



George J. Flick, Jr.

**High Pressure Processing
Laboratory and Service Center
Food Science and Technology
Department**

Virginia Tech (0418)


Blacksburg, Virginia 24061





High Pressure Processing Applications

- Ready-to-Eat Meat Products
- Ready-to-Eat Meals
- Seafood
- Value Added Fruits and Vegetables
- Beverages



Sales of High Pressure Processing Products

- A&P
- Acme
- Kroger
- Jewel/OSW
- Dominicks
- Albertson's
- Trader Joe's
- SYSCO
- Wal-Mart
- HEB
- Safeway
- Costco
- Sam's Club
- Subway
- H.E. Butt
- U.S. Food Service



High Pressure Processing of Seafood

- Reduces some pathogenic bacteria
- Reduces some viruses
- Reduces some parasites
- Reduces some allergens



HPP Has Been Used to Control Some Bacteria

- *Listeria monocytogenes*
- *Staphylococcus aureus*
- *Salmonella* spp.
- *Escherichia coli*
- Fecal coliforms
- Yeasts and Molds



HPP Has Been Used to Control Some Parasites

- *Cryptosporidium parvum*
- *Giardia lamblia*
- *Anisakis simplex*



HPP Has Been Used to Control Some Viruses

- Inactivation

- Norovirus

- Picornaviruses

- Hepatitis A


- Rotavirus

- Influenza

- Adenovirus

- Resistant

- Poliovirus



HPP induced disassociation of viruses may be fully reversible or irreversible depending on the virus and treatment conditions. The higher the treatment, the greater the lead to irreversible.



Extension of Shelf-life of Seafood

- Fish and shellfish are generally spoiled by Gram negative bacteria which tend to be relatively pressure sensitive.
- Lactic acid bacteria survive and grow. Odors produced by lactic acid bacteria are generally less objectionable than normal microflora.




Extension of Shelf-life of Seafood

- High pressure processing can enhance the action of some enzymes while inactivating others.
- Example: HPP increased the head blackening of shrimp.



Potential Limitations of HPP for Seafood

- Enzymes activity may be increased
- Sterilization may not be achievable
 - Product has cooked appearance
 - Most seafood has few intrinsic preservation properties



Sensory Quality of HPP Treated Seafood

- HPP Does not change the taste of foods but can result in a flavor change.
- HPP may result in a hardening of a product or a softening.
- May cause an opacity similar to light cooking.



Optimization of Treatment Parameters

- Low HPP can cause blackening of shrimp but high HPP can reduce blackening
- Is the product more safe or less safe?
- Yield vs. Shelf-life vs. Appearance
- Cold vs. Hot processing
- Pulses may reduce spore-forming bacteria



HPP For Oyster Processing

- Adductor muscle is released from shell
- *Vibrio parahaemolyticus*, *Vibrio cholerae* and *Vibrio vulnificus* are reduced
- Shelf-life is extended
- Higher drip loss in HPP treated oysters since water was absorbed
- Different seasons and locations affect physical and biological properties of HPP treated oysters



HPP for Crab Processing

Recent HPP Applications

Microorganisms isolated from vacuum-packaged unpressurized (control) and pressurized (550 MPa at 25°C for 5 min) crab meat stored at refrigeration temperature for 31 days


Microorganisms	Days of storage and treatment													
	Control							550 MPa						
	0	3	7	12	17	24	31	0	3	7	12	17	24	31
<i>Acinetobacter johnsonii</i>	●													
<i>Acinetobacter lwoffii</i>	●													
<i>Aerococcus viridans</i>								●						
<i>Aeromonas salmonicida</i>							●							
<i>Arthrobacter aurescens agilis</i>	●		●											
<i>Bacillus megaterium</i>		●												
<i>Brevibacillus agri</i>	●							●						
<i>Brevibacterium iodinum</i>	●							●	●					
<i>Brevibacterium linens</i>								●						
<i>Brevibacterium casei</i>								●	●					
<i>Brevibacterium epidermidis</i>								●						

● = isolated from aerobic plates * = isolated from anaerobic roll tubes

Microorganisms isolated from vacuum-packaged unpressurized (control) and pressurized (550 MPa at 25°C for 5 min) crab meat stored at refrigeration temperature for 31 days

Microorganisms	Days of storage and treatment													
	Control							550 MPa						
	0	3	7	12	17	24	31	0	3	7	12	17	24	31
<i>Carnobacterium piscicola</i>	*	● *	● *	● *	● *	● *	● *				*		● *	
<i>Chryseobacterium balustinum</i>			●											
<i>Corynebacterium auris</i>										●	●			
<i>Enterococcus mundtii</i>								*	● *	● *	●	● *	*	*
<i>avium</i>								*			*	*	*	● *
<i>solitarius</i>								*			*	● *	*	● *
<i>Exiguobacterium acetylicum</i>	●	●		●										
<i>Macrocooccus caseolyticus</i>		●						●	●	*				

● = isolated from aerobic plates * = isolated from anaerobic roll tubes



Microorganisms isolated from vacuum-packaged unpressurized (control) and pressurized (550 MPa at 25°C for 5 min) crab meat stored at refrigeration temperature for 31 days

Microorganisms	Days of storage and treatment													
	Control							550 MPa						
	0	3	7	12	17	24	31	0	3	7	12	17	24	31
<i>Moraxella catarrhalis</i>											●			
<i>Providencia rustigianii</i>							●							
<i>Pseudomonas putida aureofaciens</i>		● ●	●	●		●								
<i>Psychrobacter immobilis</i>										●	●	●		
<i>Staphylococcus kloosii</i>	●													

● = isolated from aerobic plates * = isolated from anaerobic roll tubes



Predominant microorganisms isolated from aerobic plates

Day	Control	550 MPa
0	<i>Exiguobacterium acetylicum</i> <i>Acinetobacter</i>	<i>Brevibacterium</i>
3	<i>Pseudomonas putida</i>	<i>Brevibacterium</i>
7	<i>Pseudomonas putida</i>	<i>Psychrobacter immobilis</i>
12	<i>Carnobacterium piscicola</i> <i>Pseudomonas putida</i>	<i>Psychrobacter immobilis</i>
17	<i>Carnobacterium piscicola</i>	<i>Enterococcus</i>
24	<i>Carnobacterium piscicola</i>	<i>Enterococcus</i>
31	<i>Carnobacterium piscicola</i>	<i>Enterococcus</i>



Predominant microorganisms isolated from anaerobic roll tubes

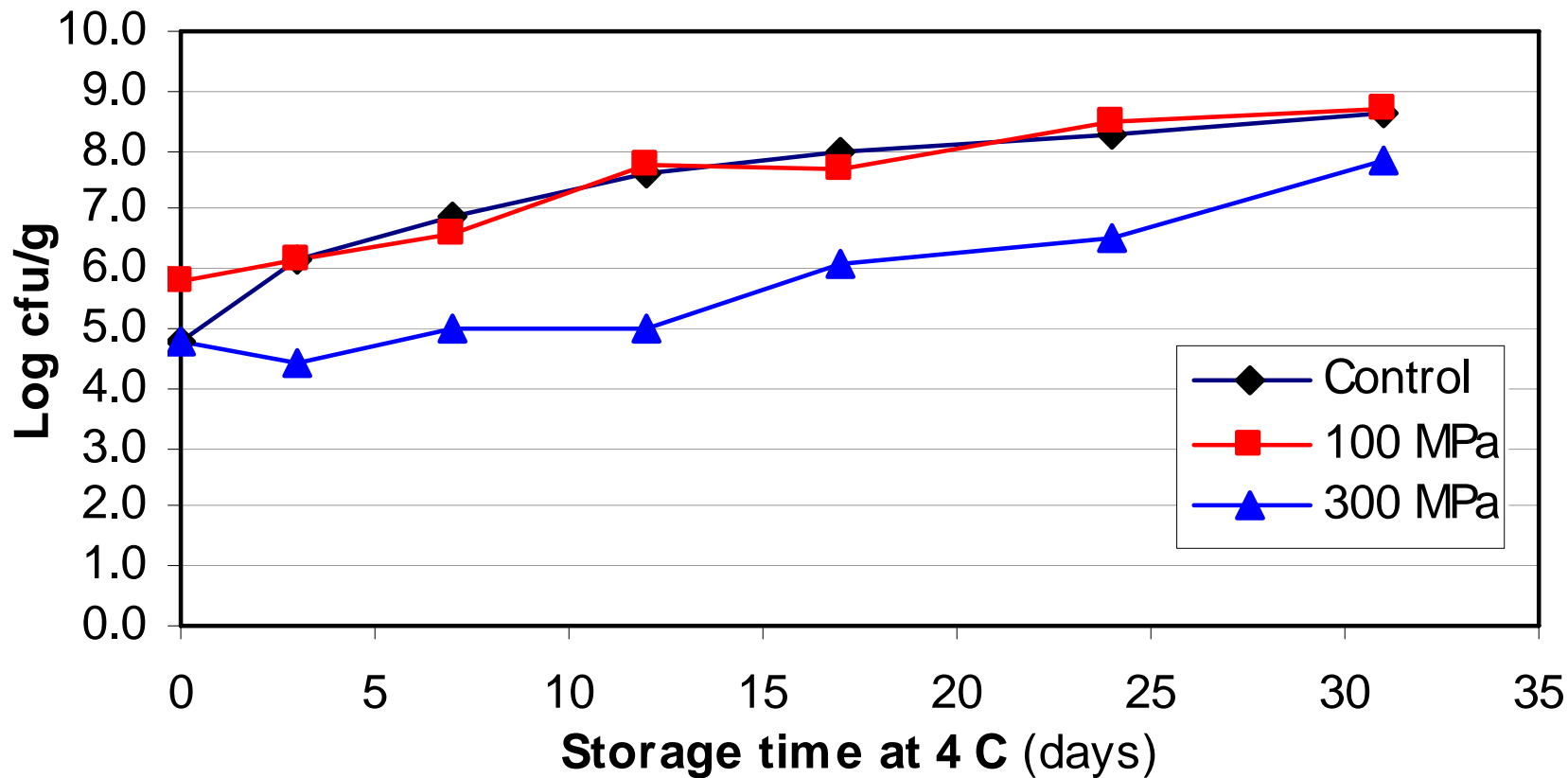
Day	Control	550 MPa
0	<i>Carnobacterium piscicola</i>	<i>Enterococcus</i>
3	<i>Carnobacterium piscicola</i>	<i>Enterococcus</i>
7	<i>Carnobacterium piscicola</i>	<i>Enterococcus</i>
12	<i>Carnobacterium piscicola</i>	<i>Enterococcus</i>
17	<i>Carnobacterium piscicola</i>	<i>Enterococcus</i>
24	<i>Carnobacterium piscicola</i>	<i>Enterococcus</i>
31	<i>Carnobacterium piscicola</i>	<i>Enterococcus</i>



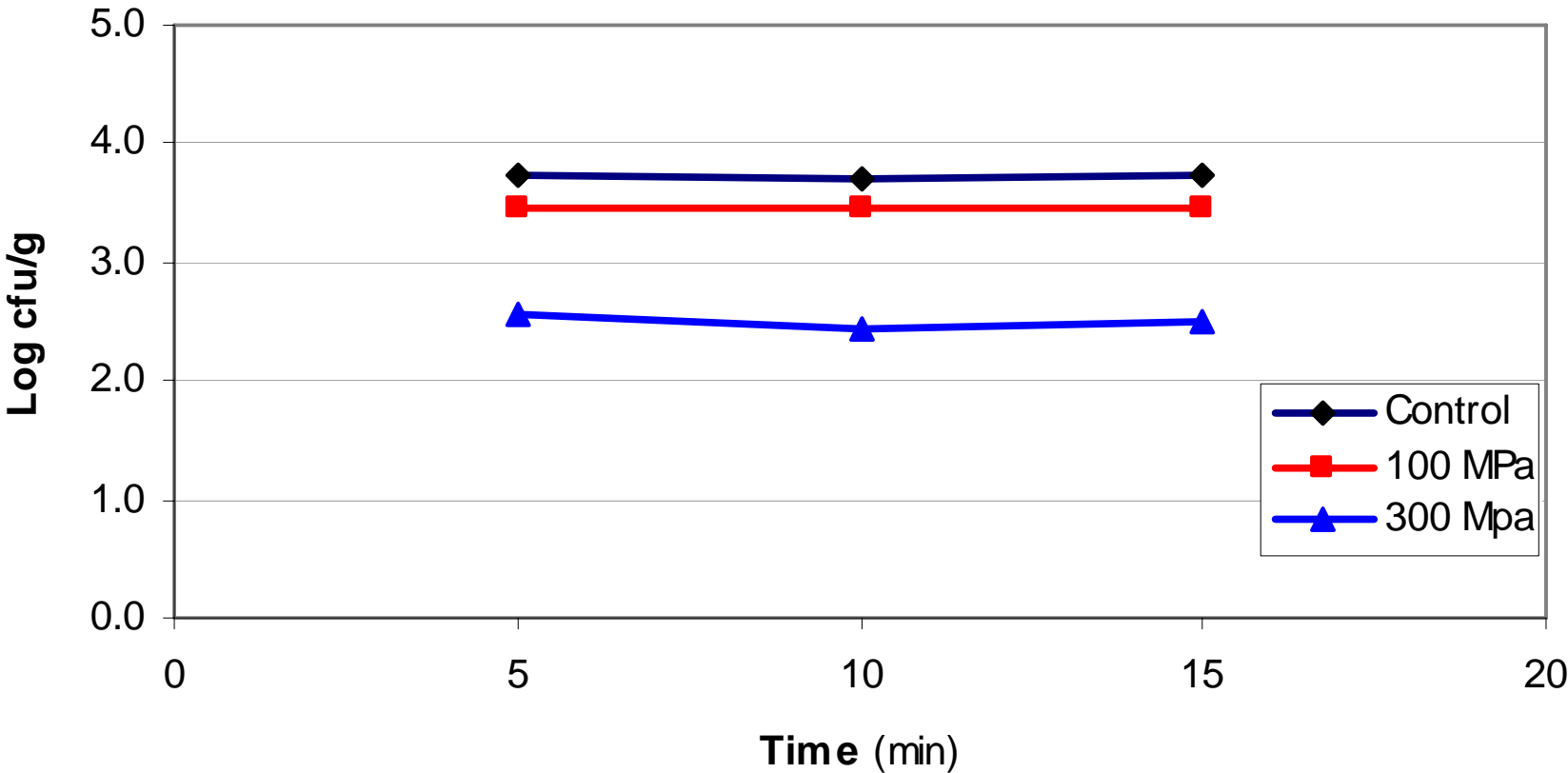
Sensory characteristics of unpressurized (control) and pressurized crab meat stored at 4°C for 31 days

Day	Control	300 MPa	550 MPa
0	Fresh	Fresh	Fresh
7	Pungent, strong odor	Fresh	Fresh
12	Pungent, strong odor	Fresh	Fresh
17	Pungent, strong odor, spoiled	Fresh	Fresh
24	Strong odor, spoiled	Stale	Fresh, acceptable
31	Strong odor, spoiled	Pungent, sweet flavor, cabbage flavor, smoky flavor, unacceptable	Little stale, acceptable

Effect of pressure levels of 100 and 300 MPa for 15 min at the starting temperature of 25 °C on total aerobic plate counts of crab meat stored at 4 °C for 31 days



Effects of processing times of 5, 10, and 15 min at 25 °C at 300 and 550 MPa on total aerobic plate counts





Other Applications of HPP to Seafood

- Used to extract gelatin from fish skins
- Used to assist thawing of fish fillets
 - Less drip
 - Improves sensory quality
- Improved rheological values of a mince over conventional heating



Recommendations for Implementation of HPP

1. Best used for

- Hot smoked fish
- Cooked crab
- Cooked shrimp
- Cooked crawfish
- Cooked lobster
- Further processed seafood products



Recommendations for Implementation of HPP

2. Need to consider application

- Shelf-life extension
- Pathogen control

3. Further steps

- Perform pilot studies
- Consider variation in barotolerance of microorganisms

4. Review the literature



About the High Pressure Processing Laboratory at Virginia Tech

About High Pressure

Services Offered

News

Bibliography

Contact Us

Links

Virginia Tech...

...is one of the nations' leading programs in Food Science and Technology, and has a longstanding record of industry partnership to make innovations in technology, safety, and product development a reality. Using HPP to treat your food product can have a remarkably positive effect on its quality, shelf life, and safety profile.

- [Directions to our Laboratory](#)
- [Download our Brochure](#)
- [Our Equipment Specifications](#)
- [Our Personnel](#)
- [Our Presentations](#)
- [Our Publications](#)

We've added a new presentation you can download - more...

Read the news article on our Lab from the March 11, 2006 edition of the Roanoke Times.