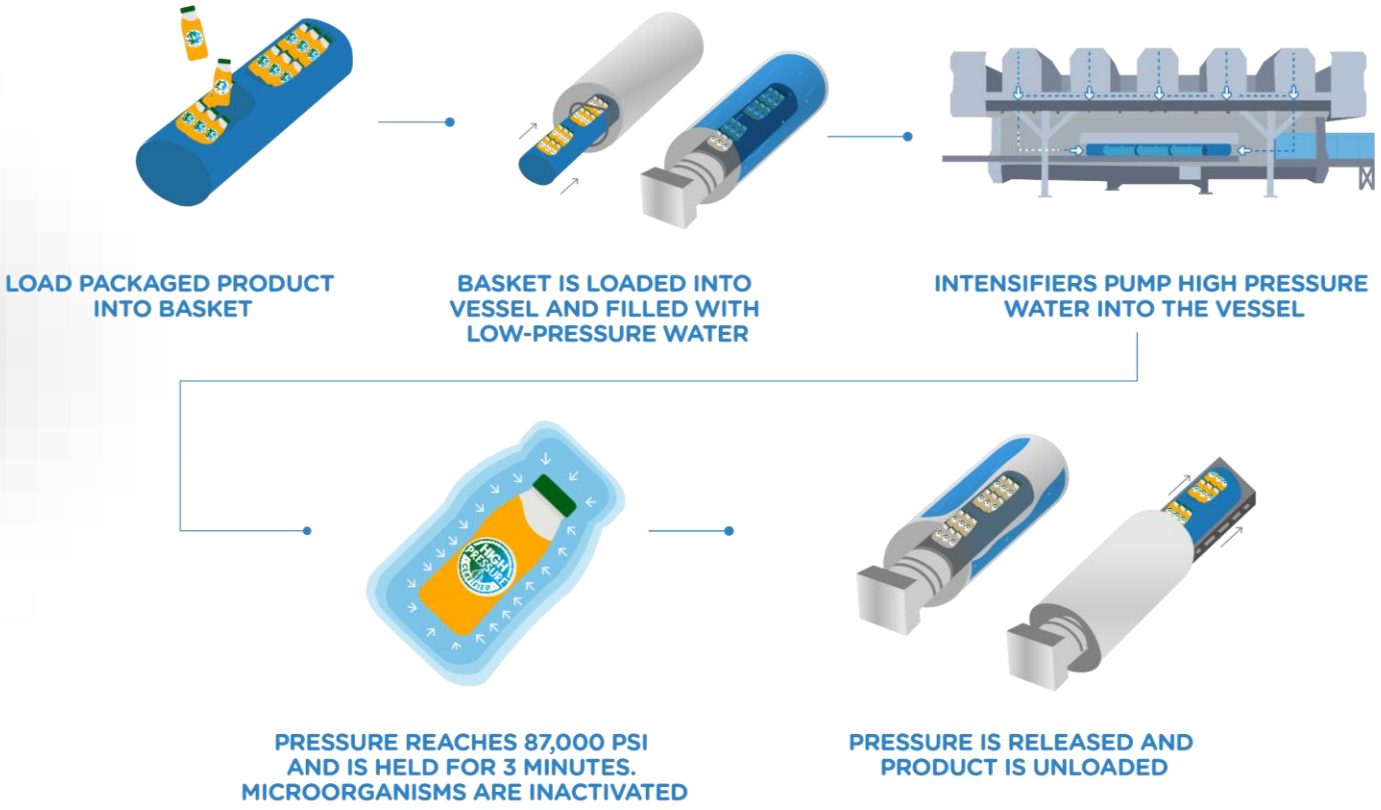
HIGH PRESSURE TECHNOLOGIES

High Pressure Processing (HPP)

Ensure food safety and maintain high quality without the use of heat

HIGH HYDROSTATIC PRESSURE

HPP **Operation Diagram**



How are petfood manufacturers implementing HPP?

FORMULATE & BLEND RAW MATERIALS

RAW FORMULA

COOKING STEP

HIGH PRESSURE PROCESSING

RAW FROZEN

COOKED REFRIGERATED

RAW FREEZE DRIED & SHELF STABLE

FURTHER PROCESSED IN A CLEAN ROOM INTO BITE-SIZED SHAPES

RAW FROZEN

HPP Pros & Cons

Pros

Food Safety

Inactivate foodborne pathogens such as *Listeria*, *E. coli, Salmonella* spp., or *Campylobacter* spp.

R&D

Versatility, multiple formulations, and packaging options.

Clean label

Natural products without compromising the quality or safety of foods.

Cons

Requires refrigerated storage

- Delays the growth of resistant microorganisms such as spores or LAB.
- Prevents product deterioration because of active enzymes.

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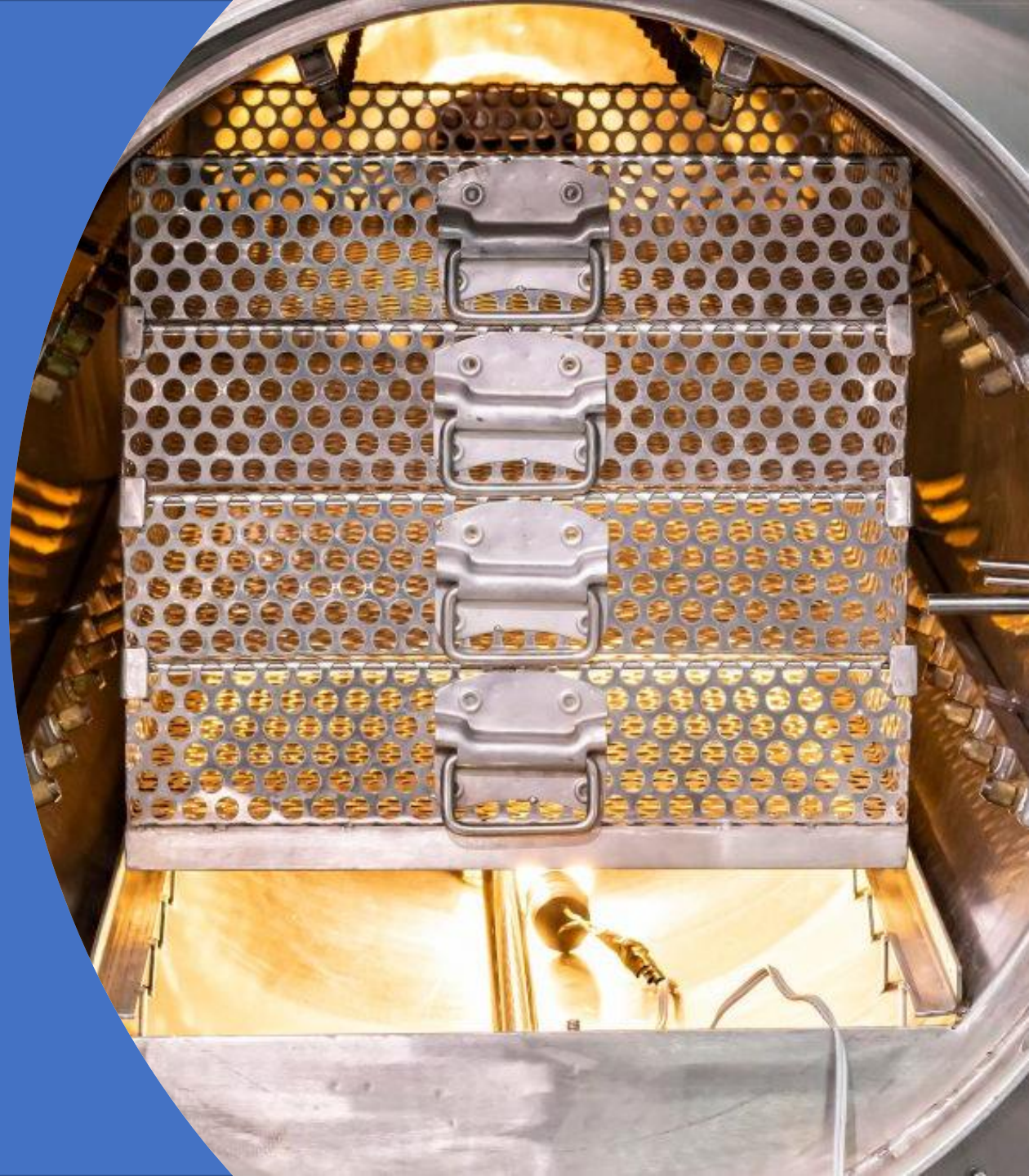
HIGH PRESSURE TECHNOLOGIES

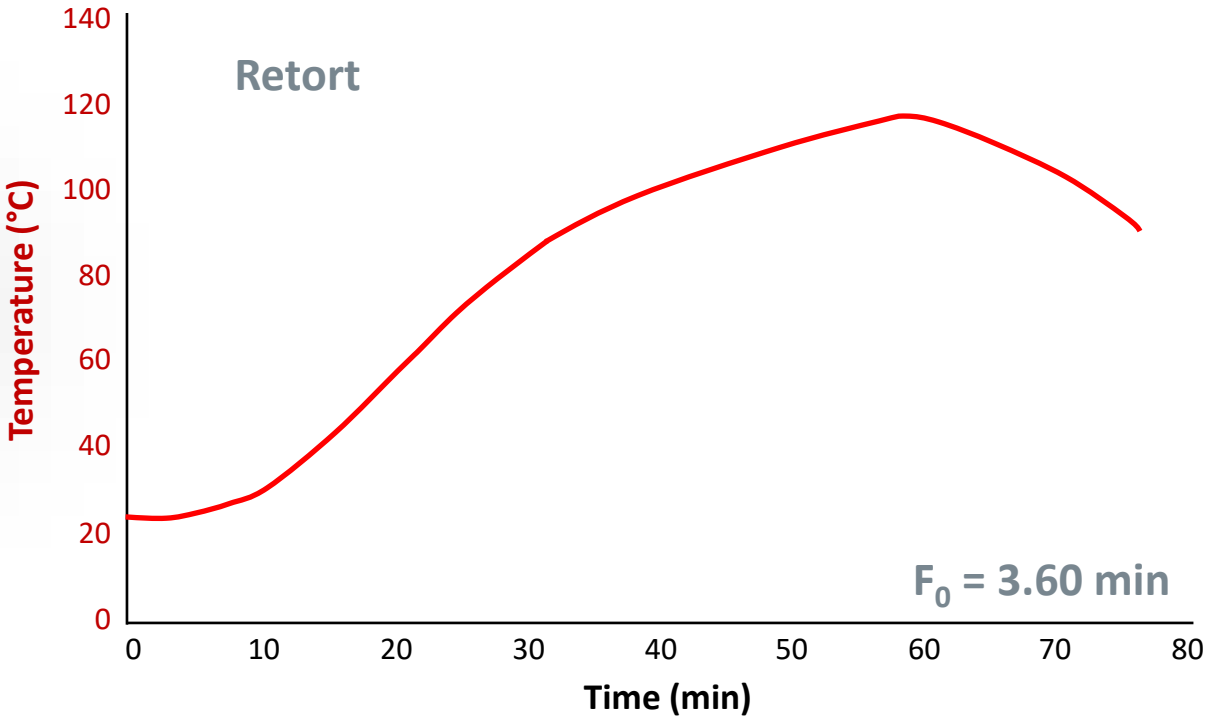
Thermal Treatments

Using high temperatures for sterilization purposes



Retort processing – High Temperatures

Retort processing achieves commercial sterility for food products by inactivating *C. botulinum* spores, ensuring they are microbiologically safe and stable through heating.



Low-acid food products

Up to 250°F
Temperature

Up to 1-1.3 bar
Pressure

Example of a temperature profile in the center of pack (346 ml) with a mixture of cereal, meat, and vegetables during HPTP and a typical retort temperature profile inside a can (384 ml). (Juliano et al. 2009)

HPP Pros & Cons

Pros

Food Safety

Achieves shelf stability while inactivating pathogens of concern, such as *C. botulinum.*

R&D

No need to add preservatives, it can last for years.

Clean label

Minimal ingredient requirements.

Cons

Food Contaminants

Production of acrylamide, furans, AGE´s.

Food Contaminants

Extended processing times at high temperatures.

Reduction in nutrient content

CSIRO

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HIGH PRESSURE TECHNOLOGIES

High Pressure Thermal Processing (HPTP)

Achieve sterile, shelf-stable products while minimizing thermal load with high pressures.

What is HPTP?

High Pressure Thermal Processing (HPTP) is a food processing technology that simultaneously applies high pressure and elevated temperatures to food products in their final package, maintaining these conditions for several minutes.

Up to 6000 bar
Pressure

+

Up to 250°F
Temperature

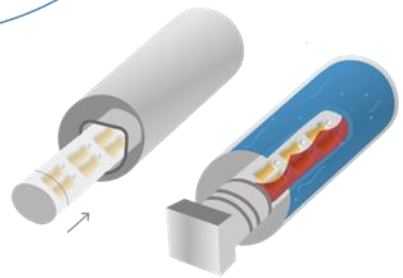
Based on the temperature range of application, the process can be categorized as follows:

- **Moderate Temperature:** 77-140 °F under pressure
- **High Temperature:** 140-250 °F under pressure

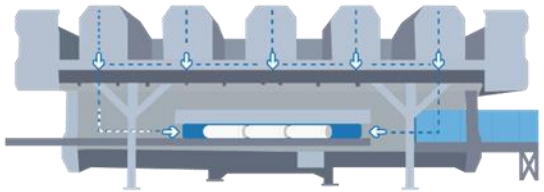
What is HPTP?

The preheating step is determined based on the product's heat specific capacity, and the time is established according to how long it takes for the coldest point of the product (the center) to reach the desired initial temperature.

1. LOAD PREHEATED FOOD INTO HPTP CANISTER

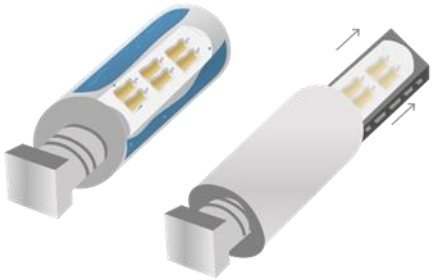


2. CANISTER IS LOADED INTO VESSEL AND FILLED WITH LOW PRESSURE WATER



3. INTENSIFIERS PUMP HIGH PRESSURE WATER INTO THE VESSEL

4. STERILIZATION TEMPERATURE (121 °C / 250 °F) IS ACHIEVED AS PRESSURE REACHES 6000 BAR / 87,000 PSI DUE TO ADIABATIC COMPRESSION HEATING PROCESSING TIME IS DRASTICALLY REDUCED

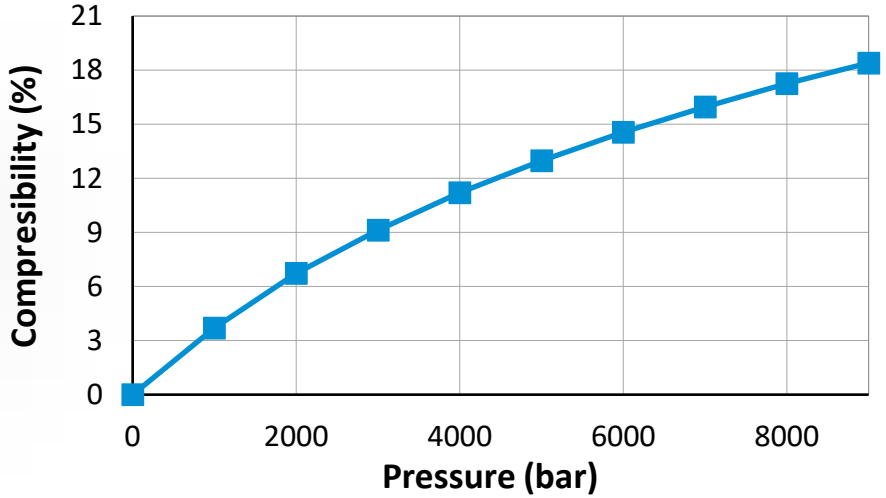


5. PRESSURE IS RELEASED TO REMOVE THE CANISTER FROM THE VESSEL DECOMPRESSION COOLING MINIMIZES NEGATIVE THERMAL IMPACT

Principles

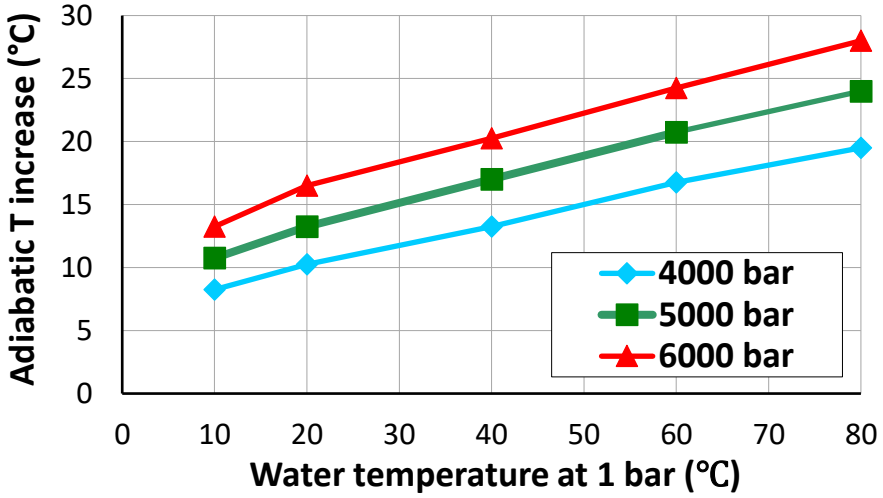
Adiabatic Compression Heating

Brigman (1912)



Water can be **compressed** because hydrogen bonds between water molecules are forced **closer together**, resulting in a new equilibrium under pressure (Le Châtelier's Principle).

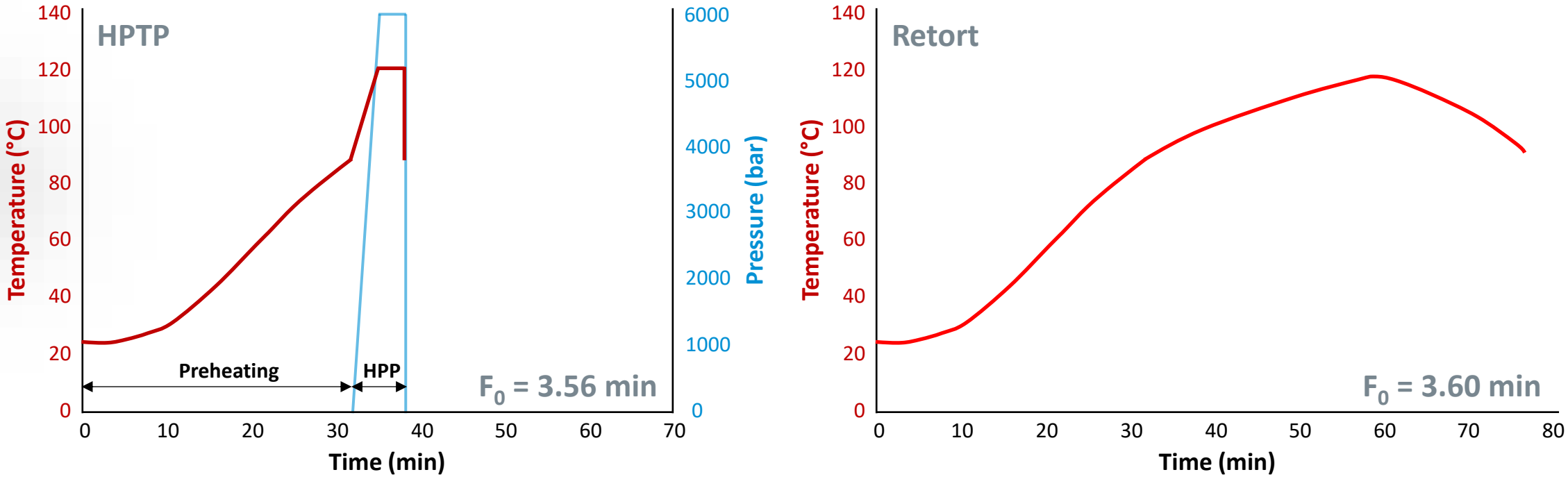
Makita (1992)



When water molecules are forced closer together, they **increase their interactions**. This compression leads to an increase in temperature, known as **adiabatic heating**.

HPTP vs. Retort

HPTP leverages the **isostatic principle**, **Le Châtelier's principle**, and **adiabatic compression heating** to drastically reduce the thermal load of conventional retort processing, and its impact on quality.



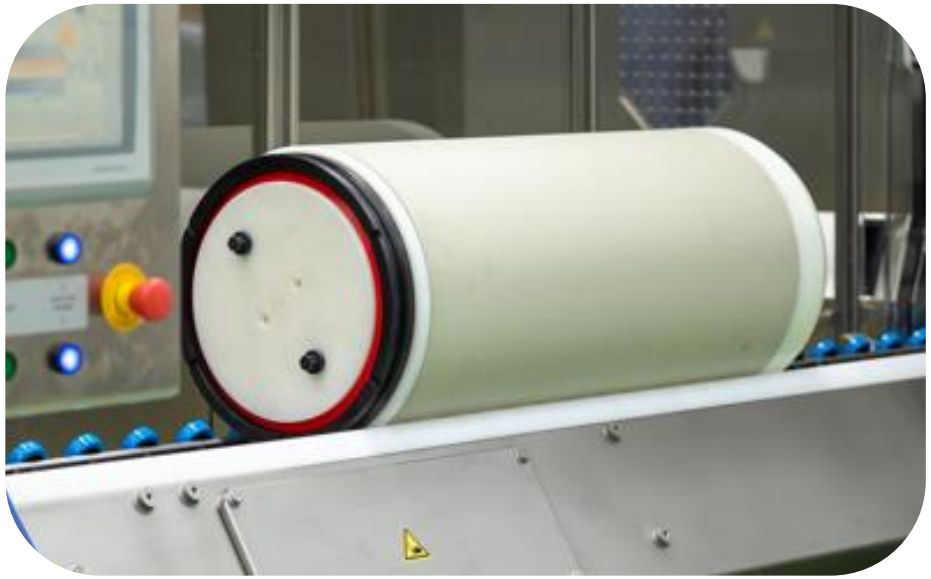
Example of a temperature profile in the center of pack (346 ml) with a mixture of cereal, meat, and vegetables during HPTP and a typical retort temperature profile inside of a can (384 ml). **(Juliano et al. 2009)**

INDUSTRIAL APPLICATION

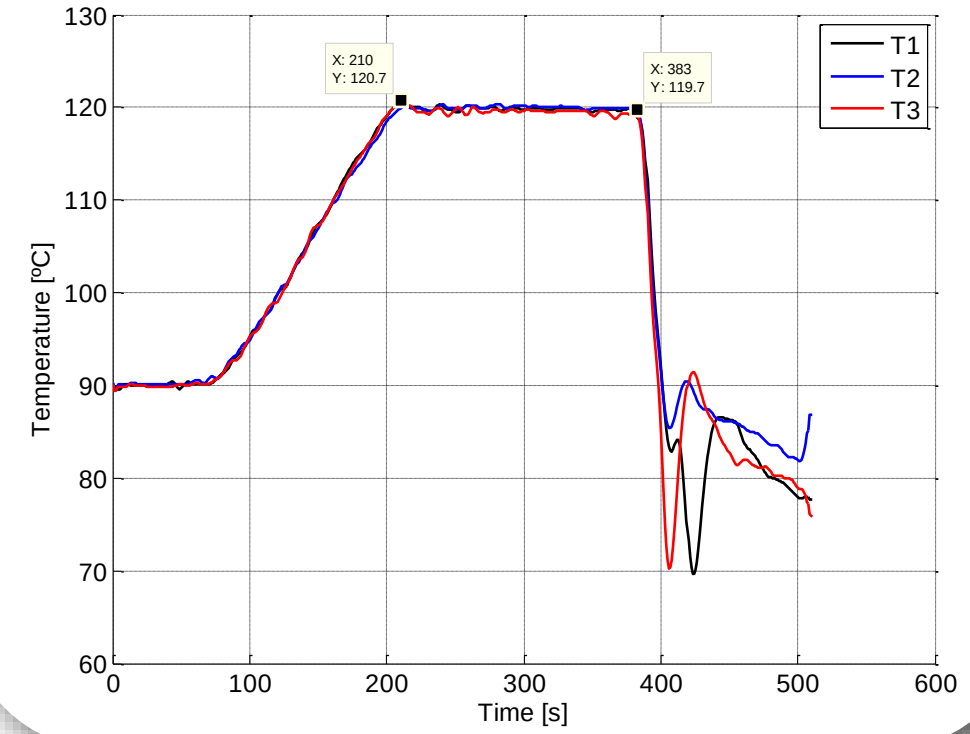
Canisters for Temperature Control

If the target pressure temperature is 250°F, the product must be preheated to 203°C for a specific amount of time.

High Temperature
(140-250 °F under pressure)



6000 bar for 3 min



Moderate temperature applied in the process

Applications

The process aims to inactivate more **vegetative microorganisms** and **enzymes** than the conventional HPP process, although it does not achieve sterility (pasteurization-like process).

Moderate Temperature
(25-60 °C under pressure)

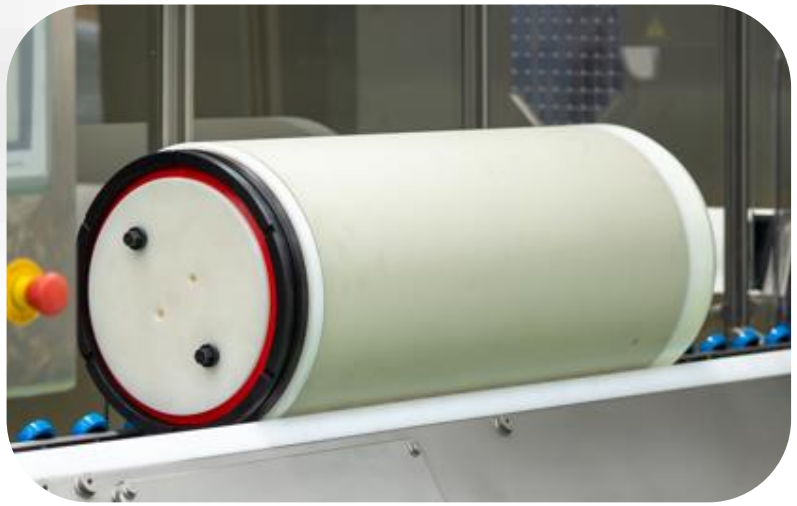
- Increased pathogen inactivation in specific applications compared to HPP.
- Longer shelf-life compared to HPP.
- Enhanced digestibility of some macromolecules.
- Creation of “**minimal cooked**” or “**sous vide**” like products.

High temperature applied in the process

Applications

The process aims to inactivate **bacterial spores**, resulting in stable products that can be stored at **room temperature** or **under refrigeration**, depending on the target microorganism.

High Temperature
(60-121 °C under pressure)



Faster process compared to conventional retort as equivalent F_0 is achieved more quickly.

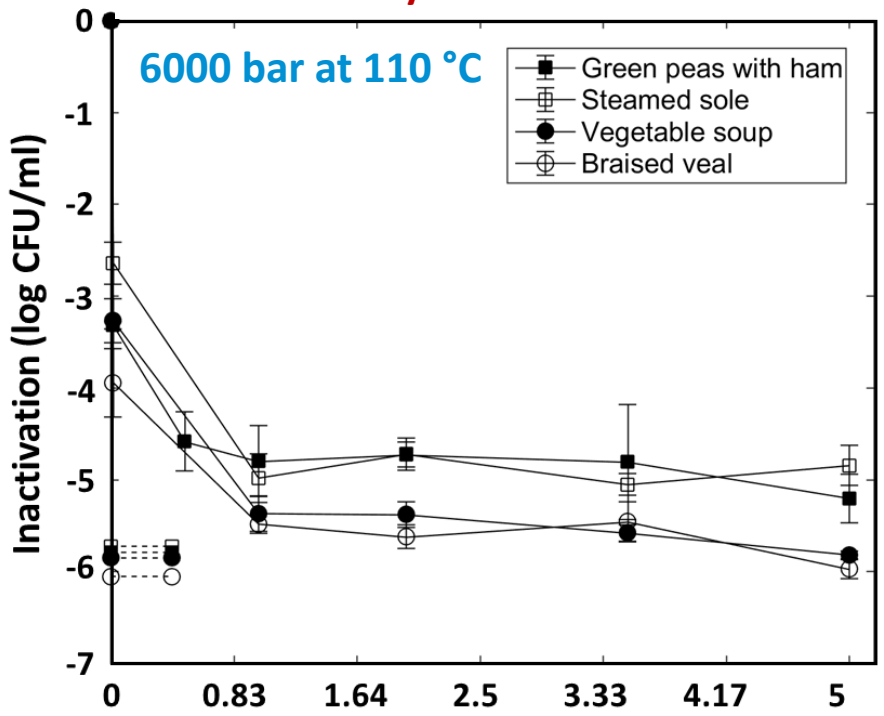
Higher nutritional and sensory qualities compared to the conventional retort.

Potential reduction of processing contaminants associated with intense thermal loads.

BENEFITS

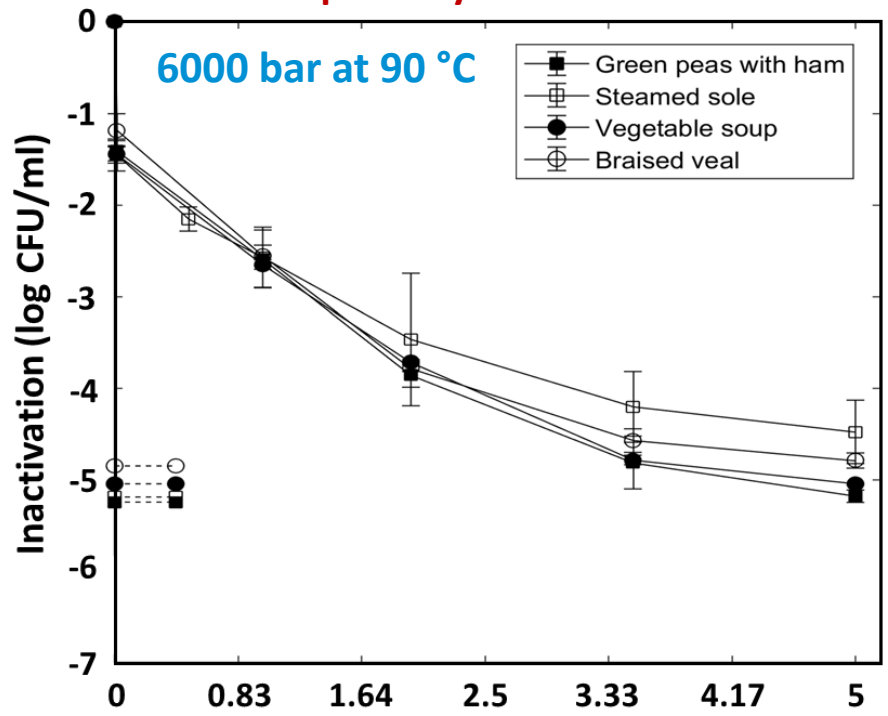
Food Safety – Spore Inactivation

Proteolytic *C. botulinum*



Maier et al. (2017)

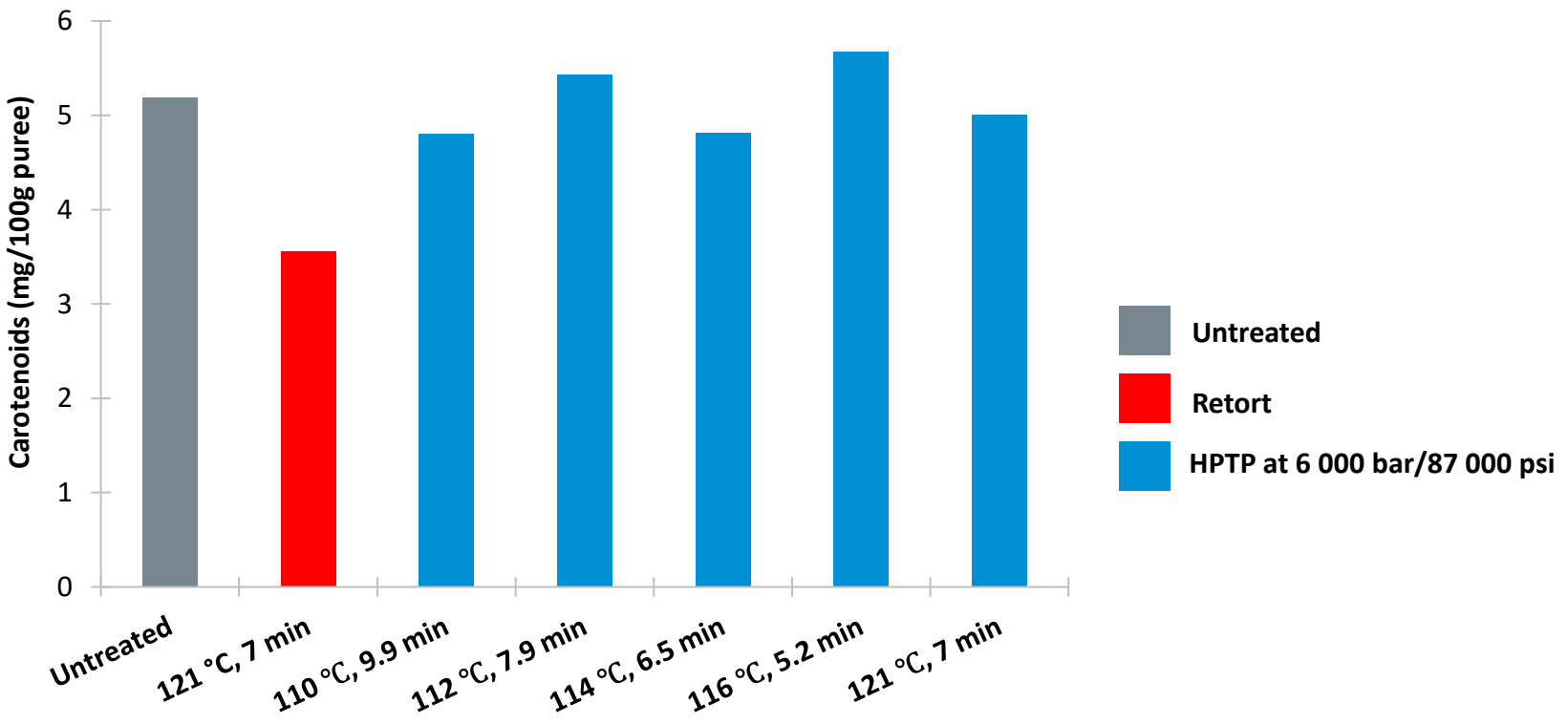
Nonproteolytic *C. botulinum*



Maier et al. (2018)

BENEFITS

Improved Nutritional and Sensory Qualities

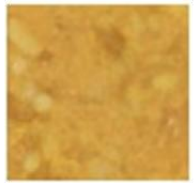


BENEFITS

Improved Nutritional and Sensory Qualities

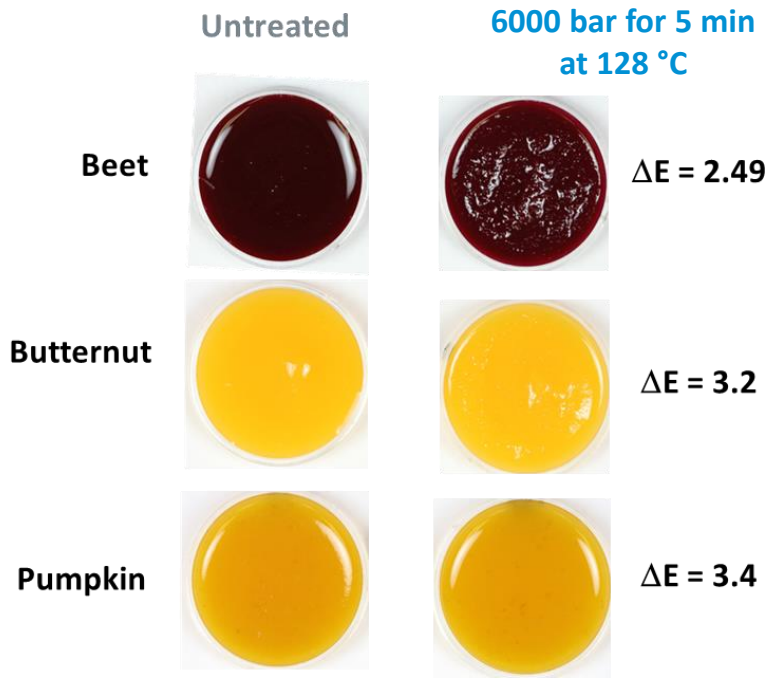
Chicken and Rice Puree

Gratz et al. (2021)



Vegetable Purees

Ghamdi et al. (2020)

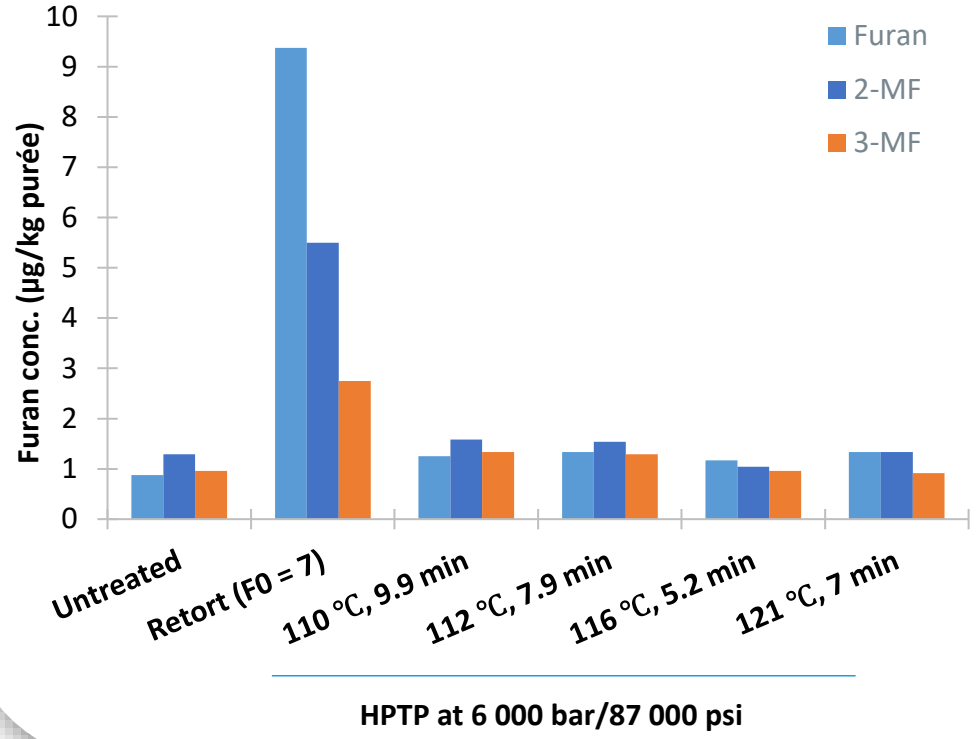


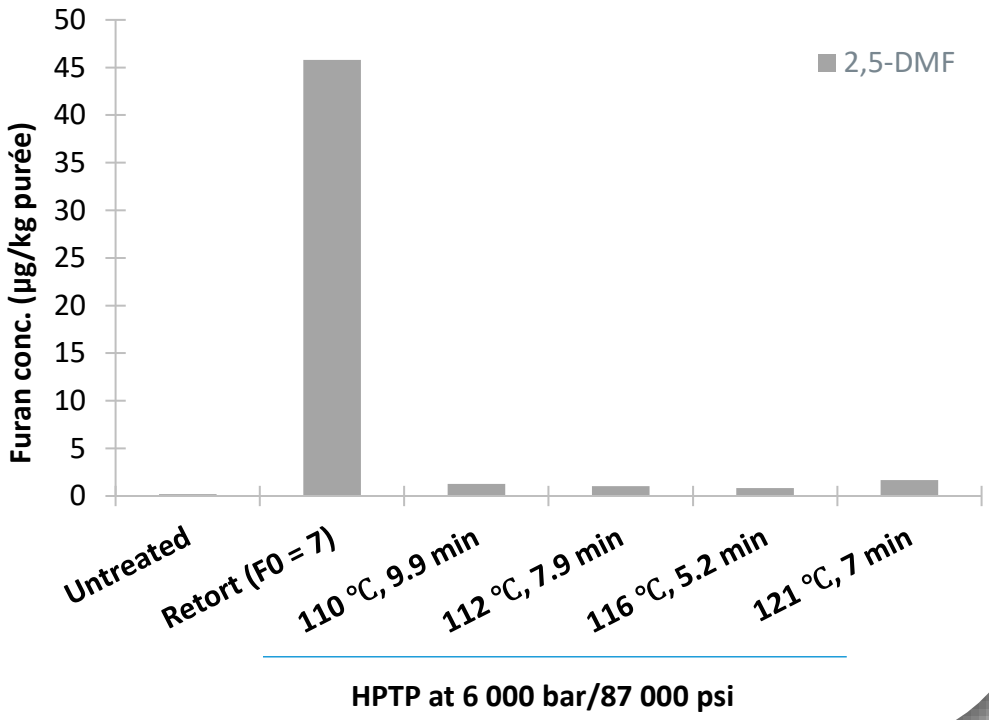
BENEFITS

Reduced Formation of Processing Contaminants

Chicken and Rice Puree

Gratz et al. (2021)





Approval

Pressure Assisted Thermal Sterilization

FOR IMMEDIATE RELEASE

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National Center for Food Safety and Technology
ILLINOIS INSTITUTE OF TECHNOLOGY

NCFST RECEIVES REGULATORY ACCEPTANCE OF NOVEL FOOD STERILIZATION PROCESS

The PATS process paves the way for advanced processing of next-generation shelf-stable foods, says national research consortium

(SUMMIT-ARGO, IL) February 27, 2009 – The National Center for Food Safety and Technology (NCFST), Illinois Institute of Technology (IIT) and Avure Technologies, Inc., announced today that the U.S. Food and Drug Administration (FDA) has accepted the research institute's filing of a new food sterilization process. The NCFST filing is the first-ever petition to FDA for the commercial use of pressure-assisted thermal sterilization (PATS) processes for application in the production of low acid foods.

- The FDA issued Letter of No Objection (LNO) in 2009.
- Process compliant with Low Acid Canned Food (LACF) regulation (21 CFR Parts 108 and 113).
- Heat penetration studies demonstrated accumulated lethality (F_0) equal to 3 min when pressure aids in raising temperature.
- The efficacy was established through an inoculated pack study with *C. botulinum*.

Approval

Pressure Enhanced Sterilization

Innovation Through Collaboration

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FOR IMMEDIATE RELEASE

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IFSH Receives FDA Acceptance of Pressure Enhanced Sterilization Process for Commercial Production of Multi-Component Shelf-Stable Foods

(Chicago, IL) July 12, 2015 – Illinois Institute of Technology's **Institute for Food Safety and Health** (IIT IFSH) announced today that the U.S. Food and Drug Administration (FDA) has accepted an IFSH process filing for applying a **Pressure Enhanced Sterilization (PES)** processing technology for the commercial production of complex particulate-bearing shelf-stable low acid foods.

- The FDA issued Letter of No Objection (LNO) in 2015.
- Process compliant with Low Acid Canned Food (LACF) regulation (21 CFR Parts 108 and 113).
- Lower pressure and temperature compared to PATS can effectively inactivate *C. botulinum* spores in complex low acid foods.

HPTP Pet food examples

Unprocessed

Stir-fried: 7min

HPTP

Stir-fried : 7 min

Preheating: 90 °C, 15min

HPTP: 6000 bar, 3 min, 120 °C

HPTP Pet food examples

Unprocessed

Stir-fried: 7 min

HPTP

Stir-fried: 7 min

Preheating: 90 °C, 15min

HPTP: 6000 bar, 3 min, 120 °C

Conclusions HPTP

- Improved nutritional and sensory qualities compared to conventional retort.
- Potential reduction of food contaminants associated with intense thermal loads (furan, acrylamide, hydroxy-methylfurfural).
- Higher productivity than conventional retort processing.

HPTP meals, courtesy of CSIRO

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Miami, FL	Burgos	Shanghai

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Food Science Support:

- Product Development
- HPP Packaging
- HPP Processing Parameters
- Food Safety Regulations
- Validation & Shelf-life Studies

PETFOOD FORUM

GLOBAL LEADER IN HIGH PRESSURE TECHNOLOGIES

Thank you
for your attention!

Hiperbaric
HIGH PRESSURE PROCESSING

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