Bridging environmental sustainability and intrinsic quality traits of pork

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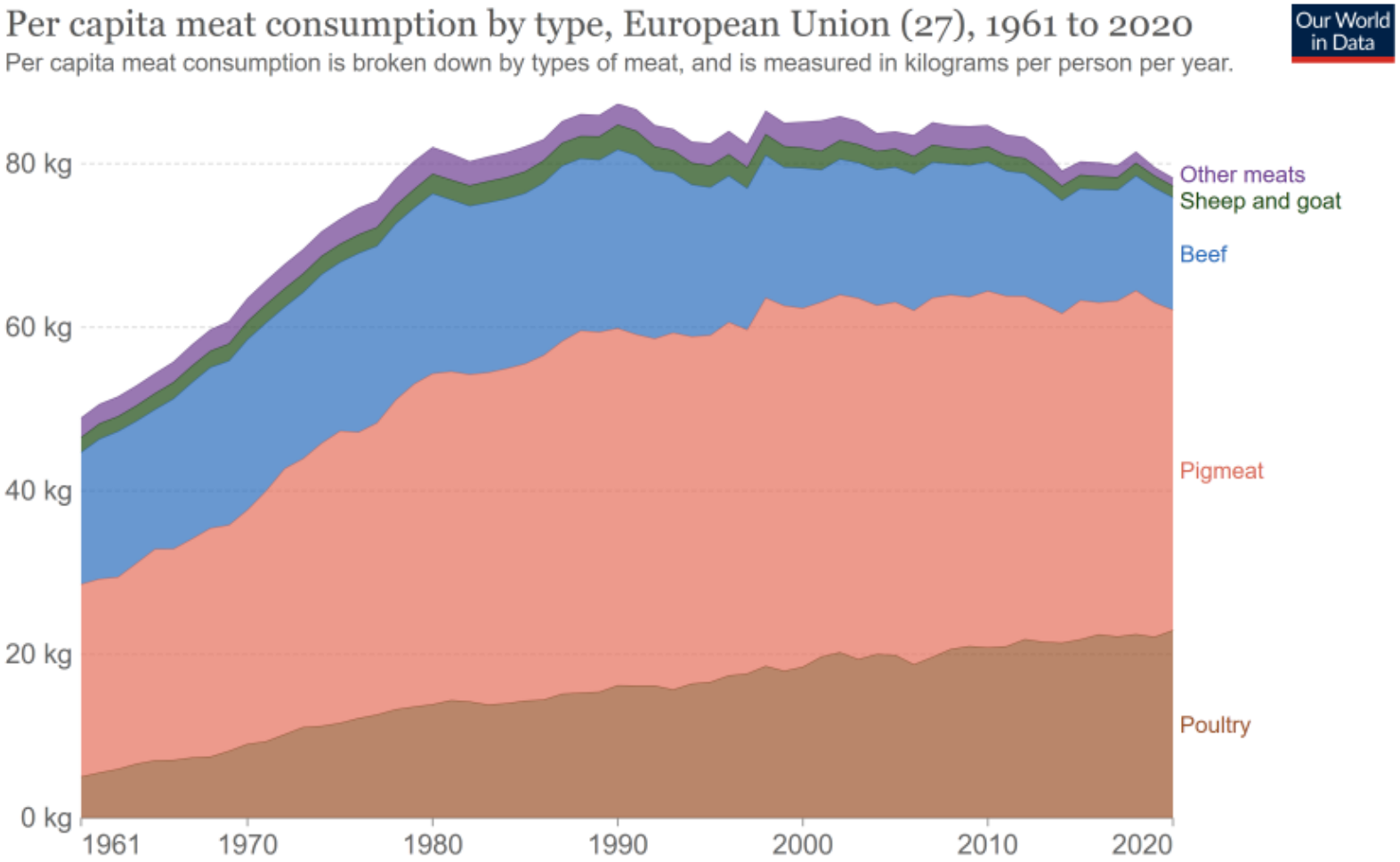
Meat consumption – Emphasis on pork (EU27)



Pigmeat is a world's most popular meat

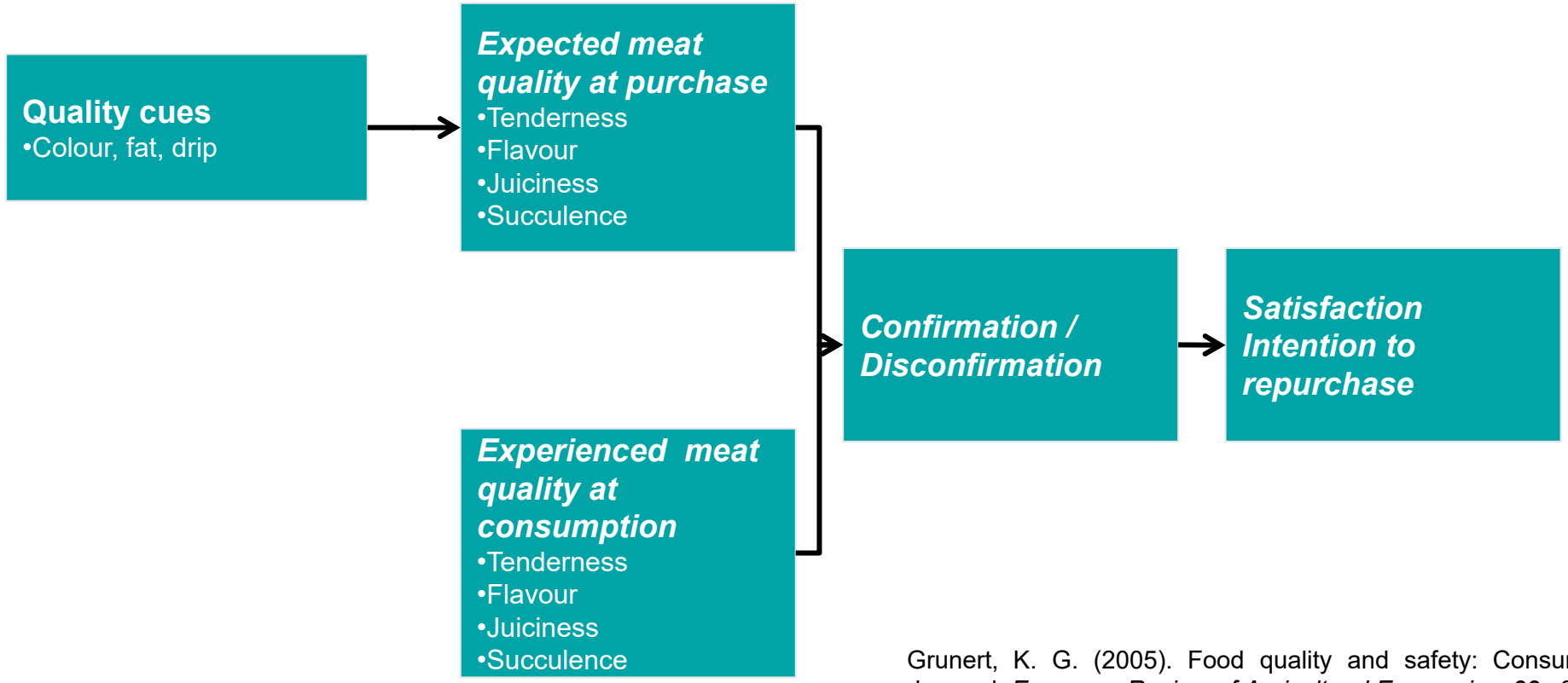
2020
in kilograms per year per capita

Other meats	0.99 kg
Sheep and goat	1.42 kg
Beef	13.73 kg
Pigmeat	39.20 kg
Poultry	22.92 kg
Total	78.26 kg

France

Other meats	1.14 kg
Sheep and goat	2.44 kg
Beef	21.02 kg
Pigmeat	31.35 kg
Poultry	23.25 kg
Total	79.20 kg

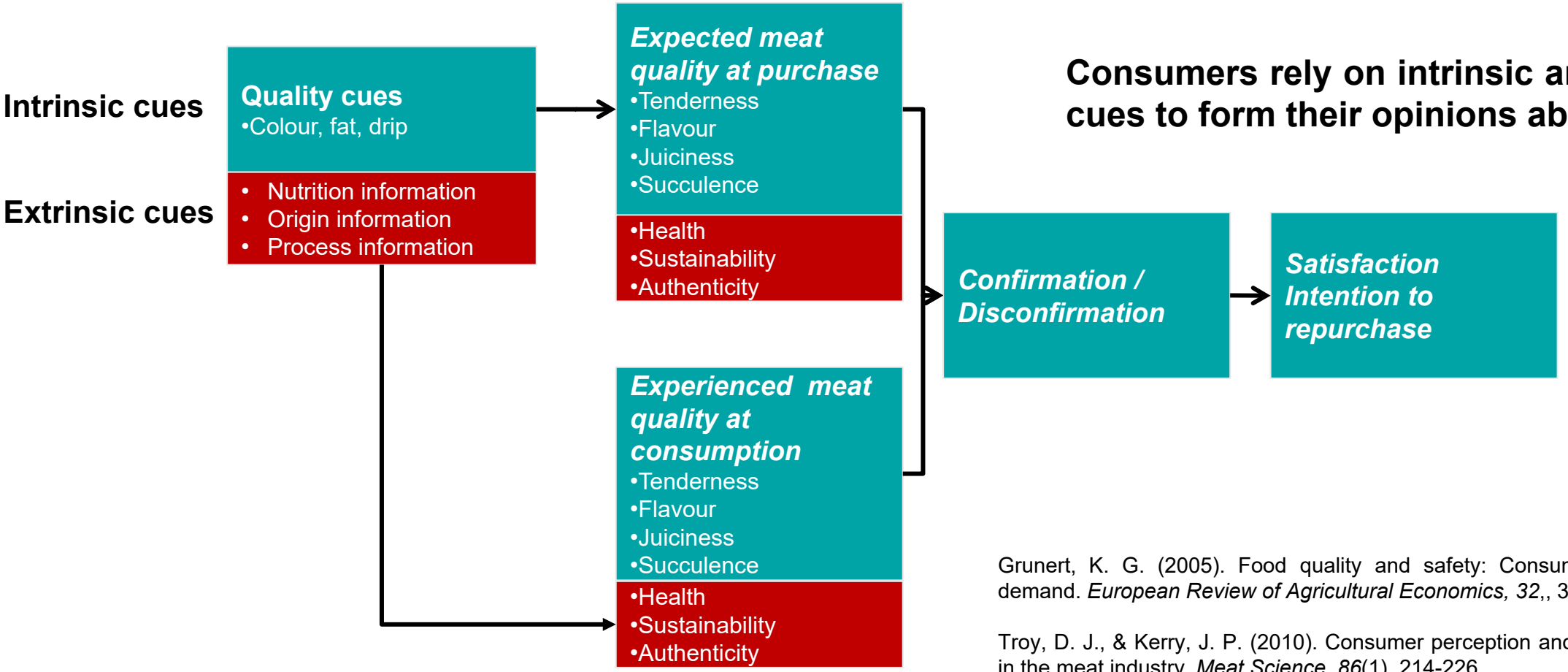
Satisfaction: the classical approach



Grunert, K. G. (2005). Food quality and safety: Consumer perception and demand. *European Review of Agricultural Economics, 32*,, 369-391.

Troy, D. J., & Kerry, J. P. (2010). Consumer perception and the role of science in the meat industry. *Meat Science*, *86*(1), 214-226.

Satisfaction: the extended approach

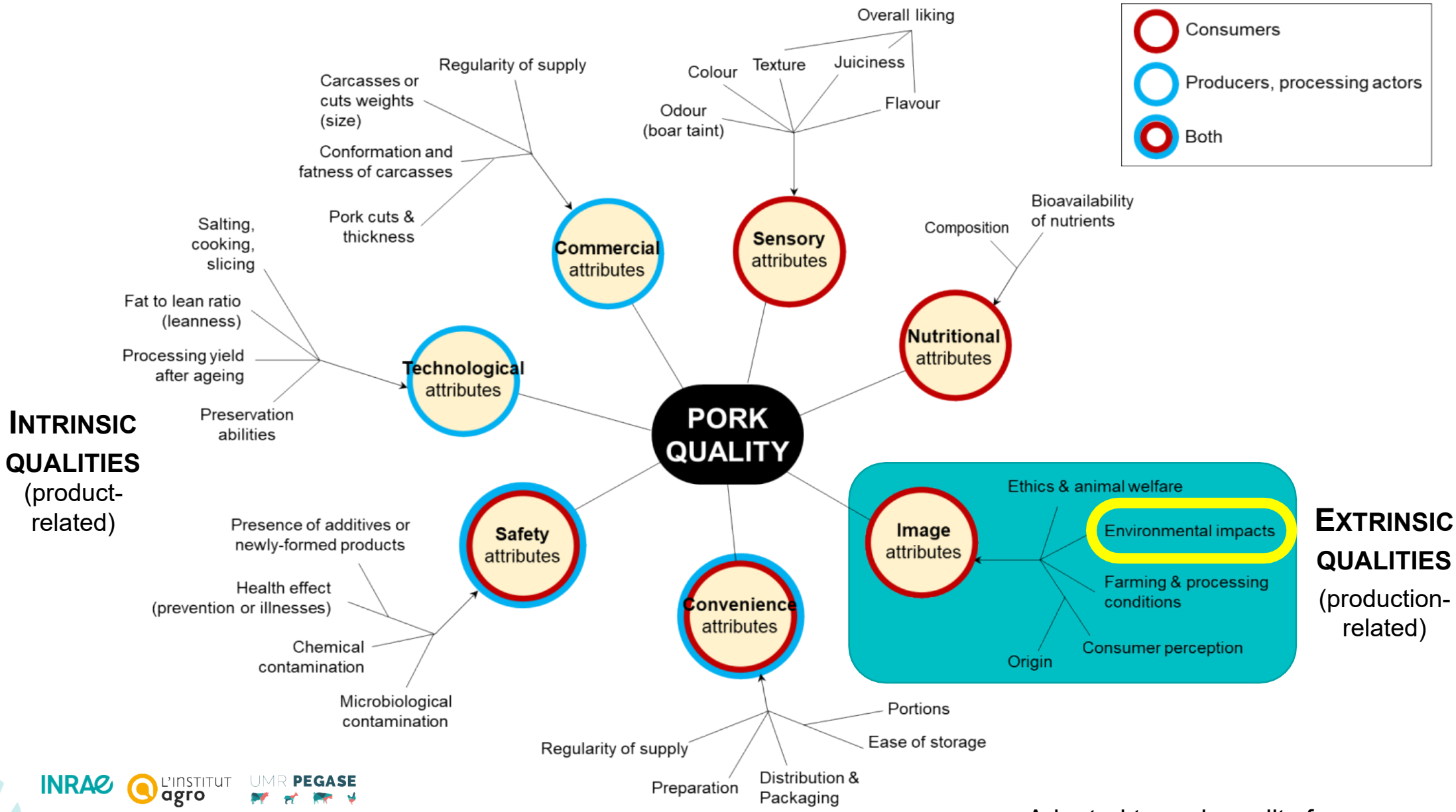


Consumers rely on intrinsic and extrinsic cues to form their opinions about pork

Grunert, K. G. (2005). Food quality and safety: Consumer perception and demand. *European Review of Agricultural Economics, 32*,, 369-391.

Troy, D. J., & Kerry, J. P. (2010). Consumer perception and the role of science in the meat industry. *Meat Science*, *86*(1), 214-226.

7 properties of meat (pork) quality: *Interplay between intrinsic & extrinsic cues*



Adapted to pork quality from Prache *et al.* (2022). *Animal* **16**, 100376

Environmental sustainability of pork production

- For pig production, most **environmental impacts arise from feed production** (Zira *et al.* 2021; McAuliffe *et al.* 2016; Silva *et al.* 2023).

Feed production for pigs is usually identified as the main contributor to the impact of GWP by LCA

Global Warming Potential

- **"PRODUCING BETTER TO EAT BETTER PORK"** could be a **lofty goal to guide meat consumption towards sustainability rather than claims**

ELSEVIER

Environmental Impact Assessment Review
Volume 56, January 2016, Pages 12-22

Review article

A thematic review of life cycle assessment (LCA) applied to pig production

Graham A. McAuliffe [a b], Deborah V. Chapman [b], Colin L. Sage [a]

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ELSEVIER

Livestock Science
Available online 23 August 2023, 105320
In Press, Journal Pre-proof What's this?

DIFFERENT LIFE CYCLE ASSESSMENT METHODS AND CAUSES OF VARIATION IN ESTIMATES OF GLOBAL WARMING IN CHICKEN AND PORK PRODUCTION SYSTEMS: A CRITICAL SYSTEMATIC REVIEW

Jéssica Pereira Silva, Carlo Juliantro Giehl, Kátia Maria Cardinal, Ines Andretta, Andréa Machado Leal Ribeiro

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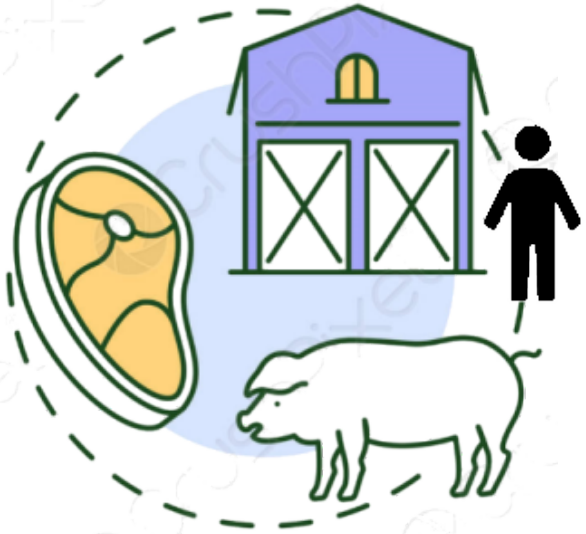
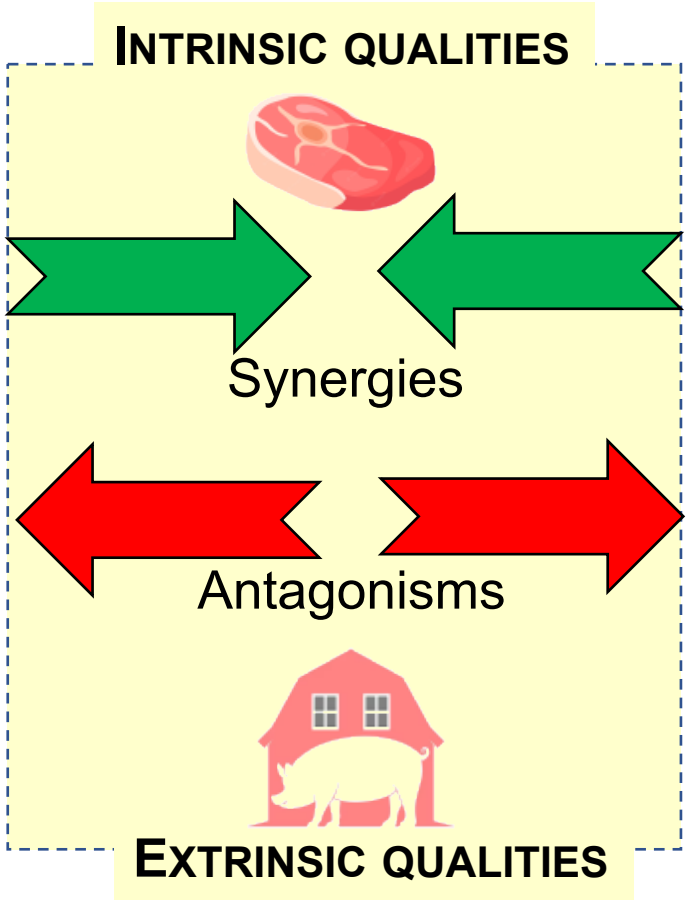
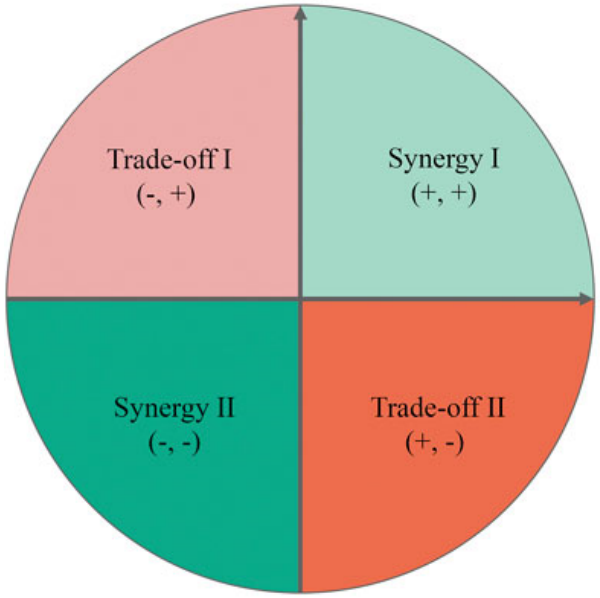
Overall scientific goal: Integrative approach of pork quality evaluation



Simultaneous integration of the intrinsic and extrinsic qualities of pork meat





Identify/understand the **trade-offs** to propose (sustainable) farming strategies for joint **improvement of multiple dimensions of pork quality**

Objectives

Integrating environmental footprints with intrinsic pork qualities

➔ ***DATA REUSE*** *of a farm-to-fork experiment designed to improve both intrinsic and extrinsic quality dimensions of pork*

ELSEVIER

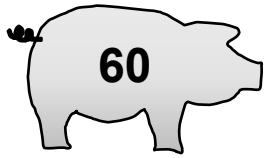
Meat Science

Volume 197, March 2023, 109074

Combining pig genetic and feeding strategies improves the sensory, nutritional and technological quality of pork in the context of relocation of feed resources

Bénédicte Lebret, Sihem Lhuisset, Etienne Labussière, Isabelle Louveau

Animal experiment to simultaneously evaluate the intrinsic & extrinsic qualities of pork



Females
(Large White x Landrace) X boars

4 experimental groups (n=15/group)

2 genotypes
2 feeding regimen

Duroc *ROC+* **DR**	Duroc *Control* **DC**	Pietrain NN *ROC+* **PR**	Pietrain NN *Control* **PC**

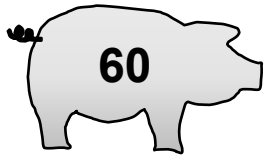
- ✓ **Duroc (D):** selected on growth, feed intake and intramuscular fat content
- ✓ **Pietrain NN (P):** selected on growth feed efficiency, body composition & technological pork quality

Feeding: **#origin** (France *versus* imported) and **#nature of protein & fat resources** / same proportion of cereals (wheat, maize, barley, wheat bran)

- ✓ **ROC+ (R)** : extruded faba bean (national origin) and linseed (as omega-3 fatty acid sources) + vit E ➔ **relocation of protein resources & improvement of pork nutritional value/profile**
- ✓ **Control (C)** : oilseed meal (imported soybean, rapeseed, shelled sunflower)

Lebret et al. (2023). *Meat Science*, 197, 109074

Animal experiment to simultaneously evaluate the intrinsic & extrinsic qualities of pork



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Duroc *ROC+* **DR**	Duroc *Control* **DC**	Pietrain NN *ROC+* **PR**	Pietrain NN *Control* **PC**

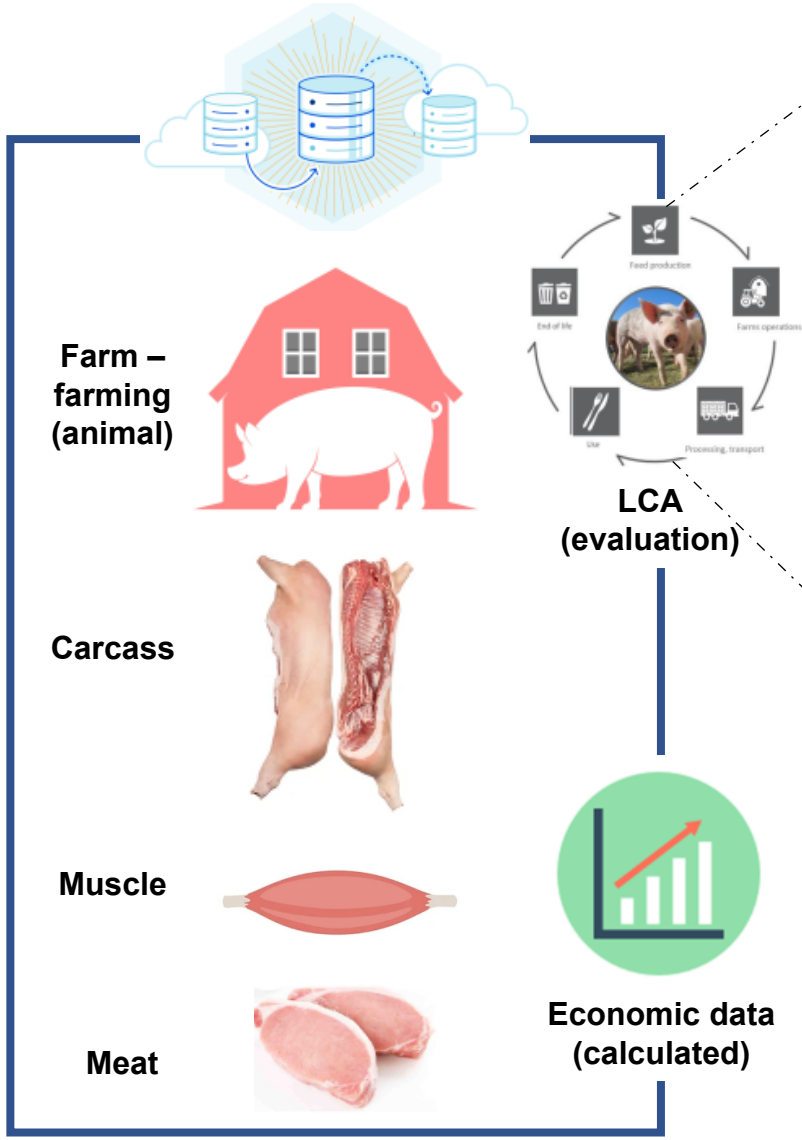
- ✓ **30 (33.6) -> 116 kg live weight**
- ✓ Individual pen
- ✓ *Ad libitum* feeding
- ✓ DLys/NE adjusted weekly on average requirements of each group: blend of high and low protein diets within C & R
  - ✓ DR & DC : from 1.0 to 0.70
  - ✓ PR & PC: from 0.95 to 0.68

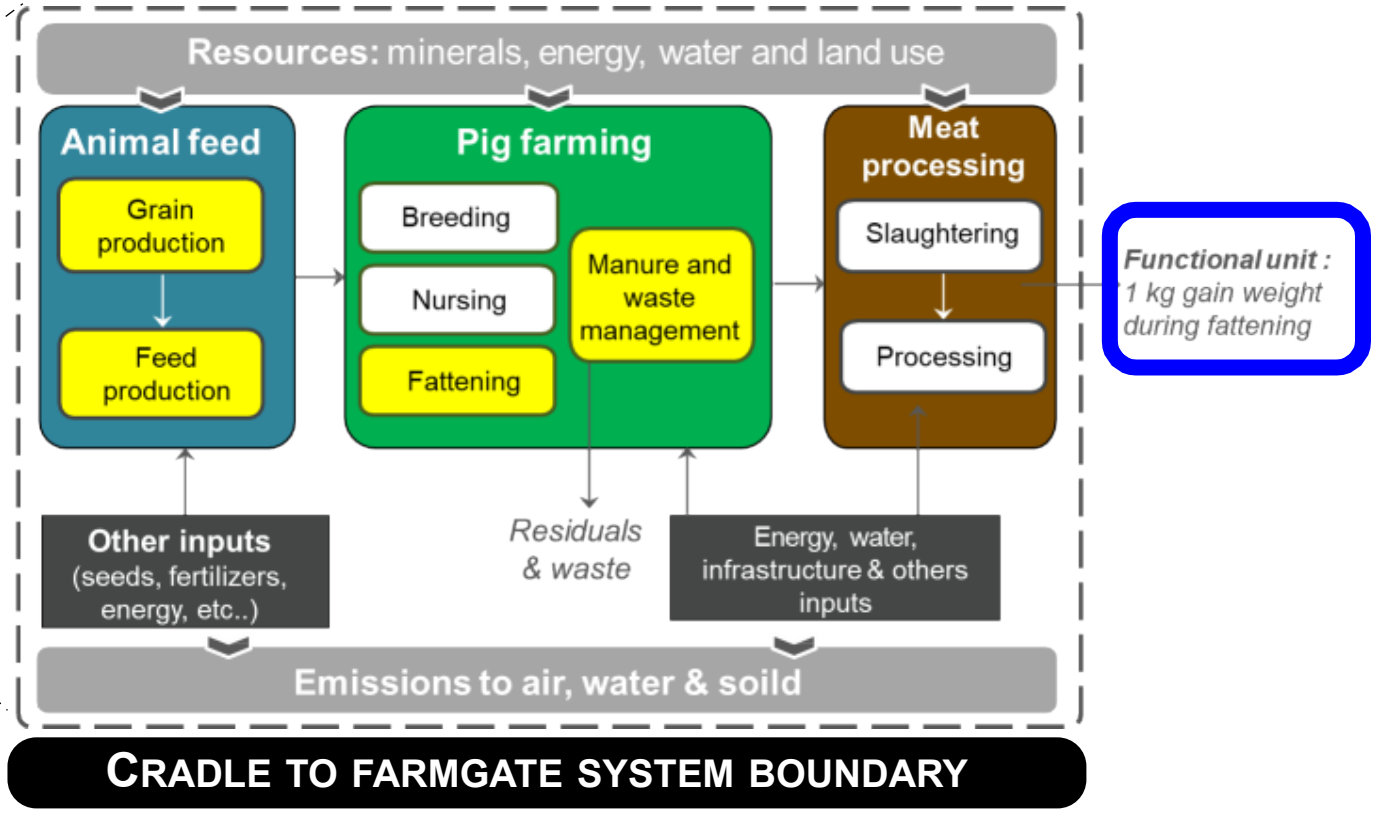
Data

- ➢ Individual growth performance
- ➢ Carcass composition
- ➢ Meat quality traits
- ➢ Chemical composition and fatty acids profile
- ➢ Sensory quality
- ➢ Economic indicators
- ➢ **Quantification of inputs and outputs: life cycle inventory (LCI)**
- ➢ **Evaluation of the impacts (LCA)**

Lebret et al. (2023). *Meat Science*, 197, 109074

Data collection and environmental life cycle analysis (e-LCA)





MEANS

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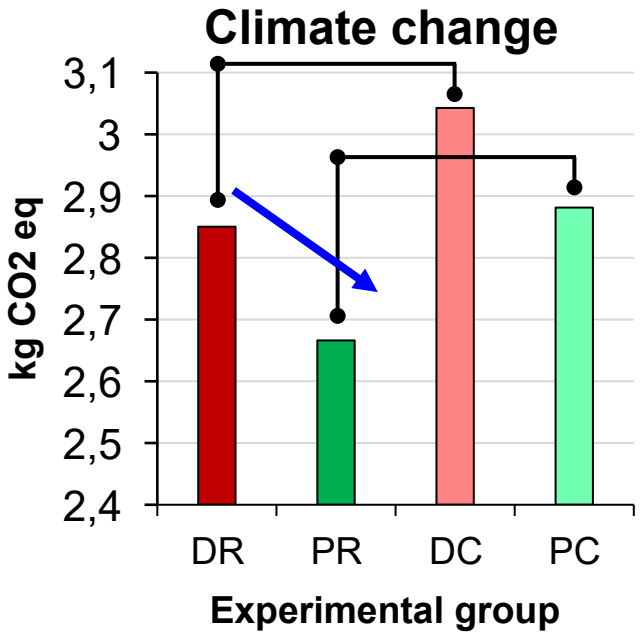
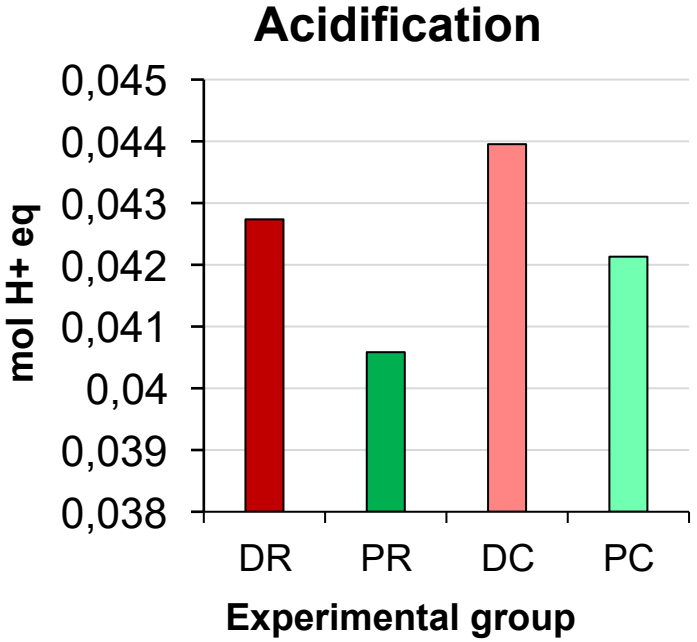
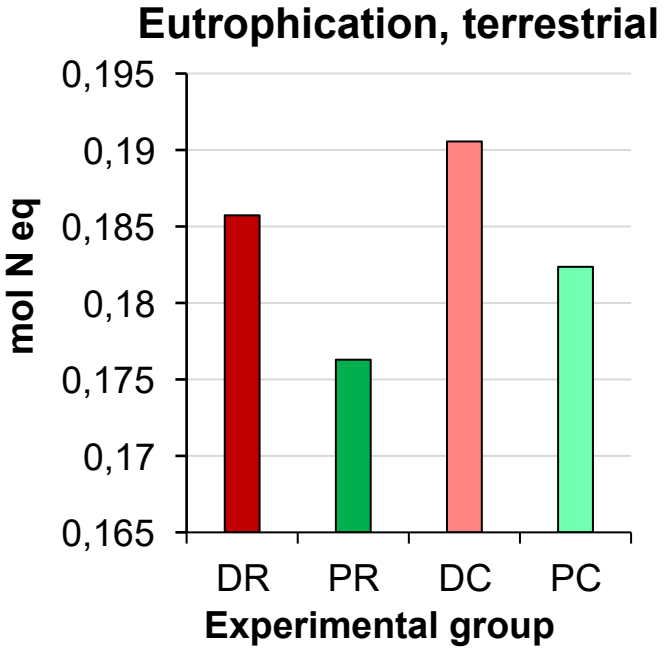
SimaPro

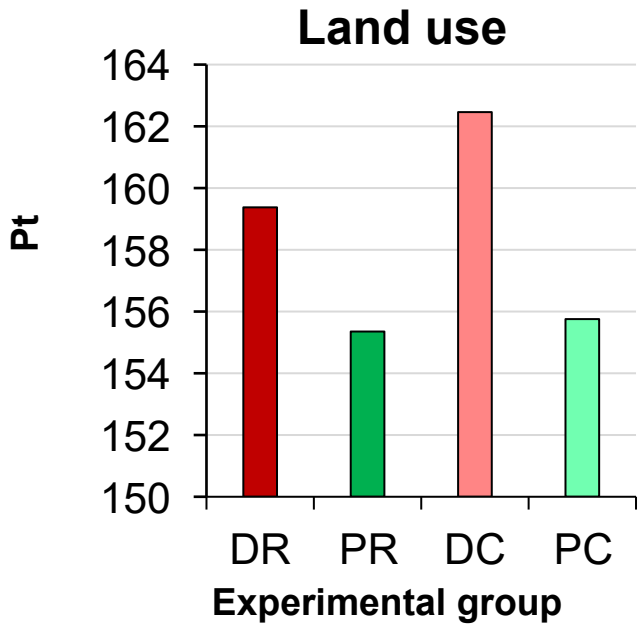
EF 3.0 Method (adapted) V1.03 / EF 3.0 normalization and weighting set

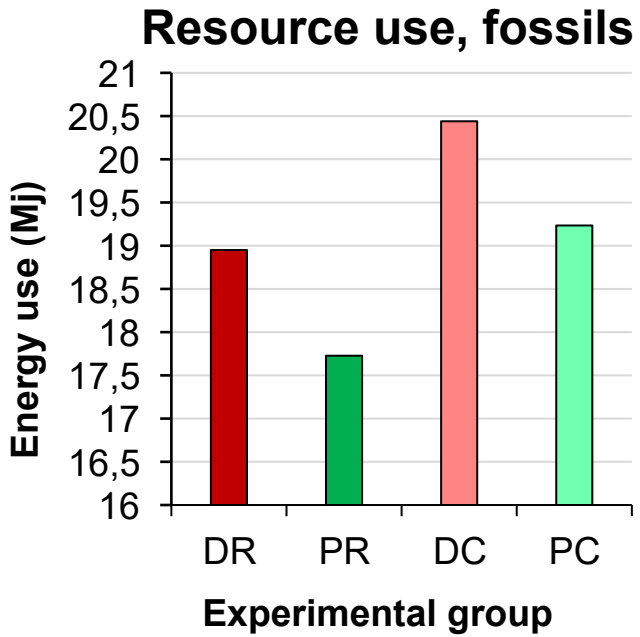
Environmental impacts for production of 1kg gain weight during fattening of pork











Duroc *ROC+* **DR**

Duroc *Control* **DC**

Pietrain *ROC+* **PR**

Pietrain *Control* **PC**

Holistic view on the intrinsic and extrinsic qualities within the 4 experimental designs

	DR	PR	DC	PC
Commercial properties				
Hot carcass (HC) weight, kg	89.4	96.7	82.2	93.8
Lean meat content, %	60.2	61.9	60.5	61.5

French specifications for high nutritional quality label
≤ 4
≤ 12

Improvement of GWP in R feeding (relocated proteins)

Conclusions & future steps

- Incorporating environmental impacts into overall assessment of pork quality can help promoting sustainable pork production practices and better guide consumers in their purchase decisions/consumption practices

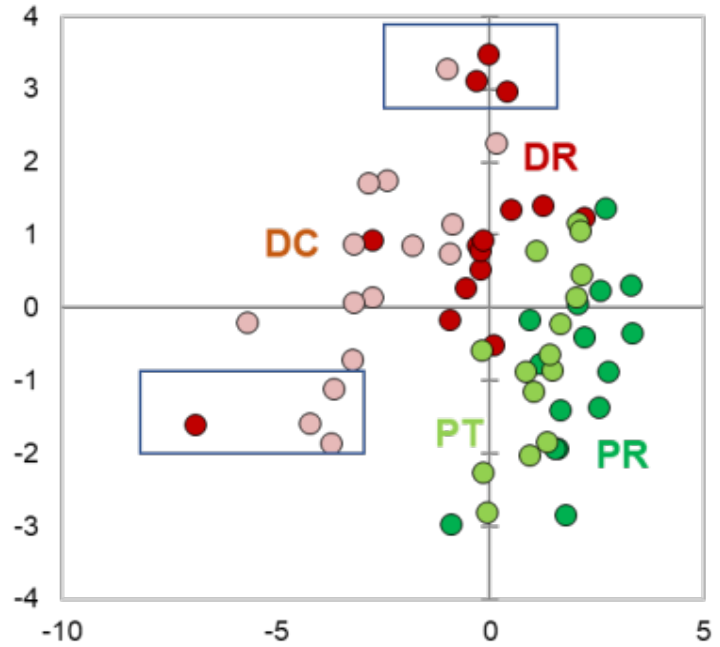
- **Relocation of proteins** as a feeding lever is a win-win strategy for both the extrinsic and intrinsic qualities of meat, but it is capitalized by the choice of pig genotype (for instance Duroc crossbreeds)

- We provided a proof of concept showing that intrinsic and extrinsic qualities of pork (meat) can be integrated for better consideration of the multiple qualities within a farm-to-fork approach

- Conduct the e-LCA at the individual level to consider the within-individual variation of the animals and develop multidimensional analyses

- The next steps will aim at the development of multi-criteria and multidimensional analyses for in-depth characterization of the synergies and antagonisms (trade-offs) between intrinsic and extrinsic quality properties

- Develop nutritional LCA (n-LCA) to better evaluate the impacts, understand the trade-offs at interplay and to compare the experimental groups in terms of nutritional profile and environmental impacts in one index



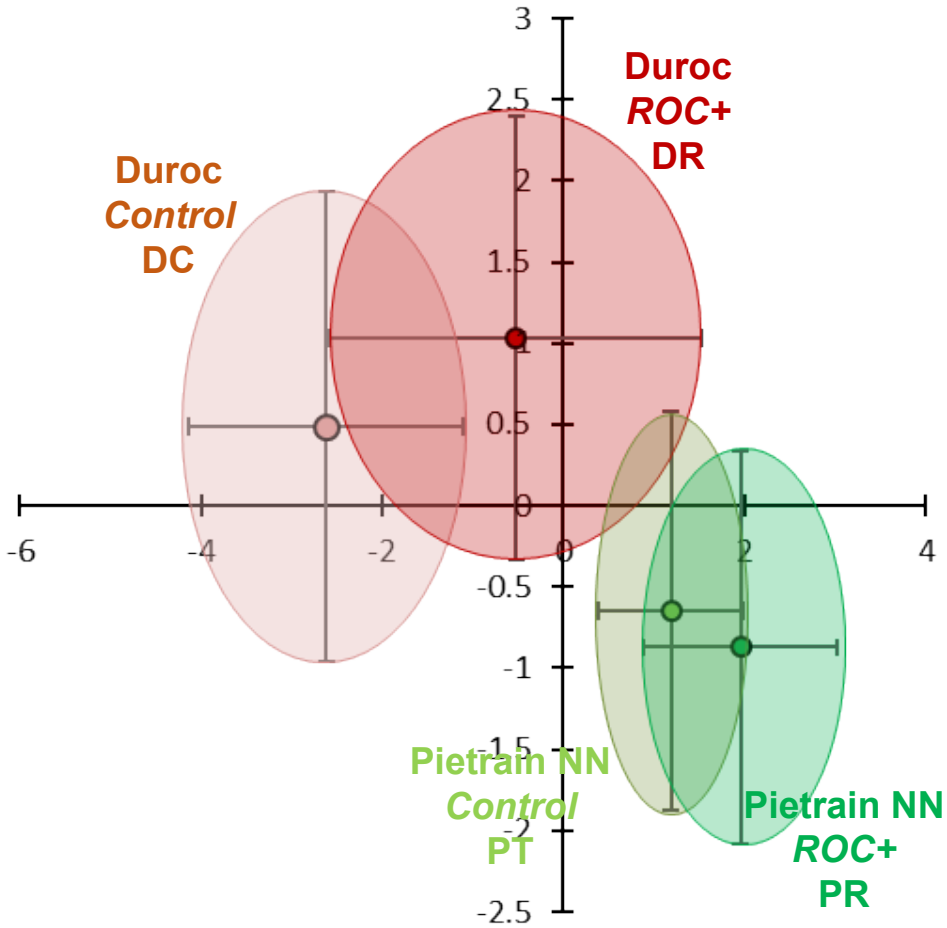
Acknowledgements

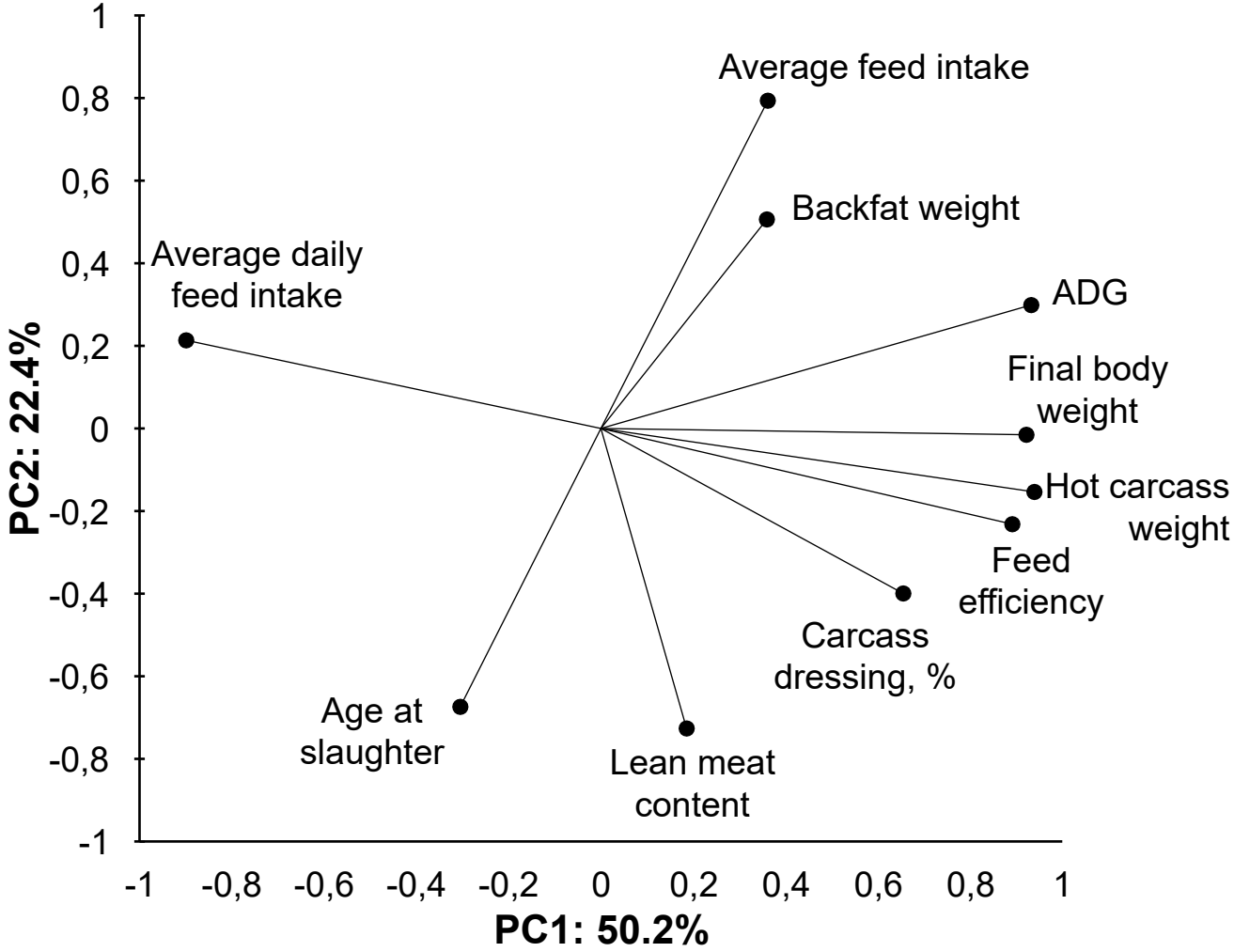
Staff of INRAE (IEU3P experimental farm, PEGASE laboratories), UMR SAS (J. Auberger)

ROC+ project partners

Région Bretagne and Rennes Métropole for funding

Growth performance and carcass traits of the 4 experimental groups





Duroc *vs* Pietrain crossbred pigs: lower (satisfactory) growth performance and carcass lean meat content, lower economic gain

Environmental impacts for production of 1kg gain weight during fattening of pork