How to improve nutritional quality

in milk, beef and chicken meat

INTAQT partners analysed the nutritional composition of milk, beef and chicken meat from a network of European farms, representing different levels of intensification. The traits include proximate chemical composition, fatty acid profile, vitamins A, D and E, group B vitamins, minerals and trace elements, and several bioactive compounds.
The results indicate significant differences between production systems for several traits, but a clear pattern according to intensification was lacking for many traits.

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In the INTAQT project different nutritional quality traits were analysed in summer and winter milk, beef loin and chicken breast and thigh meat samples from 89, 55 and 91 European farms respectively, representing husbandry systems along a gradient of intensification.

The traits included proximate chemical composition, fatty acid profile, vitamins A, D and E, group B vitamins, minerals and trace elements – all in milk and meat -, phospholipids and protein fractions and variants in milk samples, and histidine-containing dipeptides and collagen in meat samples. Amino acid composition and digestibility were also analysed in selected chicken samples.

Overall, variability in nutritional quality was primarily associated with the feeding regimen in milk and beef and with age at slaughter in beef, whereas in chicken meat the use of fast-growing vs. slow-growing strains was the main determinant. The lack of a clear pattern according to intensification for many traits suggests that strategies to improve nutritional quality traits should focus on product-dependent specific farming practices.

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Nutritional quality of chicken breast and thigh

A total of 4,550 samples were collected on 91 farms from Italy, France, Switzerland, Belgium and Poland. This farm network represents typical husbandry systems along a gradient of intensification. The chicken farms were separated in six typologies, from low to high intensification, based on the indicators outdoor range, genetics (growth rate) and slaughter weight (Fig. 1)

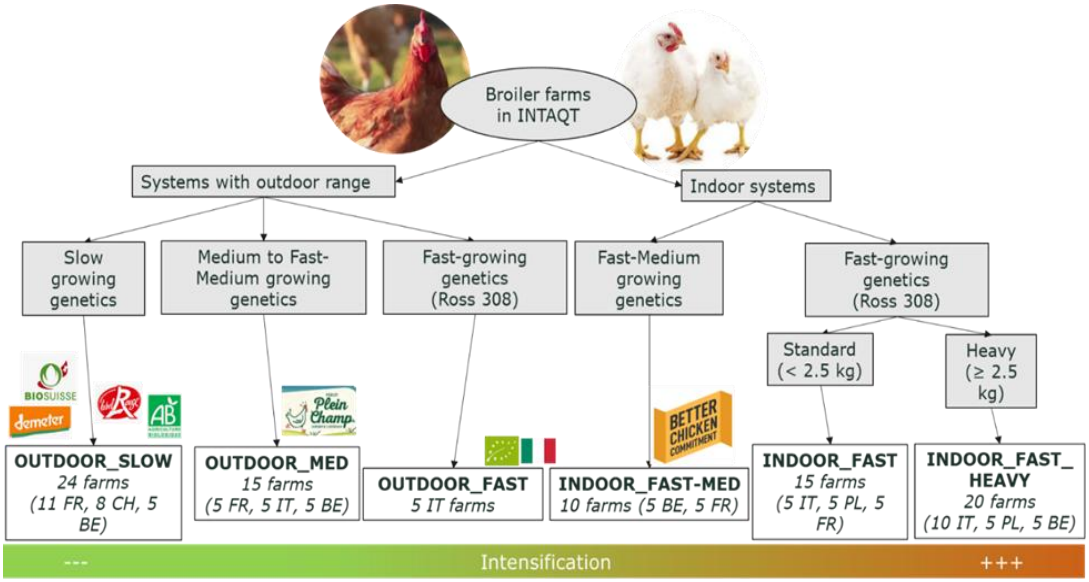

Fig. 1: Typology of chicken farms along a gradient of intensification

Meat from fast-growing strains in indoor systems compared to slower-growing strains with outdoor access had a lower protein content and protein digestibility, a higher fat content, a lower content of histidine-containing dipeptides (Fig. 3), and a higher risk of exceeding the water/protein regulatory limits (Fig. 2). The selenium and vitamin B6 content was also higher in the outdoor systems. There were significant differences between farm typologies for several other traits; however, without a clear pattern across the gradient of intensification. Large differences in nutritional composition were also noticed between breast and thigh meat.

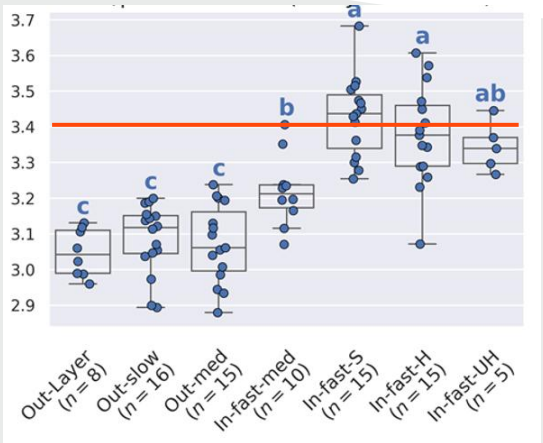

Fig. 2: Water-to-protein ratio in chicken breast. Fast-growing strains have a risk of exceeding the EU regulatory limit of 3.4.

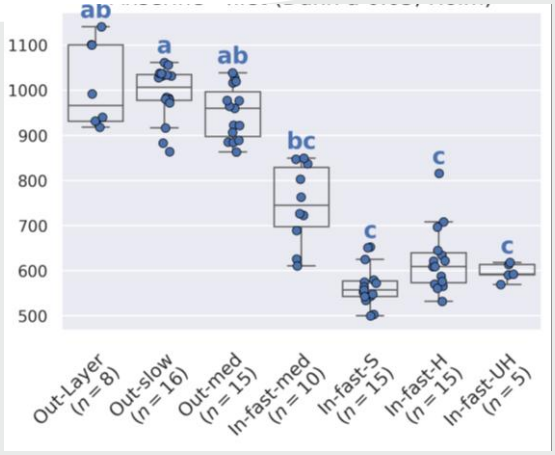

Fig. 3: Anserine content in chicken breast (mg/100g).

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Nutritional quality of beef

A total of 550 loin samples were collected on 55 farms from France, Switzerland, Italy, Spain and UK (2-8 animals per, summer and winter season). The various cattle farms were classified into 6 groups according to the age of the animals (at fattening and slaughter), whether or not the animals grazed, and the proportion of concentrate feed and maize silage in their diet (Fig. 4).

Fig. 4: Typology of beef farms along a gradient of intensification

Large differences were noticed between farm typologies for most traits; however, there was seldom a clear pattern according to the gradient of intensification.

- Intramuscular fat was higher in Suckler_HighI and Grass_MedI than in the other systems.
- Carnosine content was lower in Suckler_HighI than in the other systems.
- As expected, omega-3 polyunsaturated fatty acids and vitamin E content were higher in pasture-based systems.
- B-vitamin contents displayed differences between systems without a clear pattern. Vitamin B12 differed most and was highest in Ind_MedI and lowest in Grass_MedI.
- Heme iron and total iron were higher in Suckler_HighI and Grass_MedI than in the other systems, whereas the opposite was found for selenium. Only small differences between systems were noticed for zinc.

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Nutritional quality of dairy

In total, 81 farms were sampled in France, Italy, Switzerland, Germany and Ireland by collecting 394 tank milk samples over a span of around 2 years to obtain representative samples from the grazing season in summer and the winter indoor season. Two areas of intensification were considered: the inputs to animals (i.e. amounts of concentrates or silage maize) and the inputs to cultivated land used for feed production (i.e. nitrogen fertilizer and pesticides) (Fig. 5).

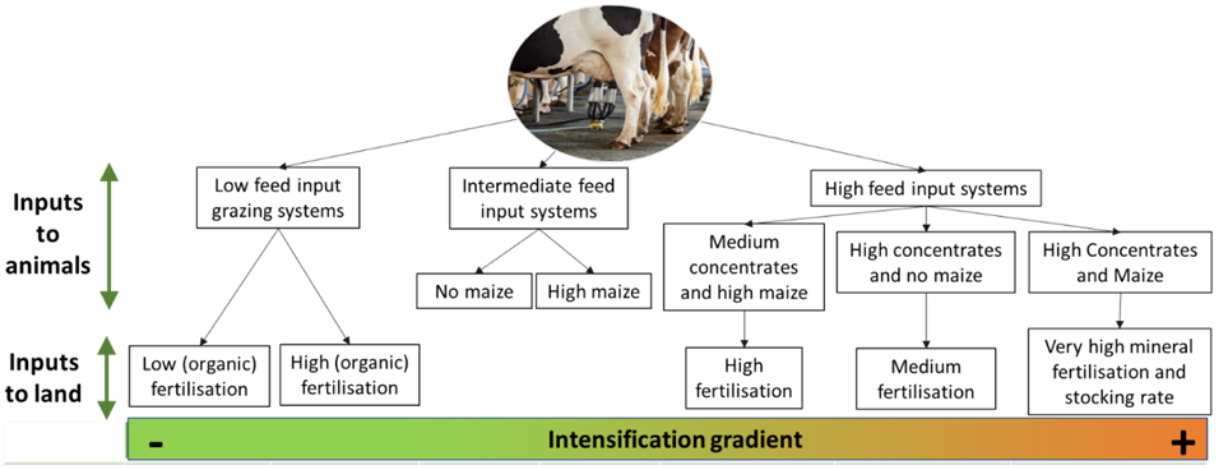

Fig. 5: Typology of dairy farms along a gradient of intensification

Significant differences were noticed between production systems for many traits.

- The lowest fat content was reported in both summer and winter milk from high-input (HI) concentrate systems, while the highest protein content was reported in HI systems using a combination of high concentrate and maize, as well as in low-input (LI) systems. No clear trend relating to intensification was evident for any of the gross composition traits.
- Differences in protein fractions and variants and in phospholipids were rather small.
- Milk from LI systems had a higher Ca content compared to medium-input and HI systems. Differences were also noticed for other elements (e.g., Cu, Zn, Fe, Mn), but these were not linked to LI or HI systems.
- Vitamin E content was highest in LI systems. Considerable differences between systems were found for several B-vitamins, in particular vit B12, however, without clear pattern according to level of intensification.
- Whereas several major and minor fatty acids showed only small or modest differences between systems, the milk from farms that used grass as the main source of forage had approximately twofold higher concentrations of omega-3 fatty acids and c9t11 CLA compared to maize and concentrate-based systems.

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