JBT AVURE® HPP

High Pressure Processing of Juices

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ICBC - September 19, 2024

Agenda

1. What is High Pressure Processing
2. Microbiology of HPP
3. Pathogenic Protozoa
4. Questions

Key Benefits of HPP

Improved food safety

Clean label

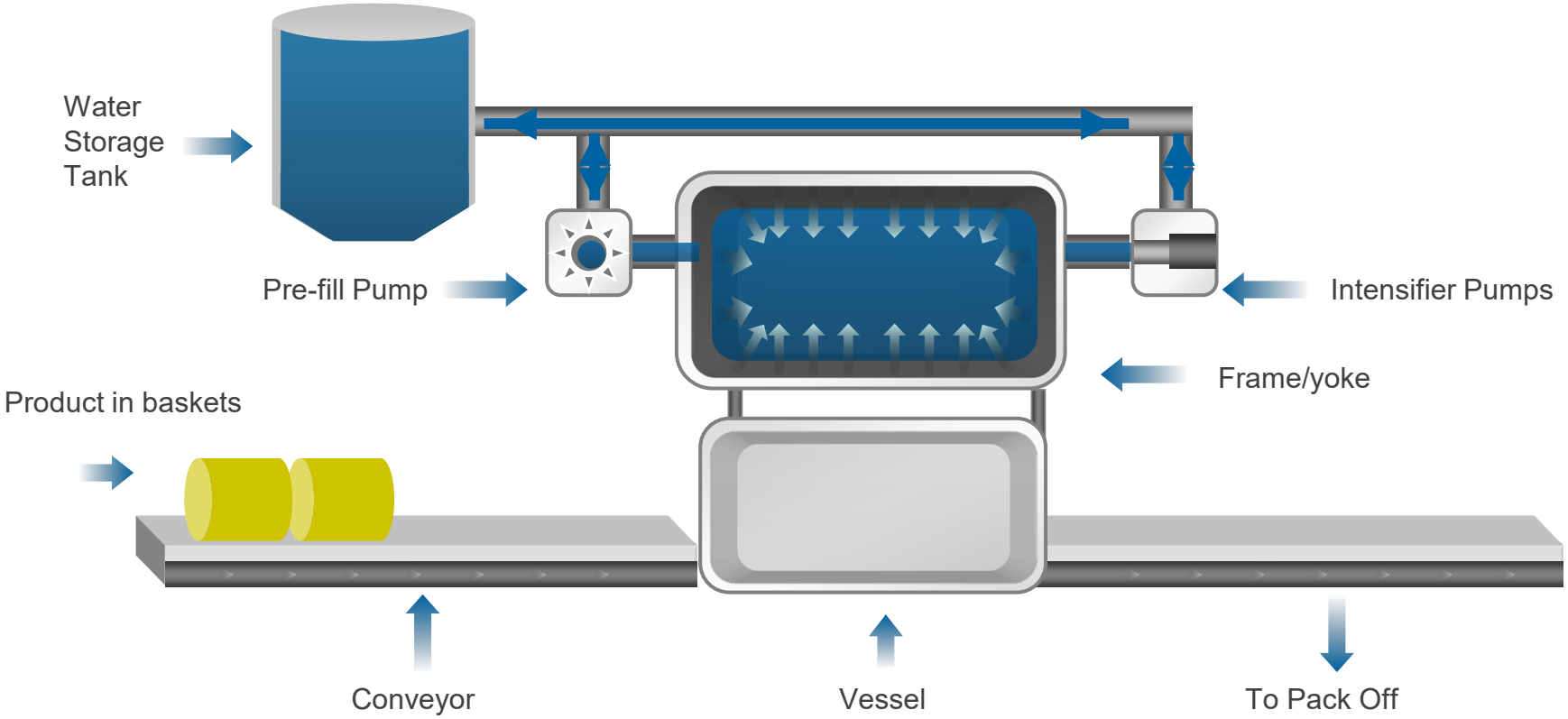
Non-thermal technology

Extended shelf life

Reduces food waste

How HPP Works

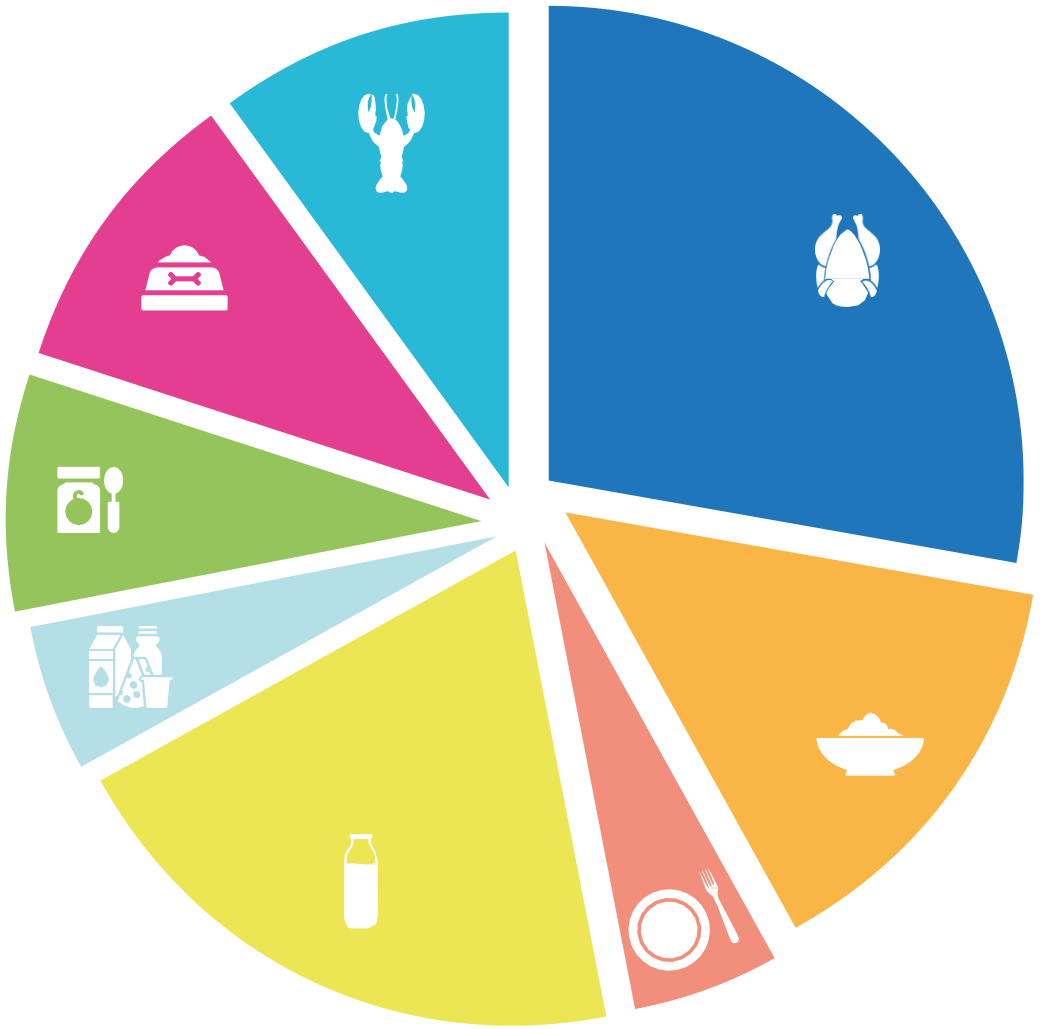
Vessel pressurized with water to 6000 bar



HPP VALIDATED

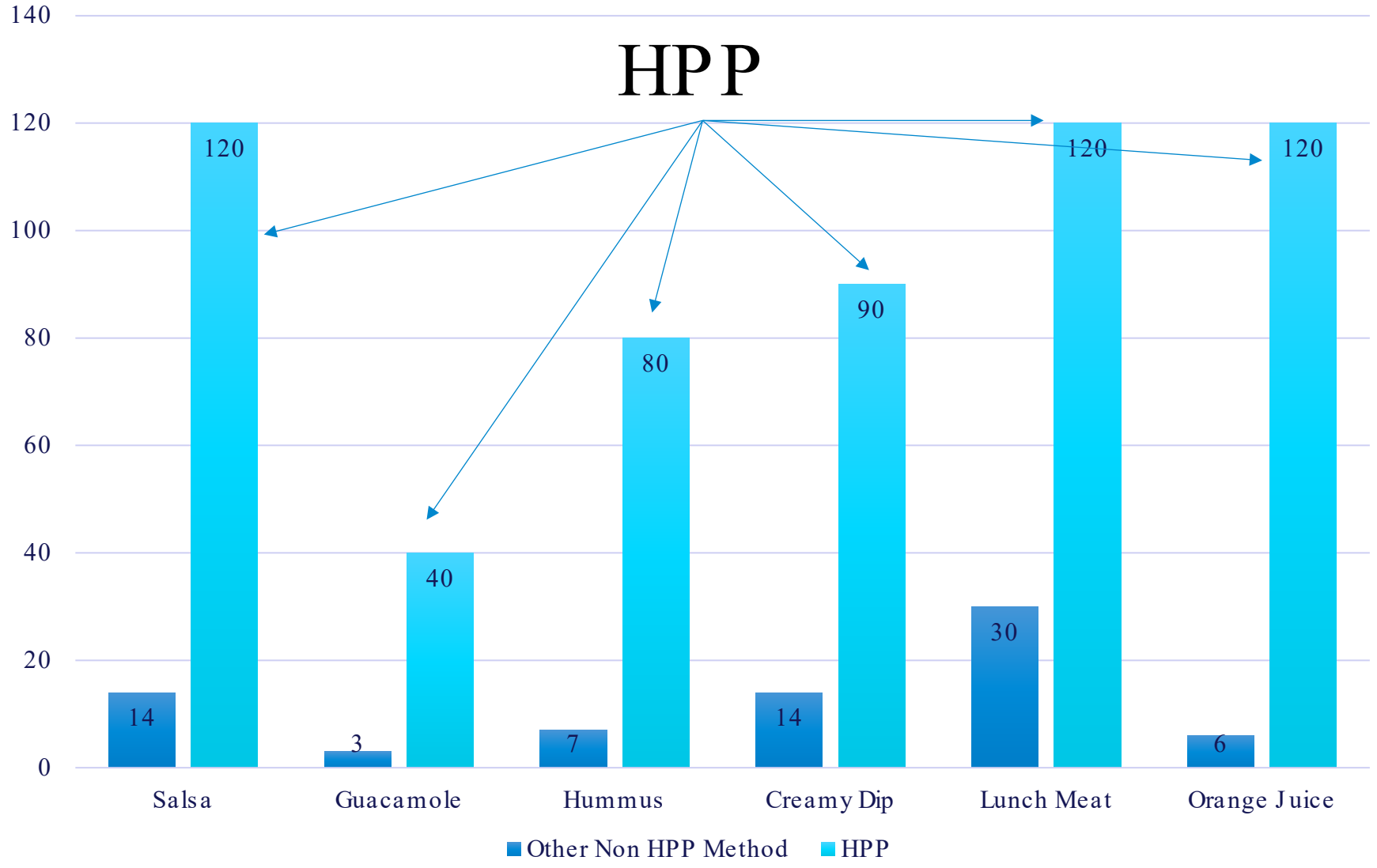
Pressure and Time

Current HPP Applications



- RTE meat and poultry
- Dips, spreads, sauces, wet salads
- Ready Meals
- Juice & Beverages
- Dairy
- Baby Food
- Pet Food
- Seafood

SHELF-LIFE COMPARISON



HPP of Juices

FDA Juice HACCP (21 CFR Part 120)

- >5 log reduction of vegetative pathogens of concern

Increase shelf life

- 90-120 days

High acid products (pH <4.6)

Refrigerated storage

Table 4
Experimentally observed log reductions of *E. coli* in 11 commercial juices or beverages treated at 550 MPa for 1 min, immediately after HPP treatment (0 h) and after 24, 48, and 72 h of refrigerated (5 °C) storage (average ± 95% confidence intervals, n = 3).

Juice or beverage	Time after processing (h)		
	0	24	48 and 72
A	>6.0 ± 0.1[a]	>6.0 ± 0.1[a]	>6.0 ± 0.1[a]
B	>5.9 ± 0.4[c]	>6.0 ± 0.1[a]	>6.0 ± 0.1[a]
C	>5.3 ± 1.4[b]	>6.0 ± 0.2[a]	>6.0 ± 0.2[a]
D	>6.0 ± 0.1[a]	>6.0 ± 0.1[a]	>6.0 ± 0.1[a]
E	>6.0 ± 0.2[a]	>6.0 ± 0.2[a]	>6.0 ± 0.2[a]
F	>6.1 ± 0.2[b]	>5.7 ± 0.6[c]	>6.1 ± 0.1[a]
G	>5.9 ± 0.3[b]	>6.0 ± 0.2[a]	>6.0 ± 0.2[a]
H	>6.0 ± 0.2[a]	>6.0 ± 0.2[a]	>6.0 ± 0.2[a]
I	>6.0 ± 0.2[a]	>6.0 ± 0.2[a]	>6.0 ± 0.2[a]
J	>6.0 ± 0.2[a]	>6.0 ± 0.2[a]	>6.0 ± 0.2[a]
K	>5.5 ± 0.8[c]	>6.0 ± 0.3[b]	>6.1 ± 0.2[a]

[a] Final population of three replicates below quantification limit.
[b] Final population of two replicates below quantification limit.
[c] Final population of one replicate below quantification limit.

Usaga et al., 2021

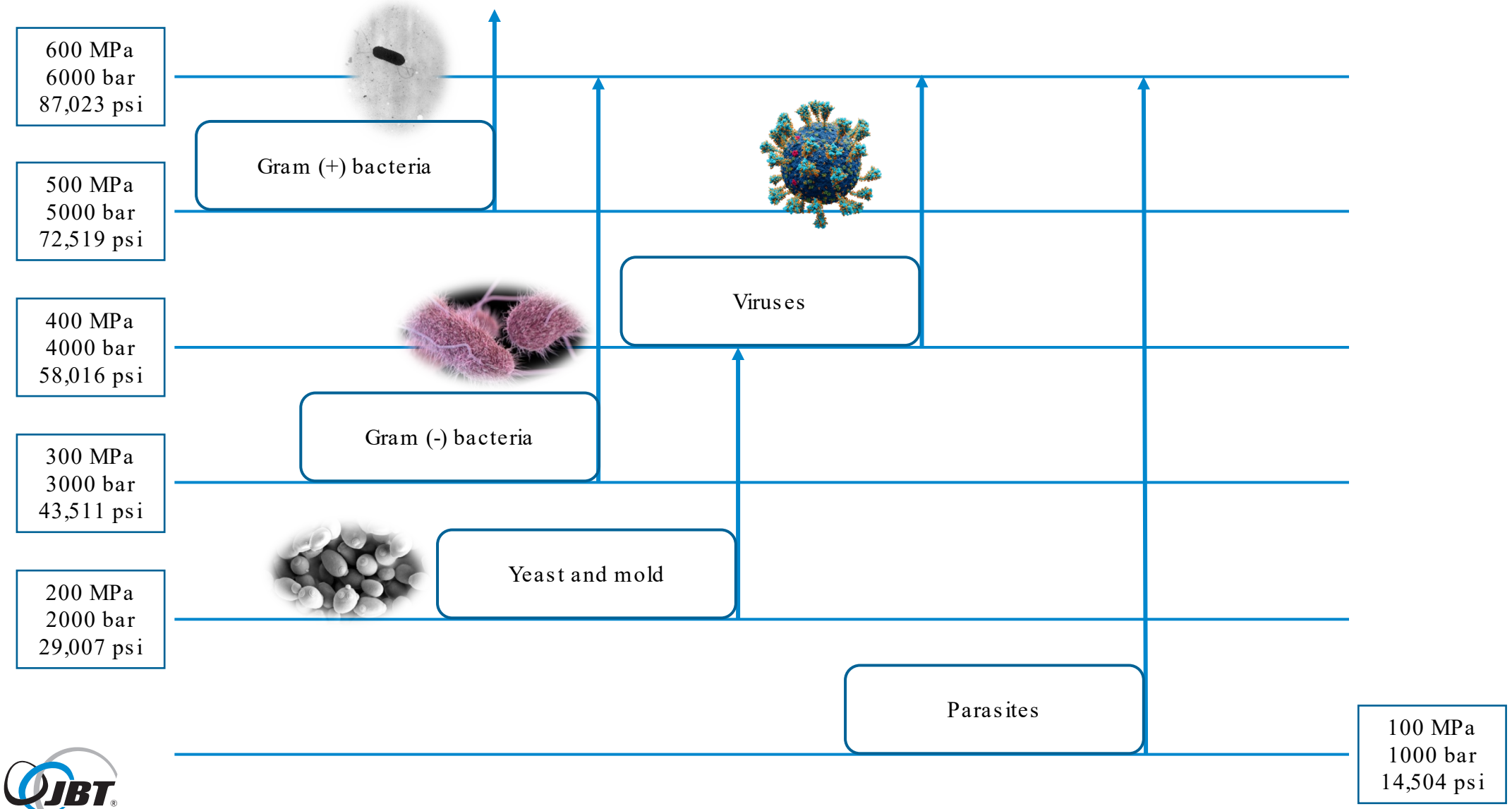
MICROBIOLOGY

- Vegetative pathogens
  - L. monocytogenes, Salmonella spp., E. coli O157:H7
- Spoilage organisms
  - Lactic acid bacteria, coliform
  - Yeast &mold
- Parasites
  - Protozoa, Trichinella
- Viruses
- Spores not affected (Clostridium, Bacillus)

Salmonella

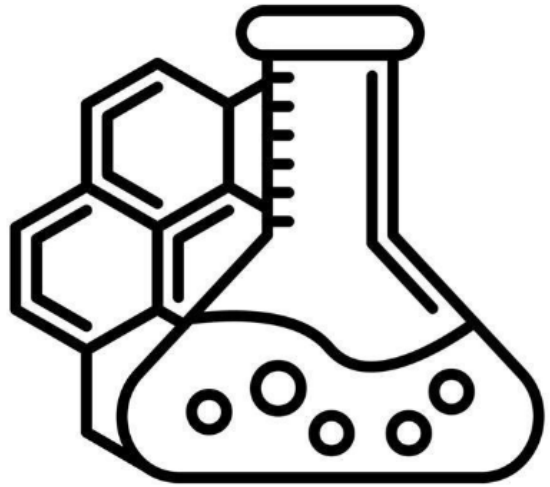
www.cdc.gov

MICROBIOLOGY



FORMULATION

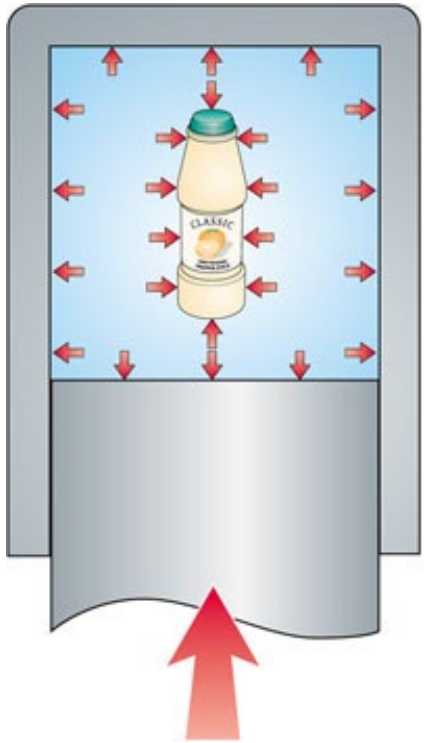
- HPP conditions for food safety/shelf life affected by
  - pH
  - Brix/water activity
  - Food matrix/ingredients



- Typical HPP process conditions
  - 80-87kpsi (5500-6000 bar) for 90-180 seconds

PACKAGING – THE BASICS

- Flexible & elastic container
- Hermetic seal
- Limited headspace



Pathogenic protozoa

Organism	Outbreaks
Cryptosporidium parvum	Foodborne: milk, apple cider, fresh produce Non-foodborne: water, live animals, infected individuals
Cyclospora cayetanensis	Foodborne: berries, basil, cilantro, salad mix Non-foodborne: water, infected individuals
Giardia lamblia	Foodborne: oysters, milk, fresh produce Non-foodborne: water, infected individuals
Toxoplasma gondii	Foodborne: undercooked meat, shellfish, milk Non-foodborne: water, soil, animal feces, infected individuals

HPP and parasitic protozoa

Organism	Product	Results	Ref
Cryptosporidium parvum	Apple juice (pH 3.69) Orange juice (pH 3.93)	Oocyst infectivity eliminated by HPP at 80,000 psi for ≥60 sec hold	Slifko et al., 2000
	Oysters	Oocyst infectivity reduced by 93% at 80,000 psi for 180 sec hold	Collins et al., 2005
Toxoplasma gondii	Raspberries	Oocyst infectivity eliminated by HPP at 49,312 psi (340 MPa) for ≥60 sec hold	Lindsay et al., 2008
	Buffer solution	Oocyst infectivity eliminated by HPP at 49,312 psi (340 MPa) for ≥60 sec hold	Lindsay et al., 2005
	Pork	Tissue cyst infectivity eliminated at 43,511 psi (300 MPa) for ≥30 sec hold	Lindsay et al., 2006
Encephalitozoon cuniculi	Apple cider	Spore infectivity eliminated in all samples at 49,457 psi (345 MPa) for 60 sec hold	Jordan et al., 2005

Conclusion

- Parasitic protozoa are an emerging pathogen category for beverages
- High pressure processing is widely used in high acid juice products to eliminate spoilage and pathogenic bacteria
- Limited evidence has shown HPP capable of eliminating infectivity of some pathogenic protozoa in high acid juice products

We are

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