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Véronique Santé-Lhoutellier

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➤ Levers to reconcile cured meat products with health concerns and culinary heritage

Dr Véronique Santé-Lhoutellier

INRAE Quality of Animal Products, Saint Genès Champanelle

veronique.sante-lhoutellier@inrae.fr

Definition of the concept of cultural heritage: is the result of complex historical processes and is constantly evolving

Culinary heritage in line

But issues facing there meat sector : environmental, health, ...



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> Outline

Cured meat history and why processing

European regulation – different types of tradition frame

Health issue : salt intake / nitrites (additives)

Levers to overcome :

genetic/farming

processing

plant based alternatives to chemical additives



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➤ Cured meat history and processing



➤ Cured meat history

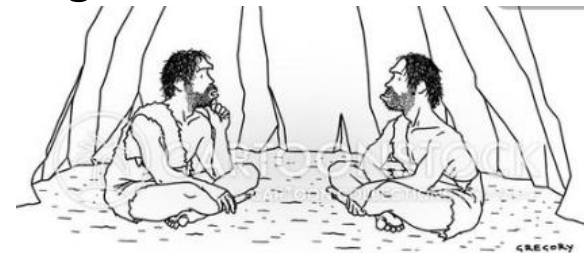
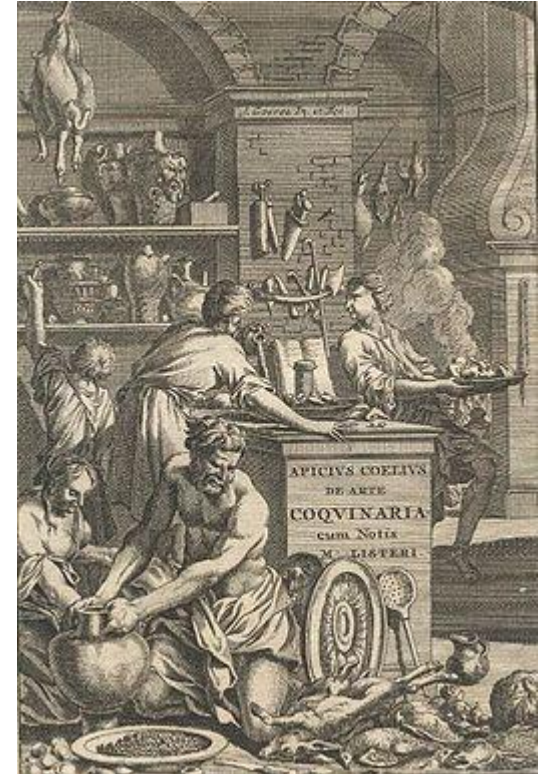
Apicius (25 BC- 37): chef, writer and poet

The 'Art Culinaire' collection is an invaluable historical record of recipes and techniques used to preserve food.

Food preservation: from paleolithic (stone age), man practised drying and smoking, salting and cold preservation in cold region and probably also fermentation

➔ One common objective to delay the inevitable deterioration, to preserve at least sanitary quality **by removing water**

Art culinaire



"Something's just not right—our air is clean, our water is pure, we all get plenty of exercise, everything we eat is organic and free-range, and yet nobody lives past thirty."

➤ Food preservation: removing water

Drying products by smoking:



Smoke generated by combustion or pyrolyse
Volatile compounds -> aroma, coloration, bacterial inhibition
Incomplete combustion : CO
PAH formation

Boucané: America, Carribean, Guyana, Reunion Island
Africa countries

➤ Food preservation: removing water

Drying products by salting: 2 iconic products

Role of salt:

dehydration by water migration - a_w

increase the palatability of foods by intensifying the perception of flavours.

Na^+ ions stimulate the taste buds, while Cl^- ions impart a salty taste.



Dry cured ham processing

1. Green ham trimmed and weighted
2. Salting $0-4^\circ\text{C}$ with NaNO_2 (0.150 g/kg), KNO_3 (0.150 g/kg) and ascorbate (0.500 g/kg) 0.7-1d/kg
3. Salt excess removal
4. Resting ~ 2 months $4-5^\circ\text{C}$
5. Drying with temperature increasing up to $12-15^\circ\text{C}$ - $> \text{rh } 60-70\%$
6. Ageing for months (specifications) weight loss 35%

burying hams in jars

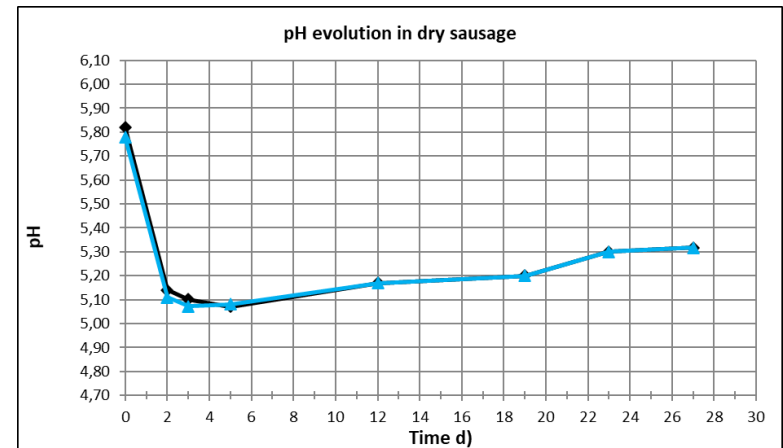
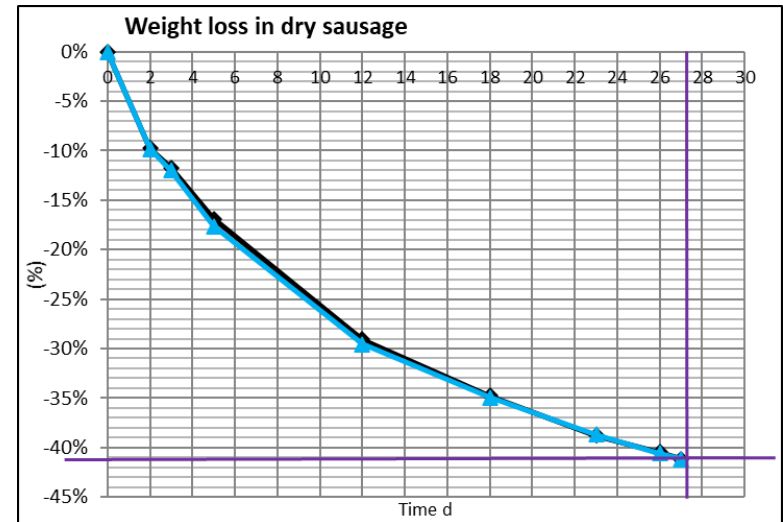


➤ Food preservation: removing water

Drying products by salting and fermentation (acidification)



- 2/3 ground meat and 1/3 back fat
- Spices, sugar, nitrate, salt, ...
- LAB + *S xylosus*, *S carnosus*
- Stuffing with natural gut



➤ Cooked and cured meat products

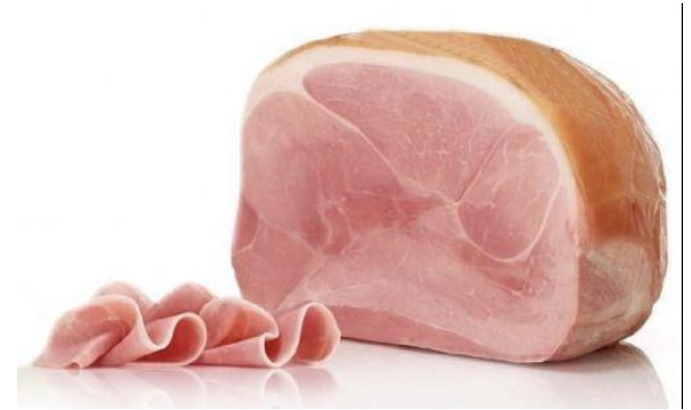
To keep water: water retention capacity

Salt brine injection

Superior quality

Additives: Nitrites, ascorbic acid

EU 150ppm, France 120 ppm



Phosphates in standard ham (<1% in France)

➤ EU quality schemes

‘Traditional foods are indicated as natural, healthy, environmentally friendly and as offering an indissoluble union between taste and cultural value, which consumers always search for’

European Commission, 2007

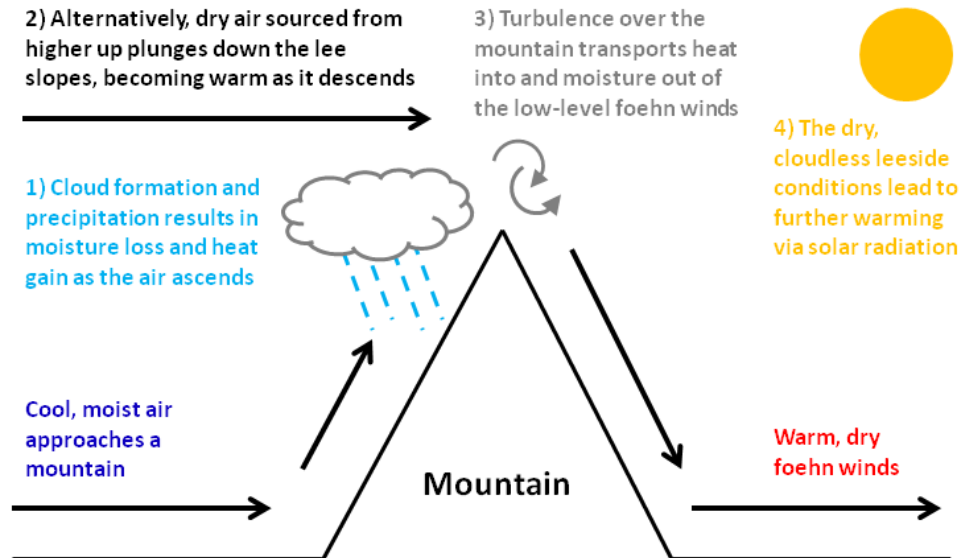
➤ Know-how geographically anchored

Why a local tradition?

Meat drying (including smoking & salting) requires specific climatic condition -> geographically anchored as a local tradition






Foehn wind



➤ Map of regional cured meat products

These features and the associated know-how are registered on a European platform

<https://ec.europa.eu/info/food-farming-fisheries/food-safety-and-quality/certification/quality-labels/geographical-indications-register/>

EU Quality Schemes	Label
“Protected Designation of Origin” (PDO)	
“Protected Geographical Indication” (PGI)	
“Traditional Specialty Guaranteed” (TSG)	

➤ EU quality schemes

definitions

Protected Designation of Origin - PDO refers to a typical product in which **all stages** of production, manufacture and processing take place in the defined geographical area, and whose typicality is based on the terroir (interactions between the geographical, physical and biological environment and human factors).



Protected Geographical Indication - PGI refers to a typical product of which at least **one stage** in the production, manufacture and processing takes place in the defined geographical area, giving it a recognisable quality, reputation or other characteristic.



Traditional Speciality Guaranteed - TSG refers to a traditional product, based on a traditional composition, manufacturing or processing method.



➤ Traditional cured meat products in Southern Europe



➤ PDO diversity

Lapin Poron kuivaliha – Finland



Istarski pršut – Slovenia Croatia



Prosciutto di Parma



Capocollo di Calabria



Jamon de Teruel



> PGI

Kiełbasa lisiecka – Poland



Greußener Salami – Germany



Timoleague Brown Pudding - Ireland



Saucisse de Lacaune



Jambon de Bayonne



Mortadella Bologna



➤ Traditional Speciality Guaranteed - TSG

Jamon Serrano, TSG since 1998, an emblematic example



Compliance with the quality standard of the Consorcio del Jamón Serrano Español.

The production process of Serrano ham takes place exclusively in Spain.

European TSG (Traditional Speciality Guaranteed) certification, which protects the “Jamón Serrano” designation.



➤ Comparison of 3 dry cured hams

Prosciutto di Parma PDO, Jambon de Bayonne PGI, Jamon Serrano TSG



Step	Criteria	PDO	PGI	TSG
Animal	Genetic and breed	Green	Grey	Grey
	gender	Green	Green	Grey
	Origin	Green	Green	Grey
Rearing	Feed	Green	Green	Grey
	Type of feeding	Green	Grey	Grey
Slaughter	Animal Transportation	Green	Grey	Green
	Slaughter	Grey	Green	Green
	Carcass properties	Green	Green	Grey
Processing	Geographical area	Green	Green	Grey
	Fresh meat properties	Green	Green	Green
	additives	Green	Green	Green
	Processing characteristics	Green	Green	Green
Packaging	Characteristics of final product	Green	Green	Green

Legend

	Criterion mandatory filled
	Criterion non filled



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Prache et al 2022

p. 18

➤ Comparison of 3 dry cured hams

Prosciutto di Parma PDO, Jambon de Bayonne PGI, Jamon Serrano TSG



Step	Criteria	PDO	PGI	TSG
Animal	Genetic and breed	filled	not filled	not filled
	gender	filled	filled	not filled
	Origin	filled	filled	not filled
Rearing	Feed	filled	filled	not filled
	Type of feeding	filled	not filled	not filled
Slaughter	Animal Transportation	filled	not filled	filled
	Slaughter	not filled	filled	filled
	Carcass properties	filled	filled	not filled
Processing	Geographical area	filled	filled	not filled
	Fresh meat properties	filled	filled	filled
	additives	filled	filled	filled
	Processing characteristics	filled	filled	filled
Packaging	Characteristics of final product	filled	filled	filled

9 months old

Umbria Tuscany
Venetia

Parmesan whey

Only sea salt

>12 months maturation



NO₂

NO₂

Producers poke the ham in five specific places to determine its quality. Hams that pass the quality test are branded with the word PARMA in a five-point crown.



10 M Parma Ham
800 M€



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Legend

	Criterion mandatory filled
	Criterion non filled

Prache et al 2022

p. 19

➤ A regulatory framework

to enlighten consumers

- the importance of product diversification and the need to support ‘the rural economy in less favoured or remote areas’ by ‘improving income of farmers
- a need to buttress consumer protection in the European market by saying increasing demand for ‘greater emphasis on quality and information as regards to the nature, method of production and processing of foodstuffs
- compliance with specifications

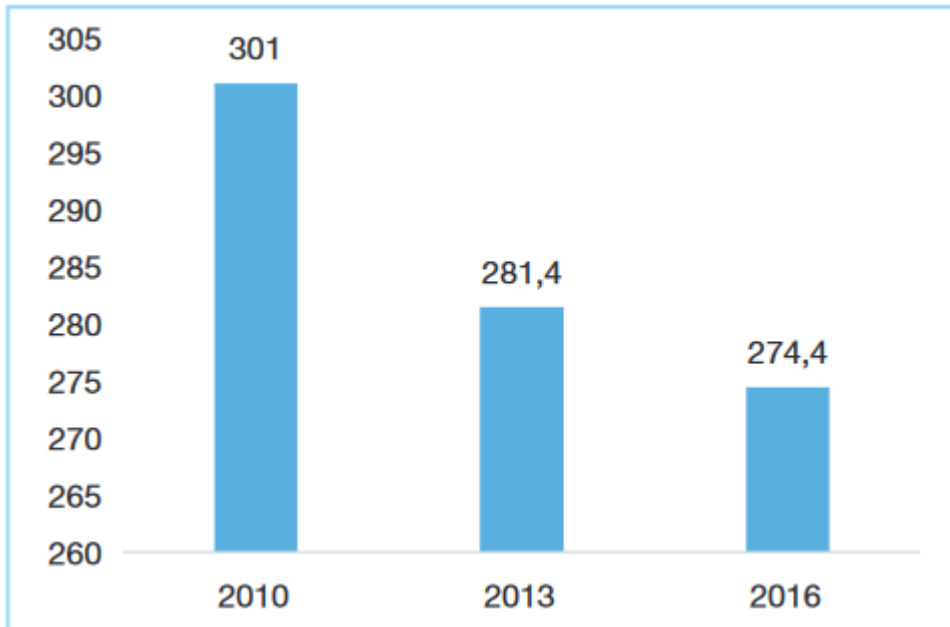


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- Cured meat consumption and health issues

➤ Processed meat consumption

In France



average quantity of processed meat consumed/week

O'Donnell et al 2015: consider a range of 3 to 5 g/d of sodium to be optimal for cardiovascular health.



- 63% of adults are above the recommendation: 150g/w
- 90% of adults are above the recommendation of WHO 5g NaCl/d
- Prevalence of high blood pressure in France ~33%



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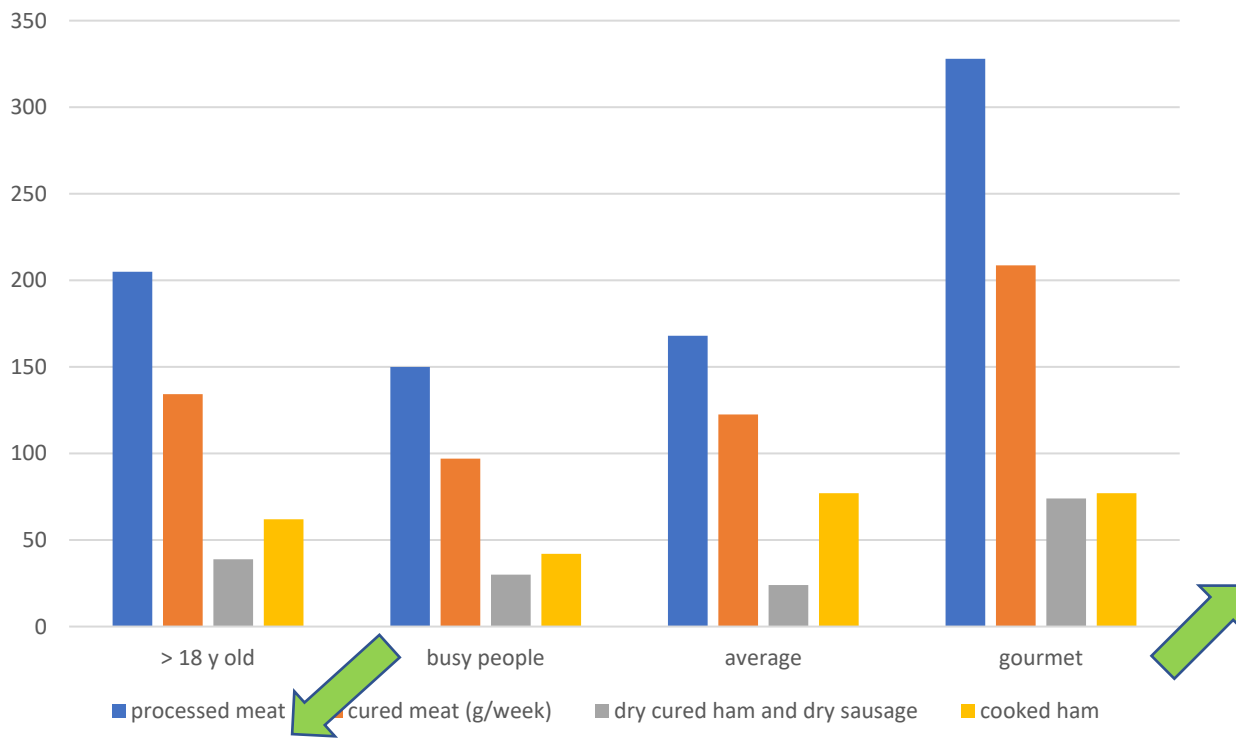
O'Donnell 2015, Hebel 2019

p. 22

➤ Processed meat consumption

Typology of people

Processed meat products consumption in France (g/week)



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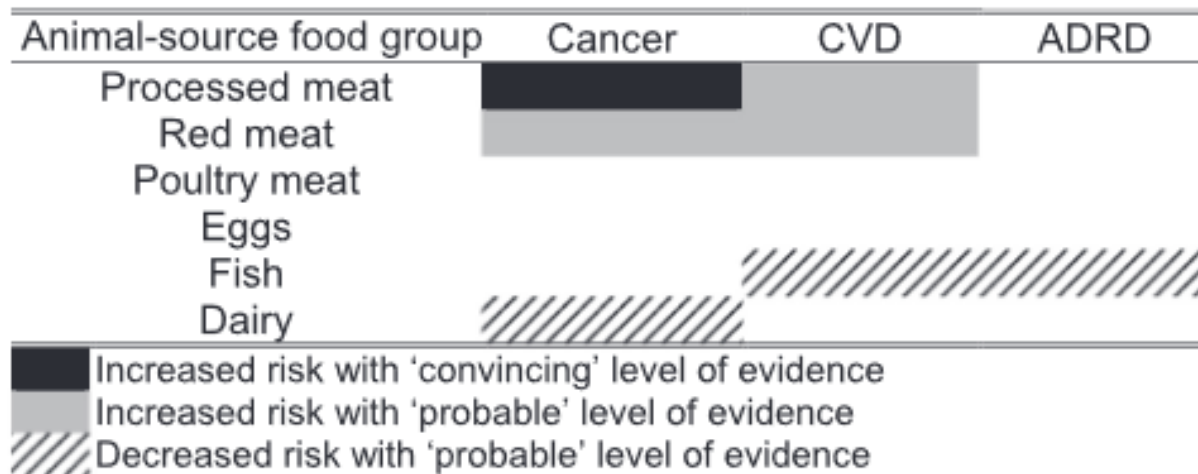
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Hebel 2019

➤ Associations between consumption of animal products and chronic diseases

Level of evidence



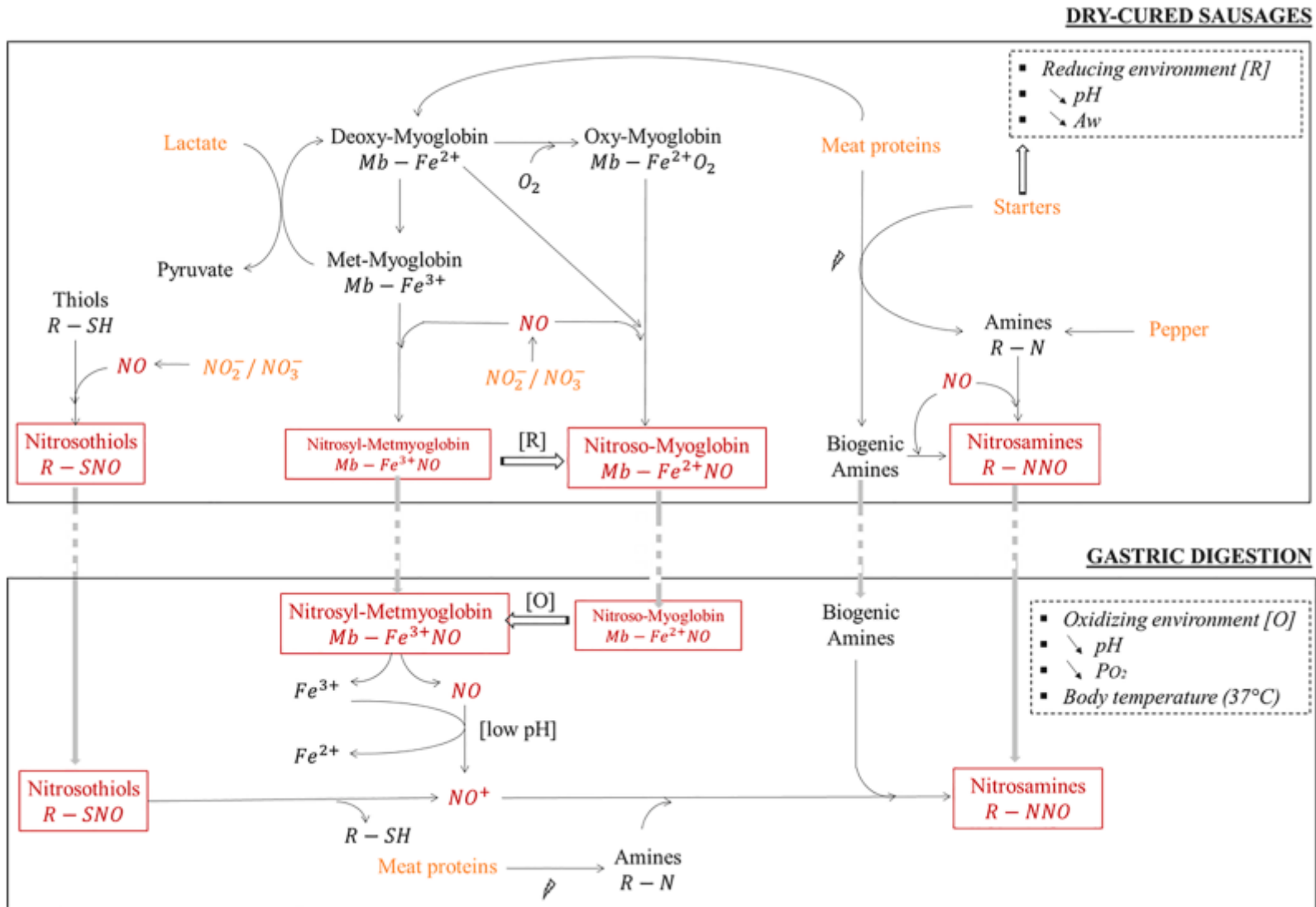
Role of salt, fat and additives ?

Any place for innovation for healthier products

<https://agriculture.gouv.fr/nitrites-nitrates-le-gouvernement-definit-une-trajectoire-ambitieuse-de-reduction-des-additifs>



➤ Nitrites chemistry



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➤ Which are the possible levers?

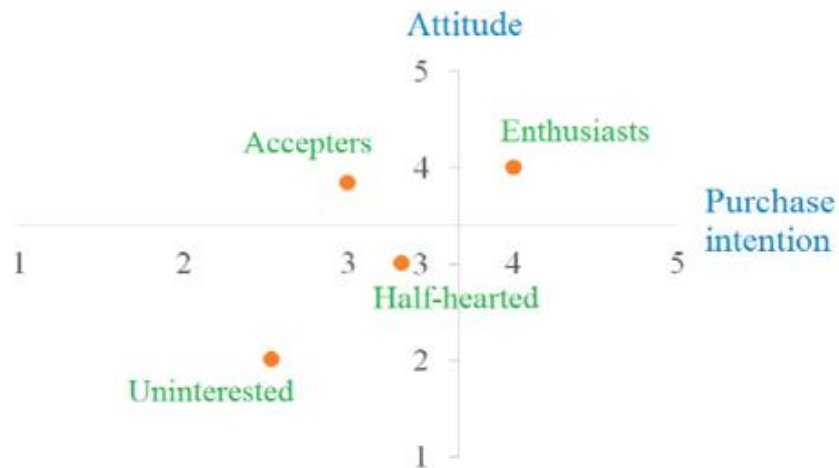


> what the consumer says

Reducing nitrites addition during processing

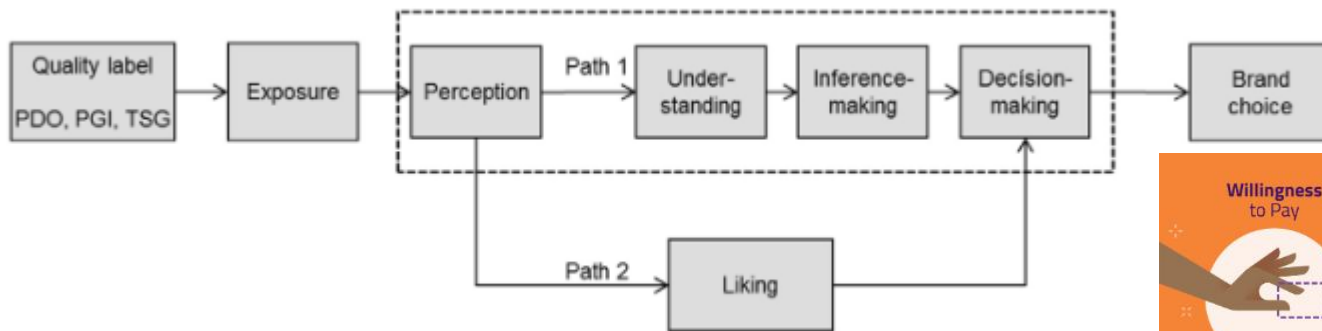
On line questionnaire : Belgium, The Netherlands, Italy and Germany (n = 2057)

- Cooked ham & dry cured ham: most consumed
- Consumer knowledge about nitrite and processed meat products is limited.
- The concept of processed meat products with natural compounds and a reduced level of nitrite is favoured
- Four market segments identified based on attitude and purchase intention.



Targeted communication strategies for each segment

➤ Consumer and quality certification



Traditional Cinta Senese dry fermented sausage 30 ppm NO₂ - T
 Innovative : natural antioxidant mixture (grape seed/olive pomace) IT



Perceived acceptability (blind) / expected acceptability (informed)



Same scoring for T and IT



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> Farming / genetic leverage

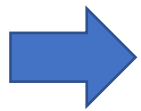
The production of PDO dry-cured ham is the most important product in the Italian pig breeding industry with remarkable economic benefits for producers

Parma & San Daniele > one billion € per year

Specification : to produce heavy pig carcasses with the requested intrinsic characteristics - right weight and maturity for PDO markets

breeding programs able to produce animals remains pivotal

2 traits : untrimmed & trimmed ham weight UTW and TTW



Identification of QTL signals on several chromosomes, with a high heritability and genetic correlation

249 unique candidate genes including CSF1, NDRG4, TDP1, CALM1, and EFCAB11 genes, already described as candidate genes for ham weight traits in pigs

➤ Farming / genetic leverage

Reducing salt in dry cured ham



Polymorphisms of 2 genes calpastatin - meat tenderization- & PRKAG3 - protein kinase AMP-activated (ultimate pH)

CAST *Arg249Lys* & CAST *Ser638Arg* –and PRKAG3 *Ile199Val*

Spanish dry-cured ham Jamón Serrano

PRKAG3 *Ile/Ile* genotype, CAST249 *Arg/Arg* genotype, CAST638 *Arg/Arg* genotype -> the most favourable for the production of ham

French Jambon de Bayonne:

PRKAG3 *Ile/Val* and CAST 249*Lys*/638*Arg* presented the highest scores for sensory and processing properties, whatever the salt content (-20%)



➤ Salt reduction

Portuguese dry sausages

Reduction of salt content from 6% to 3%

Catalão	3% NaCl	6% NaCl
Aroma / flavour intensity	no difference	
Salt perception	54	65
Colour intensity	no difference	
Overall appreciation	no difference	

Catalão



➡ Food safety criteria to estimate life span

Italian dry cured ham

30% reduction of salt content

Similar acceptance of the products : while consumer scored less saltiness and hardness



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Laranjo et al 2013; Schivazappa & Virgili 2020)

➤ Alternatives to NaCl

Partial replacement of sodium by potassium, calcium, magnesium
> modification of sensory properties, bitterness

Basic amino acids including L- lysine (L-Lys), L-histidine (L-His) and L-arginine (L-Arg) -> for cooked products

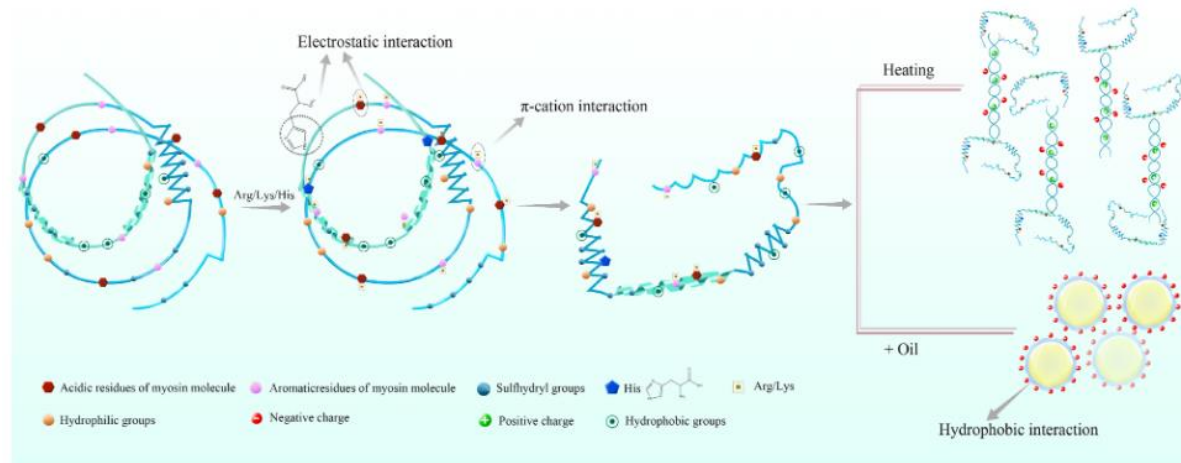
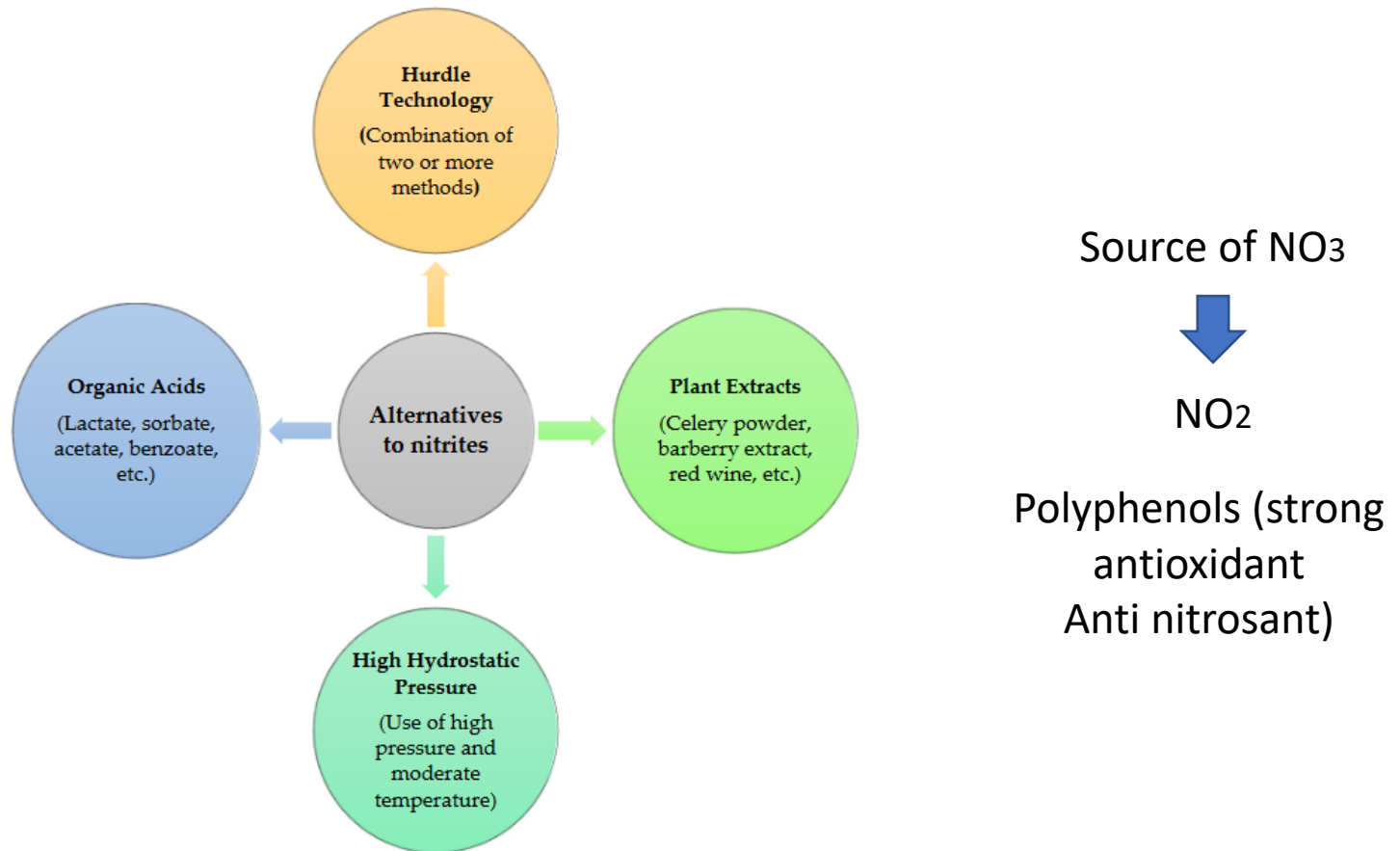


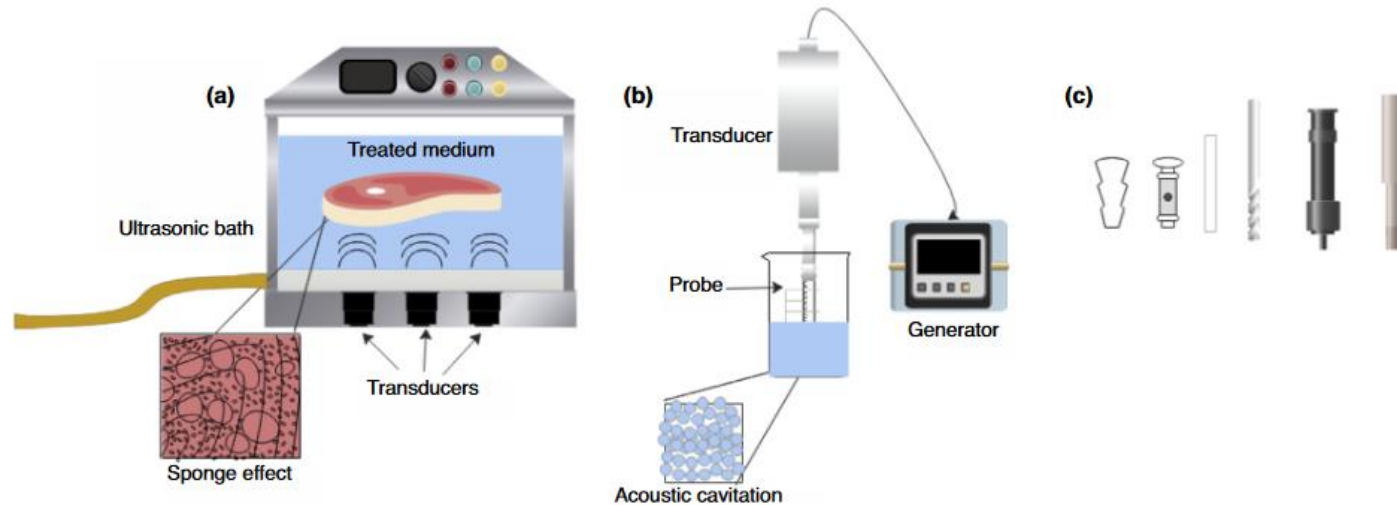
Fig. 2. A tentative mechanism of L-His/L-Lys/L-Arg acting on the myosin.

➤ Plant-based alternatives to nitrites



➤ New processing

Ultra sounds are vibrational energy



Generally, intensity ultrasound ($<1 \text{ W/cm}^2$), corresponding to a frequency range 20-100 kHz

- Ultrasound increases permeability of muscle tissue, getting greater migration of the salt and improves its stability in the meat product.
- The combination of ultrasound and heat treatments produces a disruption of the meat fibers, which facilitates the mobility and distribution of salt in the tissue
- Lipid oxidation??



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➤ Conclusion



➤ To reconcile cured meat products with health concerns and culinary heritage ?

- **Food labels** indicating quality provide a product with **legal protection** against imitation throughout the market and eliminate the misleading of consumers by non-genuine products, which may be of inferior quality.
- These labels **help producers** obtain a premium price for their authentic products, and should provide consumers with clearer information about product characteristics and facilitate the identification of food products of certified quality.
- Labels are a guarantee of quality and of traditions to which consumers are very attached. The people of **southern European countries** appear to give the most priority to the pleasure aspect of their food and to labels of “quality”, and the least to health issues...
- **Subtle touches of innovation** are possible: pig genetics, processing and reduction in salt content and alternatives to nitrites, as far as the product is still recognized!
- However, if there is innovation, the **potential pitfall** regarding its acceptance relates above all to consumers

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➤ Thank you for your attention

