

Grass feeding: a cornerstone of the "One Quality" of beef

Beef quality is not only about what is inside the product. It also depends on the quality of the production system. This is what we call “One Quality” at INTAQT: a concept that combines intrinsic quality traits—including sensory, nutritional, technological and health-related attributes—with extrinsic dimensions reflecting consumer and citizen expectations, particularly regarding animal welfare and the environmental and climate footprint of production chains.

European beef production is characterised by a remarkable diversity of farming systems, shaped by contrasting agro-climatic conditions, traditions and market contexts. At one end of the spectrum, low-input grassland farms rely primarily on grazing and hay, with little or no use of concentrates. At the other end, high-input housed systems provide large amounts of maize silage and concentrates to fast-growing cattle, with no access to pasture. In between, mixed systems combine grazing with maize silage and concentrates in varying proportions. Understanding how this diversity affects both the intrinsic and extrinsic quality of beef is essential to help each production system identify and valorise its strengths.

The “One Quality” concept applied to animal products combines intrinsic product quality with extrinsic dimensions, including feed-food competition, environmental footprint, and animal welfare. Based on a study of 55 European beef farms classified along an intensification gradient, INTAQT shows that grass-based systems offer several benefits: nutritionally superior beef, a net contribution to food-system protein production, greater ecosystem regulation services, and potentially better animal welfare indicators—all at the cost of lower productivity, with no major differences in sensory quality.

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one quality

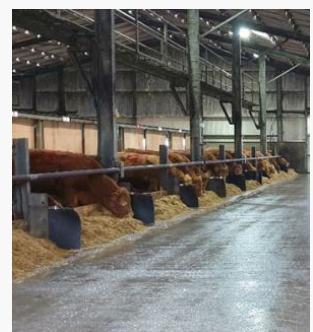


Fig 1: Illustration of the diversity of beef farming systems

A network of 55 beef-fattening farms across five countries was established to capture the diversity of beef production systems currently found in Europe. Farm characteristics and farmers' practices were documented through surveys, which were used to classify the farms into six main types ranked according to increasing levels of input use. The characteristics of these six classes are:

1. Swiss (CH) suckler beef farms operating grass-based systems with little or no concentrate.
2. French (FR) suckler beef farms with beef cull cows (grass-based systems with moderate to high levels of supplementation).
3. Swiss (CH) suckler beef farms raising young dairy-beef crossbred cattle and finishing them at up to 23 months of age on grassland, with no or minimal feed supplementation.
4. UK medium-input farms raising beef cattle on grassland from 12 to 27 months of age, with grazing animals receiving moderate levels of concentrate supplementation.
5. Swiss (CH) medium-input farms finishing cattle of mixed genetic backgrounds indoors from 9 to 16 months of age, with moderate levels of concentrate supplementation.
6. High-input indoor fattening farms in Italy (IT), Spain (ES) and Switzerland (CH), relying on high levels of concentrates and maize silage in the diet and finishing cattle by 14 months of age.

3G parameter	Suckler beef farms Pasture-based		Fattening cattle Pasture-based		Fattening cattle Indoor	
	1. No fattening of culled cows	2. Fattening of culled cows	3. Low feed inputs	4. Medium feed inputs	5. Medium feed inputs	6. 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

¹3G stands for Global Guaranteed Grading, a system to predict the eating quality of beef cuts

Table 1: Carcass characteristics of cattle from the different European farming systems

Carcasses were graded using the EUROP grid and the Global Guaranteed Grading protocol, under the auspices of the International Meat Research 3G Foundation (Table 1). Samples (N = 497) from the *Longissimus thoracis and lumborum* muscles were collected from each farm at slaughter and analysed by a network of academic laboratories. Each farm contributed between 5 and 10 animals sampled during summer or winter. For some biochemical analyses, samples collected from animals within the same farm and slaughter period were finely ground in liquid nitrogen and pooled before analysis.

The analyses included traits related to

- **Intrinsic quality:** Safety (Heavy metals, Mycotoxins, Plant toxins, Organic pollutants, Resistant bacteria), Eating and technological quality (Color, Shear force, Marbling, Ultimate pH, Connective tissue, Lipid oxidation, Tenderness, Flavour, Juiciness), Heathiness (Protein, Fat, Fatty acid, Minerals, Vitamins).
- **Extrinsic quality:** productivity, feed efficiency, feed-food competition, ecosystem services and animal welfare.

In terms of **safety**, none of the analysed contaminants exceeded regulatory thresholds.

Indicators of **healthiness** (heme iron, selenium, vitamins, fat) varied among farm types without a clear intensification-gradient trend. In contrast, n-3 fatty acid contents and the n-6/n-3 ratio showed marked differences along farms types (Fig. 2).

The predicted overall **sensory quality scores** combining tenderness, flavor, juiciness, and overall liking, and calculated using the 3G model did not differ between farm types, but varied a lot within-system. All systems were capable of producing beef of various eating quality level.

There is not a single farming system outperforming all others in term of intrinsic quality. The benefits of grazing systems mainly concern nutritional traits, but grazing does not improve all traits (e.g. vitamin B5) and may have an adverse effect on the sensory properties of ready-to-eat products when consumers are not provided with information about farmers' practices.

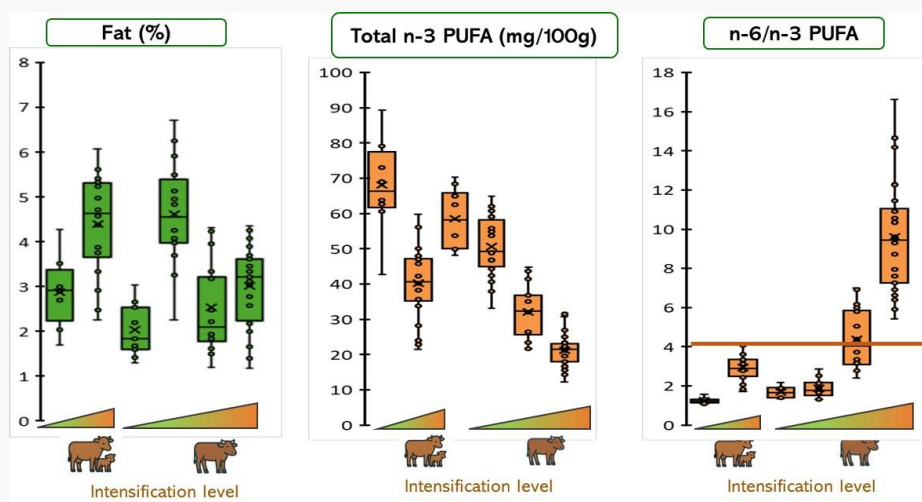


Fig 3. Nutritional traits related to intensification level for both suckler beef farms and fattening cattle farms.

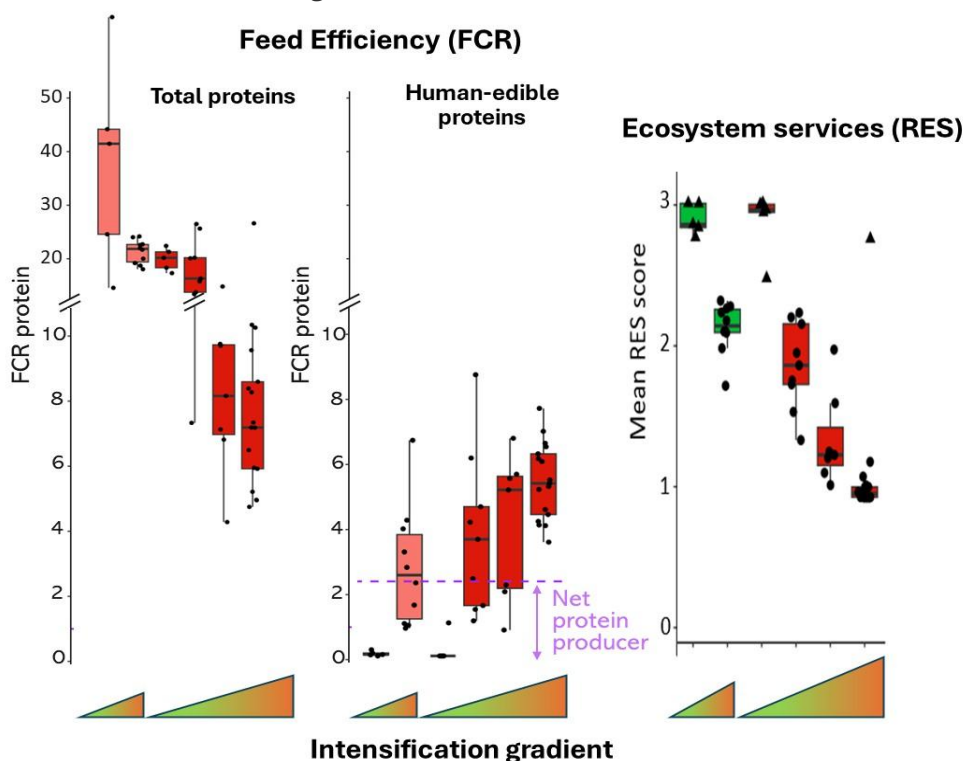


Fig 4. How intensification affects gross and net feed efficiencies* and regulating ecosystem services (C).

*Kg of feed proteins (all proteins and human-edible proteins used to produce 1 kg of beef

European beef production encompasses a wide diversity of farming systems, ranging from low-input, grass-based farms to high-input, housed systems with maize silage and concentrates, with mixed systems between these two extremes. Beef from grass-based systems contained at least twice as much n-3 fatty acids as beef from the most intensive systems. Carcass characteristics varied substantially among farming systems, without any clear relationship to either meat sensory quality or the degree of farming-system intensification.

Grass-based systems also offer major extrinsic advantages. Many grass-based beef farms are net producers of human-edible protein, whereas intensive systems rely more heavily on feeds that compete with human food. They also provide greater regulating ecosystem services and better animal welfare indicators. However, these systems generally have lower productivity, while their beef did not differ in sensory eating quality from that produced in more intensive systems.

An important finding is that, when considering the “One Quality” of beef, no farming system consistently outperformed all others across all quality traits. Grass-based systems performed best in terms of nutritional value, ecosystem service provision, feed-food balance and potentially animal welfare, whereas more intensive systems excelled in productivity and efficiency. Ultimately, each beef farming system offers its own unique combination of quality attributes.

The considerable variability observed among farms operating under similar production conditions highlights the potential for significant improvements through better management practices, without necessarily changing the production system itself. Such improvements could enhance product consistency, processing performance and consumer satisfaction while maintaining production efficiency.

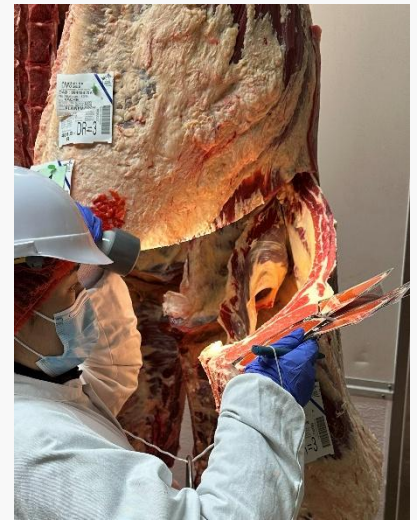


Fig 5. Grading of carcasses for marbling and meat color

Key references: Caumette et al. (2026),
Mouhanna et al. (2026), animal