COMPARISON OF MEAT QUALITY CHARACTERISTICS OF RETAIL BEEF OF DIFFERENT ORIGIN

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Background

Variation in beef quality is large and due to many factors, i.e. differences in genetic background, sex, age, management, nutrition etc. In Belgium, beef cattle are mostly of the Belgian Blue breed and fattened indoors on high-concentrate diets. However, at the retail level, imported meat from more extensive grass-based production systems is available and is labelled accordingly. Often, these meats have a positive image due to their more 'natural' character. In addition, the EU policy aims at stimulating extensification, and maximal use of forage in beef fattening systems is recommended. It is therefore worthwhile considering differences in meat quality at the consumer level, with respect to both sensory traits and health aspects. It was shown that grass-fed animals yield meat with a beneficially lower *n-6:n-3* ratio and a higher CLA content than grain-fed animals (Enser et al., 1998; Shantha et al., 1997). The greatest sensory difference appears to be in the flavour and has been attributed for grass-fed beef to an intense milky-oily, sour and fishy flavour or a grassy flavour (Griebenow et al., 1997; Larick et al., 1987). Research on tenderness and juiciness shows contradictory results (Chastain et al., 1981; Owens & Gardner, 1999).

Objective

To compare meat quality characteristics of retail beef samples of four different origins, either locally produced or imported meat. Origin of the meat refers to partially known differences in genetics, nutrition and management. Hence, differences in meat quality cannot be attributed to one or another factor, and are only relevant with respect to consumer perception.

Material and methods

Fresh beef samples of four different origins were bought at the retail level. Meat of either Belgian Blue and Limousin animals originated from local farms, commonly applying intensive indoor fattening sysems. Beef of Irish and Argentine origin was imported from the respective country and labeled accordingly. Little information was available on the background of these meat samples, but it can be assumed these samples originated from more extensive grass-based production systems. For each origin, 8 samples from 2 muscles (*M. semimembranosus* (SM) and *M. longissimus lumborum* (LL)) were purchased. The ripening time was 22 and 29 days for the Irish and Argentine beef respectively. For the Belgian Blue and Limousin samples, the ripening time was standardised at 14 days. Samples were frozen before analysis. Warner-Bratzler shear force was measured with a Lloyd TA500 Texture Analyser on cooked samples (water bath heating at 75°C for 1 hour). A ranking test for flavour intensity was performed by a 10 member sensory panel on 3x3x2 cm meat samples grilled for 2 minutes. The ranking order was converted to a score and higher values correspond to a higher flavour intensity. Samples of 10 g were taken for intramuscular fat extraction with chloroform/methanol (2/1; v/v) and fatty acids were analysed on GC. Collagen content (ISO/DIS 3496.2), sarcomere length and CIELAB colour values (L*, a*, b*) were also determined.

Results and discussion

Sensory meat quality traits (Table 1). Beef samples from Belgian Blue and Limousin animals had a higher L* value and a lower a* value, which points out the paler colour of these intensively reared animals. The lowest and highest shear force for *M. longissimus lumborum* was found in the Argentine and Belgian Blue samples respectively, which may be partly explained by differences in ageing time. The opposite was found for *M. semimembranosus.* Irish beef samples contained most collagen. No significant differences between meat origins were found for sarcomere length. Results of the ranking test for flavour intensity showed that the Argentine and Irish beef samples had a more intense flavour than the Belgian Blue and Limousin samples (Table 1). This may be partly related to their significantly higher fat content, although other factors may also be involved.

Fatty acid composition (Table 2). In both muscles, the proportion of poly-unsaturated fatty acids (PUFA) increased with a decrease of the intramuscular fat content (Belgian Blue < Limousin < Irish < Argentine), while the absolute PUFA content (mg/100g muscle) barely changed (Table 2). A three- to five-fold higher content of *n-6* fatty acids was found in the Belgian and Limousin samples, corresponding with their expected high-concentrate feed background. The content of the different *n-3* fatty acids was significantly higher for the Irish and Argentine samples, confirming their expected grass-based diet background (data not shown). The amounts were in accordance with literature findings (Enser et al., 1998; Marmer et al., 1984; Miller et al., 1981). Thus, the *n-6/n-3* ratio was more favourable for the Irish and Argentine beef. CLA content varied between 4 and 6 mg/g fat for the Limousin and Belgian Blue samples and varied around 9 mg/g fat for the Irish and Argentine samples. Shantha et al. (1997) also found a higher CLA content in grass-fed beef samples. Such high values were however not found in bulls finished on a high-concentrate diet including linseed as an *n-3* source (Raes et al., this conference).

Conclusions

Differences between retail beef samples of 4 different origins corresponded with expected differences based on literature findings. Differences in sensory meat quality as well as in fatty acid composition were found.

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Table 1. Mean CIELAB colour values (L, a*), shear force, sarcomere length and collagen content for M. longissimus lumborum (LL) and M. semimembranosus (SM) muscle samples (n=8 each) of 4 different origins.*

		CIE L*	CIE a*	shear force (N)	collagen (mg/g)	sarcomere length (μm)	flavour intensity*
Belgian Blue	LL	41.7 ^{b}	20.7 ^{b}	40.3 ^{b}	5.2 ^{b}	1.74	1.7 ^{a}
	SM	38.5 ^{z}	23.2 ^{y}	32.3	5.6 ^{y}	1.84	1.8 ^{x}
Limousin	LL	34.6 ^{a}	21.7 ^{b}	36.8 ^{a,b}	6.9 ^{a}	1.79	1.9 ^{a}
	SM	36.2 ^{x,z}	23.9 ^{y}	35.5	5.8 ^{y}	1.99	2.1 ^{x}
Irish	LL	32.9 ^{a}	24.7 ^{a}	34.8 ^{a,b}	7.0 ^{a}	1.66	2.8 ^{b}
	SM	33.5 ^{x,y}	26.2 ^{x}	36.0	7.1 ^{x}	1.81	2.9 ^{y}
Argentine	LL	31.1 ^{a}	24.3 ^{a}	26.8 ^{b}	6.2 ^{a,b}	1.75	3.5 ^{c}
	SM	29.9 ^{x}	24.4 ^{y}	36.0	6.6 ^{x,y}	1.76	3.0 ^{y}

^{a,b,c}: significant differences between meat origins for LL ($P<0.05$); ^{x,y,z}: significant differences between meat origins for SM ($P<0.05$).
* higher values correspond to higher flavour intensity.

Table 2. Mean values for the contents of saturated (SFA), mono-unsaturated (MUFA) and poly-unsaturated fatty acids (PUFA) (expressed in mg/100 muscle and in % total fatty acids) and for important nutritional parameters in M. longissimus lumborum (LL) and M. semimembranosus muscle samples (n=8 each) of 4 different origins.

		Belgian Blue	Limousin	Irish	Argentine
mg/100 g muscle					
SFA	LL	338 ^{a}	506 ^{ab}	1624 ^{bc}	1337 ^{c}
	SM	173 ^{a}	365 ^{ab}	1047 ^{c}	920 ^{bc}
MUFA	LL	269 ^{a}	472 ^{a}	1556 ^{b}	1068 ^{ab}
	SM	130 ^{a}	338 ^{ab}	1225 ^{c}	1020 ^{bc}
PUFA	LL	197	197	255	208
	SM	208	244	219	215
% total fatty acids					
SFA	LL	36.2 ^{a}	36.6 ^{a}	42.0 ^{b}	44.9 ^{b}
	SM	27.8 ^{a}	32.7 ^{b}	37.2 ^{bc}	39.5 ^{c}
MUFA	LL	31.9 ^{a}	37.0 ^{ab}	45.0 ^{c}	40.3 ^{bc}
	SM	21.8 ^{a}	31.3 ^{b}	45.1 ^{c}	43.8 ^{c}
PUFA	LL	22.0 ^{a}	17.2 ^{a}	7.03 ^{b}	7.93 ^{b}
	SM	34.4 ^{a}	25.1 ^{b}	10.1 ^{c}	9.86 ^{c}
Important nutritional parameters					
P:S	LL	0.45 ^{a}	0.35 ^{a}	0.10 ^{b}	0.10 ^{b}
	SM	0.77 ^{a}	0.55 ^{a}	0.16 ^{b}	0.14 ^{b}
n-6/n-3	LL	6.79 ^{a}	4.96 ^{b}	2.79 ^{c}	2.52 ^{c}
	SM	5.43 ^{a}	5.67 ^{a}	2.38 ^{b}	2.53 ^{b}

^{a,b,c}: significant differences between meat origins ($P<0.001$).

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