DANISH MEAT
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Case studies of packaging and processing solutions to improve meat quality and safety

Smart packaging for quality, safety and integrity

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Smart packaging **solutions**

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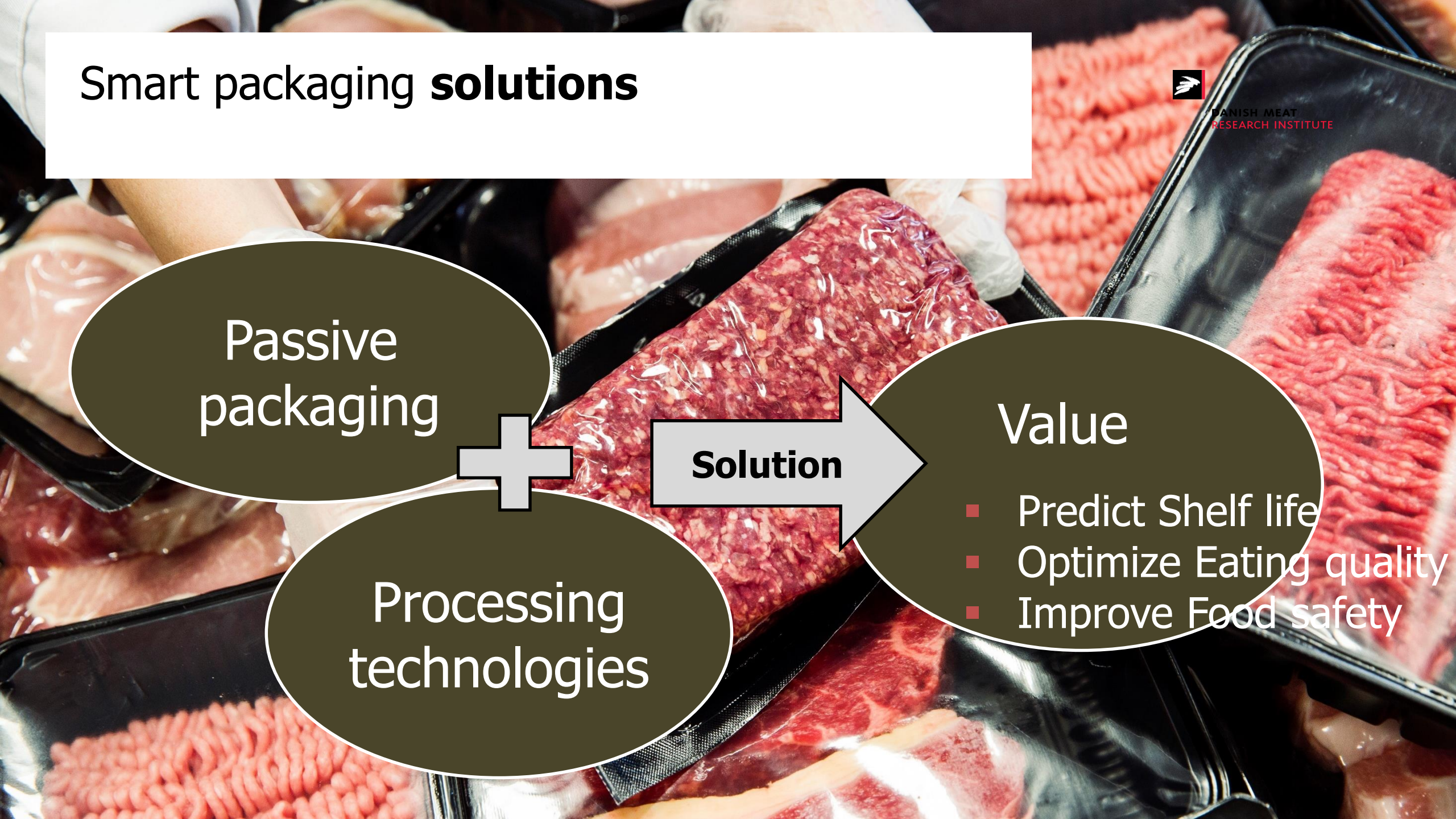
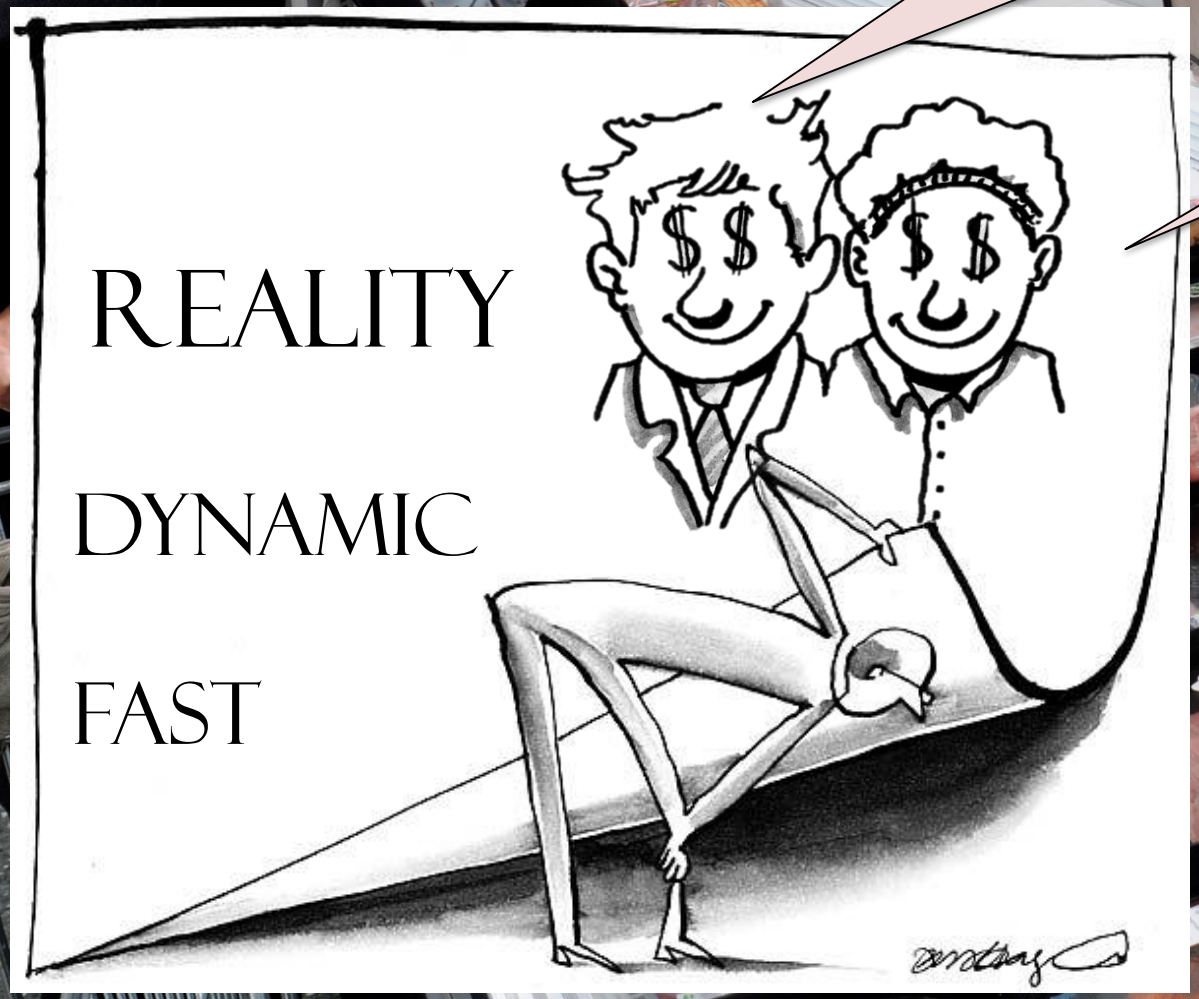


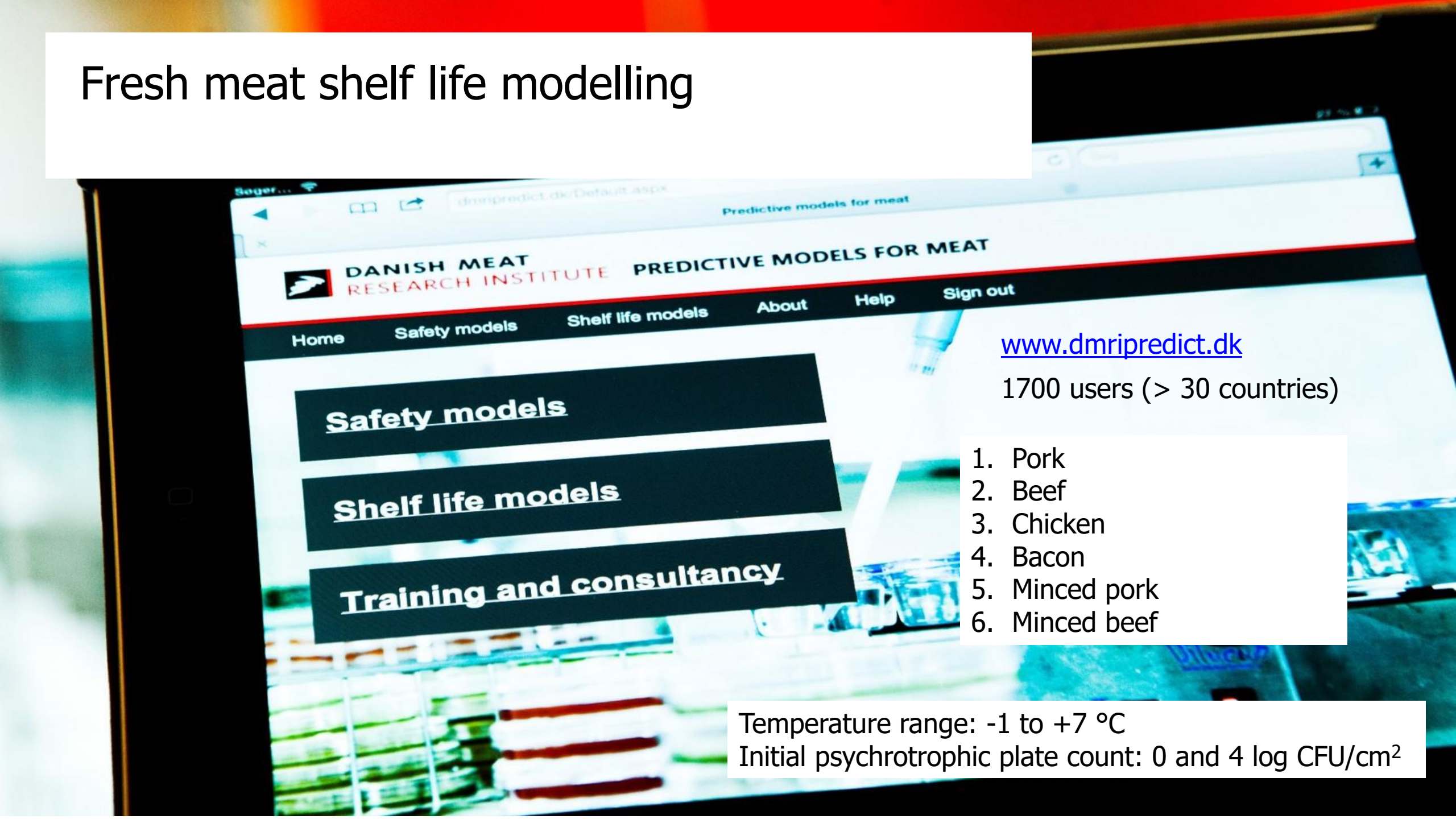
Case 1: Boosting shelf life

"A new customer wants… is it possible?"

"Where can I find a quick and reliable answer?"



Fresh meat shelf life modelling



www.dmripredict.dk

1700 users (> 30 countries)

1. Pork
2. Beef
3. Chicken
4. Bacon
5. Minced pork
6. Minced beef

Temperature range: -1 to +7 °C
Initial psychrotrophic plate count: 0 and 4 log CFU/cm^2

WWW.DMRIpredict.dk user interface

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Home | Safety models | Shelf life models | About | Help | Sign out

Shelf life of fresh pork cuts

Vacuum packed and/or MAP-packed (70% O_2 + 30% CO_2) and/or stored under aerobic conditions (on "Christmas trees" (multiple hooks), in boxes, wrapped, etc.). Version 5.1

Input

Psychrotrophic count (6.5 °C for 10 days) at packaging:

Average	2.5	log cfu/cm^2			
Standard deviation (std)	0.9				
1. Temperature	4.0	°C in	2	days	Aerob
2. Temperature	2.0	°C in	8	days	Vacuum
3. Temperature	5.0	°C in	20	days	MAP
4. Temperature	4.0	°C in	0	days	Vacuum

Update | Print | PDF | Help

Calculate days until a given raw meat odour

Valid for the current conditions

Raw meat odour - average	5.0
Days	13

Calculate

Growth

Development in shelf life

Predicted shelf life of fresh pork and beef

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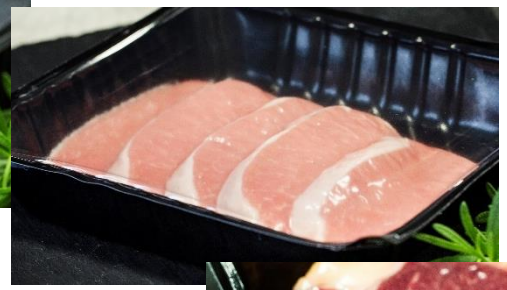

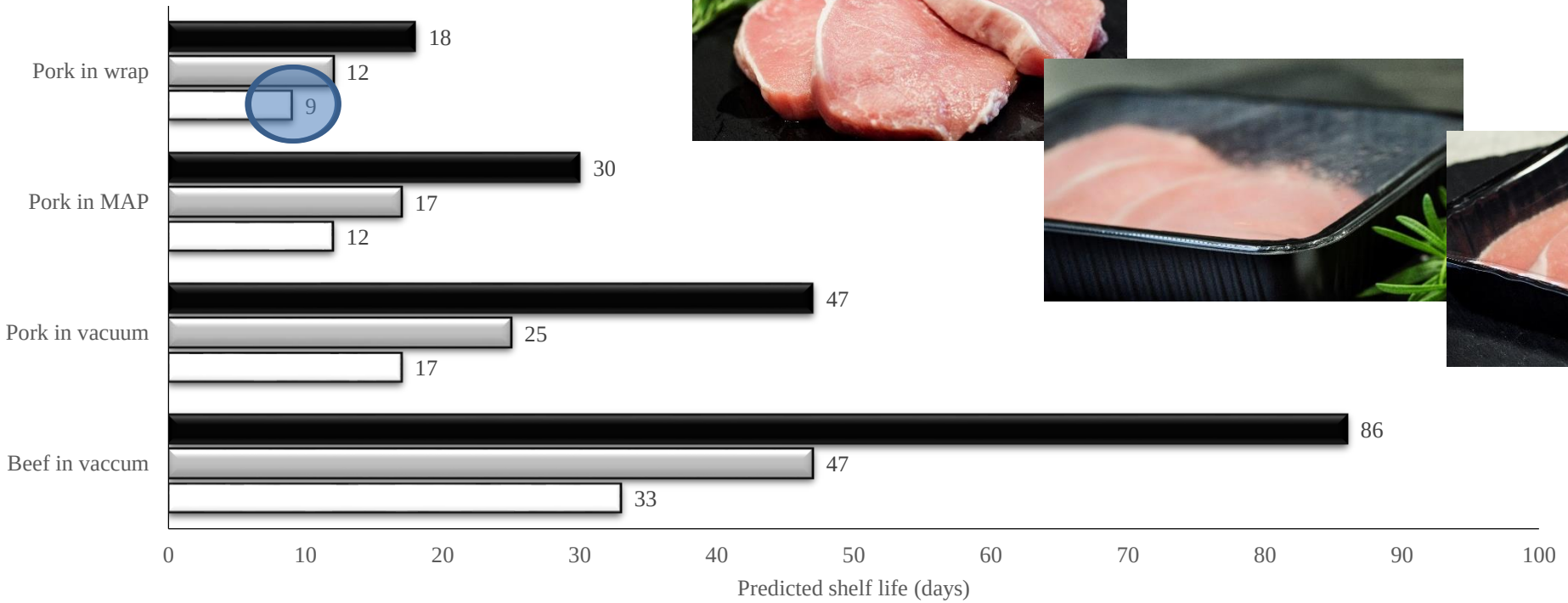

0 °C | 3 °C | 5 °C

Initial count (6.5° C for 10 days): 2.5 log/cm^2
Standard deviation (std.): 0.9.

Case 2: Boosting Eating Quality

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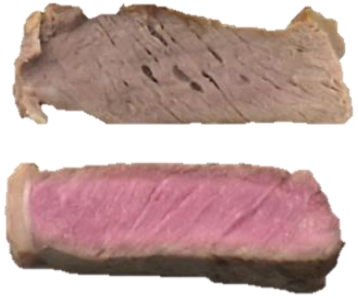

Fresh meat quality ≠ Eating quality of cooked meat

Objective: To develop an alternative solution to the traditional high-O_2 MAP, and to obtain better eating quality and uncompromised shelf life.

DMRI guidelines for 3-Gas MAP

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Aged beef	O_2	CO_2	N_2
6 days	30%	30%	40%

Aged beef steaks in low O_2
- ✓ Uncompromised shelf life
- ✓ More juicy – meat flavour
- ✓ Less PMB – WOF – hard texture

Chops & Schnitzels	O_2	CO_2	N_2
9-12 days	40%	20-30%	30-40%

Fresh pork in low O_2
- ✓ Uncompromised shelf life
- ✓ More tender - colour stable
- ✓ Less rancid - PMB

Sliced pork belly	O_2	CO_2	N_2
> 9 days	50%	40%	10%

Crispy pork belly in high CO_2
- ✓ Extended shelf life
- ✓ Less piggy - stale flavour
- ✓ More crispy

Minced meat	O_2	CO_2	N_2
No 3-gas MAP solution			

Minced meat
- Fast discolouration

Trial design for Australian beef exported to Europe

Selection - Australia

44 *longissimus thoracis et lumborum* from 22 carcasses

Analysis of initial psychrotrophic plate counts

Vacuum-packing & shipping to DK (75 days at 0.2 °C)

Sub-trial 1 - Denmark	Sub-trial 2 - Denmark
Eating quality	Shelf life
12 loins sliced (1.5 cm)	20 loins sliced (1.0 cm)
4 x packaging	4 x packaging
Wrap, high-O_2 MAP, tri-gas MAP, vacuum	Wrap, high-O_2 MAP, tri-gas MAP, vacuum
Analysis	Analysis
2 x display sampling (n = 10)	8 x display sampling (n = 5)

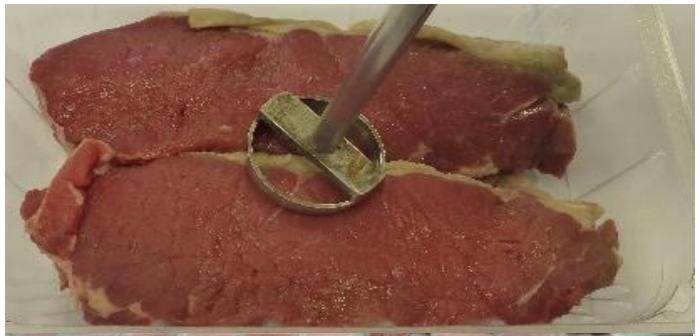
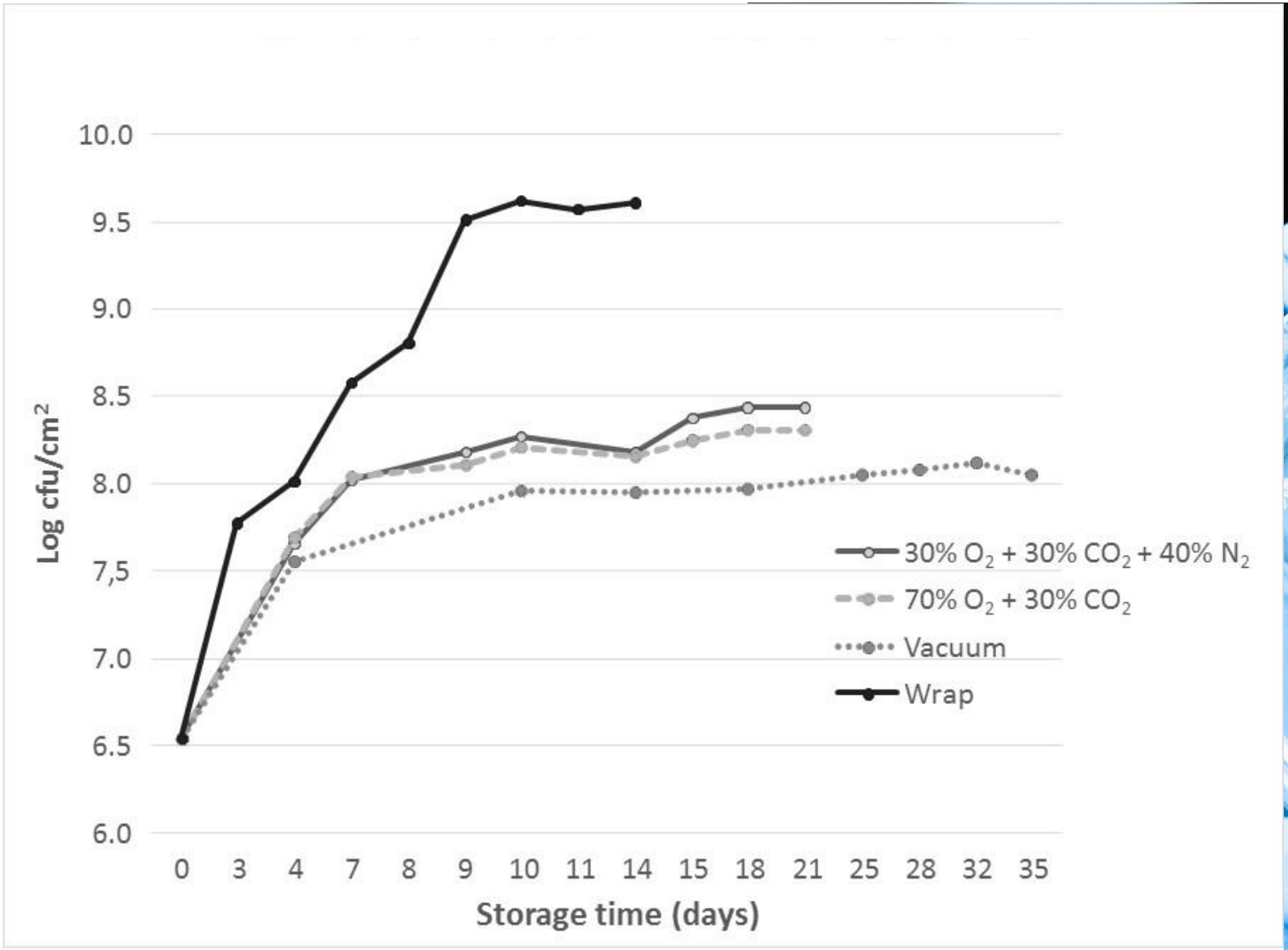


Plate count in retail display



Shelf life of Australian beef exported to Europe

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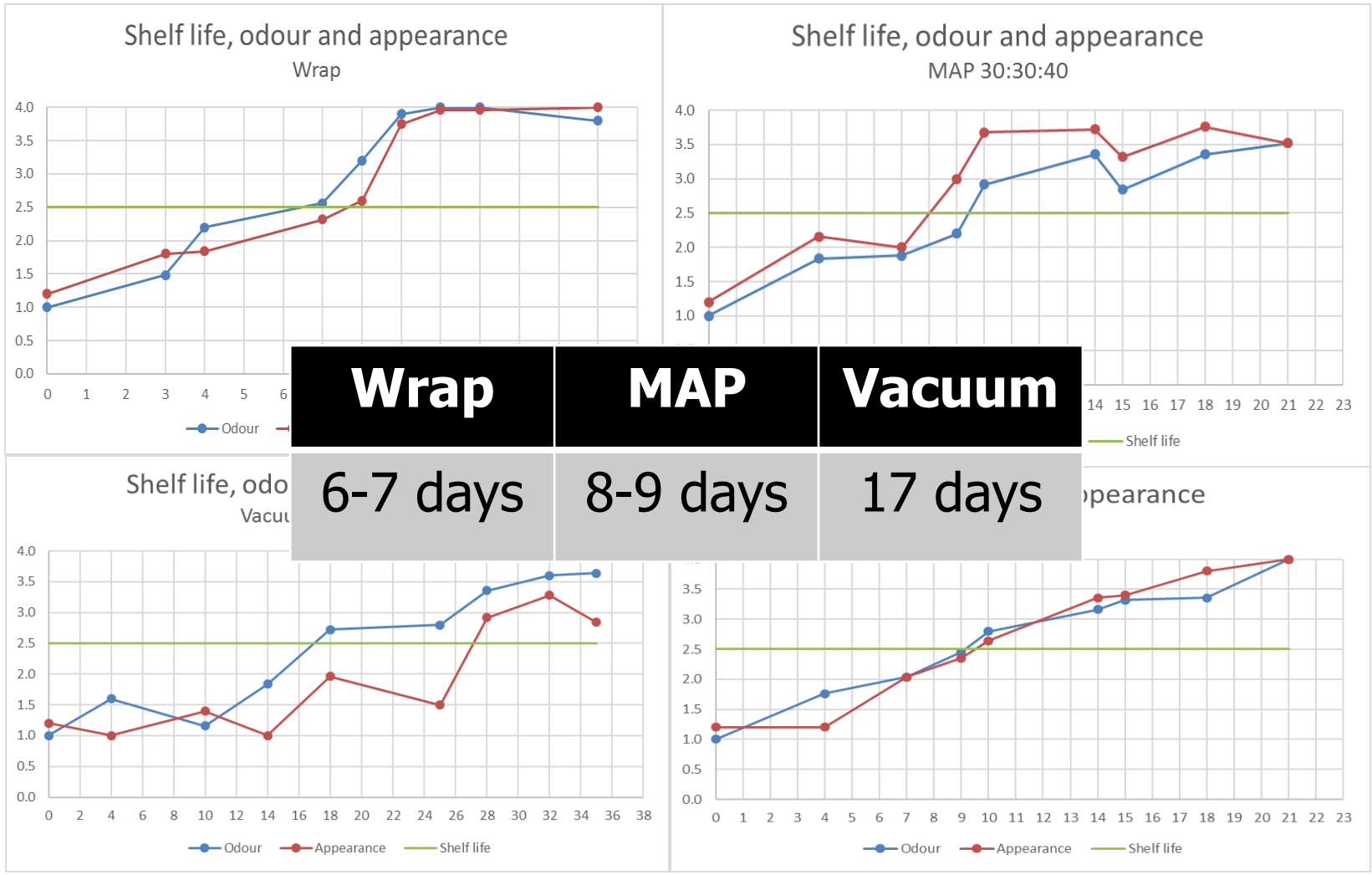
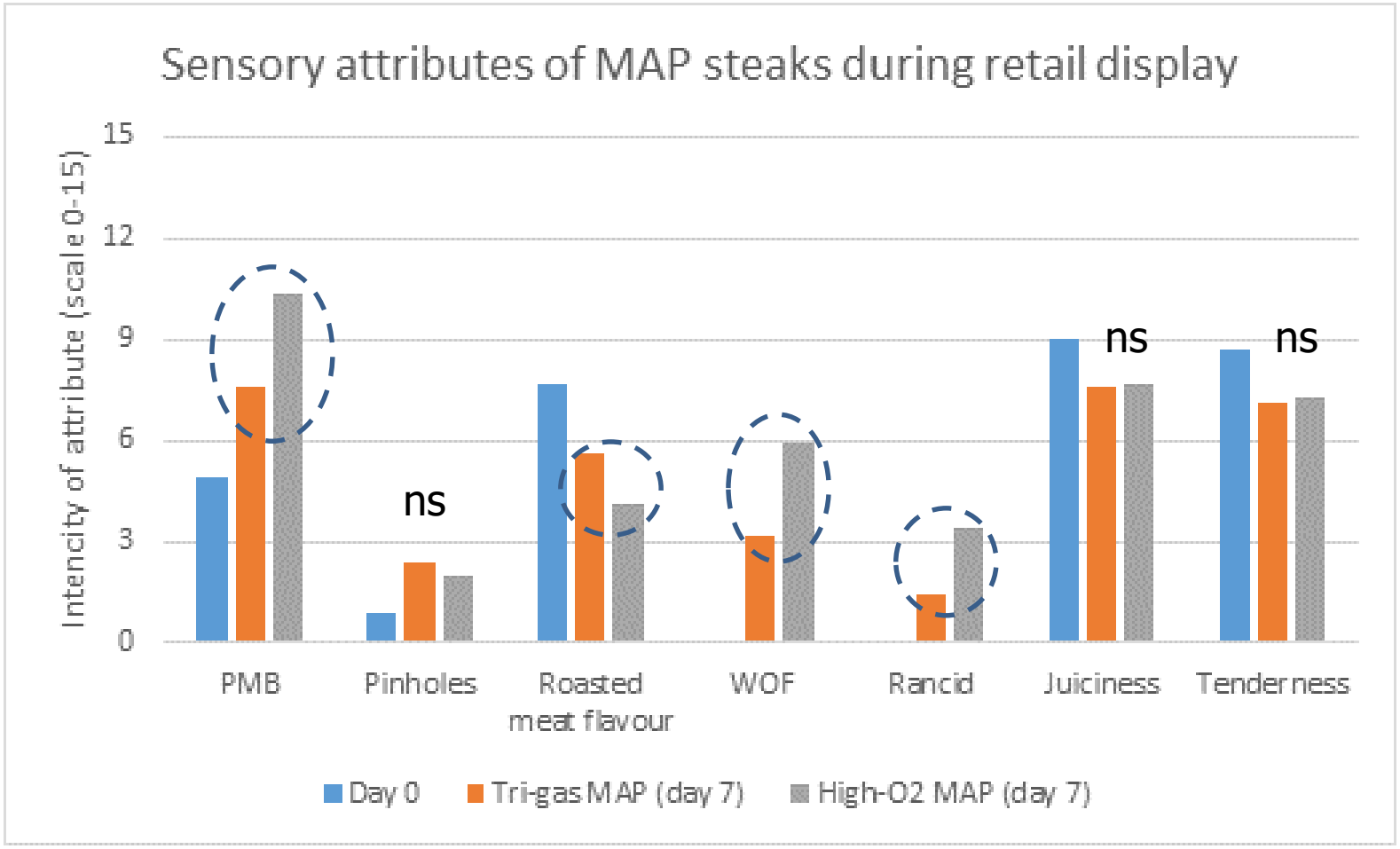


Wrap	MAP	Vacuum
6-7 days	8-9 days	17 days

Shelf life and eating quality of Australian beef



Conclusions

- Pack steaks in **wrap** for minimal changes in the eating quality
- Pack in low oxygen **Tri-gas MAP** for 2 days' extra shelf life

Case 3: Boosting food safety

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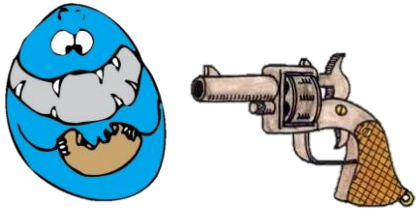
Objective

- To find a suitable method for surface in-package decontamination of vacuum-packed fresh meat
- To test if thermal shock is able to inactivate *C. botulinum* spores faster than conventional thermal treatment

FSA recommendations

Food in vacuum:

- Shelf life < 10 days (+3-8°C)
- *C. botulinum* growth risk
- Risk of toxin production



Heat treatment:

- 90°C for 10 minutes
- 6 log reduction

Testing thermal shock on *C. botulinum* spores

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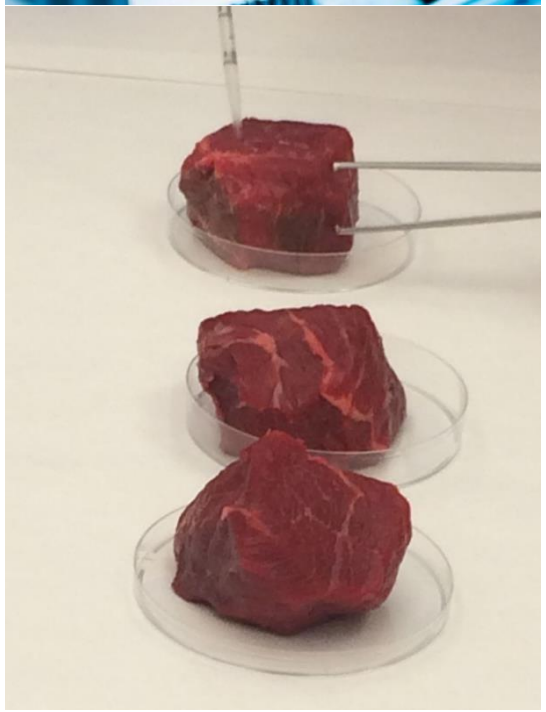


Strains and preparation of spores

The inoculation cocktail contained four non-toxigenic and gas-producing strains of psychrotrophic *C. botulinum*

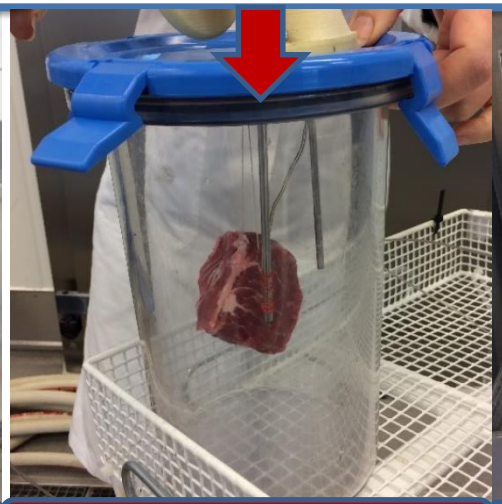
The spores were cultivated in Tryptone Peptone Glucose Yeast and Cooked Meat Medium

Preparation of meat samples

Bovine topsides were cut into cubes (4.5 x 4.5 x 4.5 cm)

Surface suspension was added to the surface (10^5 spores per cm^2) and vacuum-packed

5.8 GHz microwave



Steam flow

Hot water: 90, 95, 97, 99°C

Thermal shock with 5.8 GHz MW

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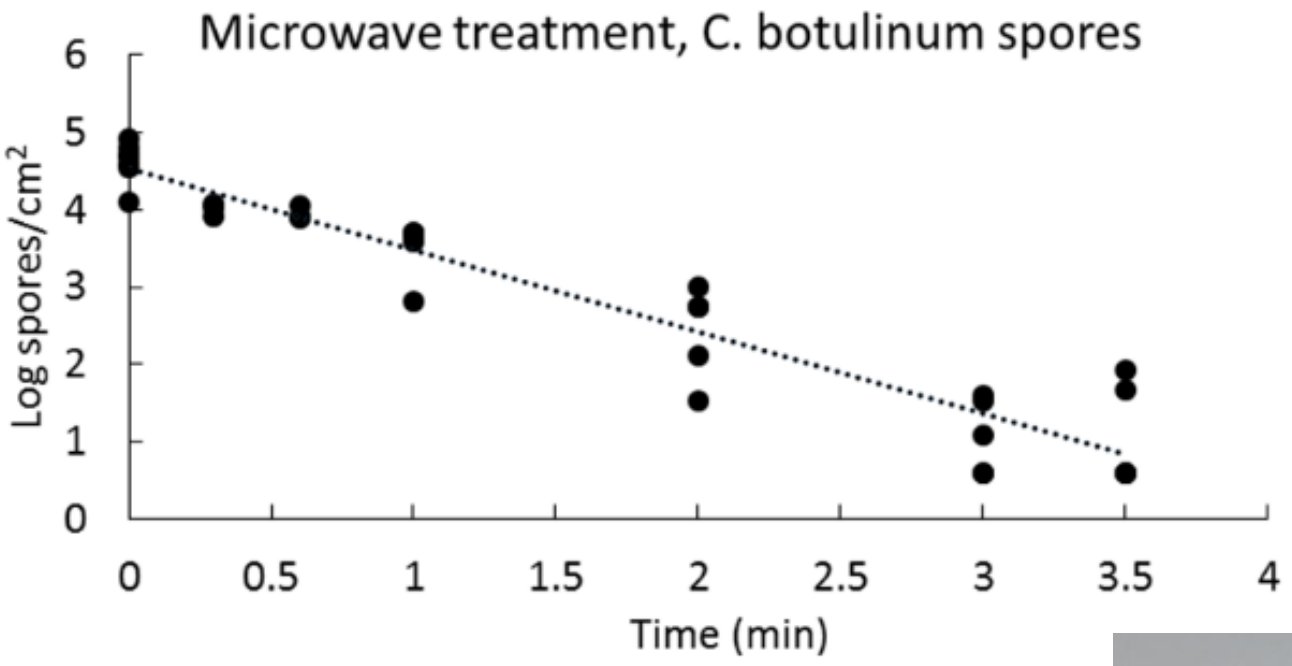

D-value: 0.79 minutes

6 log ≈ 5 minutes

4 minutes

5 minutes

Effect of thermal shock treatment

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Treatment	D-value, min	Time for 6 log, min
Water bath, 90 °C	3.99	23.9
Water bath, 95 °C	3.64	21.8
Water bath, 97 °C	2.22	13.3
Water bath, 99 °C	1.39	8.3
Microwave, full effect	0.68	4.1
Microwave, 100% (1 min) + 25%	0.79	4.7

Conclusions

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Case 1 – Boosting shelf life

- www.DMRIpredic.dk is a free access website to quickly estimate the shelf life of fresh meat
- It is a fast and dynamic tool reflecting the real-life variation
- It enables the industry to focus on optimising temperature, packaging and hygiene

Case 2 – Boosting Eating quality

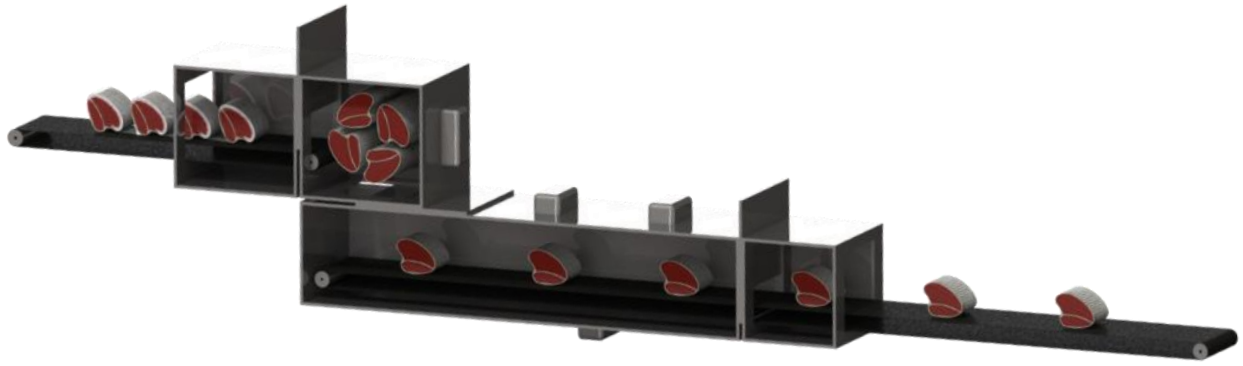
- Low oxygen tri-gas MAP (O_2, CO_2 and N_2) provides uncompromised shelf life and minimal changes in the eating quality
- Suitable for steaks and chops, but not for minced meat

Case 3 – Boosting food safety

5.8 GHz microwave processing of vacuum-packed fresh meat can potentially provide

- A 6 log reduction of *C. botulinum*
- 50% time reduction compared to hot water
- Only a few mm MW penetration
- Red centre

Only lab scale! up-scaling is necessary to achieve industrial scale



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Thank you for your attention!