VACUUM and M.A.P In Fish and seafood Packaging

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MULTIVAC
BETTER PACKAGING

SUMMARY

-Multivac Presentation

-Bacteriological reminder

-Shelf-life factors

-Vacuum packaging

-Modified Atmosphere Packaging

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Who is MULTIVAC ?

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Better packaging. Creating more value.

Multivac moves the market with innovative packaging solutions, individual consultation and exceptional service.
We call it “better packaging”. Our customers call it “success”.

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Multivac Wolfertschwenden: Historic development

Böhen

Wolfertschwenden

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Multivac Wolfertschwenden: Historic development

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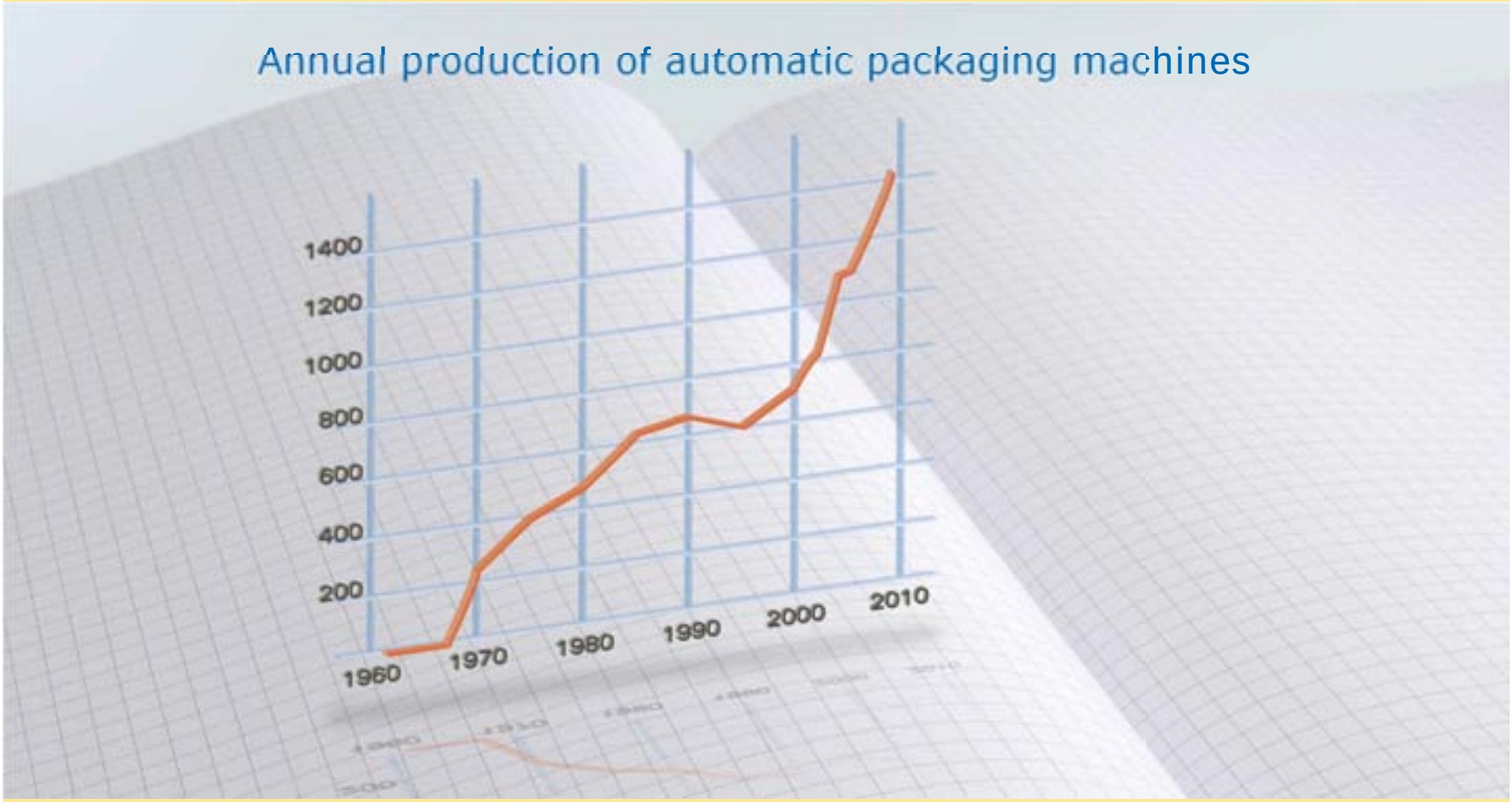
Multivac Wolfertschwenden: Historic development



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Multivac today

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Multivac today

A preeminent authority in packaging machinery, Multivac has provided countless packaging solutions across a host of industries and applications. To date, the company has sold approximately 26,000 automated packaging systems and 95,000 chamber machines.

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What Multivac customers are packaging

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Fish and seafood

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The Multivac machine spectrum

Thermoforming machines

Traysealers

Chamber machines

Automation solutions

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The functional principle of thermoforming

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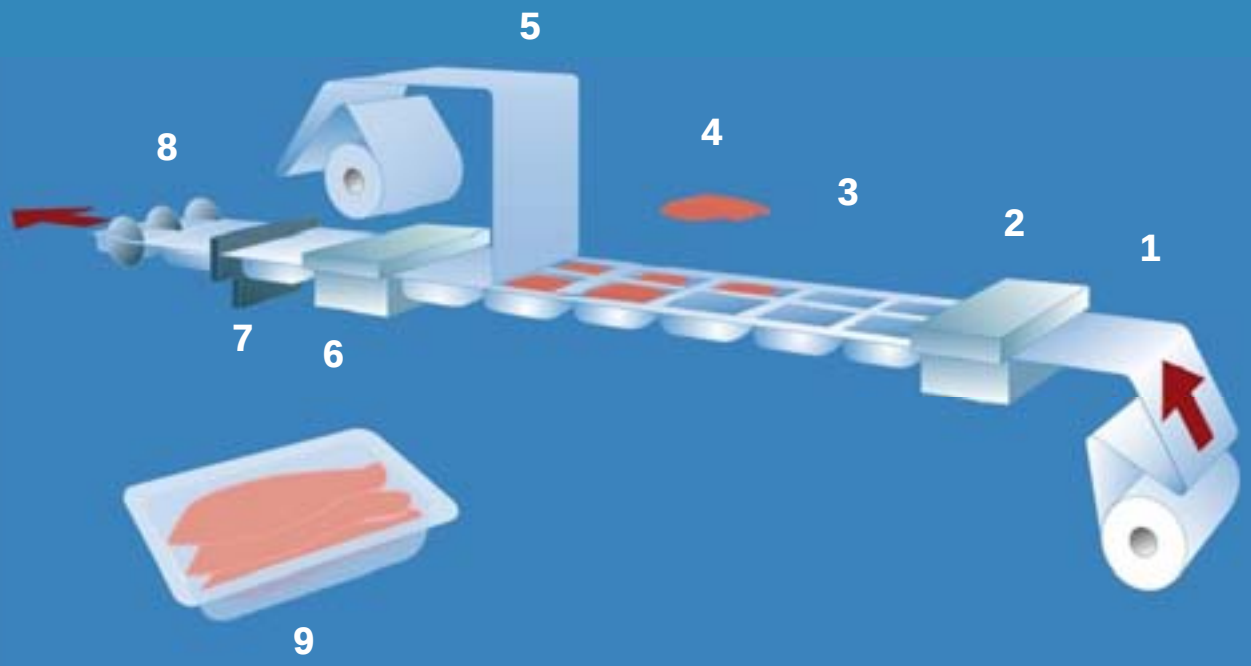
The functional principle of thermoforming



1 Bottom web
2 Forming die
3 Pockets
4 Product
5 Top web
6 Sealing die
7 Cross cutting
8 Longitudinal cutting
9 Finished package

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The thermoforming machine series

R 105
Entry level system

R 125
Economy model

R 145
Complete and compact

R 225, R 245
Complete versatility

R 535
Our highest performing thermoformer

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Packed products on a thermoforming machine

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Traysealers – fast, versatile packaging with pre-formed trays

Multivac traysealers seal filled trays with efficiency and flexibility

- Quick and easy format change
- Filling is also possible in a different location than the machine

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Traysealers – fast, versatile packaging with pre-formed trays

T 200 / T 250
Semi-automatic machines

Profitable for small and midsize batches.

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Traysealers – fast, versatile packaging with pre-formed trays

T 700 / T 800
Success included.

- Fast and easy format change over
- Consistent hygienic design
- Intuitive user guidance and control

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The functional principle of Tray sealer

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Products packed on a tray sealer

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Chamber machines – sealing good things better

- Easy to operate
- Flexible to use
- Very reliable

They package everything that fits into a pouch – whether with vacuum, protective gas or as a shrink bag

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Chamber machines – sealing good things better

C 100 / C 200 / C 300 / C350 / C 400
Versatile single chamber machines

Compact solutions for big jobs.

C 450 / C 500 / C 550
High-performance dual chamber machines

Two chambers, double the performance,
the industry standard in pouch packaging.

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Chamber machines – sealing good things better

C 700
Large chamber machine

For large and small film pouches, expandable by means of transport belts, shrink tanks, and drying tunnels.

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Chamber machines – sealing good things better

B 310 / B 400 / B 500

Fully automatic conveyor belt machines

Can also be expanded into a shrink packaging line with a shrink tank and drying tunnel.

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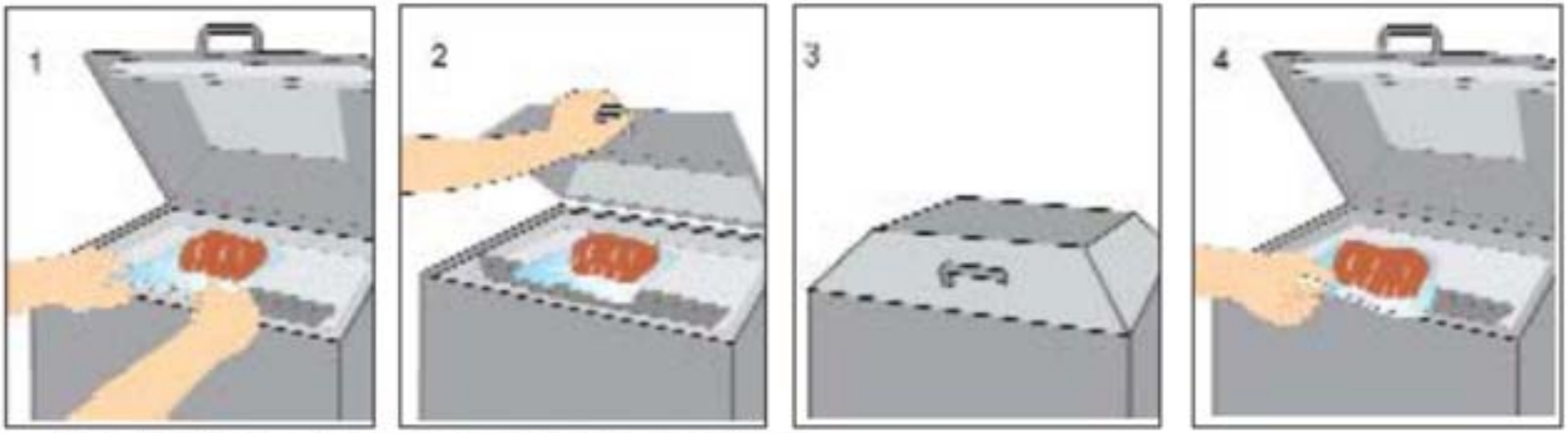
Vacuum chamber machine operating

Operation of a vacuum-chamber machine:



1. Put the bag with product in the machine.
2. Close the chamber.
3. Evacuation and sealing are performed automatically.
4. Re-opening of the chamber. The bag is now vacuum packed.

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Fish packed on a chamber machine

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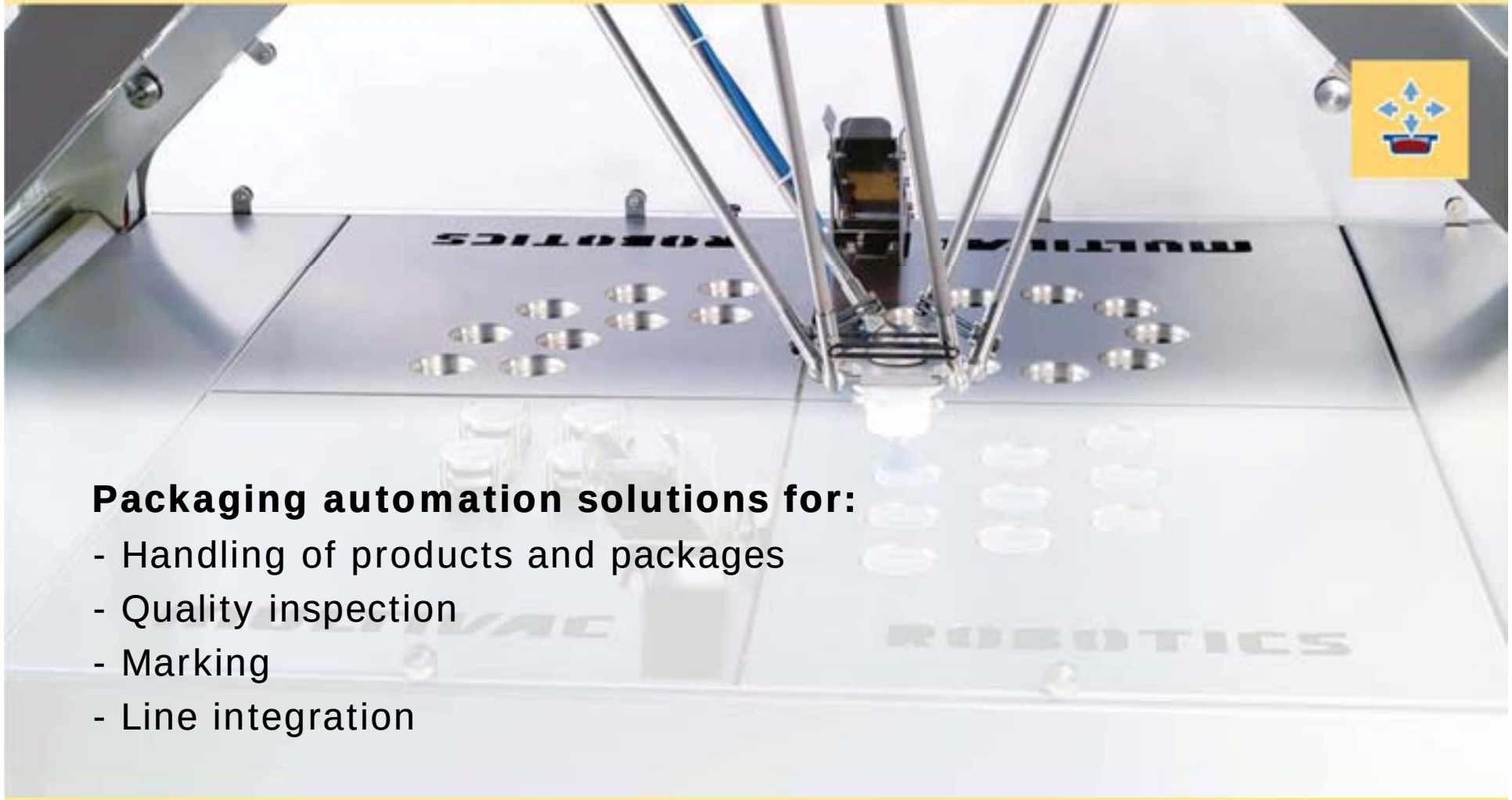
Fully integrated packaging line automation



Packaging automation solutions for:

- Handling of products and packages
- Quality inspection
- Marking
- Line integration

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Quality Inspection Systems

Vision System

Visual detection of objects and quality inspection

X-Ray Detection, Metal detector

Detection of foreign substances

Checkweigher

Verfication of quantity, weight and price

Seal Tester

Tightness of packages

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MARKING & INSPECTION

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Marking Systems

Labeling Systems

Direct film printers

Thermal transfer printers

Stamp printers and flexographic printers

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MARKING & INSPECTION

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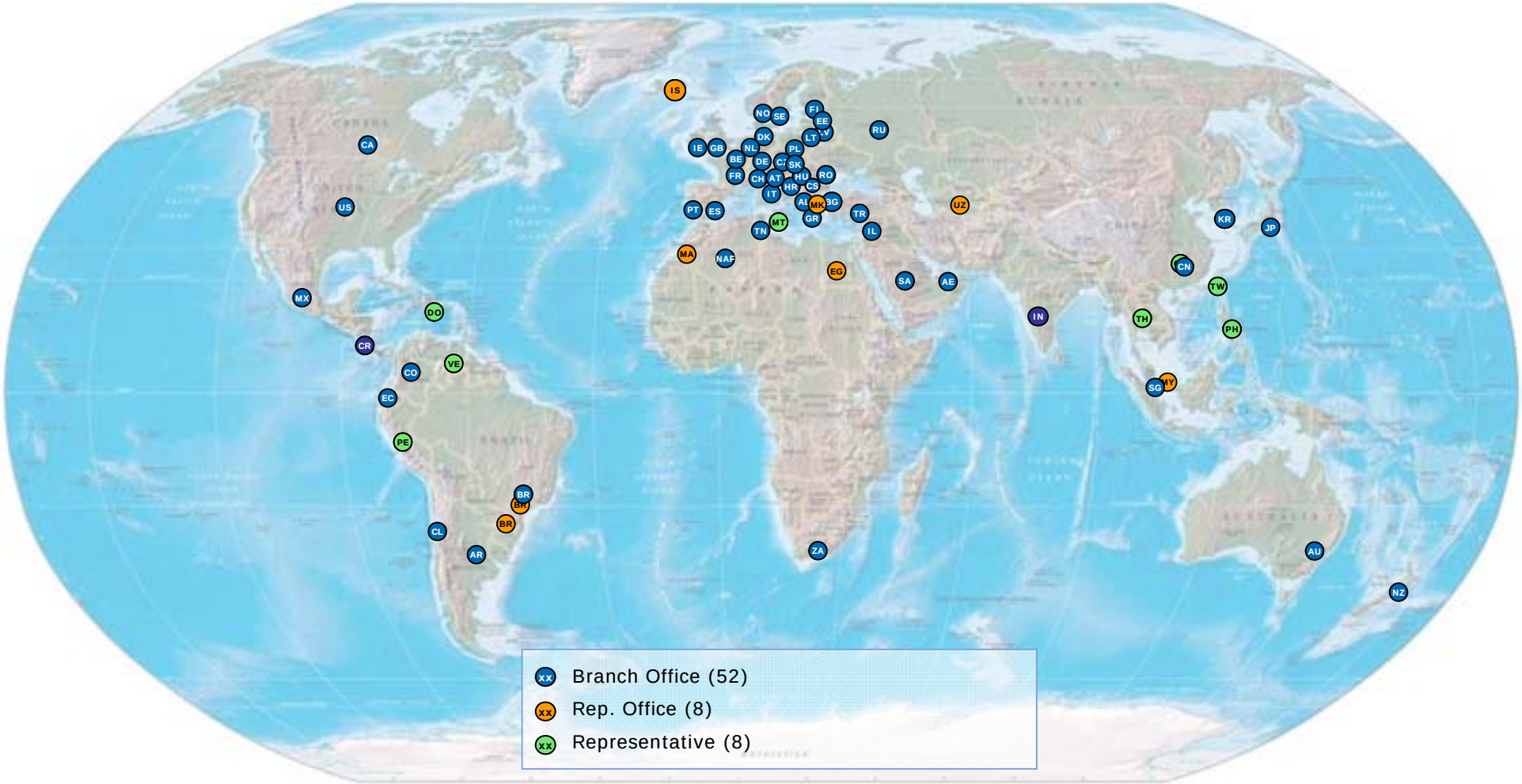
300 pre-sales consultants, 500 after-sales technicians for training, servicing and upgrading



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Bacteriological reminder

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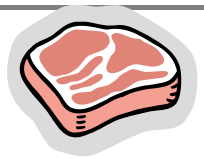
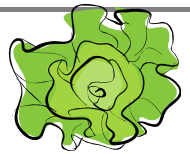
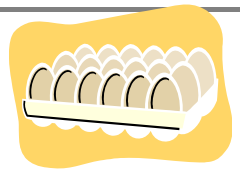
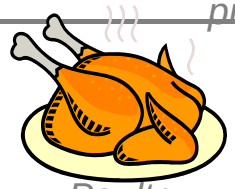
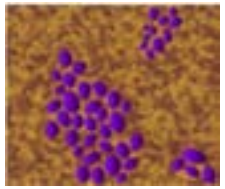
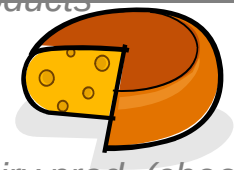
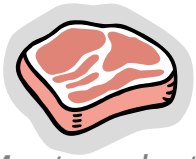
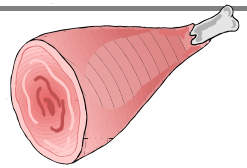
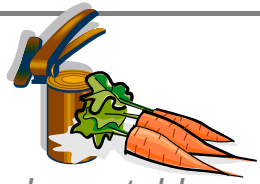
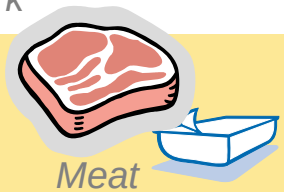
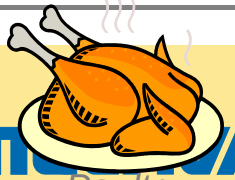
Some Common Foodborne Pathogens

Picture	Name	Main products affected
	Staphylococcus aureus	 Meat  Lettuce Dairy prod Ready meals
	Salmonella spp.	 Egg products  Poultry Seafood
	*Listeria monocytogenes*	 Dairy prod. (cheese)  Meat products
	Clostridium botulinum	 Ham & processed pork Fish  Canned vegetables
	Clostridium perfringens	 Meat  Poultry

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Bacterias.

2 differents types of bacterias :

Aerobics bacterias (living with oxygene)

Anaerobics bacterias (living without oxygene)

Vacuum or M.A.P (with other gas than oxygene) reduce the development of aérobics bacterias inside the product

Vacuum or M.A.P has no effect on Anaerobics bacterias !

For these reasons

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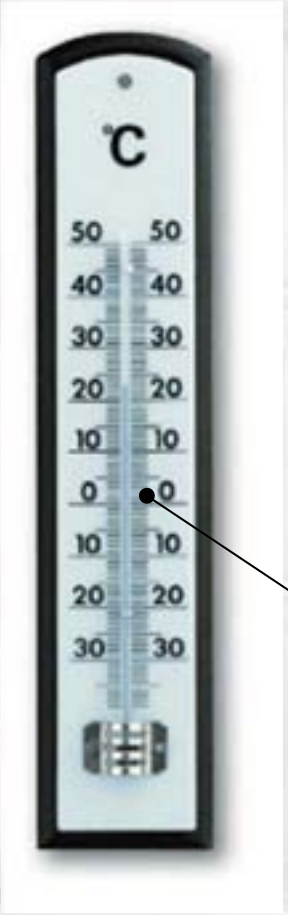
Cold chain .



You need cold storage, because aerobics bacterias are not killed with vacuum but just asleep……

You need cold storage to limit Anaerobics bacterias development and particularly the development of spores…..

You need cold storage to avoid bacteria to convert histidine to histamine

Temperature +2° Celsius

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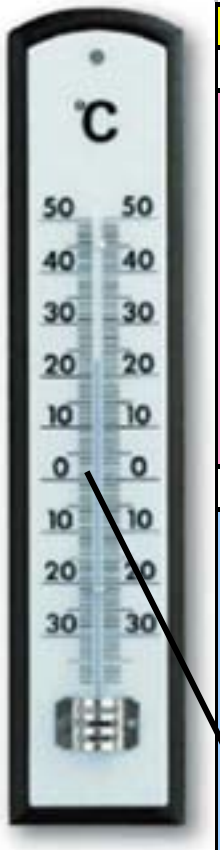
Cold chain .

GROWTH AND TOXYN PRODUCTION (c.Botulinum) IN PACKAGED FISHERY PRODUCTS



Fish Type	Storage Temperature	Atmosphere	Toxyn detection (days)	Shelf-life (days)
Salmon Filets	16°C	Air	4	4
	16°C	75 CO2 -25 N2	4	5 to 6
	16°C	Vacuum	3	3
	8°C	Air	17	13 to 17
	8°C	75 CO2 -25 N2	24	20 to 27
	8°C	Vacuum	10	6 to 10
	4°C	Air	over 66	24 to 27
	4°C	75 CO2 -25 N2	over 80	55 to 62
	4°C	Vacuum	over 66	34 to 38
Tilapia Filets	16°C	Air	4	3
	16°C	75 CO2 -25 N2	4	4
	16°C	Vacuum	3	3
	8°C	Air	20	6
	8°C	75 CO2 -25 N2	40	17
	8°C	Vacuum	17	10
	4°C	Air	over 47	10
	4°C	75 CO2 -25 N2	over 90	80
	4°C	Vacuum	over90	47

Gordon L Roberton Food Packaging Principles and practice

Temperature +2° Celsius

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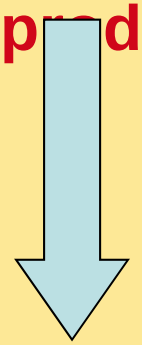
Bacteria.

Pathogenics bacterias are dangerous for health, but also non Pathogenics bacterias are numerous in the fish flesh and contribute to the fast alteration of the product.



Vacuum and M.A.P Packaging bring solution to reduce these risks.

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Shelf-life factors

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Modified Atmosphere Packaging – Food Products

Main Product Properties

AIR LIQUIDE

Water activity (a_w)

pH

Composition

Initial microbial load

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Rule 1 : Shelf-life depend from freshness of the fish !

Two main factors are contributing to the fish quality sploliation :

1.Time after Fishing.

2.Storage temperature.

Time : Ideal is to process and pack as soon as the fish die !

Temperature : Near 0° celsius as sooon as it is catch, is the must… every grade over play against !

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Rule 2 : Shelf-life depend of stress of the fish !

By Catch……

Many fish dies in the nets by fighting to escape…

Other dies on the boat board or in the ice pond……

Stress of the fish just before dying create a high concentration of toxines in the muscles….

And these toxines have a great power of alteration of the meat

It’s result a lost of shelf-life you can mesure in…..days !

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Rule 3 : Shelf-life depend of the rigor-mortis phasis

Pre-rigor phasis, is the time between the fish die and the time it's muscles are becoming hard !

During this phasis, the fish had still it's immuno-defenses actives and avoid the development of bactérias

Processing and packaging during this phasis increase the shelf-life

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Rule 3 : Shelf-life depend of the rigor-mortis phasis

Onset and duration of rigor mortis in various fish species

Species	Condition	Temperature °C	Time from death to onset of *rigor* (hours)	Time from death to end of *rigor* (hours)
Cod *(Gadus morhua)*	Stressed	0	2-8	20-65
	Stressed	10-12	1	20-30
	Stressed	30	0.5	1-2
	Unstressed	0	14-15	72-96
Grouper *(Epinephelus malabaricus)*	Unstressed	2	2	18
Blue Tilapia *(Areochromis aureus)*	Stressed	0	1	
	Unstressed	0	6	
Tilapia *(Tilapia mossanibica)* small 60g	Unstressed	0-2	2-9	26.5
Grenadier *(Macrourus whitson)*	Stressed	0	<1	35-55
Anchovy *(Engraulis anchoita)*	Stressed	0	20-30	18
Plaice *(Pleuronectes platessa)*	Stressed	0	7-11	54-55
Coalfish *(Pollachius virens)*	Stressed	0	18	110
Redfish *(Sebastes spp.)*	Stressed	0	22	120
Japanese flounder *(Paralichthys olivaceus)*		0	3	>72
		5	12	>72
		10	6	72

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Rule 4 : Shelf-life depend of processing hygien !

KEYS factors of good processing…..

Room temperature near of 2° Celsius

Clean tables

Cleans knifes and tools

Gutting methode appropriate

Washing of the cavity with clean water

Filetting method appropriate

Hygien of the workers……..

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Vacuum Packaging

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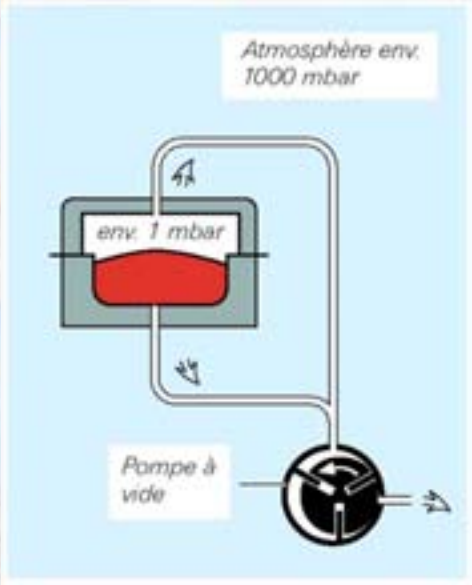
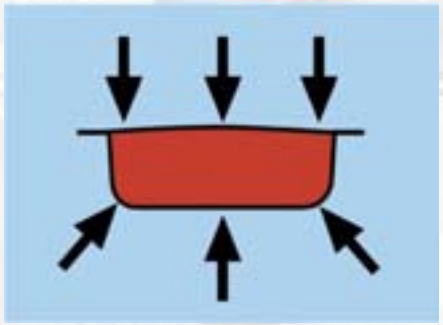
Vacuum

This process consists of removing the maximum possible amount of air with a vacuum pump, so as to go towards total evacuation. The aim is to obtain an excellent level of conservation of food-stuffs; the absence of air in contact with the product very clearly reduces the development of aerobic bacteria, which is the cause of premature ageing of fish



Since the pressure of the air inside the packaging is almost non-existent, the external atmosphere will exert a pressure of about 1 kilogram per cm^2 on the package.



package, deformation of the product, or perforations if the product has sharp-edged parts (e.g. lobsters). For presentation purposes, it is common to insert the vacuum product into a cardboard box with a window, thus covering the package while allowing the product to be seen.

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Vaccum Packaging in Fresh fish

In fresh fish:

Vacuum packaging does not bring a very longer shelf-life than traditional wraping packaging.

One of the main reason is the development of histamine and ABVT

We will always prefer to use M.A.P (see reasons after).

There are some exceptions for shell (mussels by exemple)

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Vaccum Packaging in Fresh fish

Gutted fish (6-7 days shelf life)

Mussels (8-9 days)

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Vaccum Packaging processed in fish

In processed fish:

Cooked, cured, smoked or marinated fish can be vacuum packed, having a longer shelf-life than a traditional packaging but also longer than with MAP.

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Vaccum Packaging processed in fish

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Vaccum Packaging processed in fish

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Vaccum Packaging processed in fish

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Vaccum Packaging processed in fish (Frozen)

Vacuum is also used for frozen products, allowing a better presentation of the product

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Vaccum Packaging processed in fish (Frozen)

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Vaccum Packaging processed in fish (Frozen)

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Vacuum Packaging

SKIN TECHNOLOGY

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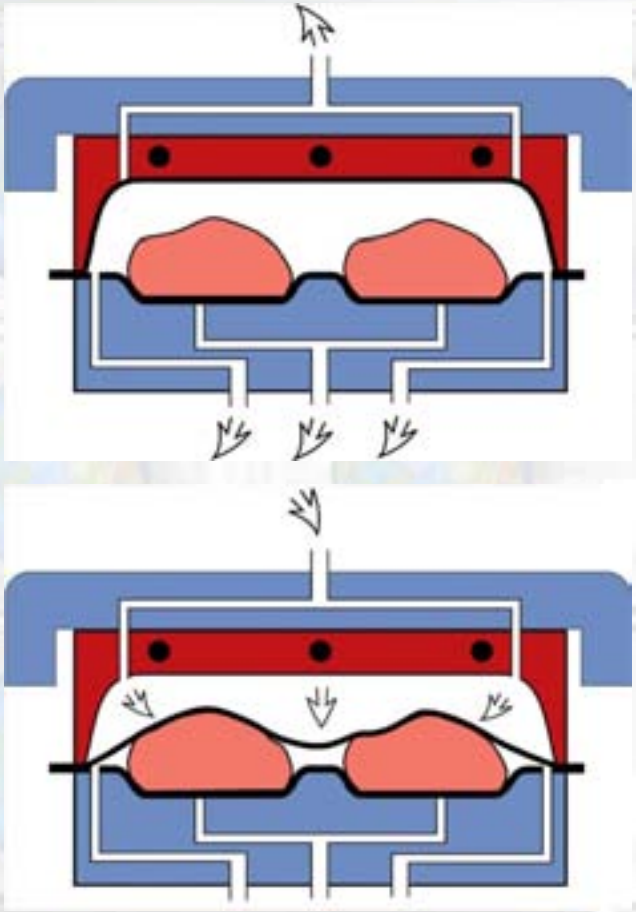
SKIN TECHNOLOGY

Using the same basic technology as vac-uum packaging, skin packaging consists of draping a highly heat-deformable film over the product, while carrying out a vacuum pumping sequence at the same time. The base support is generally rigid or semi-rigid.



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SKIN TECHNOLOGY

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SKIN TECHNOLOGY

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SKIN TECHNOLOGY

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SKIN TECHNOLOGY (Frozen)

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BETTER PACKAGING

SKIN TECHNOLOGY (Frozen)

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Sous Vide Cooking

A new technique for cooked fish

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What is Sous Vide cooking

Sous vide is a process by which ingredients are sealed in a pouch under vacuum, and subsequently cooked at a series of precisely defined temperatures to reach a desired result. This gentle cooking method has proven to be a remarkable tool of innovation for a growing number of leading chefs, and continues to grow in popularity.

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1. Preparation

Use only the best and freshest raw ingredients, working within a sanitary kitchen environment.

2. Fill the pouch

Use only the special pouches designed specifically for sous vide cooking which can withstand high temperature.

3. Vacuuming

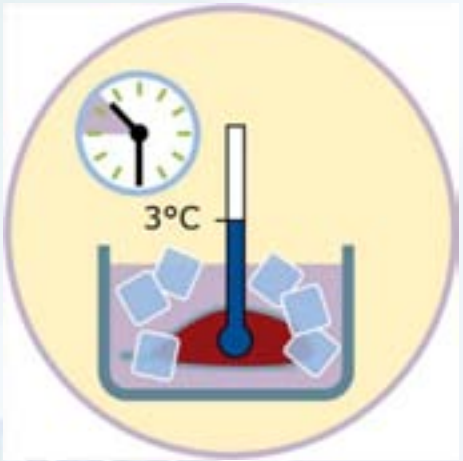
Hermetically seal the pouch under vacuum in the Multivac chamber machine.

4. Cooking

For Example:
Cook gently at only
55 to 95° C for
allotted time.

5. Cooling

For Example:
Quick cooling to 3° C within 90 minutes helps ensure food safety.



6. Cool storage

For Example:

0 to 3 °C. The menu components retain their quality for approximately one to three weeks.

7. Regeneration

Reheat/rethermalize the menu components within minutes.

Advantages of Sous Vide cooking

- Dishes retain desired aroma and texture.
- Superior moisture retention.
- No fat oxidation.
- Minimal product shrinkage.
- Increased storage times for pasteurized product.
- Dietetic cooking (no or less use of oil, butter,…)
- Vitamine content maintened
- Allow deep frozen without spoiling the product

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Sous Vide cooking

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M.A.P

MODIFIED ATMOSPHERE PACKAGING

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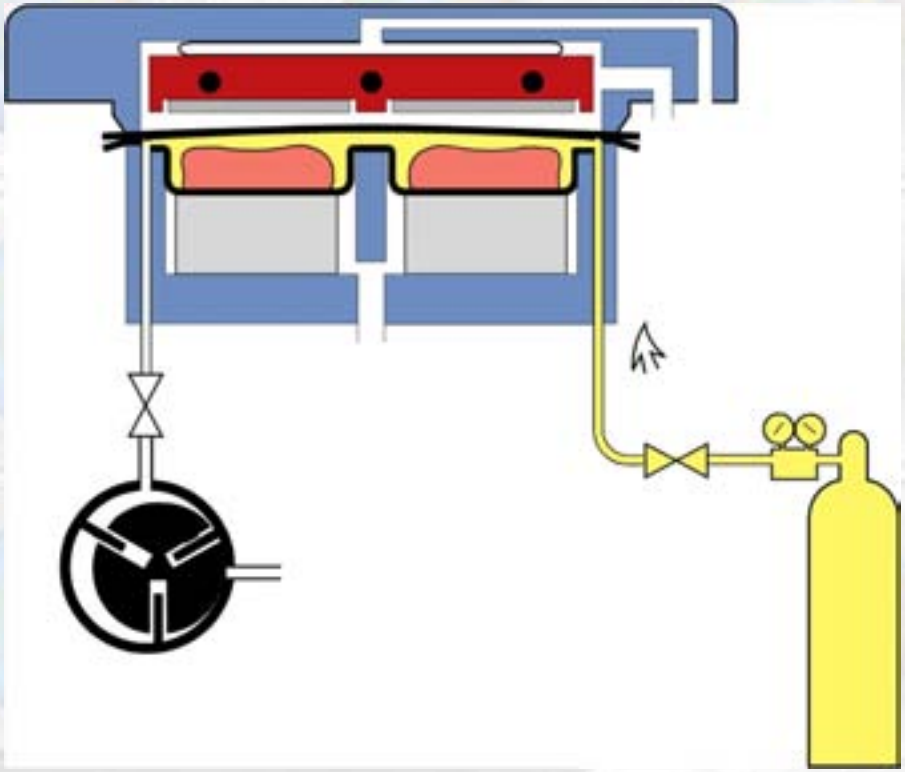
Modified Atmosphere Packaging

Gas Flushing

This process consists of removing the maximum possible amount of air with a vacuum pump, the absence of air in contact with the product very clearly reduces the development of aerobic bacteria, which is the cause of premature ageing of fish

The higher the level of vacuum in the package, the longer the conservation of the product. For the majority of products, the residual amount of oxygen in the packaging should not exceed 0.5% of the volume, which is equivalent to a vacuum pressure lower than 1 millibar.

By re-injecting gas inside the package, the external atmospheric pressure can be prevented from crushing the contents as in the case of vacuum packaging. In this way, the product will not be subject to any pressure and will benefit from a very attractive presentation and good conservation due to gas specifications



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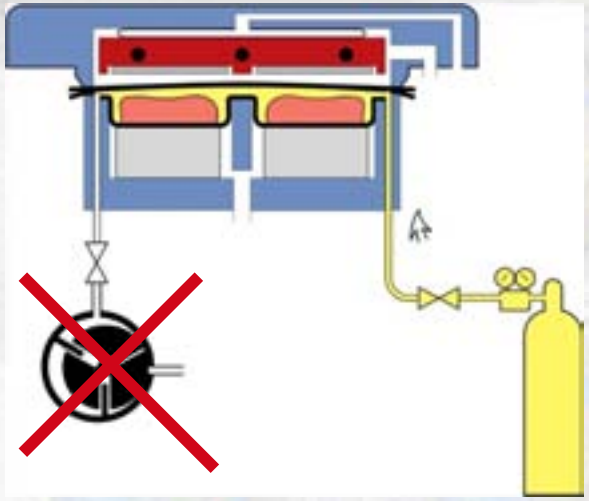
Gas specification



Gas Purging

No evacuation of the air in the pack.

Residual oxygene is high

Shelf-life is lower than in gas

System mainly used with Flow pack and specific applications*

MULTIVAC
BETTER PACKAGING

Nitrogen

- Inert
- Odourless
- Displaces oxygen
- Prevents oxidation
- Does not support growth of aerobic microorganisms
- Very low solubility in water and fats
- Prevents package collapse

Carbon Dioxide

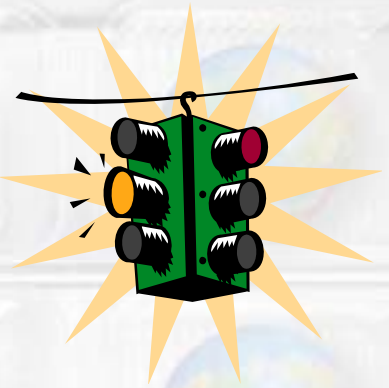
- Odourless
- Faint acid taste
- Reacts with water to form carbonic acid
- Bacteriostatic
- Fungistatic
- Insecticide
- Highly soluble in water and fats
- Allows packaging to shrink
- Can be used for detecting leaks

Oxygen

- Usually, major cause of spoilage:
  - Oxidation of fats (rancidity)
  - Growth of aerobic microorganisms
  - Causes color changes
  - Vitamin loss
  - Pigment changes
  - Aroma loss

- Required in specific cases only:
  - Essential for respiration of fresh fruit and vegetable
  - Preserves colour of red meat (beef, duck) and fish (tuna)

Carbon Monoxyde



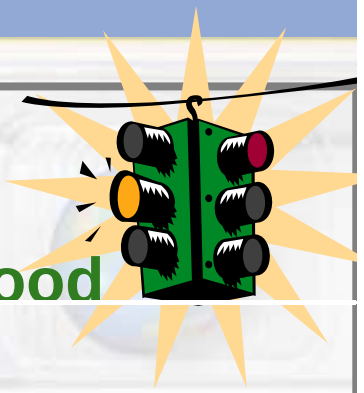
- High toxicity
- Odorless
- Flammable

- Can only be used in small quantities in addition to CO2
- Give a longer shelf life to products
- Reduce the degradation
- Reduce pathogenics bacterias development

FORBIDEN BY EUROPEAN LAW !!!!

Carbon Monoxyde

Opinion of the Scientific Committee on Food



From EUROPEAN COMMUNAUTEE

The Committee therefore concluded that there is no health concern associated with the use of 0.3%-0.5% CO in a gas mixture with CO2 and N2 as a modified atmosphere packaging gas for fresh meat provided the temperature during storage and transport does not exceed 4°C. However the Committee wishes to point out that, should products be stored under inappropriate conditions, the presence of CO may mask visual evidence of spoilage.

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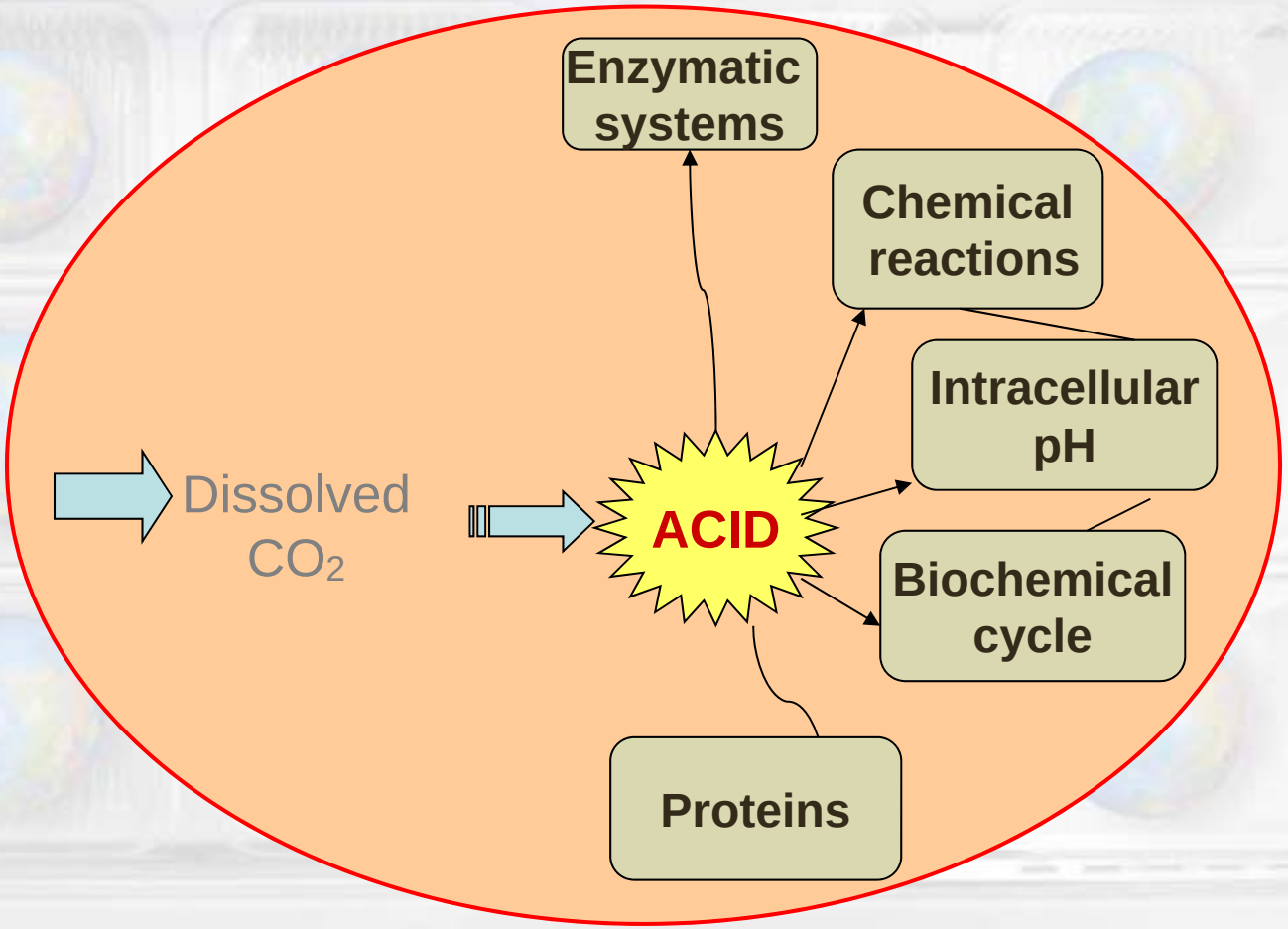
A Focus on the Bacteriostatic Action of CO_2

Step 1

Penetration of CO_2 in bacteria cell through the membrane

Dissolved CO_2

Step 2: *Action of CO_2 inside the cell*



Bacteria cell

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Modified Atmosphere Packaging – Gases

Recap of Gas Properties

	N_2	N_2O	CO_2	O_2	Ar	He
Preserve colour (red meat)				✓		
Prevent oxidation	✓				✓	
Soluble in water and fats		✓	✓		✓	
Inhibit/ do not support aerobic microbial growth	✓	✓	✓		✓	
Package leak detection			✓			✓
Reduce respiration rate (produce)	✓	✓	✓		✓	
Sustain respiration (produce)				✓		
Acidify			✓			
Inhibit growth of strict anaerobes				✓		

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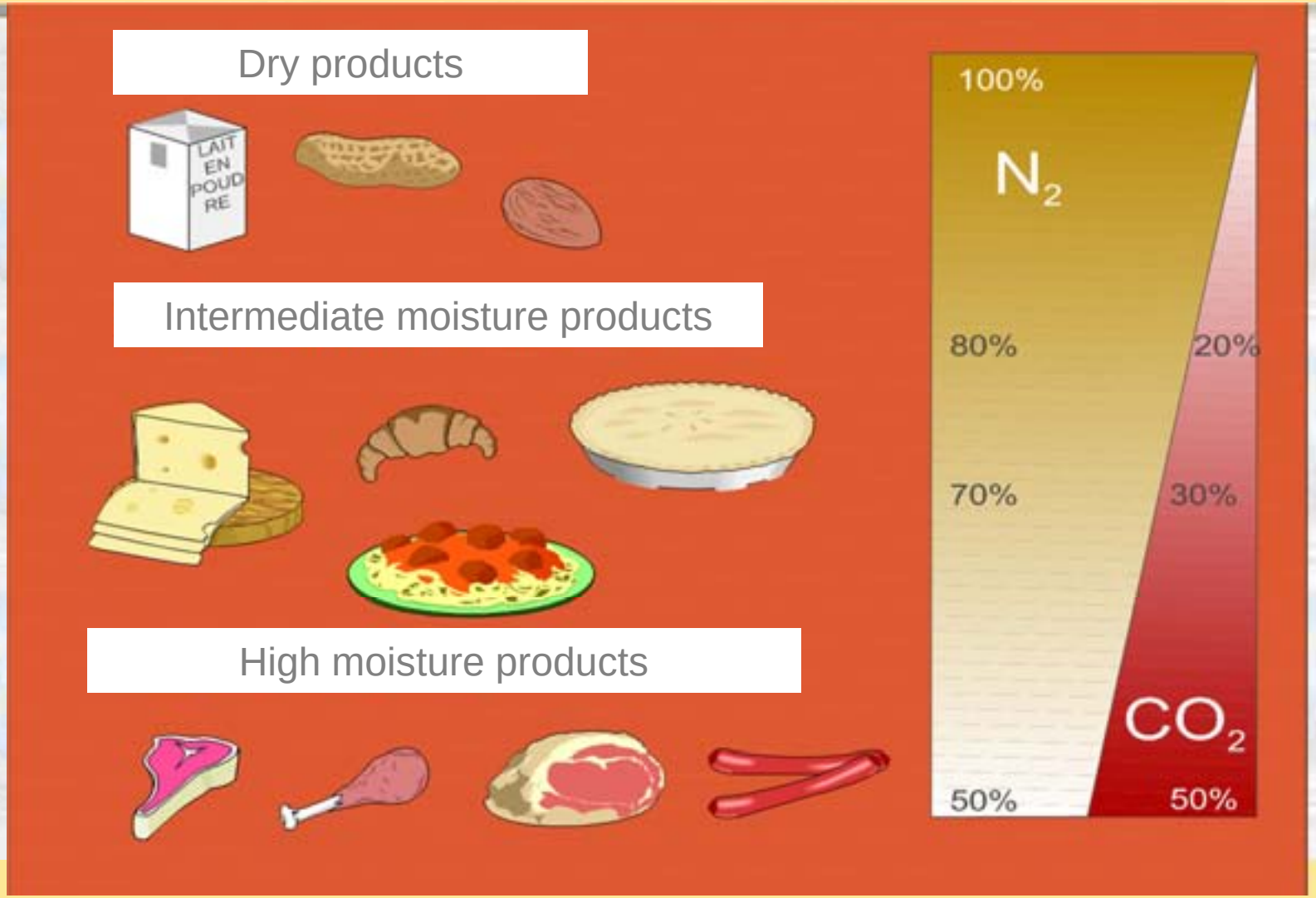
Gas selection according to food water content



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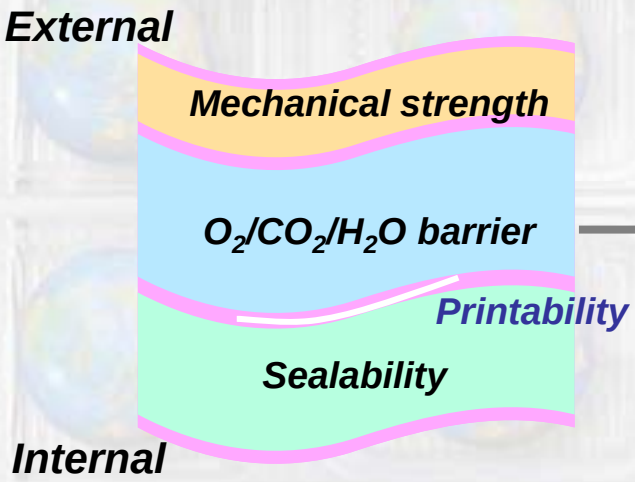
Gas and Water Vapour Permeability

Food packaging films are multi-layer (composite) => combining required properties



- Coffee/ milk powder: PET/ Alu/ PE*
- Cheese: PET/ PE/ PVDC
- Bread: PP/ PE/ PVDC
- Processed pork: PET/ PVDC/ PE
- Fresh pastry: PE/ OPA
- Cut meat: PE/ PA/ PE or PE/ EVOH/ PA

** Foil laminated film*

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SHELF LIFE IN RAW FRESH PRODUCTS

MODIFIED ATMOSPHERE PACKAGING

Shelf-life can be easily triple

improved stock control

Improved marketability of the product

Little or no need for chemical preservatives

Reduced risks of contamination

Easier labelling and handling

More effective in extending shelf-life because of the presence of CO^2

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BETTER PACKAGING

SHELF LIFE IN RAW FRESH PRODUCTS

MODIFIED ATMOSPHERE PACKAGING

Recent study from DTU AQUA had shown that

MAP reduce drastically Histamine development in fresh fish

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Modified Atmosphere Packaging

As we can see, M.A.P is the best technic to have a good shelf-life in fresh fish.

Generally we use a mix of 70% N2 and 30% CO2 but it's adapted to the type of the fish and also if it's whole fish or filets

It's recommended to make tests to obtain a good result in shelf-life, because you have to take in consideration:

- Freshness of the fish (Catch or Farming)
- Type of fish (low or high level of fat inside)
- The colour

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Modified Atmosphere Packaging

Specialized companies supply the gases in steel bottles. A gas mixer is needed to make up the desired mixture corresponding to the product. The gas suppliers can also provide ready prepared bottles of mixture.

The suppliers generally have extensive knowledge of the mixtures required according to the products to be packaged, and have specialized laboratories which perform tests to determine the suitable mixture for a product.

In certain cases, such as very large-scale use or mixtures covered by a trade secret, use can be made of a gas mixer to make up individual mixtures.

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Modified Atmosphere Packaging (M.A.P)

Products	Vacuum	N2	CO2	02	temperature	Shelf-life
Whole fish gutted	100%	Not	Not	Not	+2 to +4°C	7-9 days
Filets	100%	Not	Not	Not	+2 to +4°C	5-6 days
Whole fish gutted	100%	40%	60%	Not	+2 to +4°C	9-13 days
Filets	100%	60%	40%	Not	+2 to +4°C	7-10 days
Tuna steaks	100%	0%	20%	80	+2 to +4°C	8-10 days
Live Mussels	20%	Not	Not	Not	+2 to +4°C	8-9Days
Live Oysters	20%	Not	Not	Not	+2 to +4°C	8-9days
Live Mussels	100%	Not	20%	80%	+2 to +4°C	11-13 days
Live Oysters	100%	Not	20%	80%	+2 to +4°C	11-13 days
Shrimps	100%	30%	40%	30%	+2 to +4°C	8-10 days
Shrimps Coated with lactic acid	100%	30%	40%	30%	+2 to +4°C	18-21 days

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Air Liquide classification of gas

Modified Atmosphere Packaging – The Aligal™ Range

A Range of food grade Cylinder Gases to meet every MAP need

ALIGAL™	N_2	CO_2	O_2	Ar	He	N_2O
1	✓					
2		✓				
3			✓			
4					✓	
9						✓
6				✓		
12	✓	✓ 20%				
13	✓	✓ 30%				
15	✓	✓ 50%				
62		✓ 20%		✓		
27		✓ 30%	✓			
28		✓ 20%	✓			

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Modified Atmosphere Packaging
Very moist products

Fresh fish and seafood products: *low fat fish (e.g. cod, pollack, whiting, ling…), fatty fish (e.g. mackerel, sardine, salmon, herring, red tuna…), dried fish, smoked fish, surimi, roes, shellfish*

- ✔ Sensitivity to oxidation (especially fatty fish)
- ✔ High microbial risk, especially after processing (filleting, skinning…) => risk of Clostridium Botulinum E growth (anaerobic)

- *Preservation solution:*
  - Fresh fish: packaging 3 days after fishing at 0-2°C
    - **Aligal 15** or 60% CO_2 + 40% N_2
    - If C.B.E. risk: 60% CO_2 + 10% O_2 + 30% N_2
  - Smoked fish, diced smoked salmon, and surimi: **Aligal 12 and 13** at 4°C
  - Dried fish: 100% N_2 at ambient temperature

- *Preservation result:*
  - From 6 days (filets), 8-11 days (whole fish) to 30 days (dried fish)

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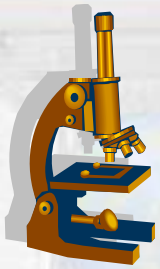
Modified Atmosphere Packaging
Very Moist Products



- **Products tested**: mackerel (fatty fish) and whiting (low fat fish) => 1-3 days out of sea, eviscerated and kept under ice
- **Temperature conditions**: kept at +2°C after packaging
- **Packagings tested**:
  - Under air: PSE tray with stretch PVC film
  - Under vacuum: Vacuum Skin Packaging (VSP) and classic vacuum
  - Under MAP => several blends; best results with:
    - 60% CO_2 +40% N_2
    - Film => OPP/ PVDC/ PE (15 cm^3 O_2/ m^2/ 24h)

Comparing Use by Date according to different packaging modes*

Product	MAP	Vacuum Skin Packaging	Classic vacuum	Under Air (Stretch PVC)
Whole fish	8-11 days	6-9 days	6-9 days	6-9 days
Filet of fish	6 days	5 days	4 days	-

** Observation between 1 and 11 days of packaging: total volatil basic nitrogen (ABVT), mesophile aerobic flora (FAM), organoleptic test (before and after cooking)*

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Lactic Acid Coating

- **Slows development of altering flora**
- **No bacteriocine evidenced**
- **Sold under lyophilized form**
- **Applied by injection or “brumization” machine**
- **470 bacteria isolated from sea products and tested**

- **Suitable for large variety of seafood**
  - **Smoked fish, fresh fish, pre-cooked fish, shrimps, prepared products, shellfish…**
- **Ferment LLO® from Bioceane (On shrimp double the shelf-life)**

Modified Atmosphere Packaging
With a Thermoformer

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Modified Atmosphere Packaging
With a Traysealer

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TRIWEB

A mix Packaging vaccum and gas…..

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TRIWEB

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bottom web

gives tray shape to pack

middle web

seals contents firmly in place

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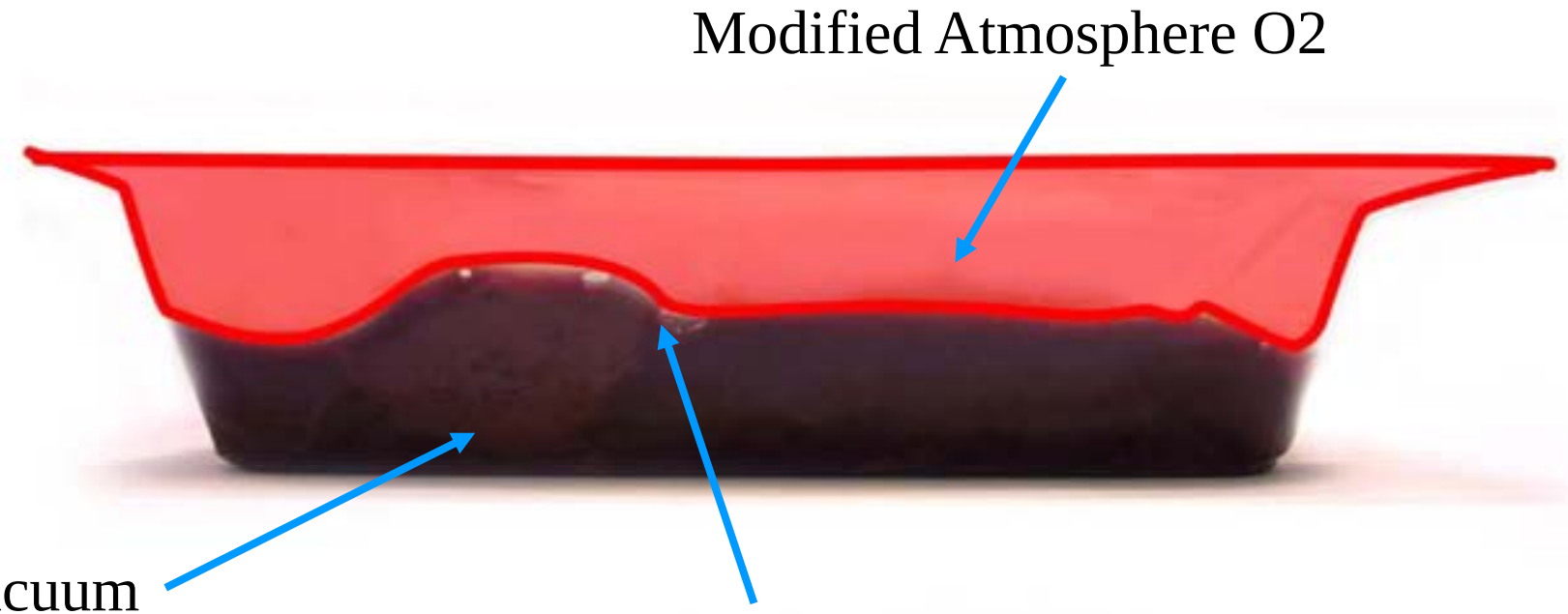
top web

give appearance of rigid try top seal film

space between middle and top web



ADVANTAGE FOR FRESH TUNA :

- LONGER SHELF-LIFE (10 to 14 days depending of the meat and Freshness)
- NICE ATTRACTIVE PACKAGING
- VERTICAL STORAGE POSSIBLE
- NO BLOOD EXUDATION
- MAINTAIN RED COLOR DUE TO OXYGEN IN THE TOP SPACE

TRIWEB

Tuna Steacks are loaded and vacuum packed with a O2 permeable film

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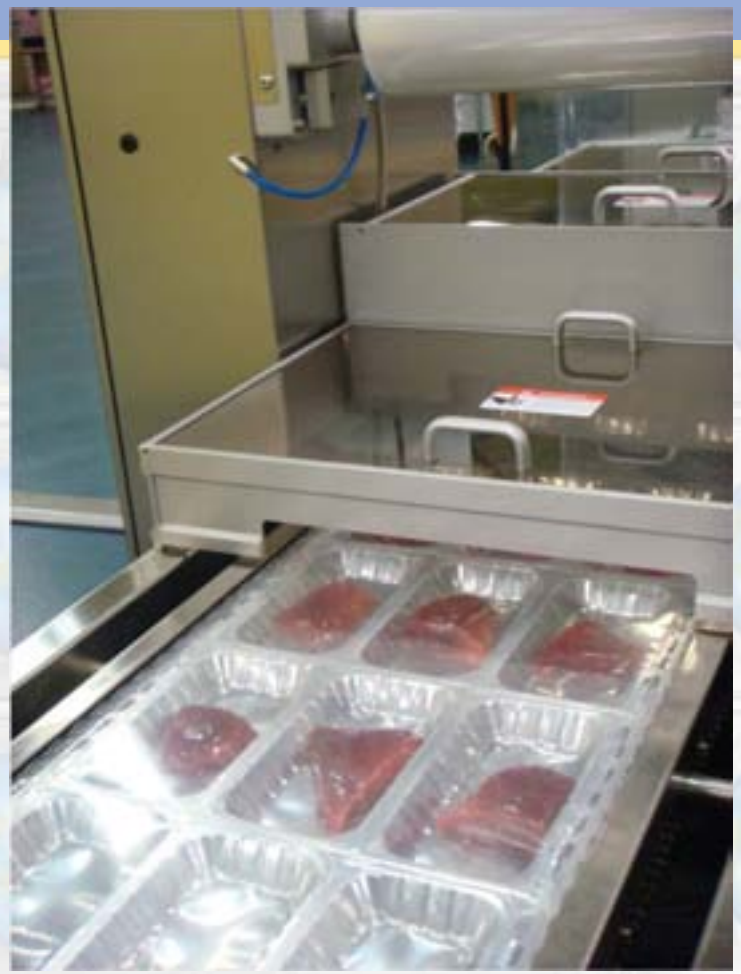
TRIWEB



Steacks are gash flushed with O2 in the upper part of the tray.

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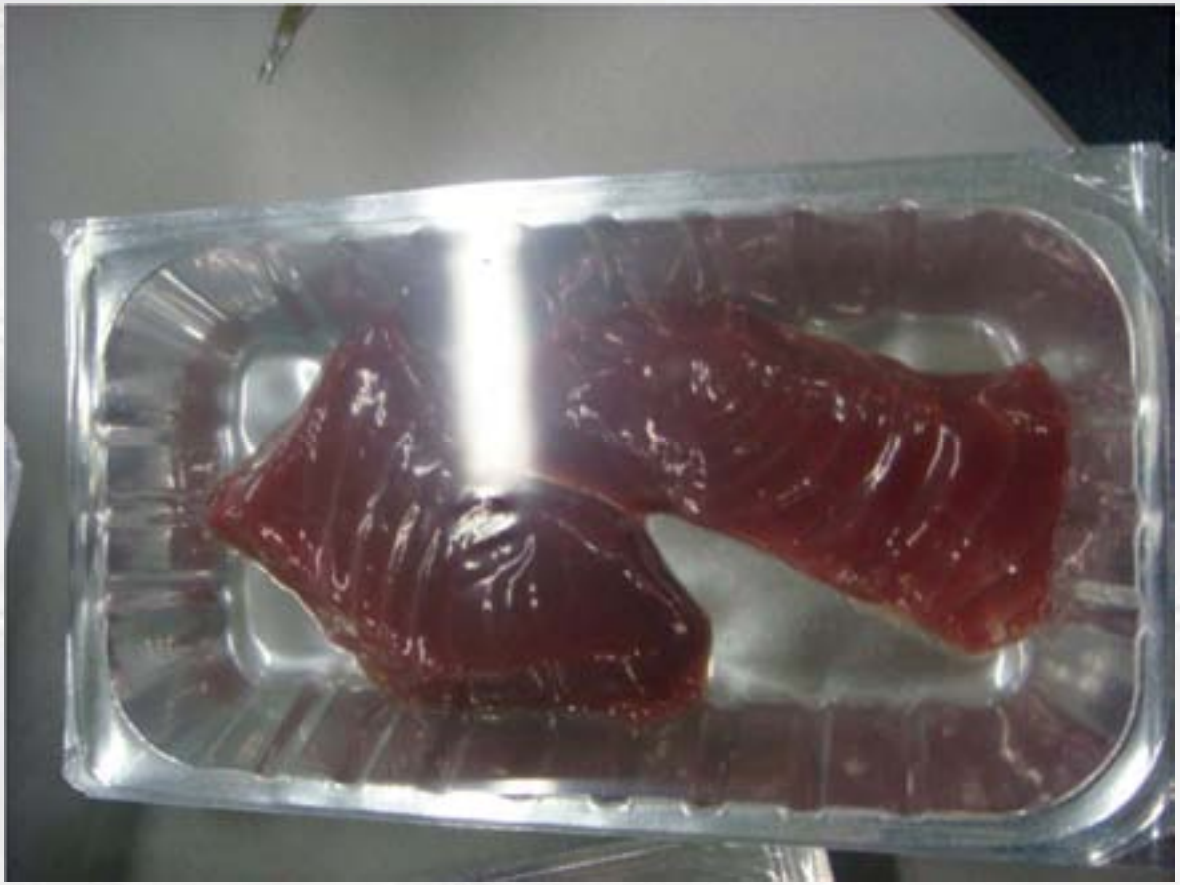
TRIWEB



Vertical presentation in stall, no exudation…….Nice red color

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Thanks to

MULTIVAC WOULD LIKE TO THANK

CRYOVAC SEALED AIR

AIR LIQUIDE

PBI DANSENSOR

BRUNO GOUSSAULT (CREA)

FOR THEIR CONTRIBUTION TO THESE PRESENTATION

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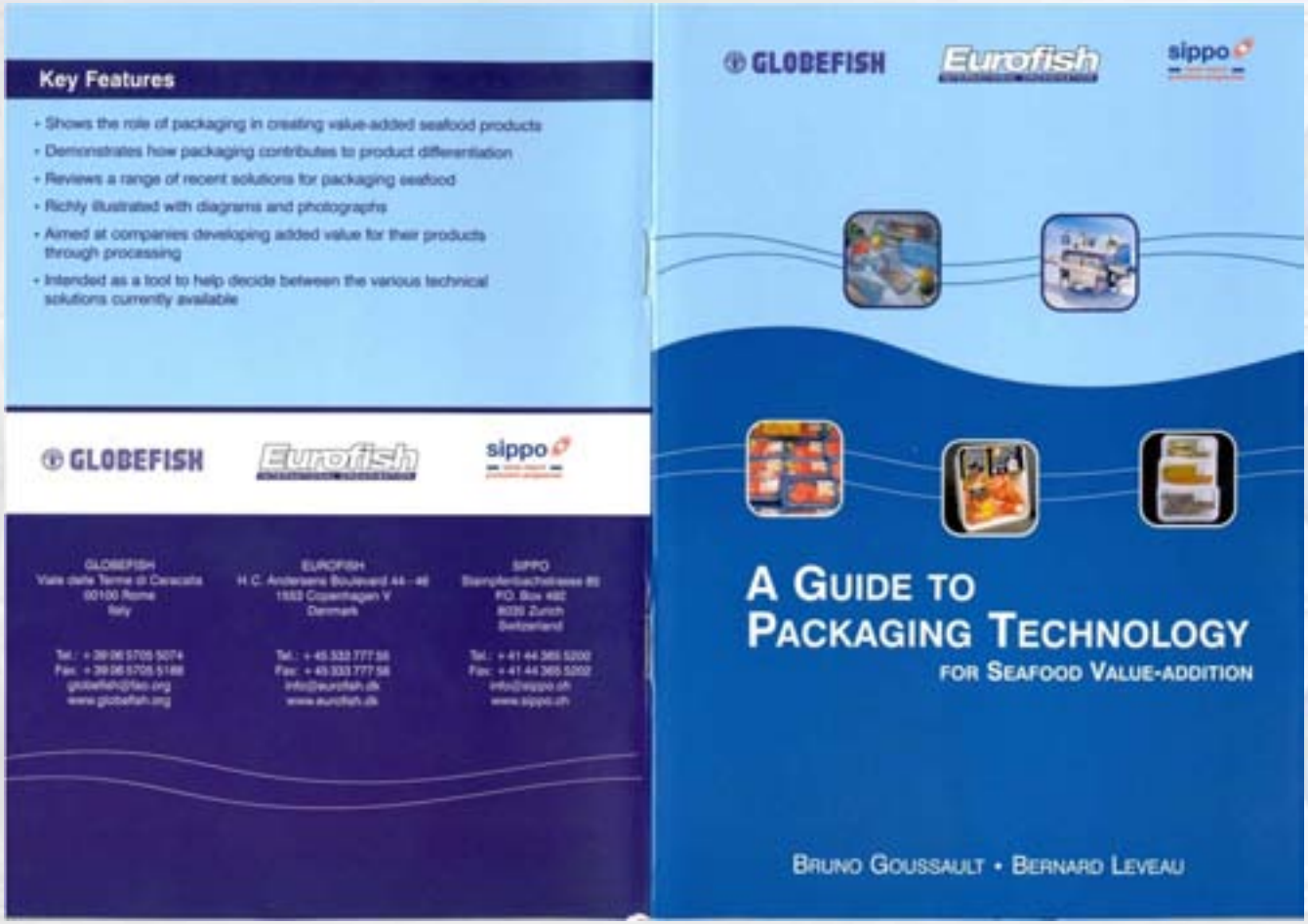
Documentation



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THANKS FOR YOUR ATTENTION

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