

# Reducing salt and fat in meat products

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- Salt is necessary for the **human being** and also for production of **processed foods** (80%; from it 20% meat products)

## Meat

**Preservation effects** – lower the water activity and inhibition of microorganisms

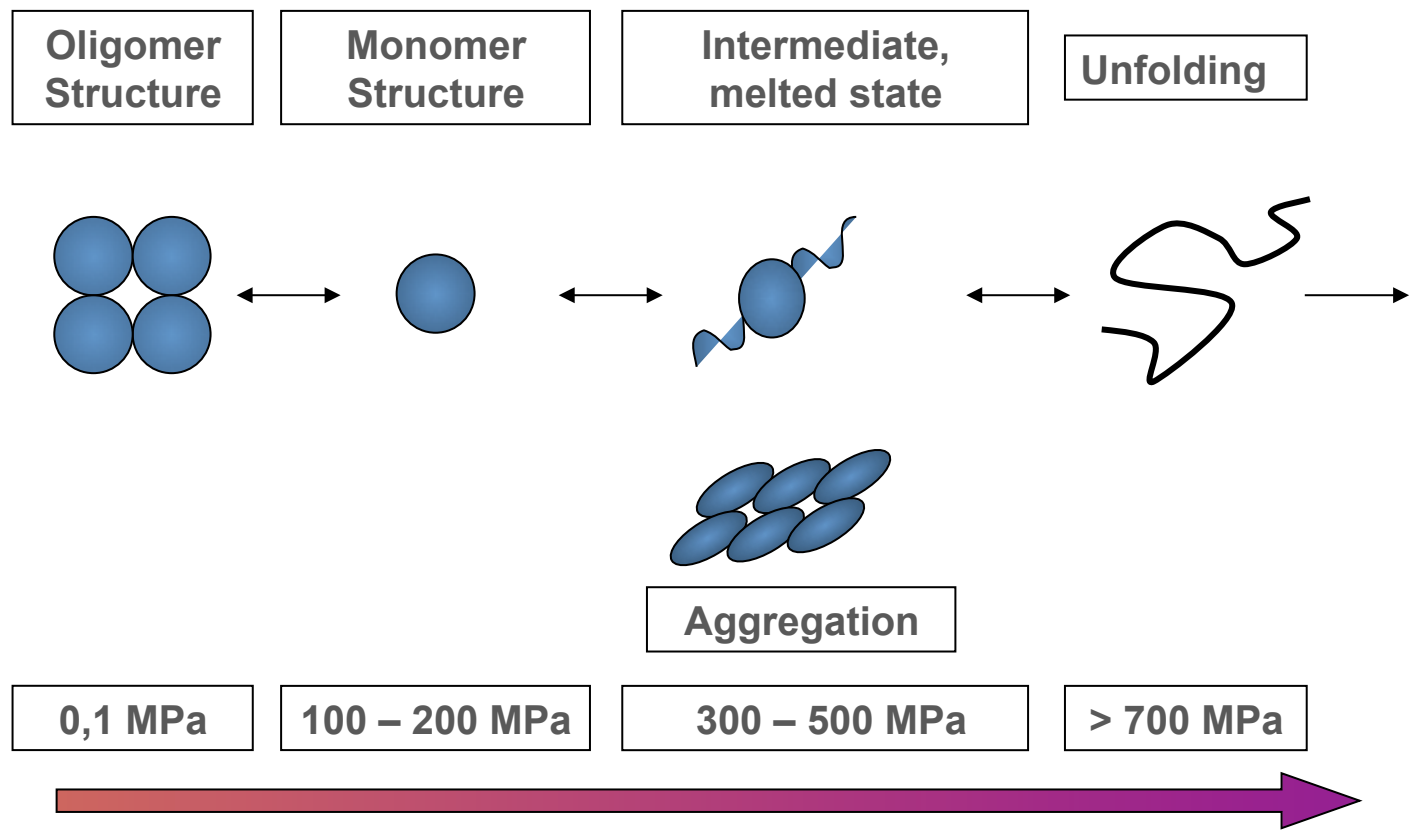
**Sensorial effects** - flavour enhancement

**Physical effects** – structure formation (texture and water holding capacity)

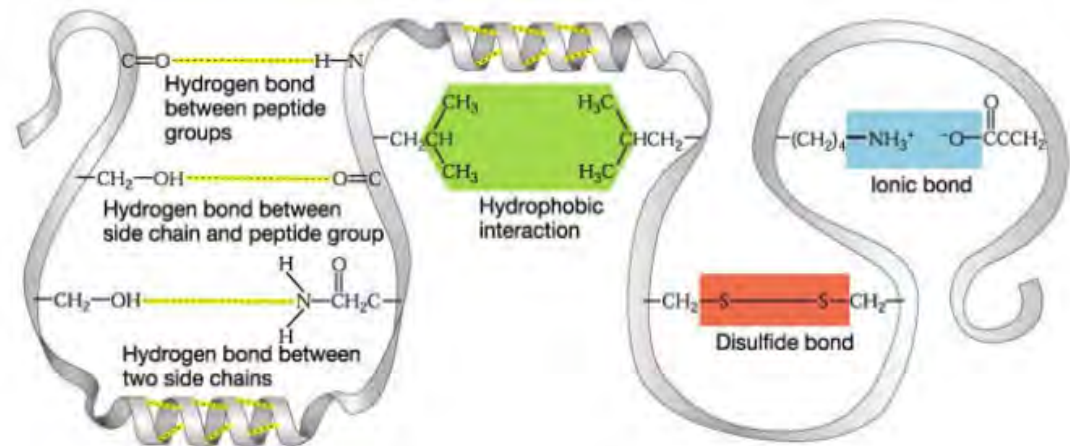
- myosin and actin swell in the presence of salt

- Currently: 8 – 10 g/person and day
- Recommended: 5 g/person and day





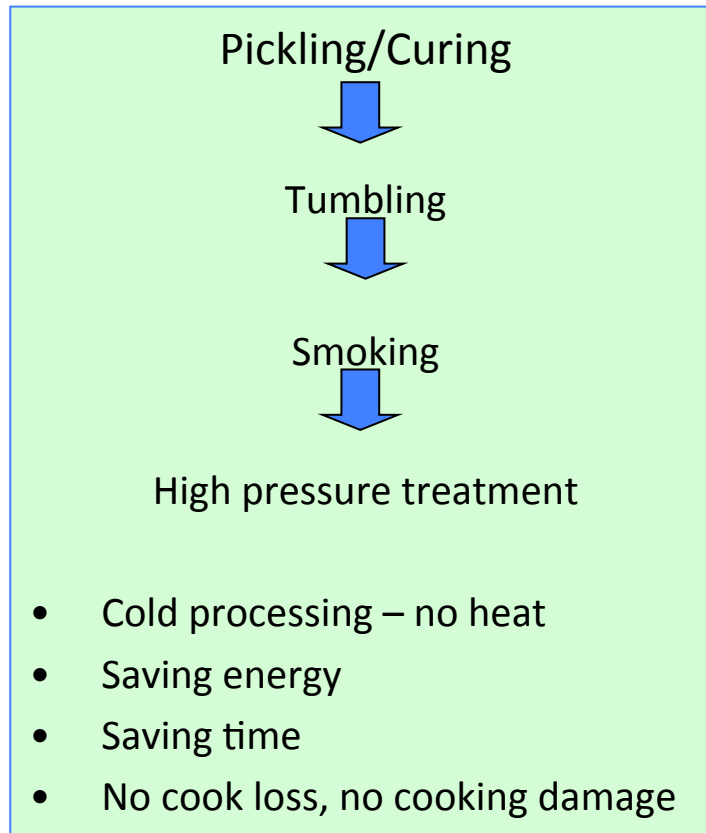
- Structural changes
  - Disassociation of subunits (acto-myosin complex)
  - Aggregation of new structures
  - Destabilization of hydrophobic interaction
  - Does not influence primary structure



## High Pressure Processing

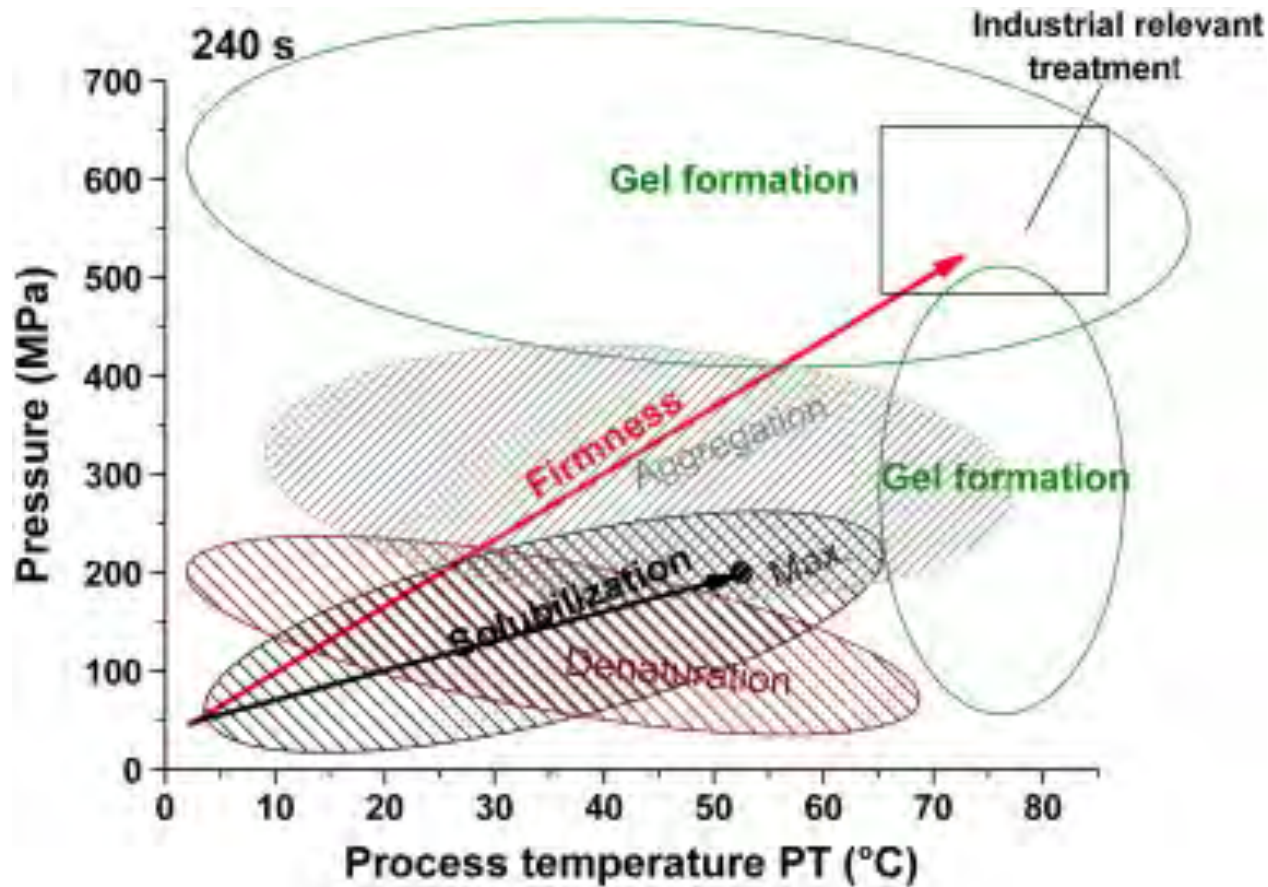
HPP „cooking“

Cold production of pork chop (Kassler)



HPP Product

Hypothetic P–T ranges of myosin solubilisation, aggregation and gelation after HPP treatment of 240 s.



Tintchev et al. 2013

Available for product development and co-processing



Wave 6000/55

Hiperbaric, Spain

Pressure up to 600 MPa

Room temperature



Work done at Pleasure project  
is at room temperature !!!

Functionalization of raw meat (with or without salt addition) by HPP treatment (5 min at the specified pressure 100 or 400 MPa) applied to the production of cooked sausages.



**1: Control cooked sausages without added phosphates.**

**2: Cooked sausages treated by HPP at 100 MPa with salt addition before HPP treatment**

**3: Cooked sausages treated by HPP at 100 MPa with salt addition after HPP treatment**

**4: Cooked sausages treated by HPP at 400 MPa with salt addition before HPP treatment**

**5: Cooked sausages treated by HPP at 400 MPa with salt addition after HPP treatment**

**6: Cooked sausages with added phosphates (0.06 %).**

1

2

3

4

5

6

Control

100 MPa

400 MPa

With phosphates



## Meat products

Cooked sausage - control

- Salt content: 1.8 % NaCl

Cooked ham - control

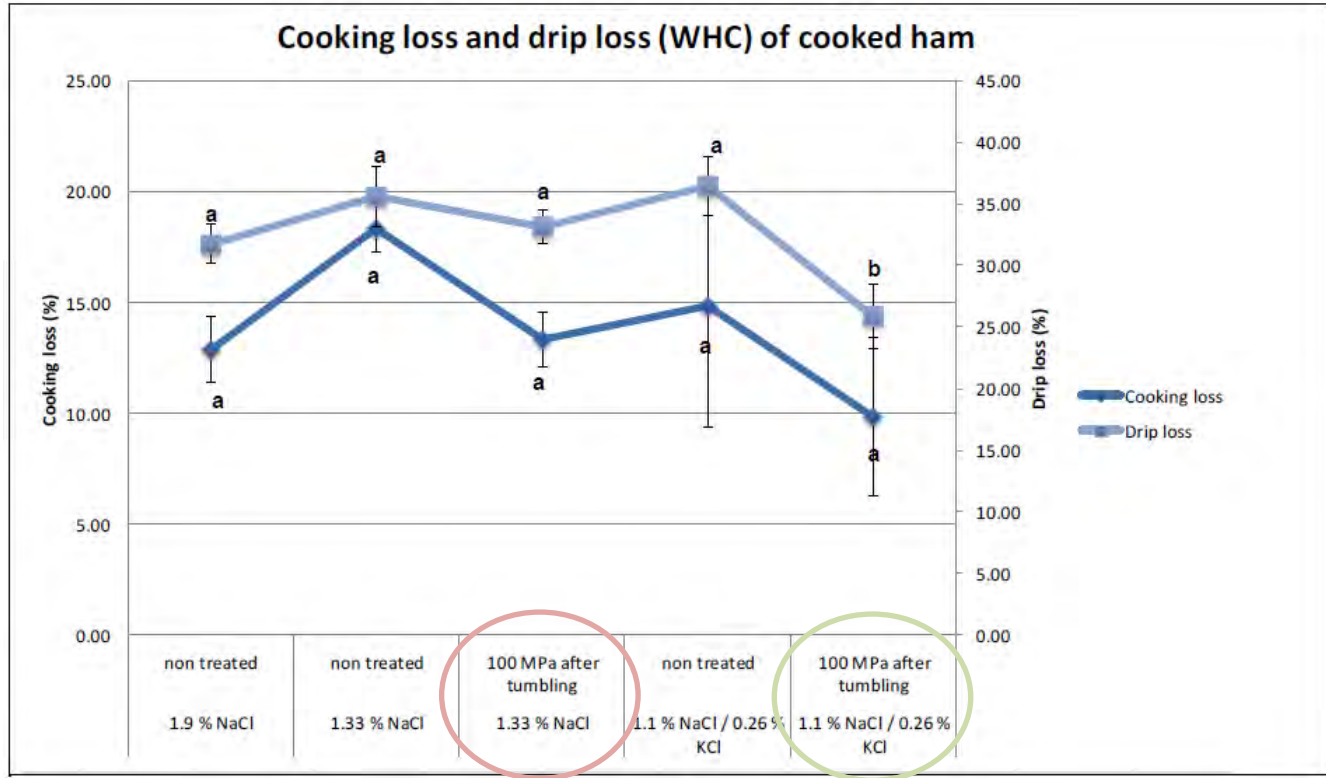
- Salt content: 1.9 % NaCl

## Aim

- Lowering the sodium consumption
- Salt reduction of 30 % or more
- Functionality of salt replaced by
  - High pressure processing technology (HPP)
  - Addition of salt replacer

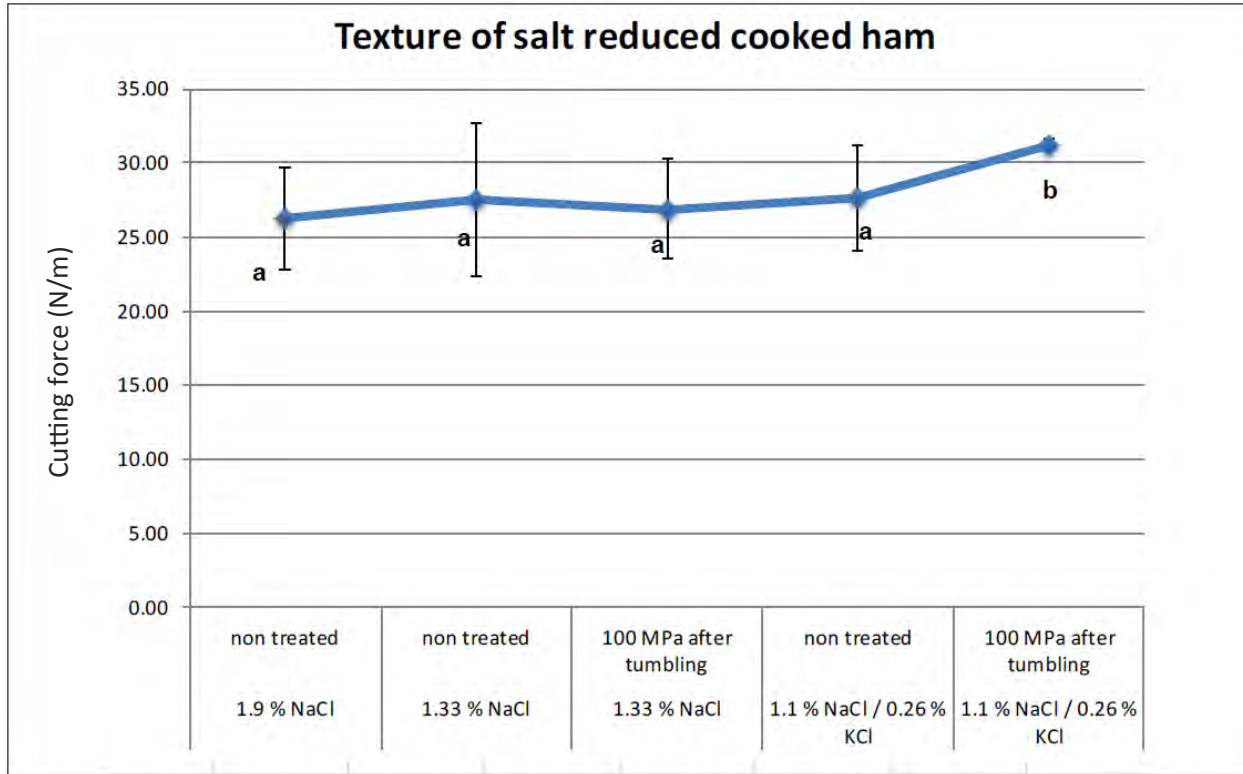


	Cooked sausage	Cooked ham
<b>Salt reduction</b>	<ul style="list-style-type: none"> <li>• 1.2 %, 1.4 %, 1.8 %, 2.0 %, 2.2 %</li> <li>• 0 %, 0.72 %, 1.26 %</li> </ul>	<ul style="list-style-type: none"> <li>• 0 %, 0.95 %, 1.1%, 1.33 %, 1.9 %</li> </ul>
<b>Phosphate reduction</b>	<ul style="list-style-type: none"> <li>• 0 %, 0.06 %, 0.25 %</li> </ul>	<ul style="list-style-type: none"> <li>• 0 %, 0.25 %</li> </ul>
<b>HPP – Process settings</b>	<ul style="list-style-type: none"> <li>• Before and after salt addition</li> <li>• Before and after chopping</li> </ul>	<ul style="list-style-type: none"> <li>• Raw material</li> <li>• After injection</li> <li>• After tumbling</li> <li>• After cooking</li> </ul>
<b>HPP – Pressure levels</b>	<ul style="list-style-type: none"> <li>• 100 MPa – 600 MPa</li> </ul>	<ul style="list-style-type: none"> <li>• 100 MPa</li> <li>• 300 MPa</li> <li>• 600 MPa</li> </ul>
<b>Salt replacer - KCl</b>	<ul style="list-style-type: none"> <li>• 0.26 %</li> </ul>	<ul style="list-style-type: none"> <li>• 0.2 %</li> </ul>
<b>Salt replacer - Sub4Salt</b>	<ul style="list-style-type: none"> <li>• 1.8 %</li> </ul>	<ul style="list-style-type: none"> <li>• 1.9 %</li> </ul>



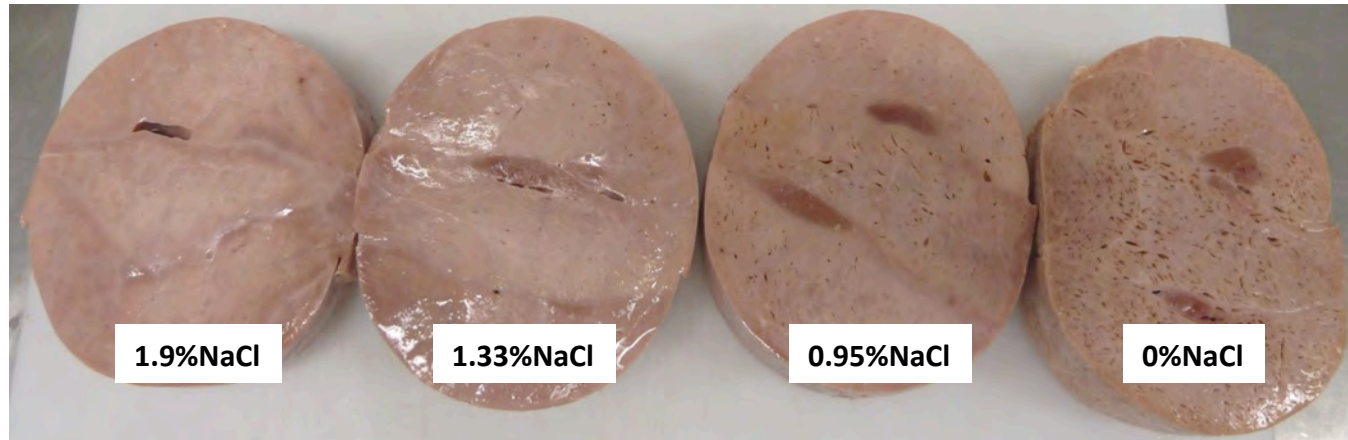
Positive effects on the structure formation and the cooking loss of salt reduced cooked ham

The pressurization reduced the cooking loss by 5 %, in comparison to the non-treated salt reduced sample.



- Cutting force increased by the use of KCl and HPP

- ❑ Salt reduction of 30 % (1.33 % NaCl) is possible for both meat products
  - ❑ Structure of cooked ham is more challenging than cooked sausages



- ❑ Use of HPP improves the structure formation of cooked ham (100 MPa after tumbling)
  - ❑ For cooked sausage the use of HPP is not required
- ❑ Addition of KCl (0.2 %) possible for both meat products

- ❖ Salt content of the cooked ham can be reduced by 30 %; to a salt content of 1.33 %
- ❖ The use of HPP improves the water binding and cooking loss – depending on pressure (low P as 100 MPa) and application time (e.g. after tumbling)
- ❖ More homogenous structure, due to improved swelling of the proteins under HPP
- ❖ The products acceptable in terms of water binding, consistency and appearance
- ❖ But perceived as less salty - no enhancement after HPP
- ❖ Addition of salt replacer (KCl) no effect on colour changes



	Cooked sausage		Cooked ham	
<b>NaCl</b>	1.26 %	1 %	1.33 %	1.1 %
<b>Phosphate</b>	0.25 %	0.25 %	0.25 %	0.25 %
<b>KCl</b>	-	0.26 %	-	0.2 %
<b>Process conditions</b>	-	-	100 MPa after tumbling	100 MPa after tumbling
<b>Final salt reduction</b>	<b>30 %</b>	<b>45 %</b>	<b>30 %</b>	<b>42 %</b>

- Declaration with the claim “reduced in salt” is possible

# Fat reduction in meat products



- 60 % of all reported diseases originate from malnutrition - mainly based on:
  - low vitamin intake,
  - high amount of calories and
  - high consumption of **fat** and sugar



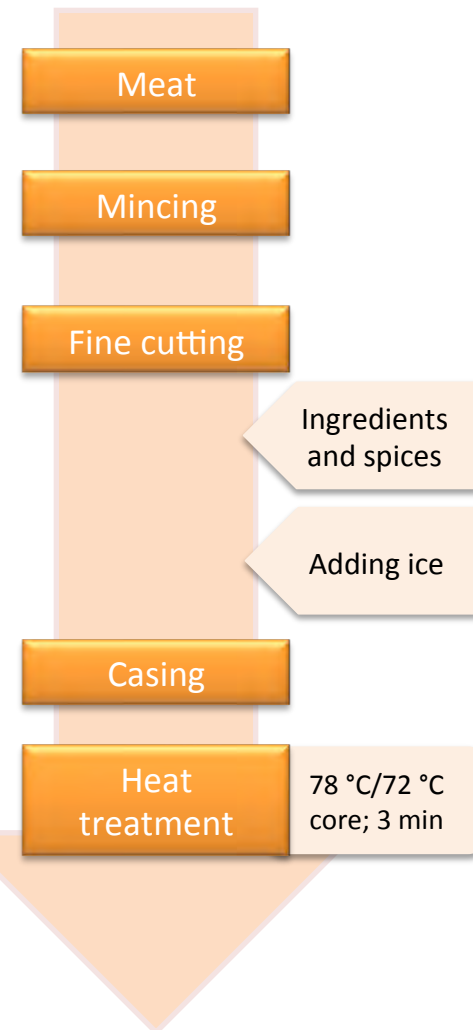
## Aim

- Need to develop new meat products with a healthier fat fraction
- Due to its popularity in Europe, Bologna type sausage chosen
- fat replacement by olive oil – diff. fat content and combinations
- Analysis:
  - water holding capacity, texture, colour and sensory



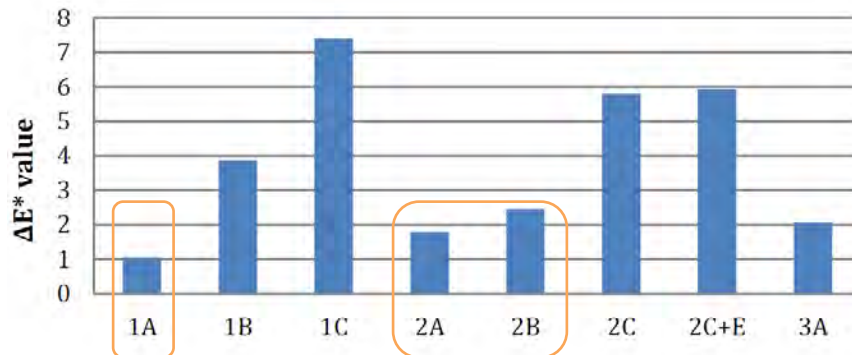
## Formulations and experimental design

Batches	Code	Ingredients					Total Fat (%)	Fat Reduction (%)
		Meat trimmings	Fatty Tissue	Cheeks	Ice	Oil		
		(%)	(%)	(%)	(%)	(%)		
Control	C	50.0	15.0	20.0	15.0	0.0	24.0	0.0
Fat reduction 15 %	1A	56.0	9.0	20.0	15.0	0.0	20.9	15.0
Fat reduction 30 %	1B	62.0	3.0	20.0	15.0	0.0	17.2	30.0
Fat reduction 45 %	1C	65.0	0.0	20.0	15.0	0.0	15.0	45.0
Fat replacement 3 %	2A	52.0	10.0	20.0	15.0	3.0	24.2	0.0
Fat replacement 6.5 %	2B	53.5	5.0	20.0	15.0	6.5	24.3	0.0
Fat replacement 10 %	2C	55.0	0.0	20.0	15.0	10.0	24.4	0.0
Fat replacement 10 % (with emulsifier)	2C+e	55.0	0.0	20.0	15.0	10.0	24.4	0.0
Fat reduction 30 % and replacement 2%	3A	63.0	0.0	20.0	15.0	2.0	17.0	30.0



- The fat content was reduced and replaced by olive oil as a replacer for the animal fat

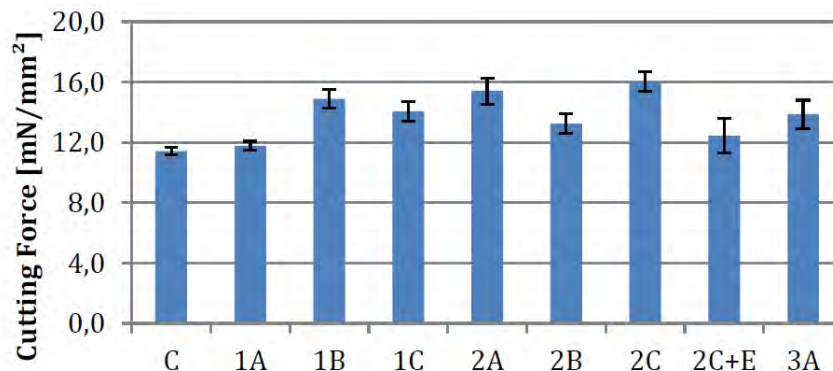
## 1. Colour



The colour is different compared to the control, but acceptable as the difference is partly only visible for a trained eye.

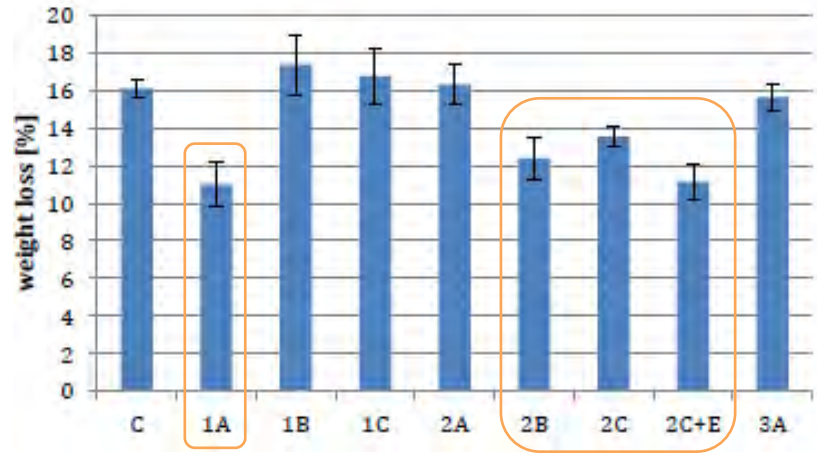
Batches	Code
Control	C
Fat reduction 15 %	1A
Fat reduction 30 %	1B
Fat reduction 45 %	1C
Fat replacement 3 %	2A
Fat replacement 6.5 %	2B
Fat replacement 10 %	2C
Fat replacement 10 % (with emulsifier)	2C+e
Fat reduction 30 % and replacement 2%	3A

## 2. Firmness

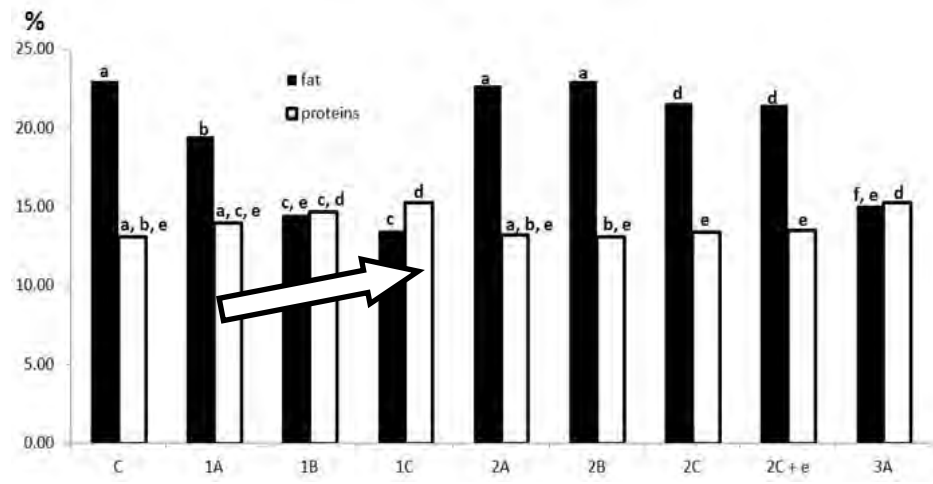


Difficult to conclude clear statements for samples with harder or softer texture.

## 2. Weight loss



## 3. Effect on fat and protein content



Batches	Code	Total Fat (%)	Fat Reduction (%)
Control	C	24.0	0.0
Fat reduction 15 %	1A	20.9	15.0
Fat reduction 30 %	1B	17.2	30.0
Fat reduction 45 %	1C	15.0	45.0
Fat replacement 3 %	2A	24.2	0.0
Fat replacement 6.5 %	2B	24.3	0.0
Fat replacement 10 %	2C	24.4	0.0
Fat replacement 10 % (with emulsifier)	2C+e	24.4	0.0
Fat reduction 30 % and replacement 2%	3A	17.0	30.0

**Fat: different formulations lead to expected differences**

**Protein: comparable results**

## 4. SFA

Batches <sup>a</sup>	Saturated Fatty Acids						Total SFA (g/ 100 g product)
	Lauric	Myristic	Pentadecilic	Palmitic	Margaric	Stearic	
	(g/100 g fat)						
C	0.16	1.61	0.13	23.60	0.32	12.20	8.87
1A	0.16	1.71	0.14	24.30	0.33	12.00	7.62
1B	0.16	1.75	0.19	24.90	0.37	11.80	5.75
1C	0.16	1.72	0.20	24.90	0.38	12.00	5.38
2A	0.14	1.46	0.12	22.60	0.31	10.90	8.17
2B	0.12	1.23	0.11	20.90	0.28	9.61	7.53
2C	<0.10	0.92	0.10	18.80	0.23	7.83	6.17
2C+E	<0.10	0.89	0.11	18.70	0.23	9.70	6.54
3A	0.14	1.48	0.18	22.40	0.32	10.30	5.34

Replacing animal fat by olive oil, the saturated lipid profile improves

## 5. USFA

Batches <sup>a</sup>	Unsaturated Fatty Acids							Total MUFA (g/ 100 g product)	Total PUFA (g/ 100 g product)
	Palmitoleic	Oleic	Linoleic	Eicosenoic	Arachidonic	Erucic	Docosapentanoic		
	(g/100 g fat)								
C	2.77	43.60	11.90	0.86	0.43	0.15	0.11	10.90	3.22
1A	2.92	42.70	12.10	0.81	0.47	0.14	0.12	9.10	2.78
1B	3.08	42.40	11.70	0.78	0.56	0.13	0.13	6.73	2.02
1C	3.02	42.30	11.70	0.77	0.57	0.13	0.13	6.24	1.88
2A	2.63	46.80	11.70	0.76	0.39	0.13	0.10	11.40	0
2B	2.36	51.10	11.10	0.69	0.36	0.10	<0.10	12.50	2.97
2C	2.08	56.50	10.60	0.61	0.33	<0.10	<0.10	12.80	2.63
2C+E	2.00	55.30	10.00	0.59	0.32	<0.10	<0.10	12.50	2.48
3A	2.73	47.50	11.50	0.72	0.52	0.12	0.11	7.72	2.04

Batches	Code
Control	C
Fat reduction 15 %	1A
Fat reduction 30 %	1B
Fat reduction 45 %	1C
Fat replacement 3 %	2A
Fat replacement 6.5 %	2B
Fat replacement 10 %	2C
Fat replacement 10 % (with emulsifier)	2C+e
Fat reduction 30 % and replacement 2%	3A

## 4. Sensory

Batches	Code	Ingredients					Total Fat (%)	Fat Reduction (%)	
		Meat trimmings (%)	Fatty Tissue (%)	Cheeks (%)	Ice (%)	Oil (%)			
		(%)	(%)	(%)	(%)	(%)			
Control	C	50.0	15.0	20.0	15.0	0.0	24.0	0.0	
Fat reduction 15 %	1A	56.0	9.0	20.0	15.0	0.0	20.9	15.0	
Fat reduction 30 %	1B	62.0	3.0	20.0	15.0	0.0	17.2	30.0	
Fat reduction 45 %	1C	65.0	0.0	20.0	15.0	0.0	15.0	45.0	The best
Fat replacement 3 %	2A	52.0	10.0	20.0	15.0	3.0	24.2	0.0	More myoglobin, red colour, better acceptance
Fat replacement 6.5 %	2B	53.5	5.0	20.0	15.0	6.5	24.3	0.0	
Fat replacement 10 %	2C	55.0	0.0	20.0	15.0	10.0	24.4	0.0	The worst
Fat replacement 10 % (with emulsifier)	2C+e	55.0	0.0	20.0	15.0	10.0	24.4	0.0	
Fat reduction 30 % and replacement 2%	3A	63.0	0.0	20.0	15.0	2.0	17.0	30.0	

Panel able to differentiate:

- control from 1C and 2B (1C better than control and 2B)
- 2C lower appreciation – replacement above 6.5% can impair sensory

- ❖ Fat **reduction** and **replacement** by olive oil **are alternatives** to develop healthier meat products.
- ❖ Sausage with **45% fat reduction** (1C) had the lower caloric content (good sensory acceptance) and the cooked sausage having **10 % of olive oil** (replacing fatty tissue) (2C) (lower sensory appreciation) had the **best lipid profile**.
- ❖ The sausage with **45% of fat reduction** (1C) was considered as **the best for the panellists** according to the **appearance, texture, flavour and smell**.
- ❖ Cooked sausages Bologna type having **6.5 % of added olive oil** (2B) as well as the combination of **30% of fat reduction with the addition of 2 % olive oil** (3A) showed good lipid profiles and acceptability by the consumer and thus represent **realistic strategies to improve the lipid fraction** of cooked sausage.
- ❖ **Fat reduction (up to 45 %)** might be applied to cooked sausage Bologna type **without compromising sensorial** acceptability.

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		Meat trimmings (%)	Fatty Tissue (%)	Cheeks (%)	Ice (%)	Oil (%)		
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Fat reduction 30 % and replacement 2 %	3A	63.0	0.0	20.0	15.0	2.0	17.0	30.0

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