NUOVI STRUMENTI E TECNOLOGIE PER LA VALORIZZAZIONE DEI PRODOTTI ITTICI

A cura dei GTI Acquacoltura e pesca

OPEN DISTAL '23

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI
SCIENZE E TECNOLOGIE AGRO-ALIMENTARI

Innovazione sostenibile nelle tecnologie di processo e confezionamento dei prodotti della pesca e acquacoltura

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Critical Factors in Seafood preservation

Fish products in general have a high degree of perishability due essentially to:

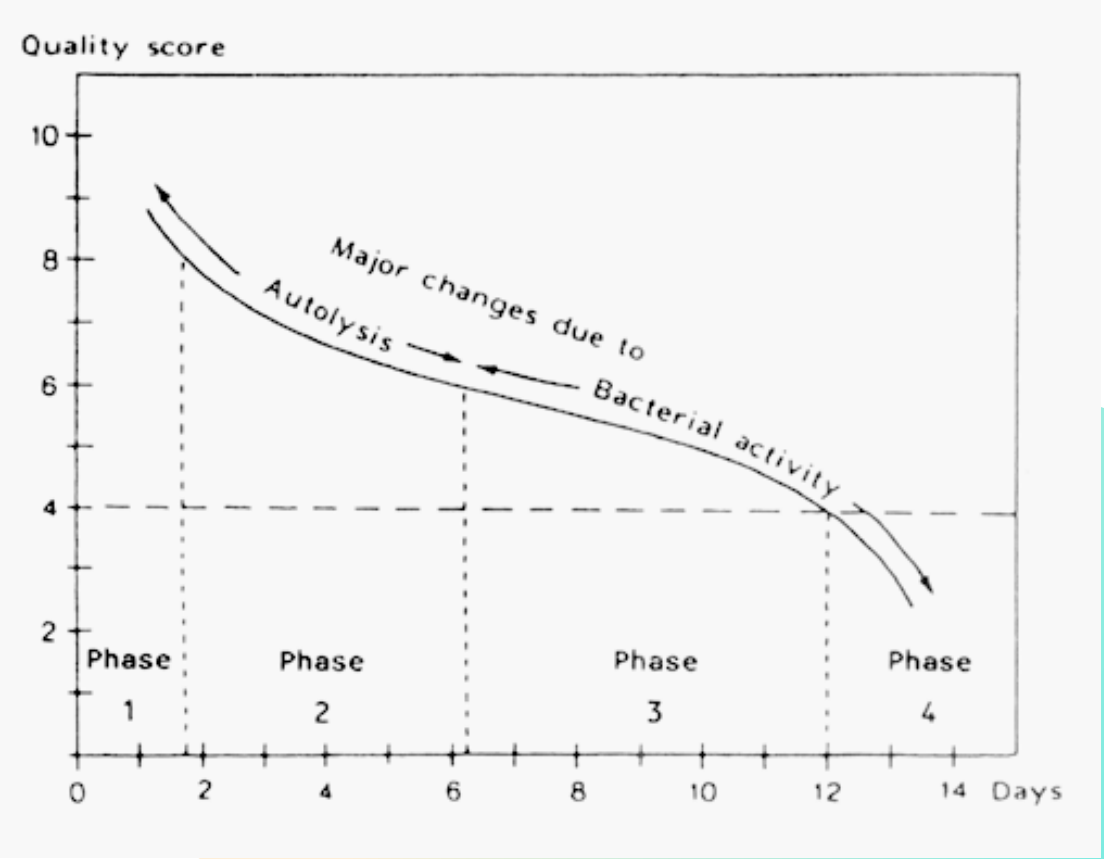
High content of spoilage bacteria

Presence of autolytic enzymes

pH ≈ low acid

High water activity (a_w)

Factors favorable to microbial development and degradative reactions



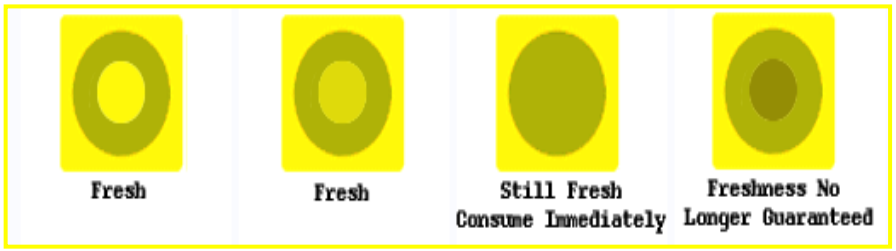
Fresh-like quality and cold chain

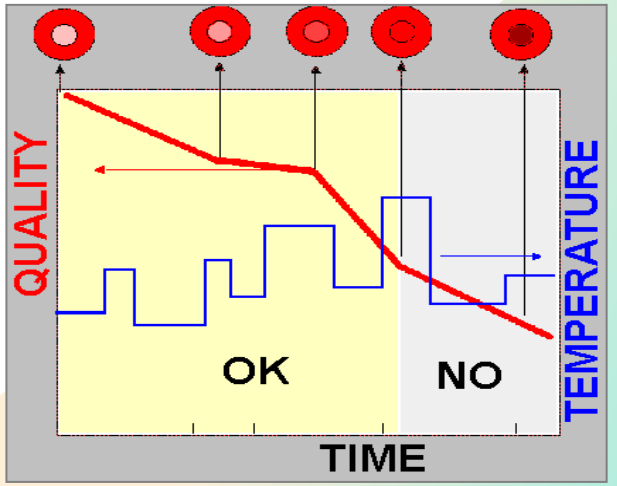
Real needs *vs.* reality!

Primary transport	4°C	24-48 h
Distribution platform	4°C	12 h
Secondary transport	6°C	12 h
Unloading point of sale	12°C	4 h
Storage point of sale	6,5°C	3 d
Consumer transport	20°C	2 h
Home refrigeration	7,5°C	End of shelf-life

Intelligent packaging

- Time-temperature integrators





Why not?

Nonthermal Processing Techniques

HPP: hiperbaric.c

High Pressure

Ultrasound

Pulsed Electric Fileds

Minimal Processing

Others…

UV and Pulsed Light

PEF: elea-technology.de

Ozon: bwt.de

UV: uv-light.co.uk

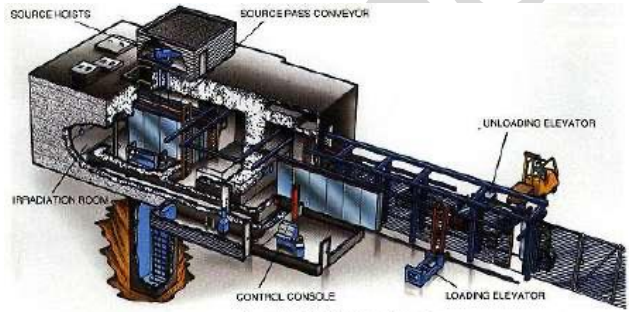
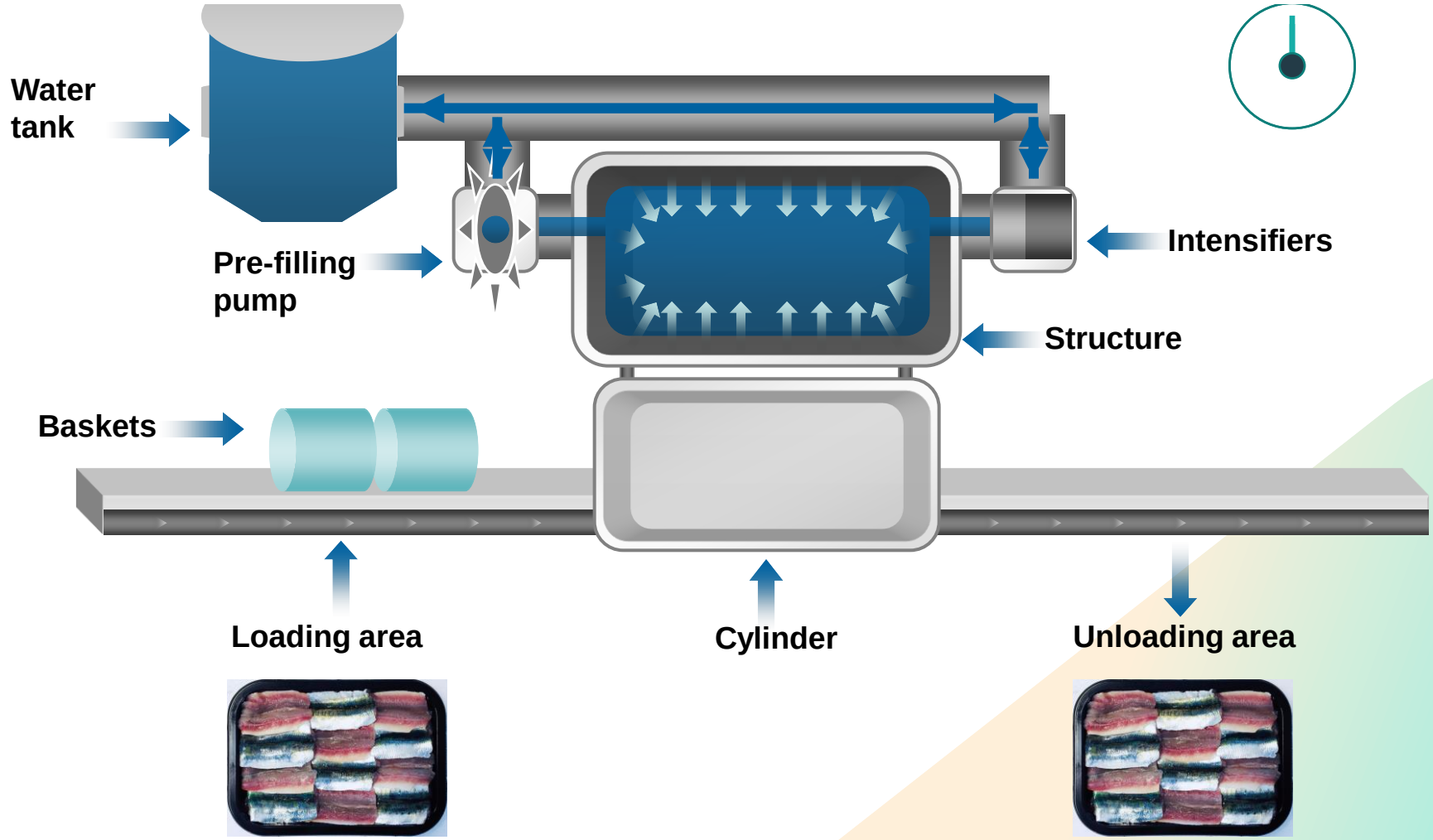


Figure 1: JS-6900 Unit Carrier Irradiator

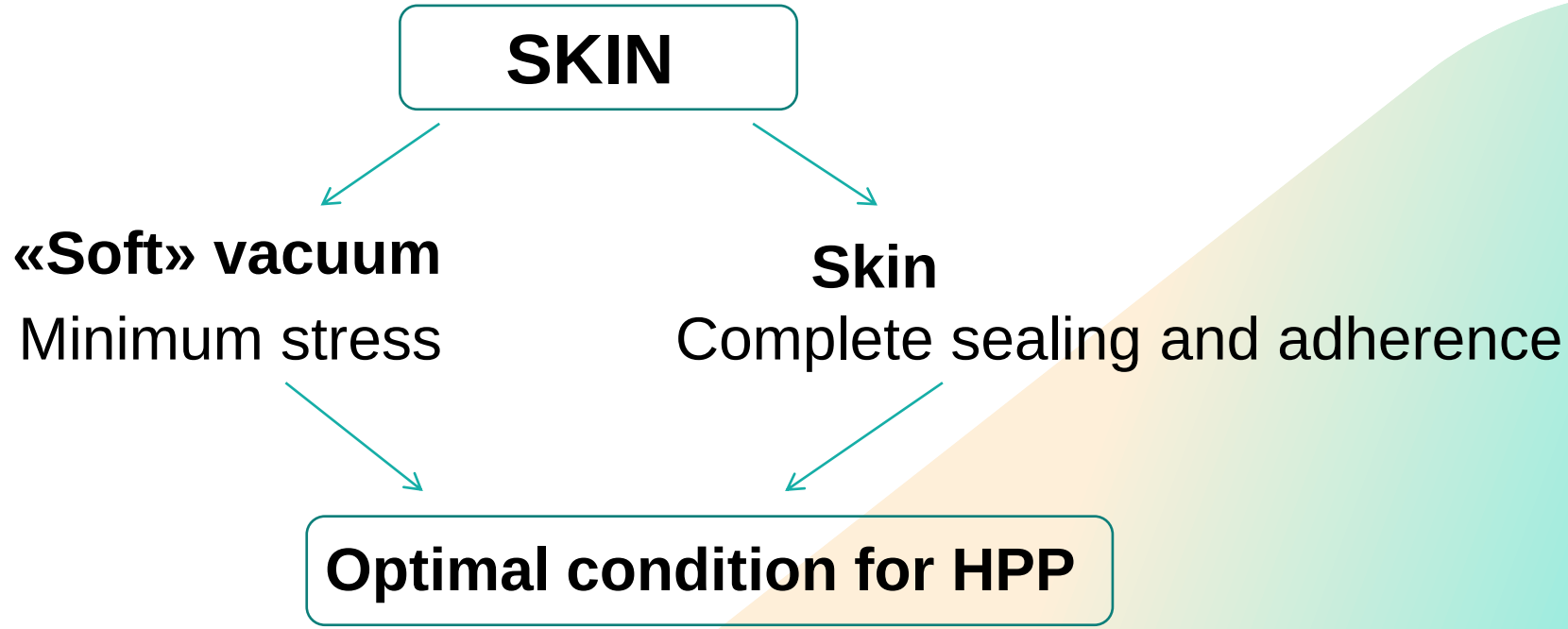
High Hydrostatic Pressure (HPP)

Maintenance



High Hydrostatic Pressure (HPP)

- HPP work with **flexible packaging** (and *water friendly labels*) => no glass, no canned foods
- **Vacuum packaging is the optimal condition**



High Hydrostatic Pressure (HPP)

Shrimp sausage

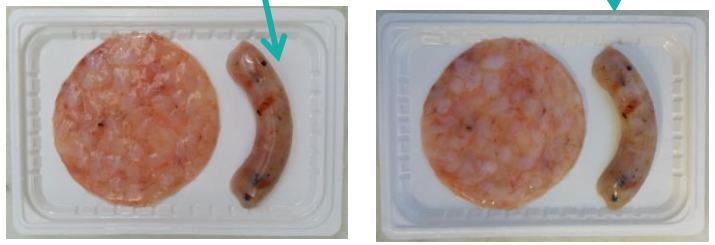
Shrimp sausage + seaweed

PRE-HPP (SL = 8 d) POST-HPP (SL > 30 d)

No detectable differences!

Shrimp burger

Shrimp sausage



PRE-HPP (SL = 8 d) POST-HPP (SL > 30 d)

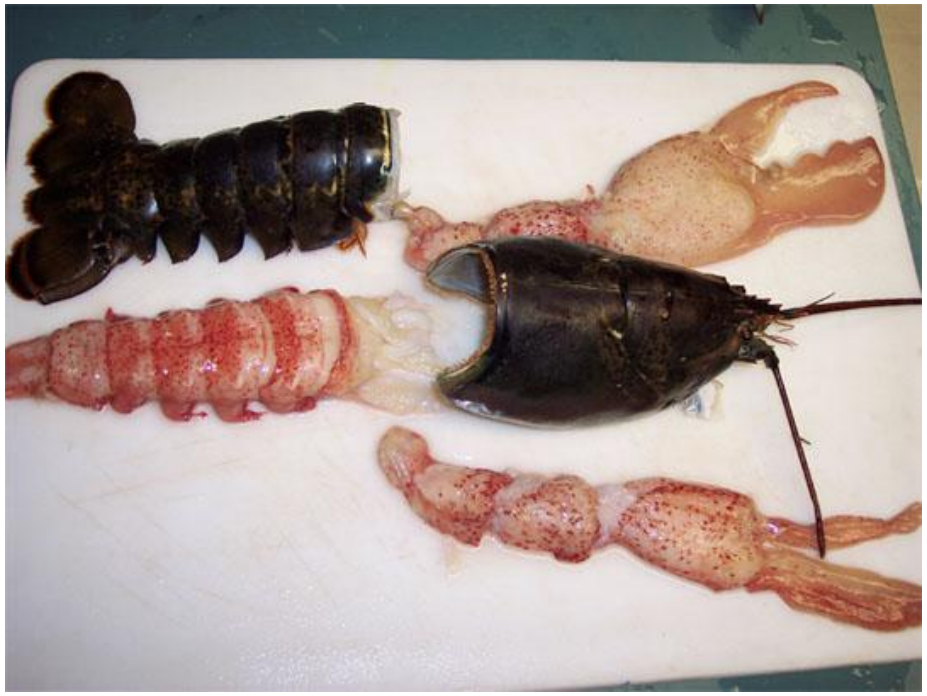
No detectable differences!

Salmon sausage

PRE-HPP (SL = 8 d) POST-HPP (SL > 21 d)

Detectable colour modification!

High hydrostatic pressure (HPP)



Lobster: Complete flesh separation

Easy to get the full lobster-meat in 3 steps…

Put lobster ready..! For bake, grill, steamed, on plate

step 1

step 2

step 3

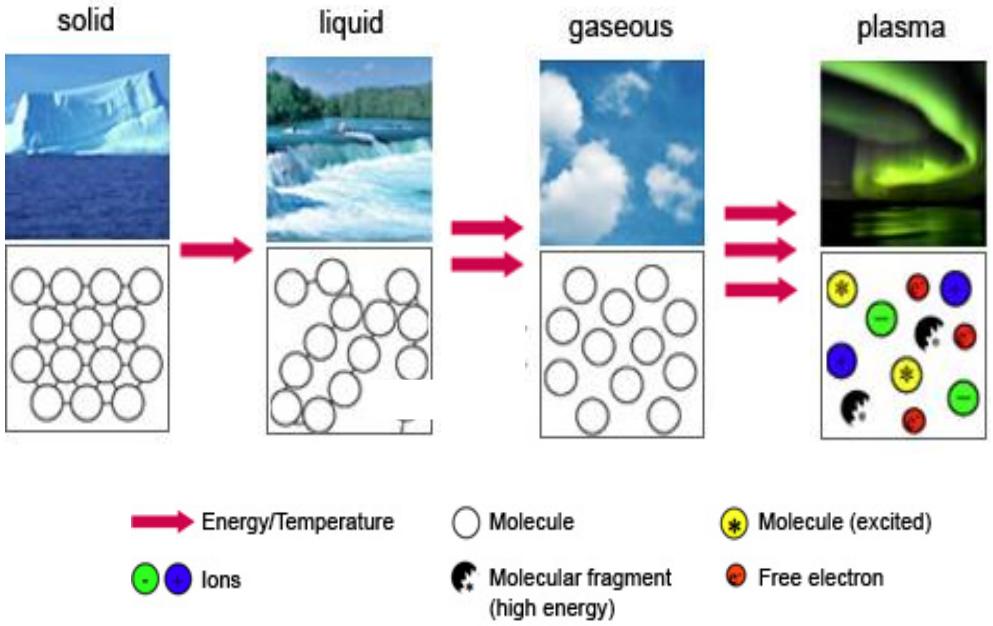
and butter poached, sous-vide …

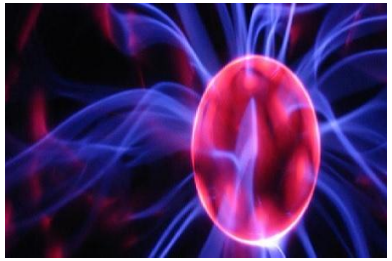
High hydrostatic pressure (HPP)

Blue Crab Processing

Callinectes sapidus

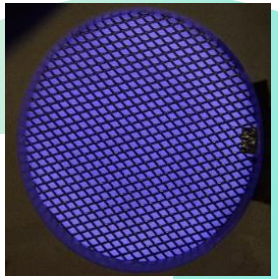
Atmospheric pressure cold plasma





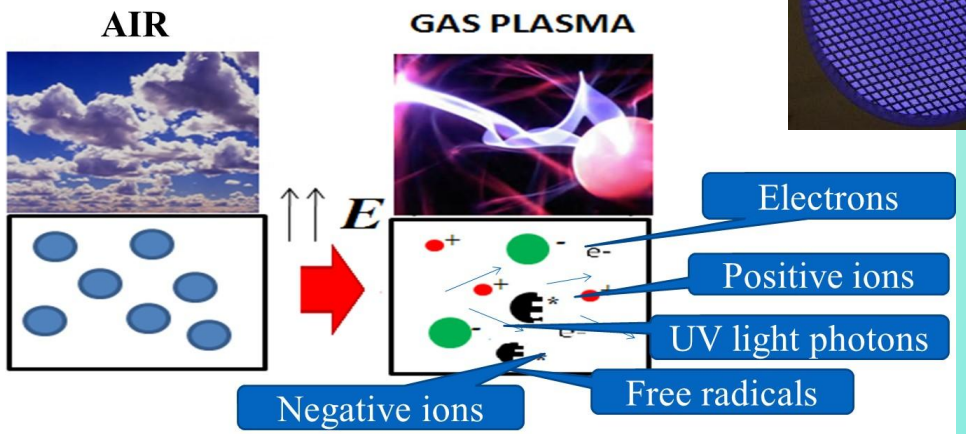
Ionized gas obtained by applying energy to a gas mixture

Contains: reactive oxygen and nitrogen species, radicals, electrons, ions, UV …



Main effect in Food

- Microbial decontamination
- Enzymatic inactivation
- Effect on living tissue metabolism
- Oxidation of fat and bioactive compounds



Atmospheric pressure cold plasma

Mackerel fresh fillets
Albertos et al (2017)
DBD 70-80 kV
Treatment time: up to 5 min

Dried filefish
Park et al (2015)
Treatment time up to 20 min

Results:
Spoilage bacteria was significantly reduced as DBD voltage-time increased.
Colour parameters not affected by DBD.
Lipid oxidation increased after DBD exposure.

Promising treatment for microbial inhibition in fish products
Necessary to tailor treatment parameters for each specific products

Modified atmosphere processing and packaging

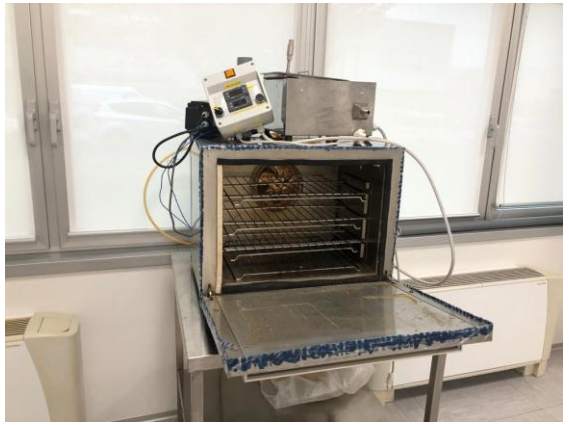
Cryo-smoking – set up of procedures

Equipment, developed and in the process of patenting by CS

Smoking

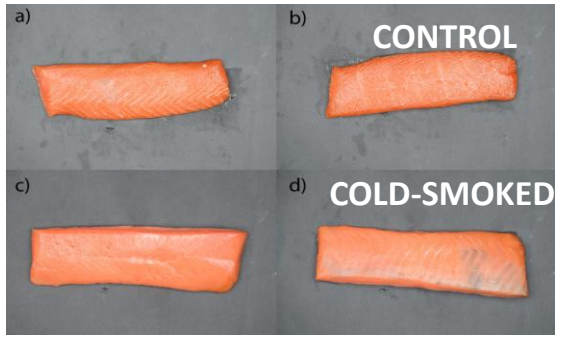
- 30 °C (without ice) 1-2 h Smoking: Chippings Beech Tree

- 1°C Carrier gas: Cold Nitrogen 1-2 h Smoking: Chippings Beech Tree



AIM

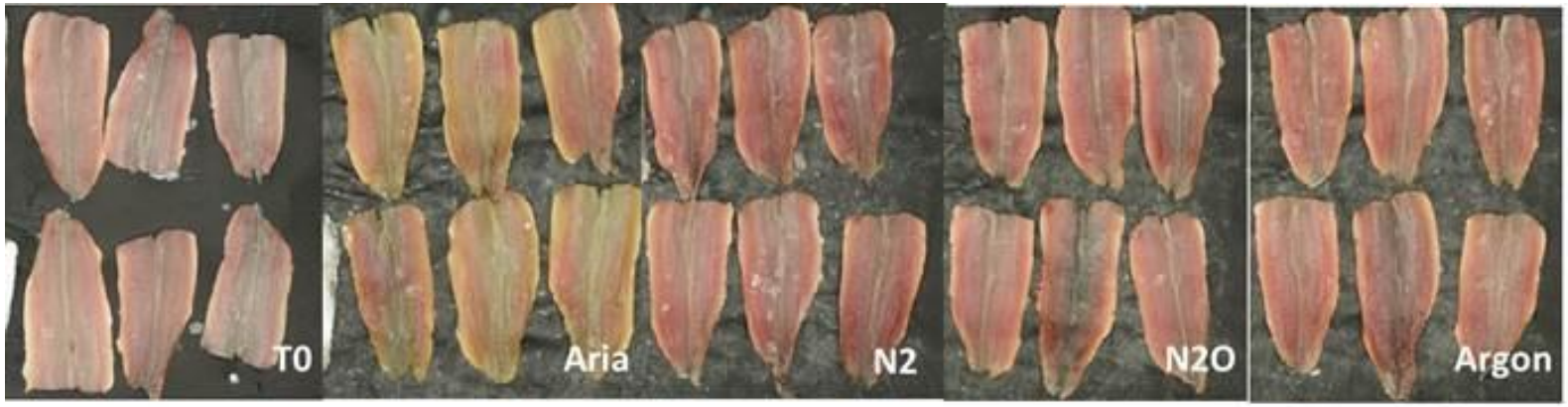
obtain smoked salmon with improved quality and nutritional characteristics compared to the traditional method



Preliminary tests

	Color			a_w	Hardness	Dry matter
	L*	a*	b*		(N)	(%)
Control	38,68 ^{a} (± 1,24)	15,13 ^{a} (± 0,54)	20,73 ^{b} (± 1,75)	0,894 ^{a} (± 0,006)	22,36 ^{b} (± 1,93)	45,51 ^{b} (± 1,18)
Cryo-Smoked	41,39 ^{b} (± 1,37)	16,73 ^{a} (± 1,00)	15,84 ^{a} (± 2,85)	0,950 ^{b} (± 0,003)	12,42 ^{a} (± 1,22)	38,19 ^{a} (± 0,61)

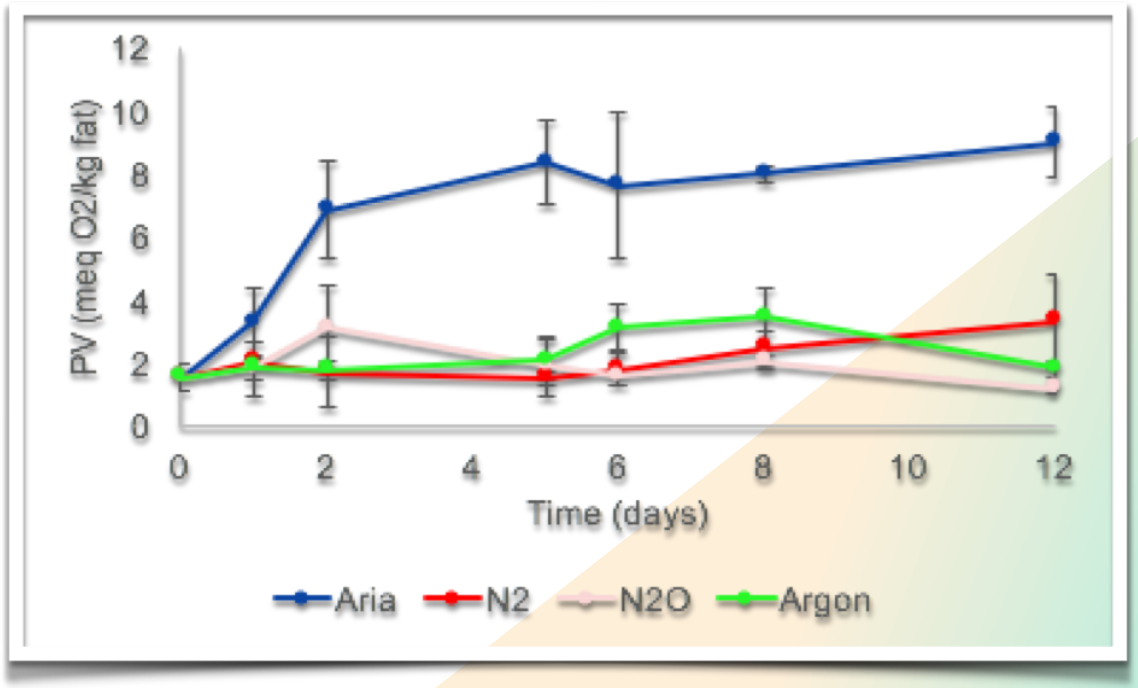
Modified atmosphere processing and packaging



Colour was affected by MAP and resulted in higher L* and lower a* values in Air sample

Fat oxidation was inhibited by

MAP as shown by PV values.



Tappi et al., 2018, FoodOmics Conference, Cesena (ITA)

Fish production & By products

178 million tons

(The State of World Fisheries and Aquaculture -SOFIA, 2022)

20 million tons were used for non-food purposes

EU 5.2 million tons per year

"non-target" species, fish processing residues and by-products

Fish by-products
A treasure trove of value-added compounds

Fish by-products

Minced fish

Fish-based products

Functional ingredients

*Protein, **fish protein hydrolysates**, bioactive peptides, natural pigments, collagen, fatty acids (Omega 3), vitamin D and B12, minerals, chitin, chitosan*

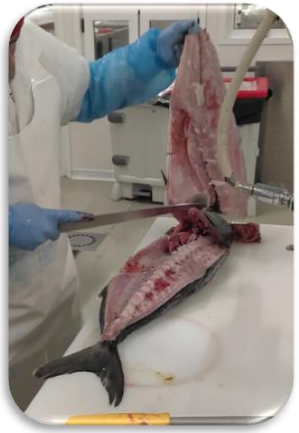
Wellness and disease prevention
Antioxidant, Antihypertensive, Immunostimulant, Antimicrobial, Antitumor,

Technological Function
Thickeners, Emulsifiers, Gelling agents, Colorants, Clarifiers, Antioxidants, Cryoprotectants

Food Industry

Fish by-products

Amberjack fish flesh obtained through mechanical separation



Fileting

Trimmings

Belt-drum separator

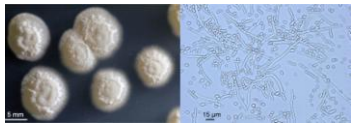
Amberjack meat

Frozen at -40°C

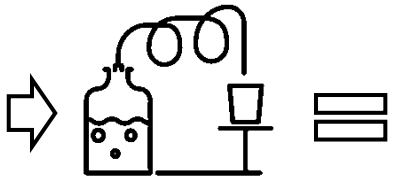
Laboratory of food technology

Fish protein hydrolysate development

Mullet by-products



Yarrowia lipolytica (YL2)



Fermentation process

FPH (Freezer dried)

Food Microbiology Laboratory

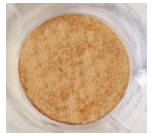
- The yeast strain YL2 was selected based on previous studies
- Functional and flavour properties

Rich in acids, mainly acetic acid, propanoic acid and butanoic acid and 3 methylbutanoic acid

Fish by-products

Amberjack fish-balls formulation

Amberjack pulp Abouty 80%



1.5% Fish protein hydrolisate

Formulations of amberjack fish balls

Ingredient	Traditional (Relative content)	Innovative (Relative content)
Mechanically separated amberjack meat	**80.00%**	**78.50%**
Breadcrumbs	6.25%	6.25%
Olive oil	5.63%	5.63%
Potato starch	6.88%	6.88%
Sodium chloride	0.50%	0.50%
Potassium chloride	0.31%	0.31%
Black pepper	0.03%	0.03%
Garlic powder	0.03%	0.03%
Onion powder	0.06%	0.06%
Lemon juice	0.13%	0.13%
Parsley powder	0.13%	0.13%
Nutmeg	0.06%	0.06%
FPH*	**0.00%**	**1.50%**

A total of 328 fish balls each meatball weight 15 g

Traditional formulation (Control)

Innovative formulation with 1.5% FPH

Storage 4°C 19 days

*Preparation and packaging in **MAP (80% N_2 and 20% CO_2)***

Fish by-products

Optimization of extraction processing for chitin and chitosan production

Shells

↓

Demineralization in HCl

↓

Deproteinization in NaOH

↓

Chitin

↓

Deacetylation

↓

Chitosan

✓ Chemical extraction using acids and alkali (method of Tolaimate et al., 2003 modified).

✓ Chitosan yield around 10%
1kg shell = 100 g chitosan

Most relevant research projects

- **PRIZEFISH** – *Piloting of eco-innovative fishery supply-chains to market added-value Adriatic fish products*. Project Interreg Italy-Croatia, European Regional Development Fund (2018-2021).

- **FUTUREUAQUA** – *Future growth in sustainable, resilient and climate friendly organic and conventional European aquaculture*. Project H2020. Call: H2020-BG-2018-2020 (Blue Growth). Taype of action: IA (2018-2022).

- **NEWTECHAQUA** - *New Technologies, Tools and Strategies for a Sustainable, Resilient and Innovative European Aquaculture* H2020-BG-2018-2020 (Blue Growth) Type of action: IA (2019-2022)

- **PLASMAFOOD** – *Study and optimizazion of cold atmospheric plasma treatment for food safety and quality improvement.* PRIN: PROGETTI DI RICERCA DI RILEVANTE INTERESSE NAZIONALE (2018-2021).

- **IMPRESSIVE** - Improved processing to enhance seafood sidestream valorization and exploration. BLUEBIO COFUND, Sustainable and resilient biomass pproduction and processing (2022-2025)

From research to commercial products!

Research

DIPARTIMENTO DI SCIENZE E TECNOLOGIE AGRO-ALIMENTARI

Plant producers

Seafood products

From research to commercial products!

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Thank for your attention !!