Combining sustainable farming with high-quality and authentic chicken and cattle products

From "One Quality" research to farm practice and policy.

29th October 2026
Brussels, Belgium

INTAQT One Quality

How production systems shape beef intrinsic quality?

Jean-François Hocquette- INRAE

intaqt
one quality

ONE QUALITY 1Q

01. Farm network

✓ 55 farms – 10 groups – 4 to 10 farms / group



Yearlings (beef and dairy)

Semi-extensive, pasture

UK

Weidebeef (dairy breeds)

Extensive, pasture

Natura beef (beef breeds)



Extensive, pasture

Charolaises cows (beef)

Semi-intensive,

FR-2

CH-1 CH-2

Natura Farm (beef breeds)



Limousines cows (beef)

Semi-extensive, pasture

FR-1

CH-4

CH-3

Semi-extensive, indoors

IT-2

QM Muni (mainly dairy breeds)

Semi-intensive, indoors

IT-1

Intensive system (dairy)

Intensive, indoors

Intensive system (beef breeds)

ES



Intensive system (beef breeds)

Caumette et al., 2026, Agric. Systems.
https://doi.org/10.1016/j.agsy.2026.104871

02. Beef farms - Typology





Suckler beef farms

Pasture-based

No fattening of culled cows



Fattening of culled cows





Fattening cattle

Pasture-based

Low feed inputs



Medium feed inputs



Indoor

Medium feed inputs



High feed inputs





Intensification inputs gradient

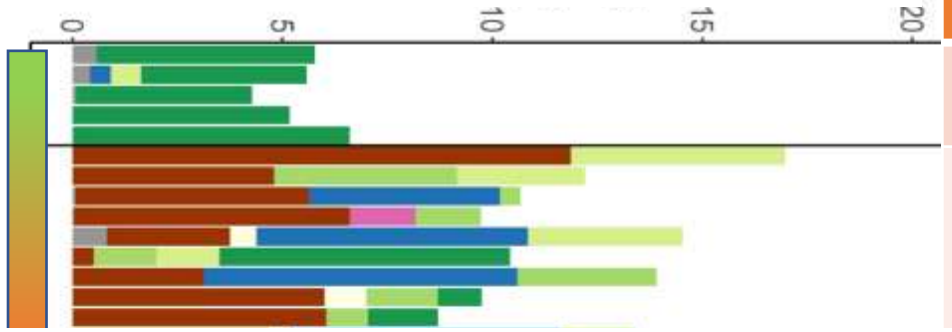


Intensification inputs gradient

02. Beef farm characteristics



Diets (grazing season) (kgDMI/D)

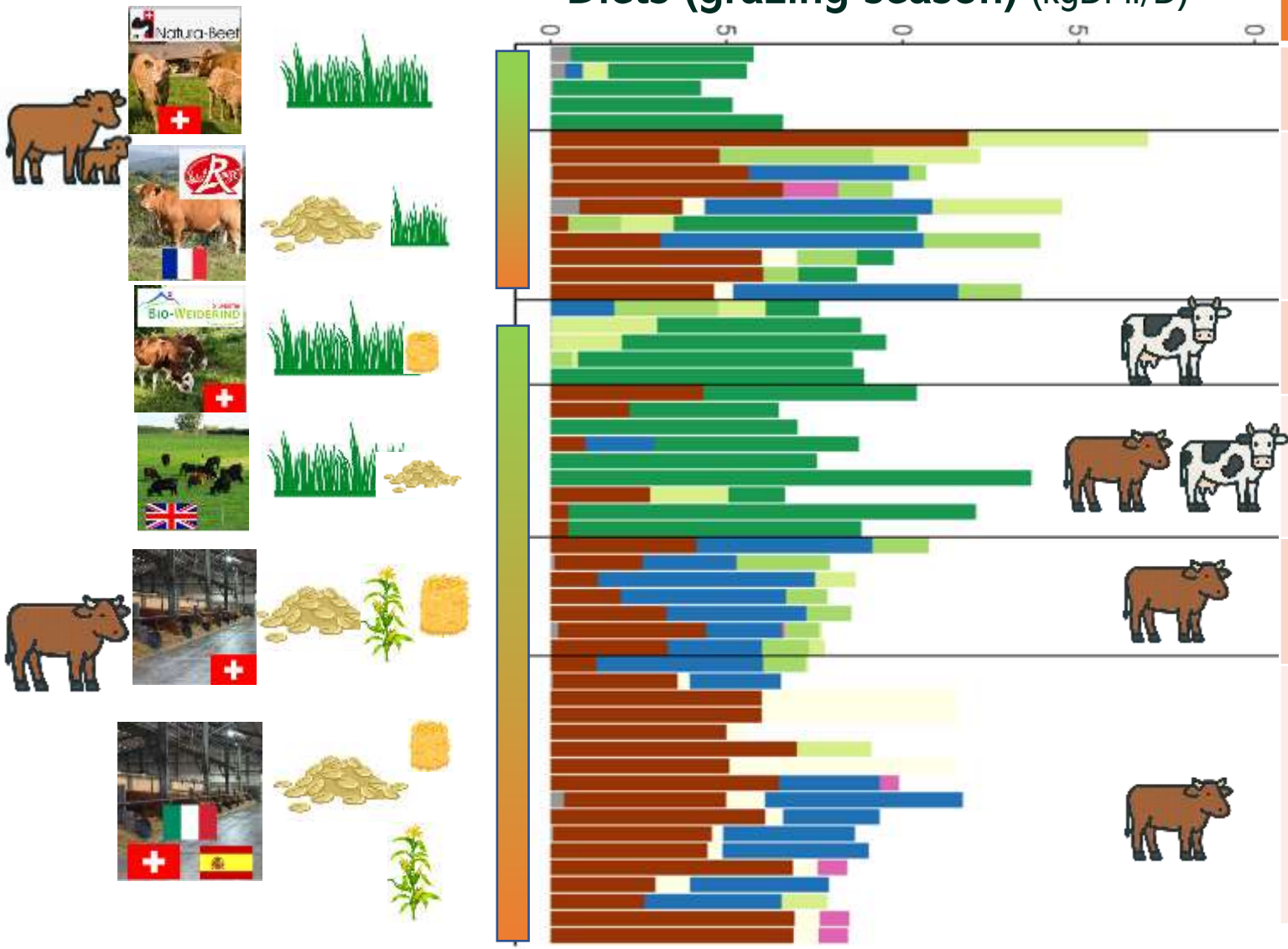


Number of animals	Age at slaughter (months)	Live Weight at slaugter (kg)	Average daily gain (kg)
37 (35-100)	11	400	1.18
122 (88-167)	70 culled cows	809	1.36

- Grazed grass
- Grass hay
- Grass silage
- Lucerne hay
- Maize silage
- Straw
- Concentrates
- Supplements

02. Beef farm characteristics

Diets (grazing season) (kgDMI/D)

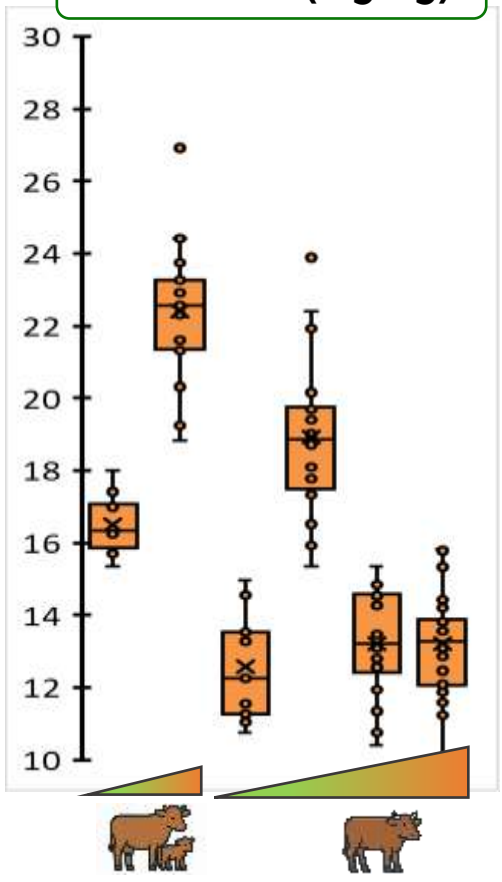


Number of animals	Age at slaughter (months)	Live Weight at slaugter (kg)	Average daily gain (kg)
37 (35-100)	11	400	1.18
122 (88-167)	70 culled cows	809	1.36
32 (25-41)	6 → 23	585	0.76
240 (152-998)	12 → 28	700	0.68
240 (108-265)	9 → 15	545	1.23
1,031 (155-2,335)	6 → 14	550	1.33

02. Vitamins and minerals - beef

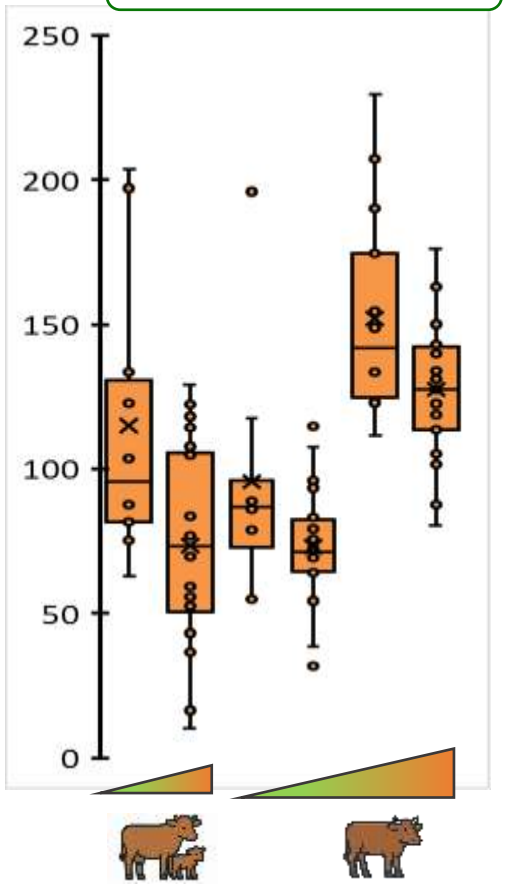


Heme iron (mg/kg)



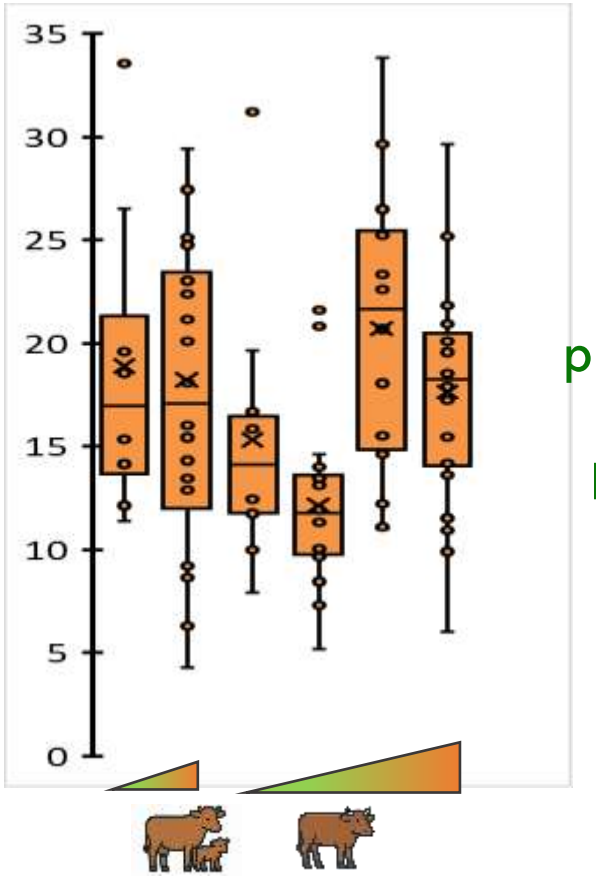
~ slaughter weight

Selenium (µg/kg)



~ Se in premix and soil

Vit B12 (µg/kg)



One steak of 150 g provides % of Adequate Intake or Average Requirement for adult:

~ 35% for Fe

~ 25% for Se

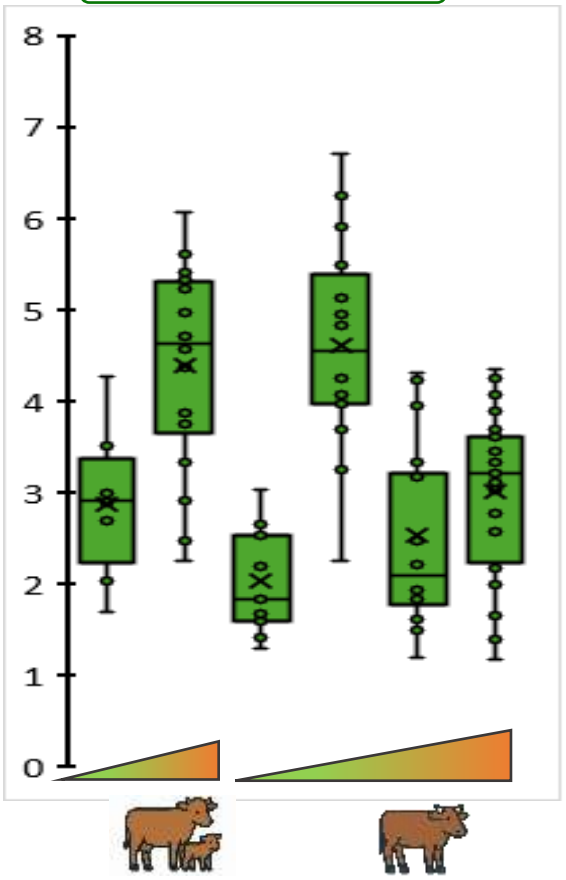
~ 60% for vit B12

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02. Fat content and fatty acid profile- beef

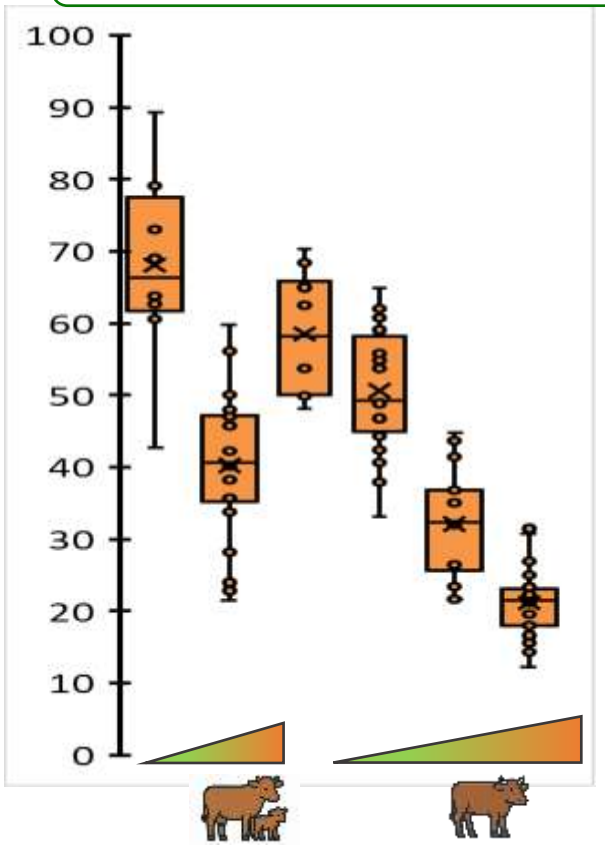


Fat (%)



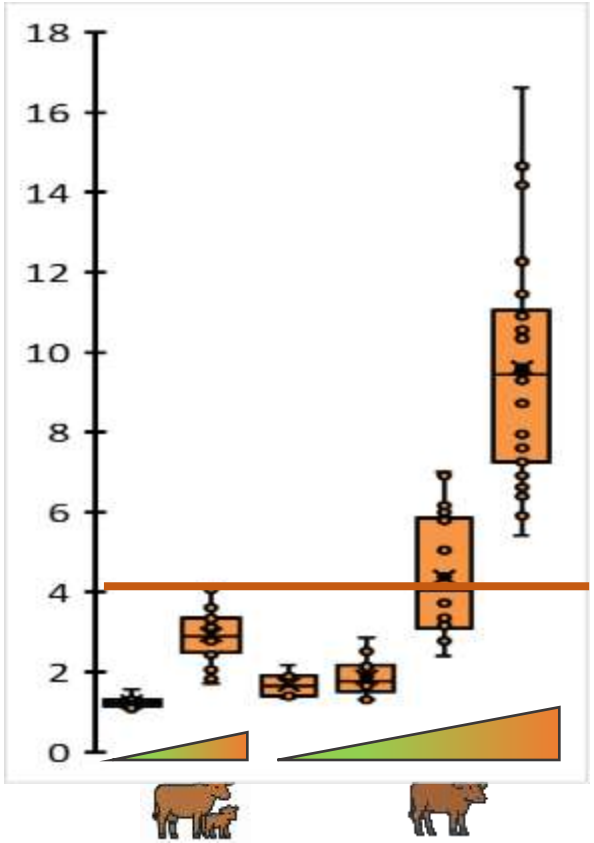
Intensification level

Total n-3 PUFA (mg/100g)



Intensification level

n-6/n-3 PUFA



Intensification level

~ breed, slaughter weight, fattening regime

~ proportion of (preserved) grass in the diet

02. Summary about nutritional quality

- Variability in nutritional quality primarily associated with feeding regimen and age at slaughter
- Positive (for n-3 FA and n-6/n-3 ratio) or neutral effects (vitamins and minerals) of extensification on nutritional quality.
- This suggests that strategies to improve nutritional value of animal source foods should focus on specific farming practices

02. Summary about safety

- All measured parameters [heavy metals (cadmium, lead, arsenic copper) mycotoxins and persistent organic pollutants (PFAS, Dioxins, PCBs)] for which EU maximum levels exist were well below these thresholds for all farm typologies.
- Access to pasture or more extensive green forage–based feeding does not result in a general increase in the investigated safety–relevant parameters. Observed differences might partly be related to location/region.

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02. Carcass and quality descriptors - beef



MSA[1] parameter	Suckler beef farms Pasture-based		Fattening cattle Pasture-based		Fattening cattle Indoor	
	No fattening of culled cows	Fattening of culled cows	Low feed inputs	Medium feed inputs	Medium feed inputs	High feed inputs
n. of carcass	*18*	*36*	*19*	*36*	*27*	*64*
Age (months)	**11**	**70**	**24**	**32**	**15**	**15**
Carcass weight (kg)	**206**	**477**	**294**	**319**	**296**	**356**
Ossification	**122**	**458**	**152**	**209**	**152**	**168**
Marbling (MBC)	**194**	**335**	**331**	**359**	**232**	**357**
Rib fat (mm)	**3.8**	**4.5**	**5.3**	**7.8**	**7.1**	**6.4**
Ultimate pH	**5.51**	**5.66**	**5.50**	**5.53**	**5.39**	**5.51**

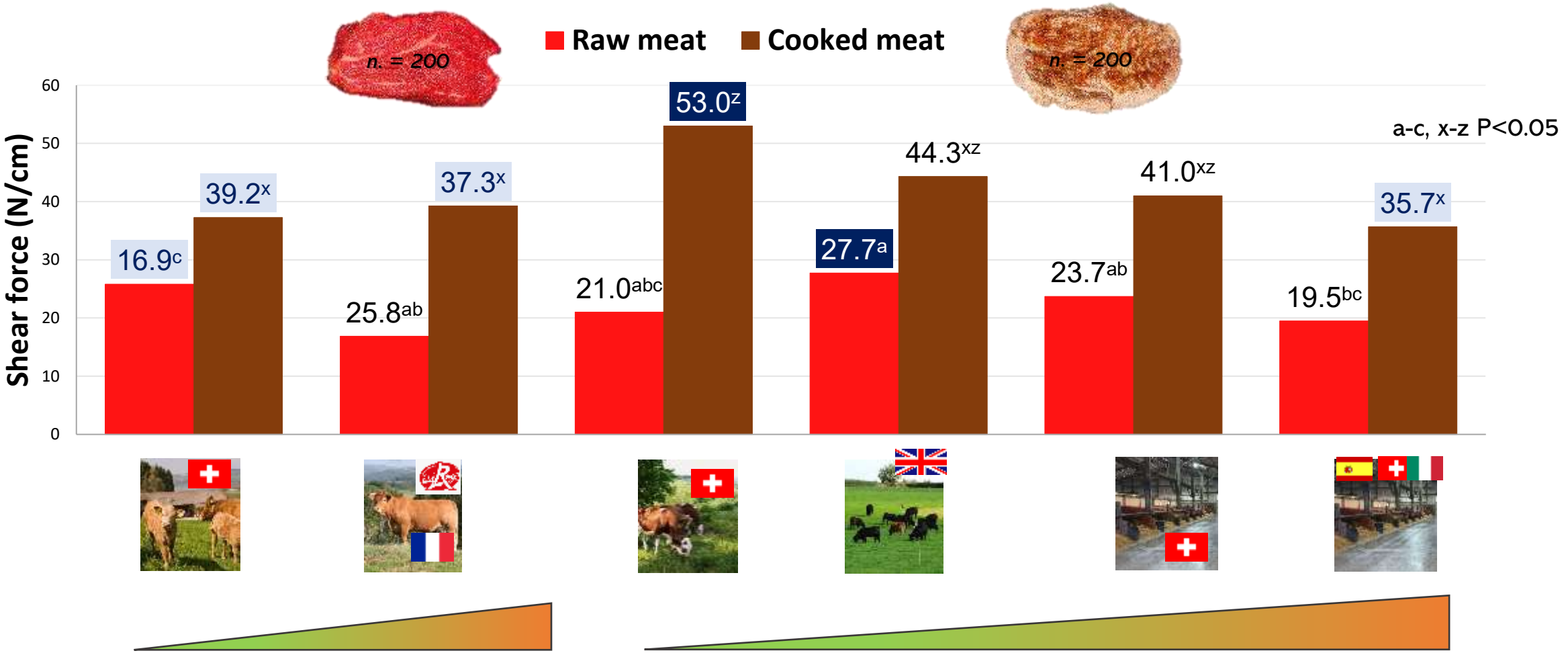
[1]MSA stands for Meat Standards Australia , a comprehensive, science-based eating quality grading program developed by Meat & Livestock Australia

n. = 200 *Values are means (standard deviations)*



Systems primarily separated animal category and carcass maturity; marbling, fatness and pH overlapped and showed no consistent intensification gradient

02. Instrumental tenderness - beef

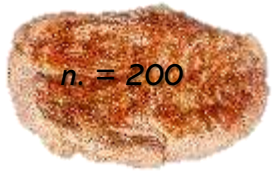


Shear force differed among production systems, with no relationship with intensification

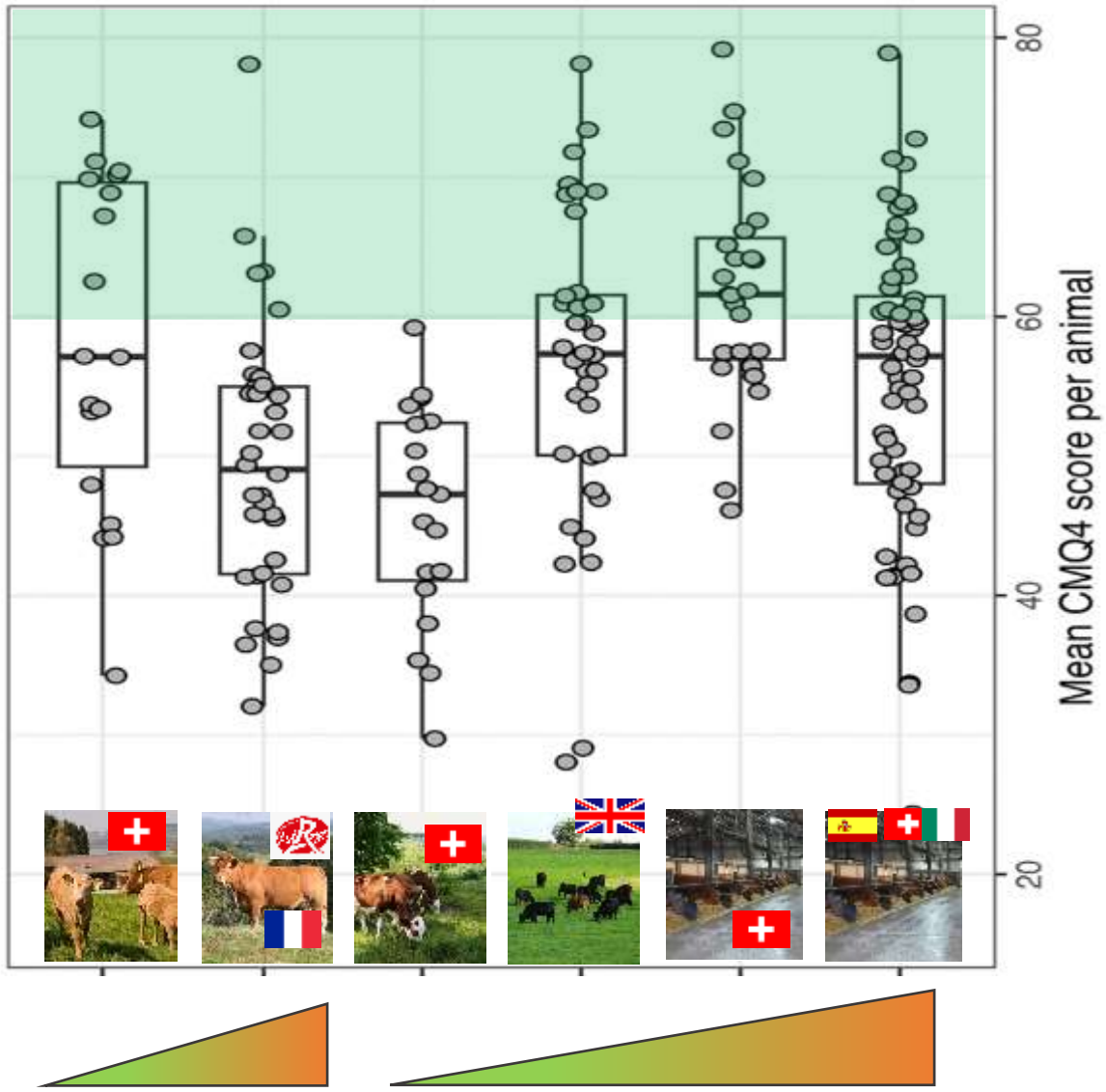
02. Consumer eating quality- beef

MQ4 is an internationally recognised score that describes the complete eating experience of a consumer (0.3 × tenderness + 0.1 × juiciness + 0.3 × flavour liking + 0.3 × overall liking)

Consumer tests in Italy, France and Poland –Blind tests



Each point represents one animal (n = 200); boxes show the median and interquartile range, and whiskers show the full range.



System means differed without following the intensification gradient; within-system ranges were four to five times wider than the range between system means

02. Summary about sensory quality

- **Intensification did not generate a quality gradient for beef eating quality**
- **Production systems characterized animals more strongly than eating quality**
  Age, carcass weight and ossification clearly separated systems
- **A shared cross-country eating-quality framework appears feasible**
  Consumers from different countries broadly agreed on sample ranking
- **Product distinctiveness and consumer liking are not interchangeable**
  A production signature may support authentication and differentiation, but it does not guarantee preference or the quality of an individual portion
- **Eating quality is shaped along the entire chain**
  Dominant within-system variation highlights importance of animal selection, pre-slaughter handling, ageing and *post-mortem* management
- **One Quality requires targeted optimisation, not a single ranking**
  The relevant levers depend on the product, farm context and target market

03. Multicriteria assessment thanks to a global score



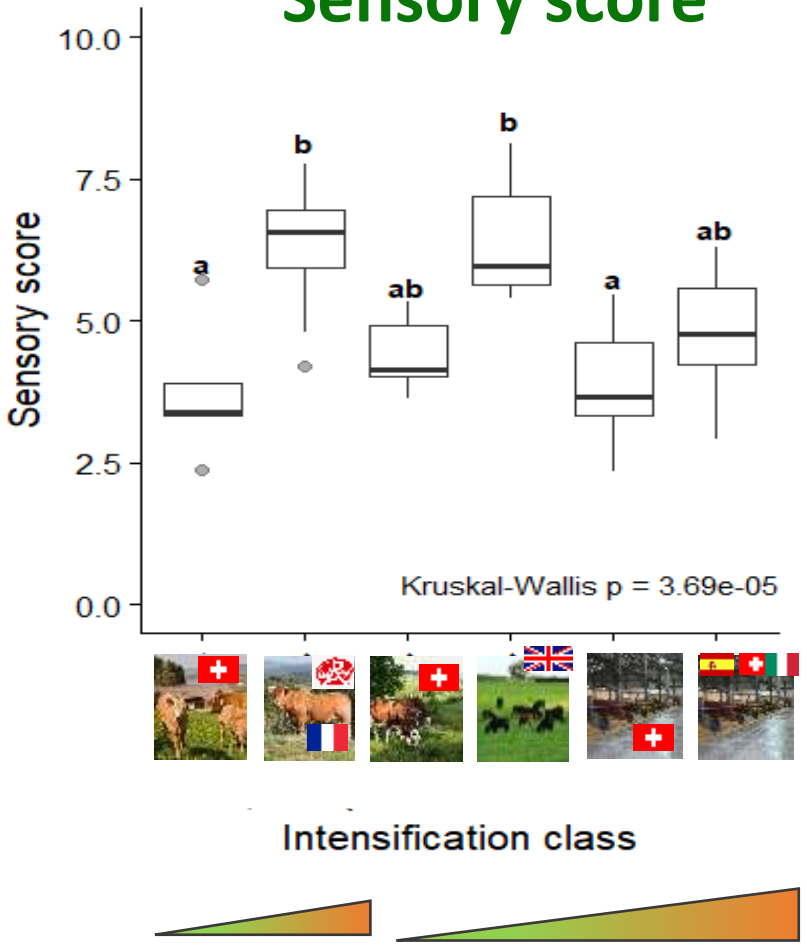


Sensory quality	Colour
	Tendersness / Shear force
	Juiciness
	Flavor
Technological quality	pH
Nutritional quality	Fat
	Protein
	Minerals
	Vitamins
Safety	Toxicity
	Microbiological risks
	Chemical risks
	Relative benefits and risks of nutrients

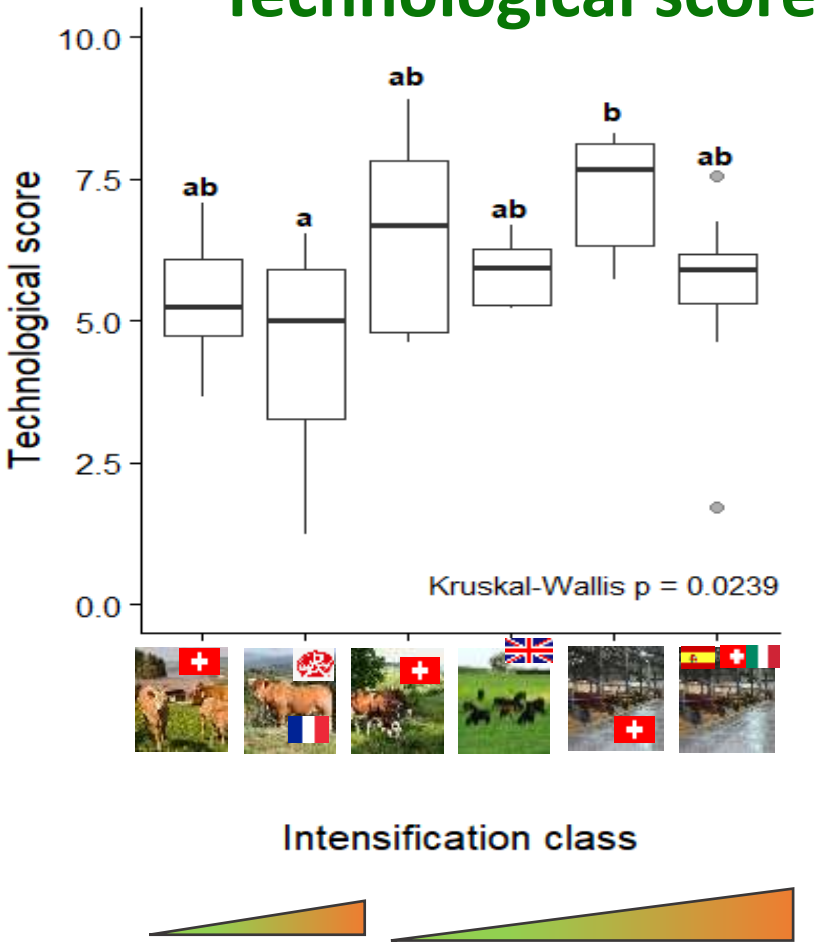
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03. No intensification gradient for global scores

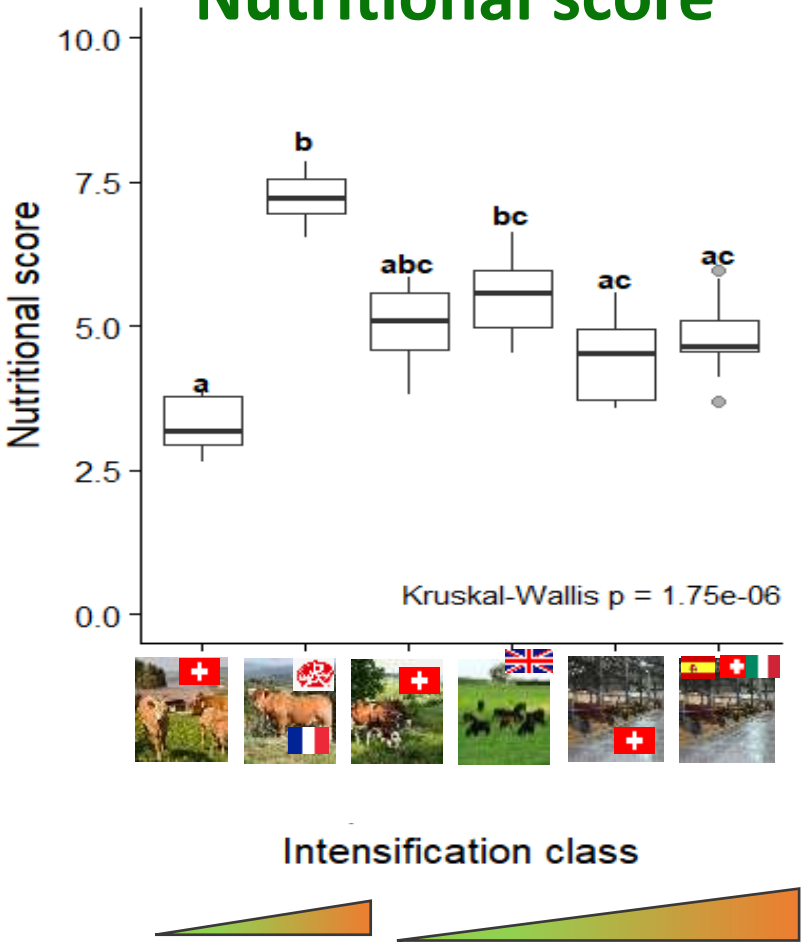
Sensory score



Technological score



Nutritional score

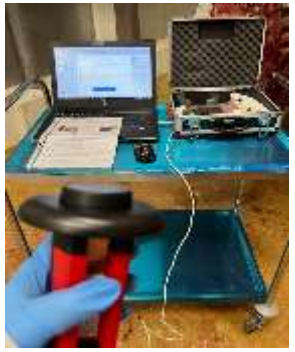


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03. Infrared spectroscopy

- Low cost - rapid

Portable Spectrometers







Benchtop Spectrometers



- **Prediction** of product composition: moisture, protein content, fat content, fatty acids, total iron and haeme iron (R^2 > 0.50), but not for polyunsaturated fatty acids, TBARS, carnosine, anserine, zinc, selenium, B-group vitamins, ultimate pH, marbling score, shear force, sensory traits.
- **Authentication** of type of farming systems (gradient of inputs, grazing)

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03. Portable-NIR for authentication of beef



Category	Accuracy
Indoor	73%
Outdoor	

Category	Accuracy
Beef	59%
Dairy	62%
Mixed	56%

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29th October 2026

Brussels, Belgium

INTAQT One Quality

How production systems shape dairy products' intrinsic quality

Bruno Martin - INRAE

intaqt one quality

ONE QUALITY 1Q

01. Farm network



80 dairy farms



Conven-tionel

Large diversity of farming systems

≠ representativness

Farms classified according to a gradient of inputs

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02. Dairy farms - Typology



Low feed input grazing systems

Medium inputs systems

High feed input systems

Low fertilisation

High fertilisation

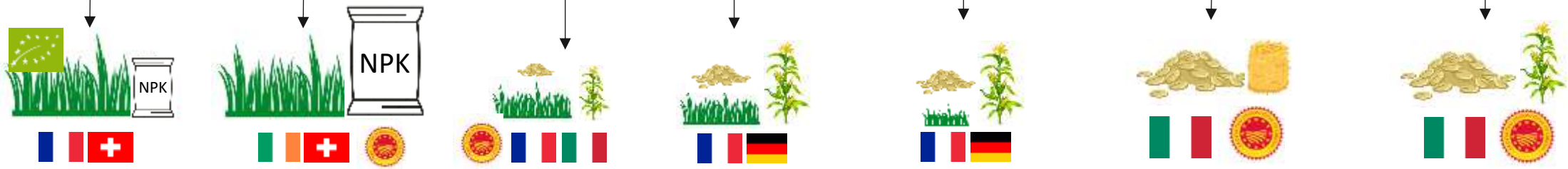
High **maize**

High **concentrates** and no maize

High **concentrates** and **maize**

Low stocking rate

High stocking rate



- - - **Intensification inputs gradient** **+ + +**

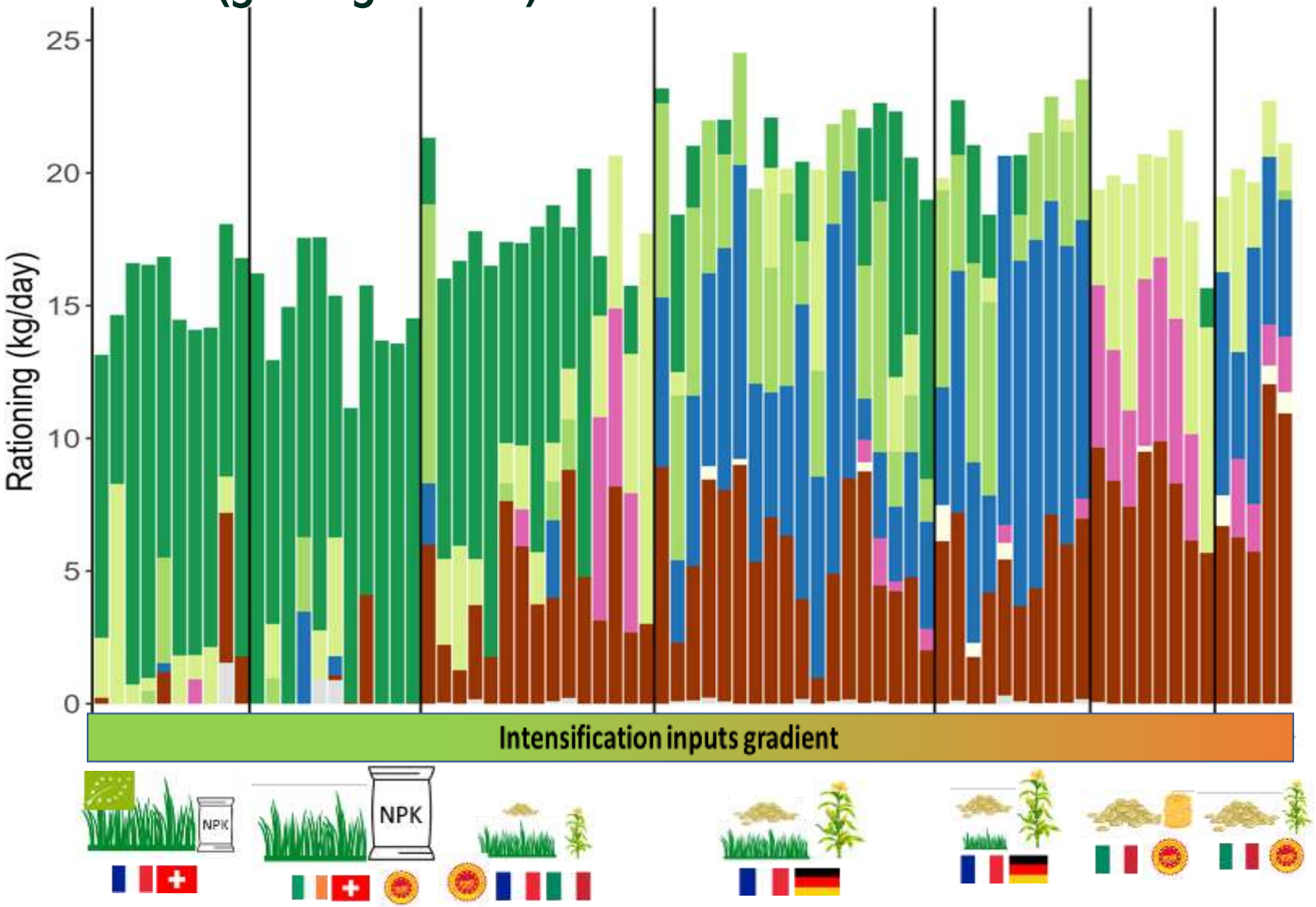
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Caumette et al., 2026, Agric. Systems.
https://doi.org/10.1016/j.agsy.2026.104871

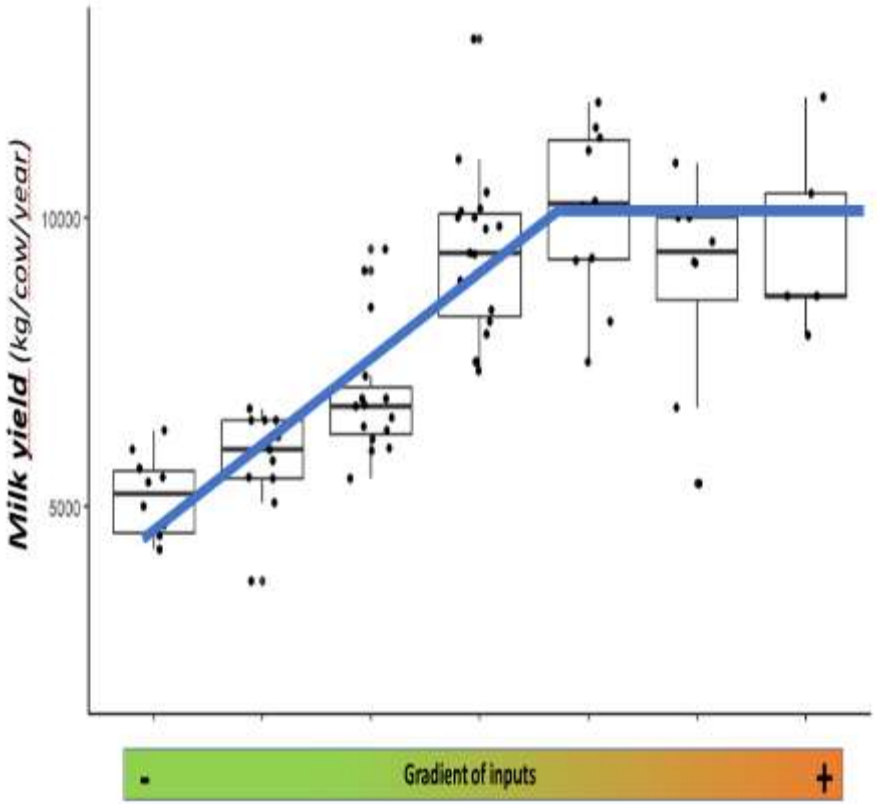
02. Diets and milk yield



Diets (grazing season)



Milk Yield



Caumette et al., 2026, Agric. Systems.
https://doi.org/10.1016/j.agsy.2026.104871

02. Intrinsic quality traits



Sensory

Technological

Nutrition

Safety

Technological traits



- Composition, colour and microbiological quality (raw milk)
- Freezing point, lipolysis, protein fractions and variants (raw milk)
- Microbial diversity (raw milk)

Sensory traits





- Trained sensory profiling and volatile organic compounds (UHT milk)
- Consumer testing (UHT milk and cheese)

Nutritional traits





- Proximate composition (fat, protein, caseins, lactose…)
- Fatty acid composition
- Mineral and trace elements (Ca, P, Mg, Na, K, S, Cu, Fe, Mn, Zn, I)
- Vitamins (B1, B2, B6, B12, E)
- Bioactive compounds (phospholipids, protein fractions and variants)

Safety traits

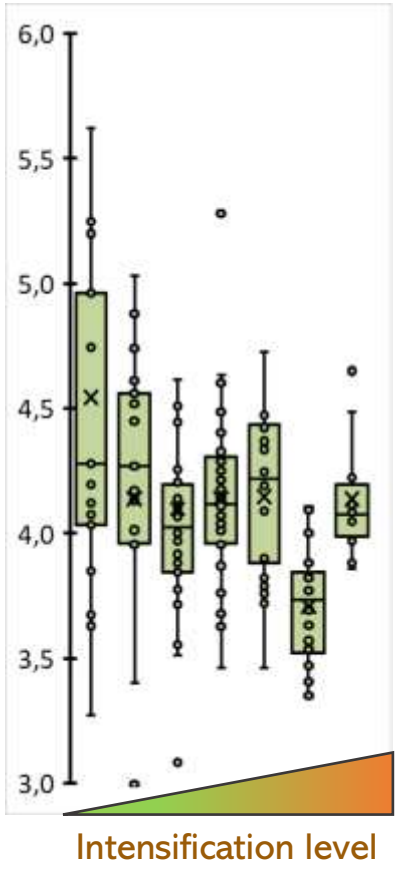


- Heavy metals (Cadmim, Lead, Copper, Mercury, Arsenic)
- Myco- and plant toxins (Aflatoxin M1, Enniatins…)
- PCBs, Dioxins (PCDD), Furans (PCDF)
- Perfluorinated alkyl substances (PFAS)

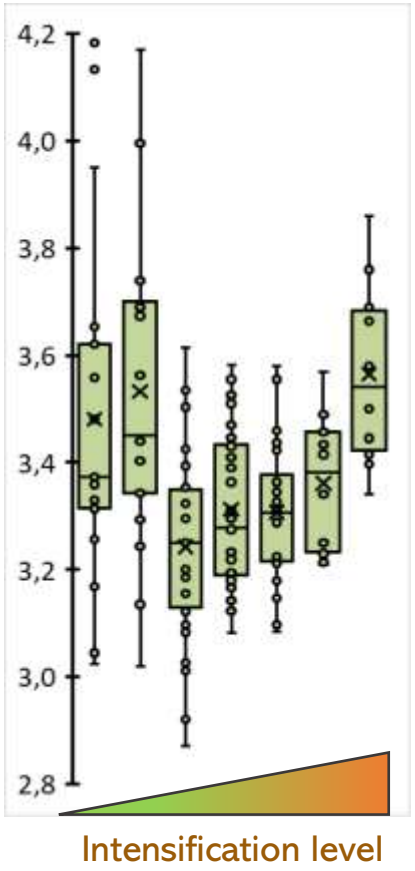
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02. Technological quality

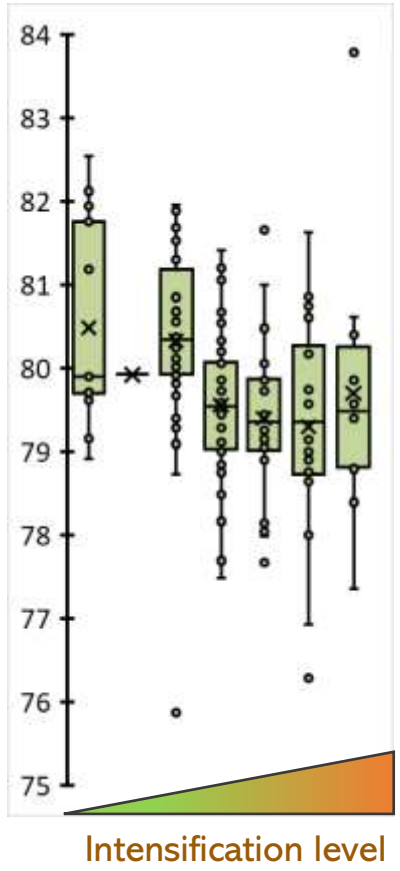
Fat (%)



Proteins (%)



Caseins (% Proteins)

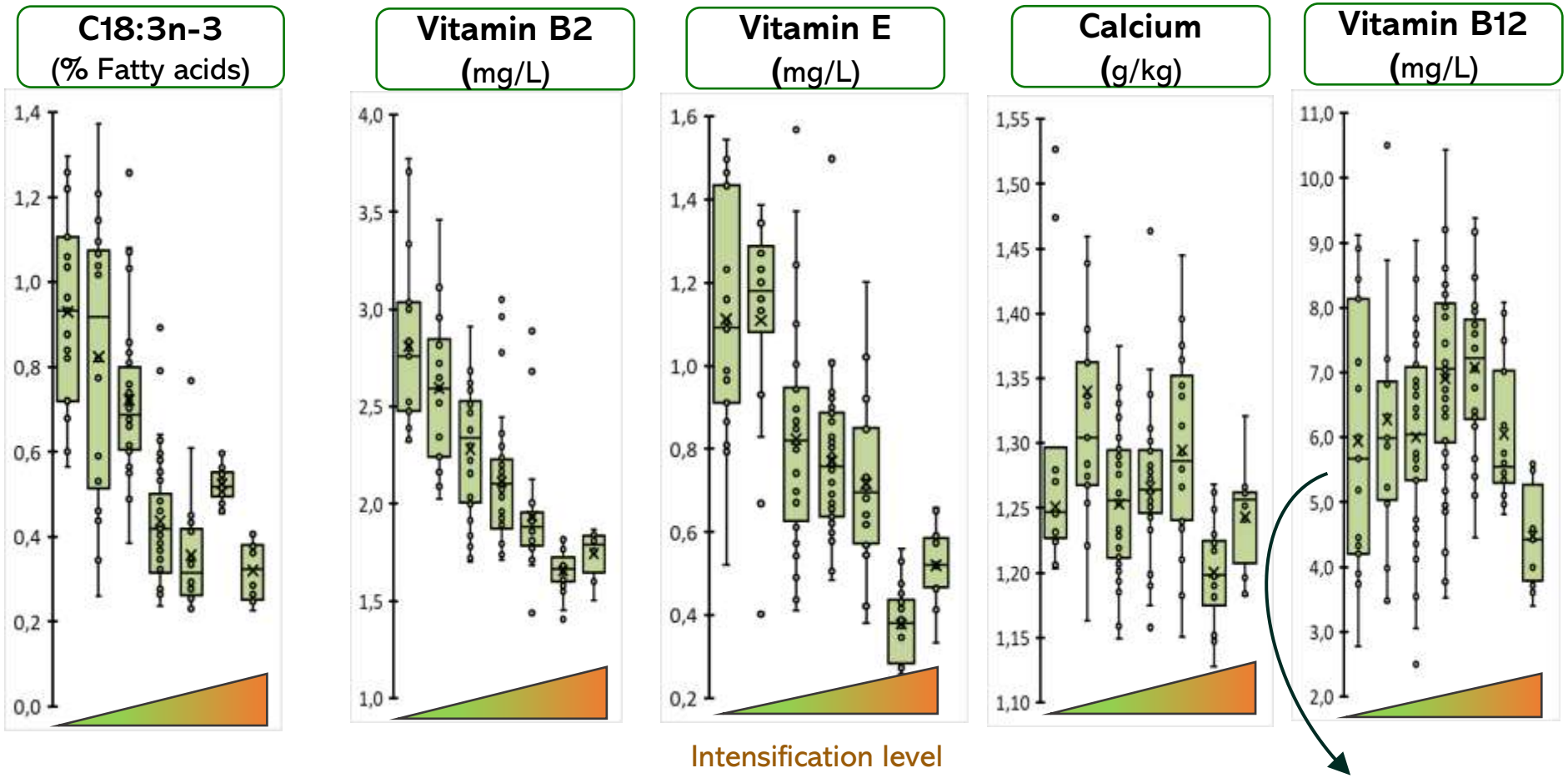


No clear gradient related to intensification

→ **No dilution effect!**

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02. Nutritional quality



High variability
Clear gradient related to intensification

Higher nutritional value of milk from **grass-based** farms !

A portion of milk (200 mL) provides ~ 30% of Adequate Intake
Variation from 20 to 40% according to the milk

Mohanna et al., 2026, J. Dairy. Sci.

02. Sensory quality



Distinct cheese sensory features according to animal diets

- Yellower colour, a more melting texture and stronger flavours are associated with fresh-herbage feeding

Cabiddu et al., 2022



Results confirmed when 1/3 of hay is replaced with fresh grass

- Italian consumers: no preference in average
  - ↳ Appreciations depend on consumers' expectations for colour and texture

Tura et al., 2024; Gagliano et al., 2025

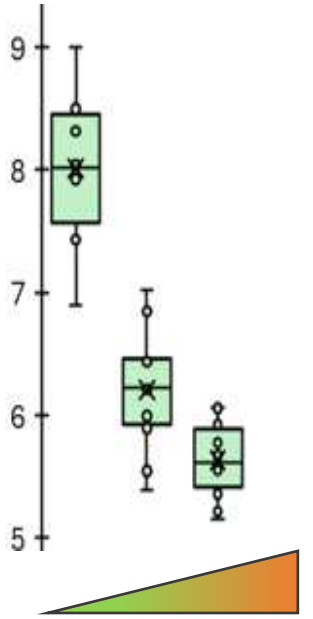
➡ Grass-related sensory distinctiveness did not translate into consistent consumer preference



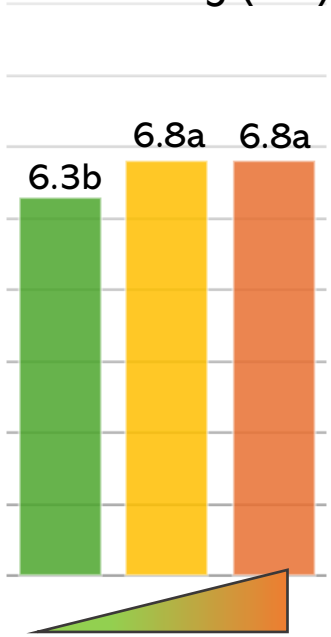
UHT Milks
produced from 15 farms

Naive French & Italian consumers - **Blind tests**

Yellow Index



Taste liking (1-9)



➡ Grass-based farm group: yellower, more flavoured milks, **less liked**

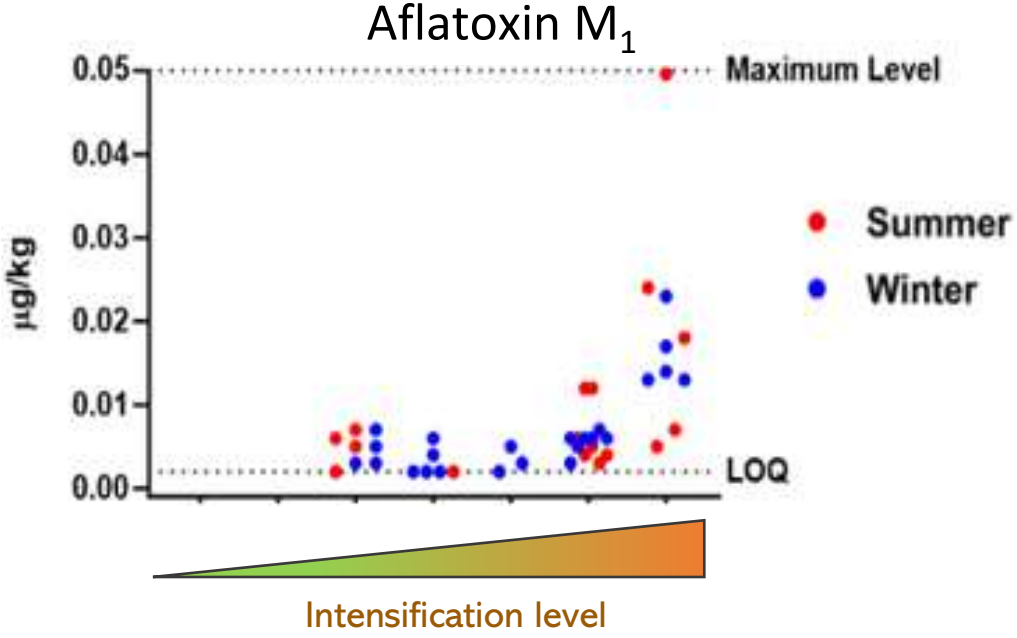
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02. Safety

- **All measured parameters for which EU maximum levels exist were well below these thresholds for all farm typologies.**

Maximum level*

- Aflatoxin M_1 0.05 µg/kg raw milk



A.H. El-Khatib, JAFC, accepted

- Access to pasture does not result in increase in the investigated safety–relevant parameters (at least in areas without known contamination).
- Observed differences might partly be related to location/region.

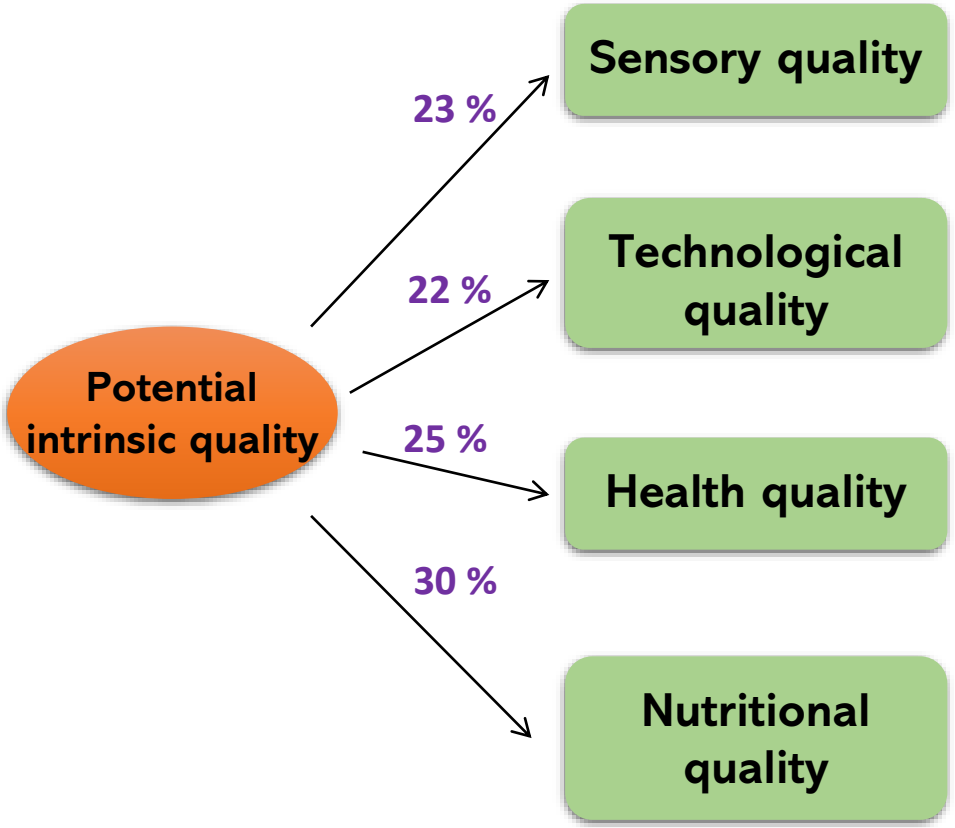
* Maximum values by COMMISSION REGULATION (EU) 2023/915
LOQ: Limit Of Quantification

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03. Multicriteria scoring tool



- Milk quality depends ont its fate !
- Target product is **standard UHT milk** semi-skimmed, standardized, indirect UHT (140°C-4s)



Colour, bacterial load, somatic cell count, lypolysis

Bacterial load, total and whey proteins, mineral balance

(+) Fatty acids, minerals and vitamins
(-) Heavy metals, aflatoxin M_1, plant toxins, PFAS

Minerals and vitamins



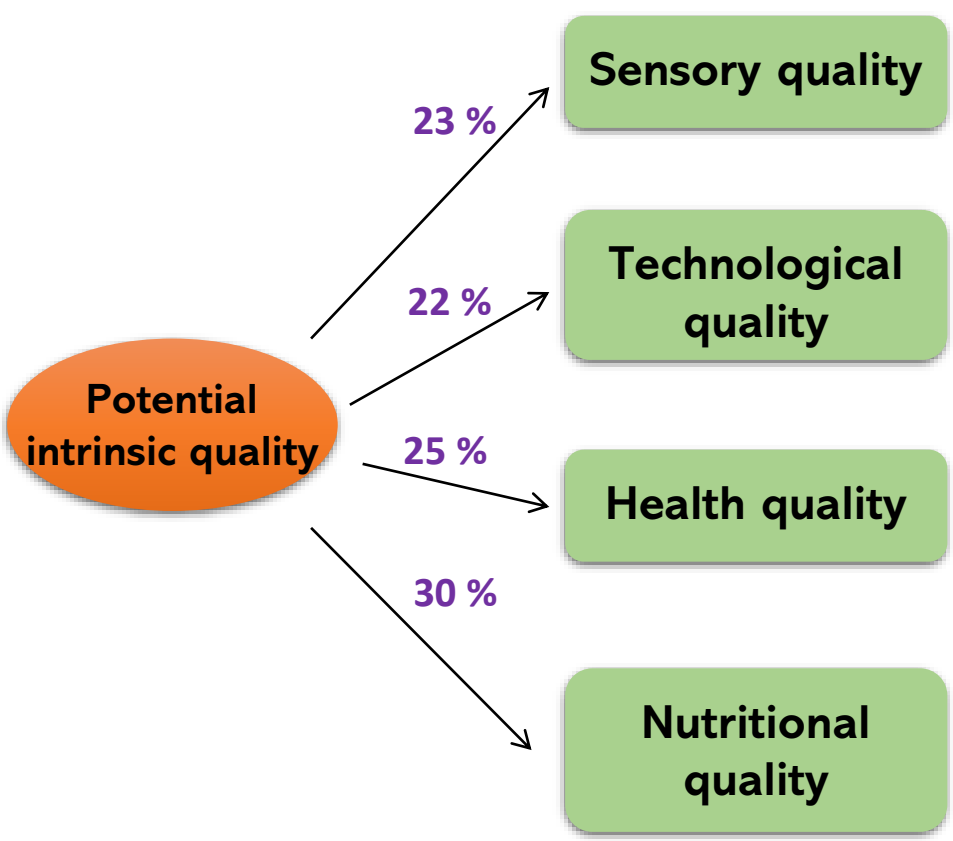
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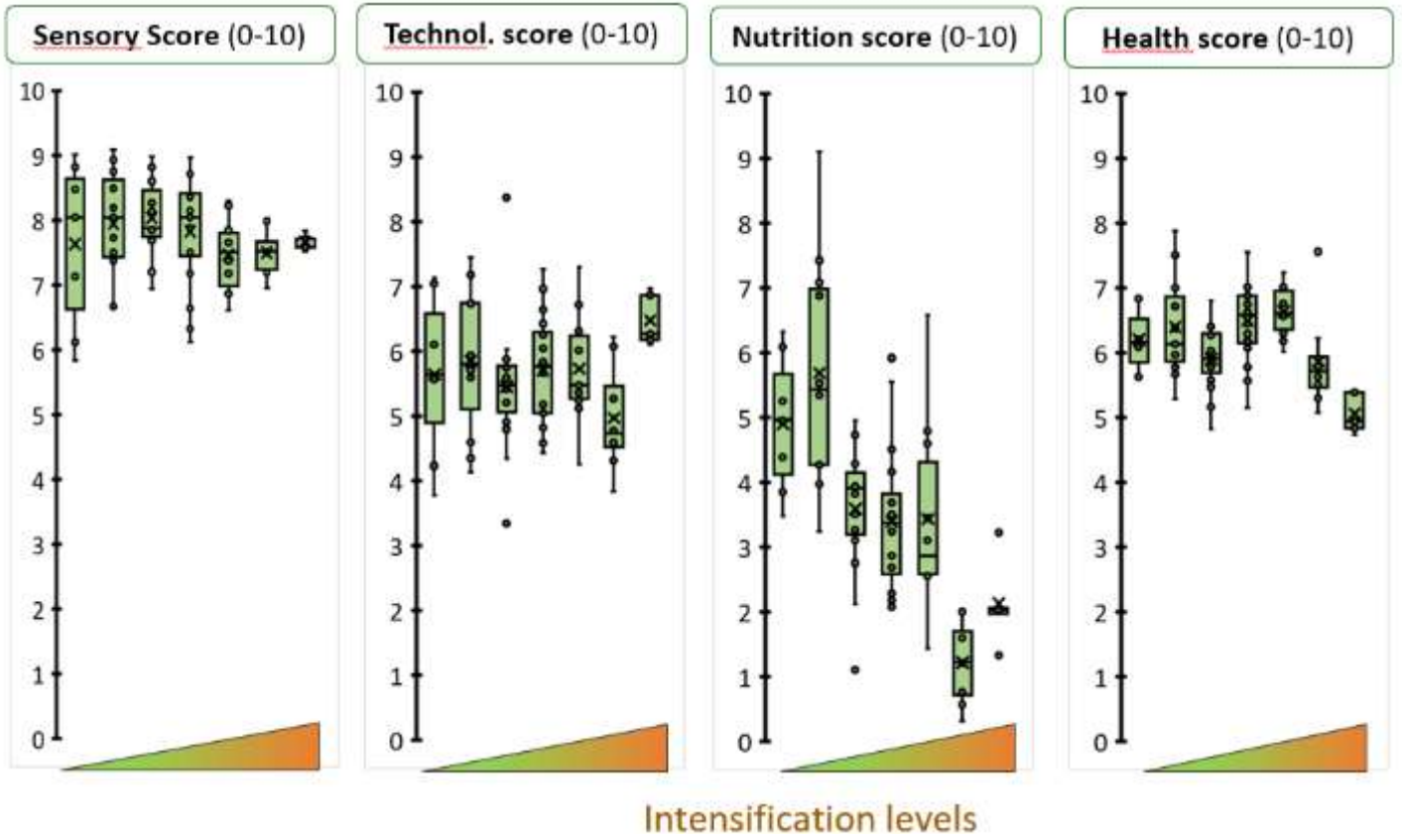
03. Multicriteria scoring tool





- Milk quality depends ont its fate !
- Target product is **standard UHT milk** semi-skimmed, standardized, indirect UHT (140°C-4s)





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03. Authentication tools

Authentication of breeds

DNA analysis - genotyping



- Authentication of the main EU cattle breeds





Authentication of milk quality

Infra-red spectroscopy – low cost, rapid

- Prediction of milk composition (proteins, fat, etc.)
- Prediction of proportion of grazed grass in dairy cows diets
- Authentication of farming systems







04. Take Home message

- **Diversity of dairy farming systems** co-exist in Europe: they partly shape the **intrinsic quality** of dairy products
- **Intensification** (inputs for the production) is highly related to reduced outdoor access and grass used to feed cattle



- **Grass feeding** :



  - positive or neutral effect on nutritional value
    differences observed might be relevant for human nutrition
  - poorly related to technological quality and safety (non-issue in our network),
  - distinctive sensory properties of dairy products, but it does not guarantee liking when it departs from familiar standards.

- **Intrinsic quality** can be **predicted, scored** and **authenticated** thanks to low-cost and rapid techniques

- **No single system wins on all criteria** and **within system variability** reveals scope for improvement

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