

Novel sterilisation technologies

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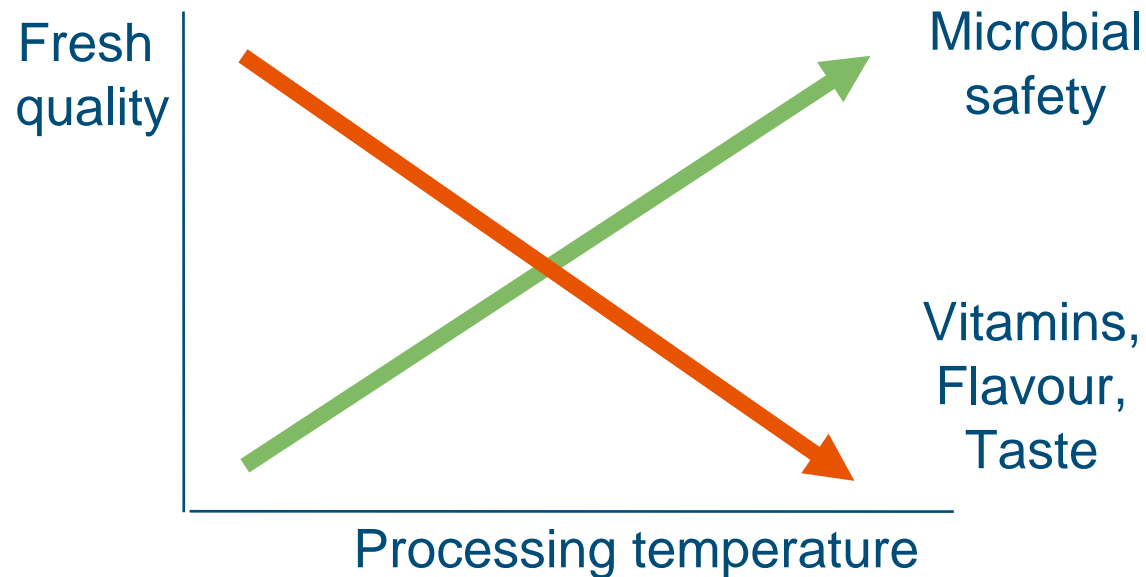
Overview

- Introduction: why are mild sterilisation technologies interesting?
- High pressure sterilisation: what is it and how to achieve?
- Surface decontamination with cold plasma: why can this be interesting?



Why mild preservation?

- Current technologies are not always sufficient to reach consumer demands.
- Preservation of fresh characteristics combined with shelf life and safety is main goal of preservation.



Novel mild preservation technologies

High Intensity
Light HIL

Plasma

Steam
heating

Pulsed
electric
field PEF



Microwave
(with steam)

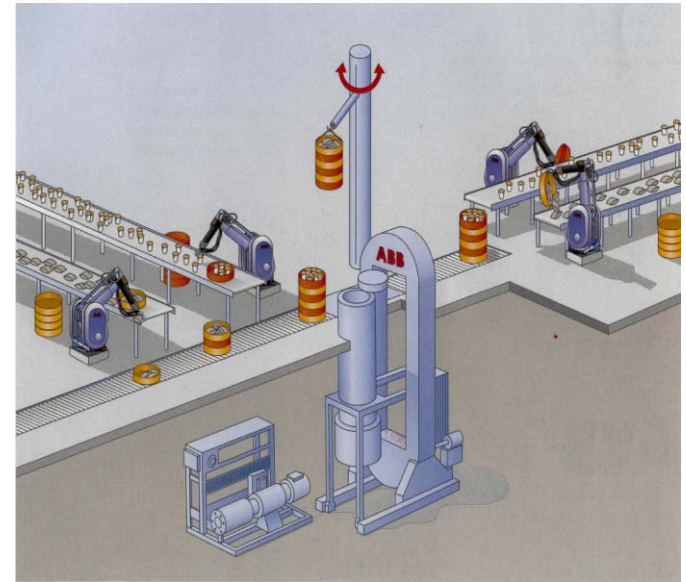
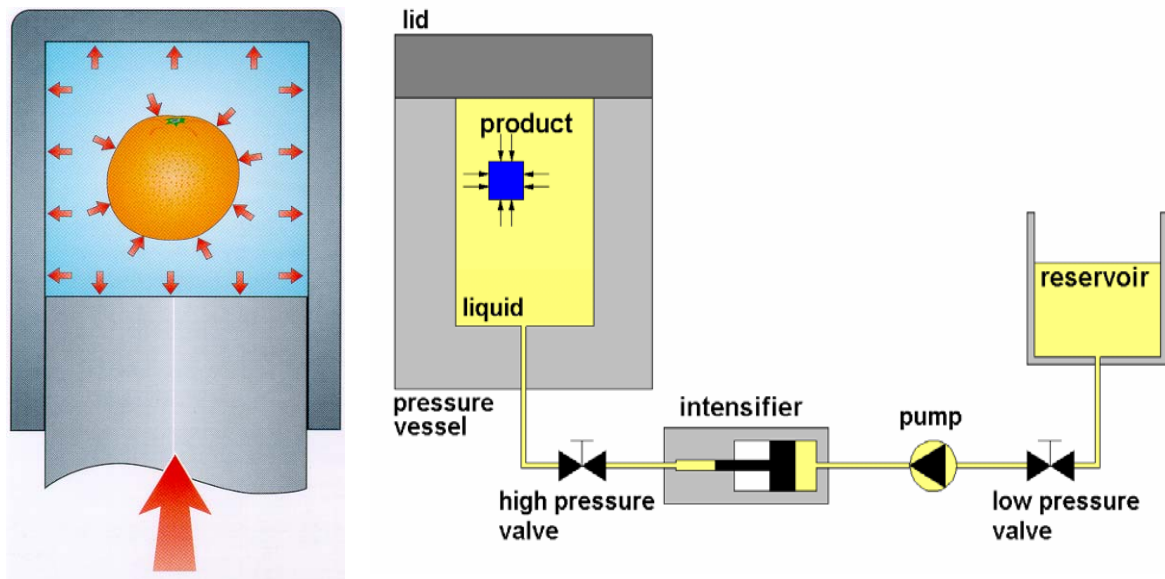
High pressure
processing
(HPP)

RF
heating



High pressure processing (HPP)

- Mild preservation by using pressure as processing variable.
- Treatment of consumer package in high pressure vessel.
- Additional costs: € 0.10 - 0.15/kg product.



Product-examples HP-pasteurisation

- Principle: inactivation of vegetative cells (pasteurisation) and enzymes at 400 - 600 MP and room temperature.
- E.g.: fruit juices, salsa, meat products, soup, jam, oysters, guacamole (from 2 hours to 4 weeks chilled shelf life).



High pressure sterilisation

- Current research shows that high pressure sterilisation is possible
- Inactivation of spores with high pressure and elevated temperature
- In general higher quality compared to conventional retort sterilisation

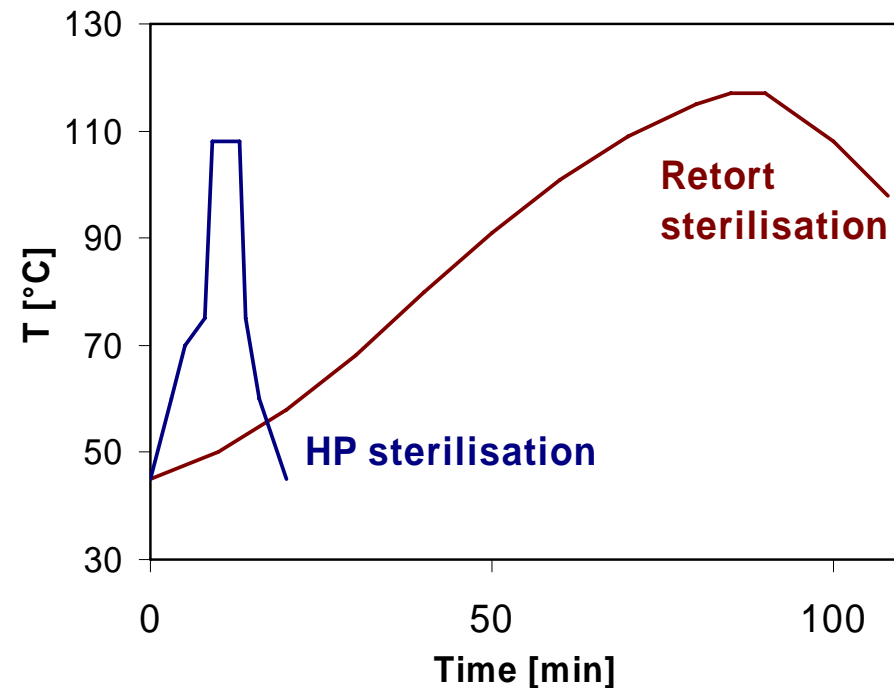


High pressure sterilisation: how does it work?

- Previous idea: germination of spores at 100 - 200 MPa, inactivation of germinated spores at 400 - 600 MPa.
- Problem: not all spores can be germinated: safety risk.
- Current insight: sterilisation possible with a combination of pressure and elevated temperature

High pressure sterilisation: principle

- Start at elevated temperature: 70 – 90 °C.
- Use heat generated by applying pressure for uniform rapid increase of temperature, and vice versa cooling at pressure decrease.
- Spores inactivated by combination of P and T.
- Maximum temperature is 5 - 10 °C lower.
- Lower heat input compared to retort => higher quality.



High pressure sterilisation: microbiology

- Inactivation of spores by high pressure sterilisation in food products

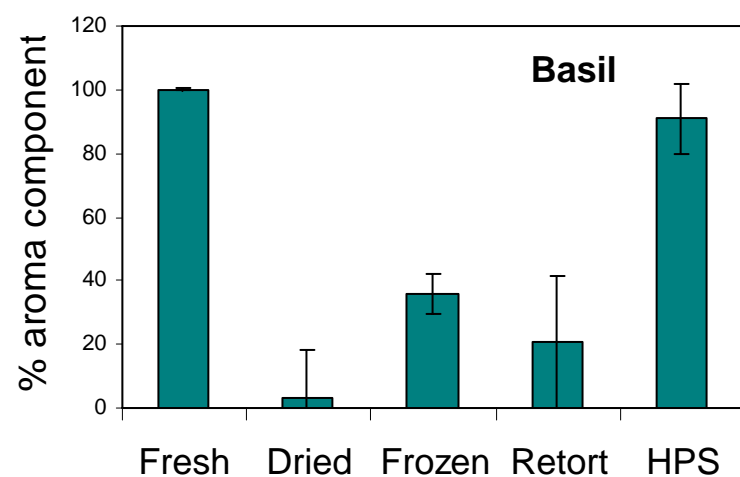
	Total count		Spore count	
	Initial	HPS	Initial	HPS
Green beans	6.1	<CT	3.5	<CT
Spinach	8.2	<CT	3.5	<CT
Asparagus	6.9	<CT	4.7	<CT
Milk	4.4	<CT	0.7	<CT
Basil	4.8	<CT	3.9	<CT



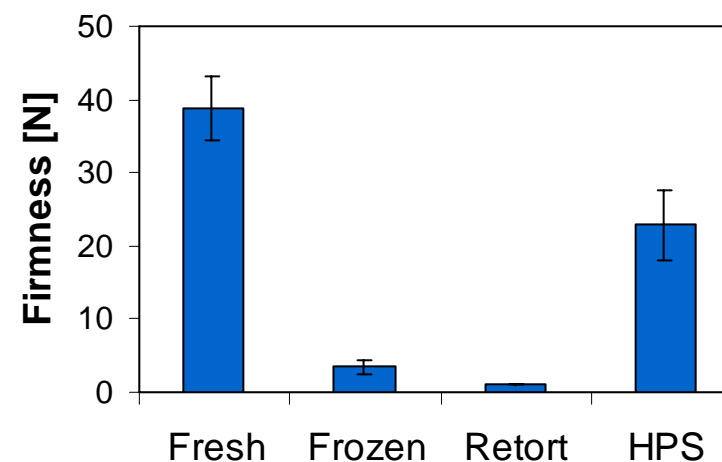
Quality improvement by HP-sterilisation

Better food quality (vitamins, colour, taste, texture):

Flavour of fresh basil



Firmness of green beans



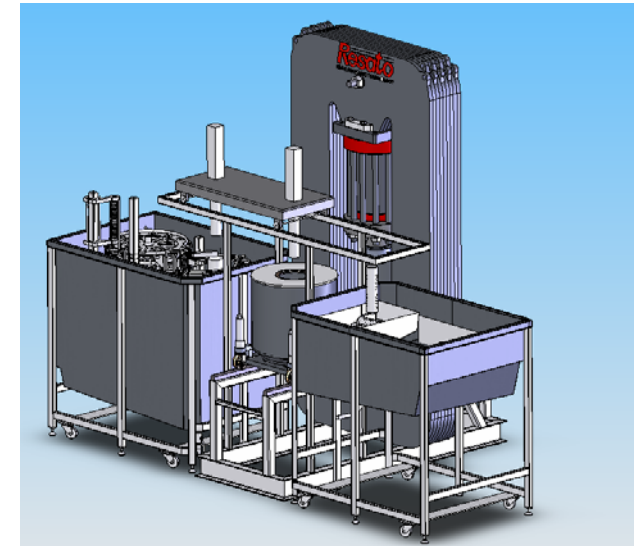
High pressure sterilisation: impact on equipment

- High pressure in combination with high temperature.
- Impact on materials of vessel and seals.
- Pressure increase and resulting heat generation is uniform.
- Temperature changes due to cooling at vessel wall can result in T variations => variations in inactivation of spores.
- Solutions necessary for especially seals and homogeneity of temperature.



High pressure sterilisation: commercial equipment

- Price of high pressure sterilisation largely determined by costs of equipment.
- Relatively low energy costs.
- Cost reduction by rapid process with internal intensifier, fast opening and closing, rapid pressure build up.
- Pilot equipment will be available this year.



High pressure sterilisation: conclusions

- Combined use of P and T results in shelf stable product.
- Product treated in consumer package.
- Higher quality compared to conventional retort.
- Pilot equipment will be available this year.
- Estimated price: € 0.15/kg product.

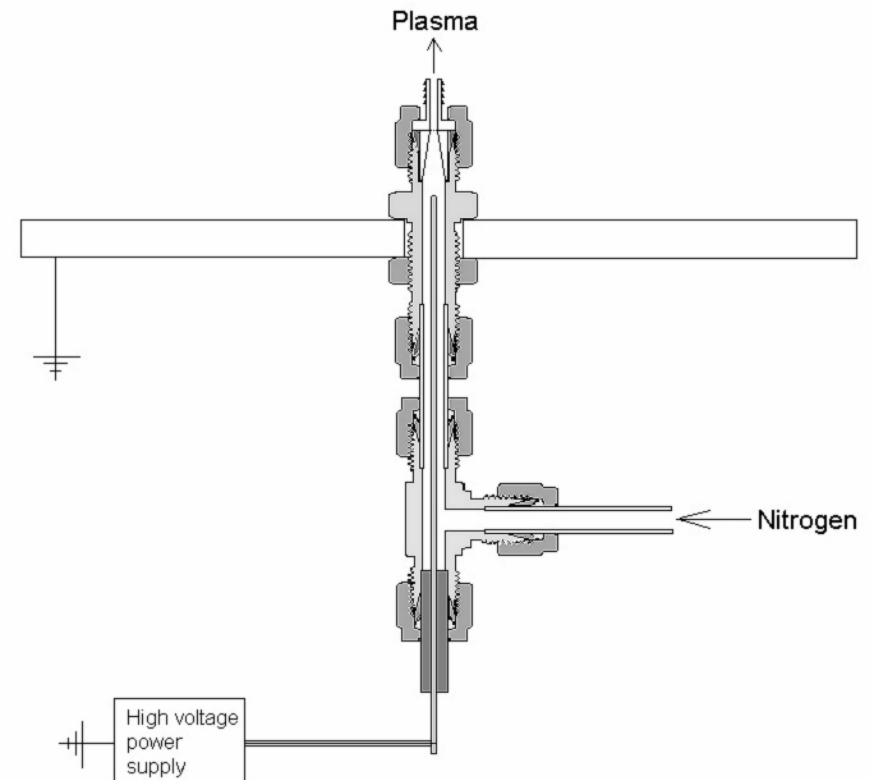


Surface decontamination with cold plasma

- Surface decontamination of food product is serious problem:
 - Salmonella and Campylobacter of fresh poultry: estimated 10 - 20 deaths/year in the Netherlands.
 - Demand for mild method without affecting product quality.
- Surface decontamination of packaging materials:
 - Temperature restrictions of plastic materials.
 - Environmental impact of water and H₂O₂ use.

Technology of cold plasma

- Plasma's are produced by in a gas discharge.
- In this application: N₂ as carrier gas.
- Flame temperature 40 °C.

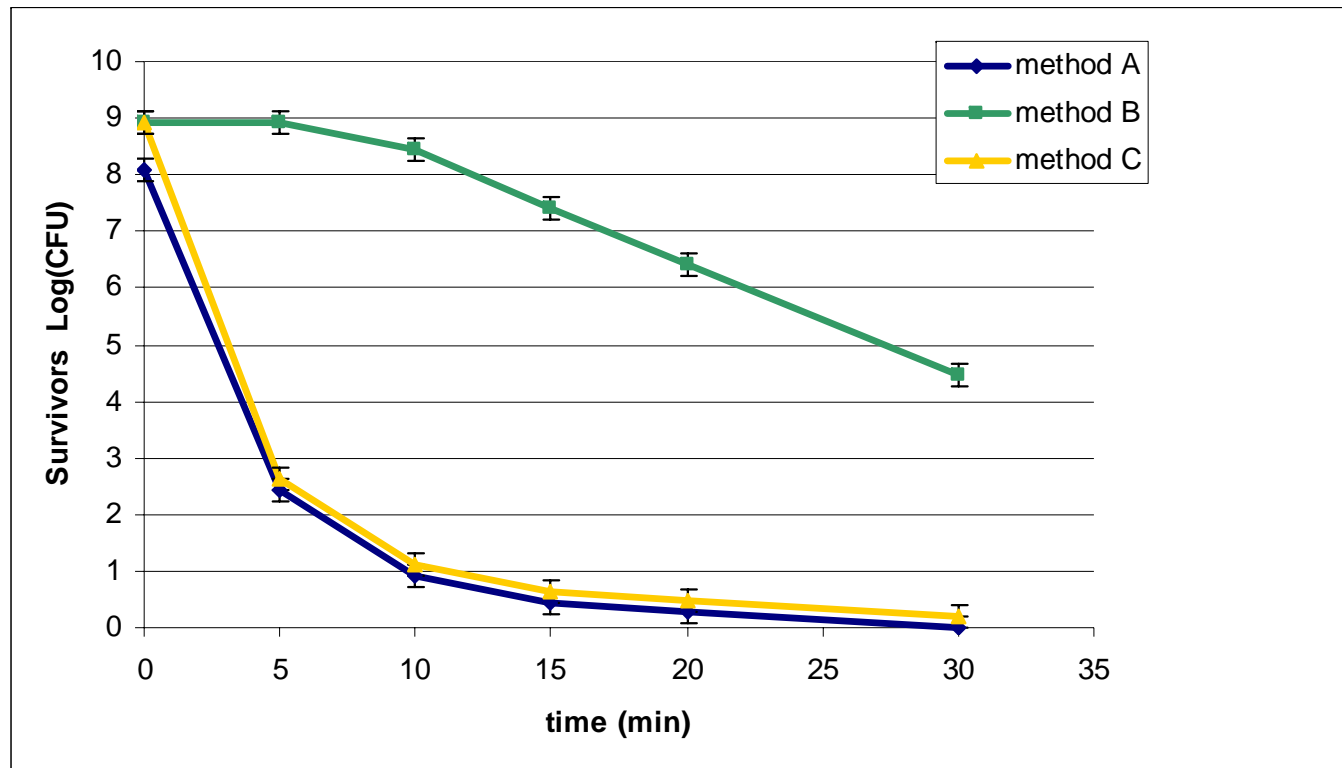


Features of cold plasma

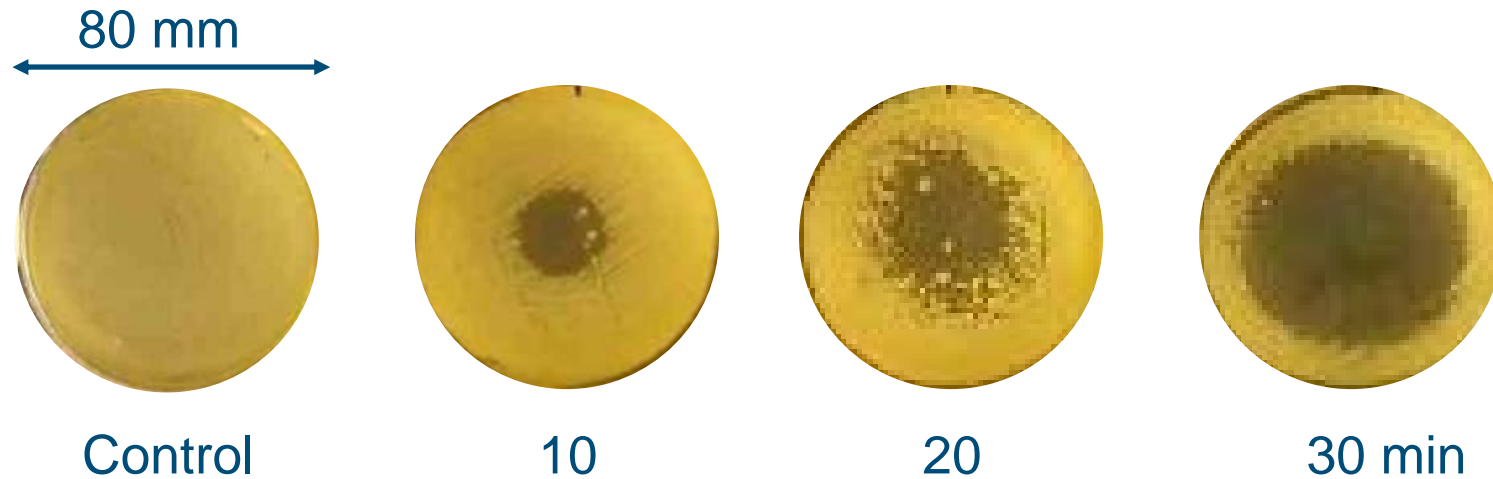
- Treatment in a gas phase.
- Non chemical based.
- Surface treatment at low temperature.
- ‘Around the corner’ capability.
- No effects of appearance of food products and packaging materials.



Inactivation kinetics: observations



Inactivation kinetics: Explanation



6.3×10^7 CFU/cm²
E.coli ATCC 8739



Quality assessment



Plasma treatment of fresh chicken Left) Control Right) Plasma treated sample. No differences in appearance have been observed.



Surface decontamination: conclusion

- Cold plasma has potential as a mild surface disinfection treatment of perishable foods and packaging materials
- Development and exchange of lab scale equipment
- Assessment of equipment and products
-
-
- Development of industrial scale operations



Thank you for your attention!

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