MEAT QUALITY IN FOUR MUSCLES OF HYPERTROPHIED PIEMONTESE AND BELGIAN BLUE AND WHITE YOUNG BULLS

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Introduction

It is well documented that hypertrophied cattle have meat with paler colour, higher nitrogen content, lower fat percentage and higher tenderness than normal animals (Boccard, 1981). An extensive program of research, carried out in our Department in order to characterize the hypertrophied Piemontese animals in comparison to normal Piemontese and hypertrophied Piemontese x Friesian crosses, confirmed the better chemical, physical and sensory characteristics related to muscular hypertrophy (Destefanis *et al.*, 1993; Barge *et al.*, 1993; Destefanis *et al.*, 1994). The aim of this investigation was to compare Piemontese with the Belgian Blue and White breed, which seems to differ from the general situation, because, according to the results of Uytterhaegen *et al.* (1993), normal subjects have meat with lower shear force than hypertrophied subjects.

Material and methods

The experimental design included 23 Belgian Blue and White (B) and 23 Piemontese (P) young bulls reared at the experimental farm of our Department. The animals were fed with concentrate and mixed grass hay in order to meet the nutritive requirements for 1.2 kg daily weight gain, according to feeding standards for the late maturing cattle (INRA, 1988). B and P animals were slaughtered at 557 kg and 553 kg average live weight respectively. After 7 days of cooling at 2°C, from the right side of each carcass portions of *longissimus thoracis et lumborum* (LTL), *semitendinosus* (St), *supraspinatus* (Ss) and *pectoralis profundus* (PP) were taken. From LTL, 4 steacks were taken across the long axis of muscular fibres, the 1st in correspondence with *longissimus lumborum* (LL) and the following with *longissimus thoracis* (LT). The 1st steak, 4 cm thick, was employed for colour measurement (Hunter system; Minolta CR 331C chromameter). On the same steak the cooking losses of the sample (70°C for 30 min) were measured. and expressed as a percentage of the initial weight. Then, the shear force (kg) of 8-10 cylindrical cores of 2.54 cm of diameter, taken in parallel to muscular fibres, was measured by means of an Instron 1011 equipped with a Warner Bratzler shear and calibrated on a slipping speed of 100 mm/min. The 2nd steak, 1.5 cm thick, was used for drip loss determination (48 hrs at 5°C), according to Lundström and Malmfors (1985); the loss was calculated like the water bath losses. The 3rd steak, approximately 2 cm thick, was used for chemical analysis (AOAC, 1971). The 4th and 5th steaks, 1.9 cm thick, were employed for sensory analysis, performed by a trained panel on the basis of an 8-point structured scale, where 1 and 8 are the minimum and the maximum score. Sensory characteristics concerned: appearance of raw meat, tenderness (ease of sinking, friability and residue after chewing), initial and sustained juiciness and overall acceptability. The cooking method is described in Destefanis *et al.* (1993). On the average, each sample was examined by 7 assessors and the overall judgements were 328. The same analyses, except for sensory evaluation, were carried out on the other muscles. The data of instrumental analyses were statistically evaluated by means of ANOVA (SPSS, 1992), considering breed and muscle as independent variables. The data concerning sensory evaluation were analyzed considering the scores of each assessor as repetitions.

Results and discussion

Concerning the chemical composition (table 1) the two breeds differed only for ether extract content, which resulted lower in B (0.38% *vs* 0.45%; $P<0.05$). On the contrary the muscles differed for both water and protein content ($P<0.01$). LT had the lowest water and highest protein content (75.23% and 22.59%), while the opposite occurred for Ss (77.40% and 20.38%). Moreover the protein percentage of St was significantly lower than that of PP (21.97% *vs* 21.43%). These data confirm the results reported for the hypertrophied animals (Bailey *et al.*, 1980; Boccard, 1981). It is particularly important to point out the high protein/dry matter ratio, equal (P) or superior (B) to 90%, better than the average value of 87.5% reported from Boccard (1989) for beef. Another consideration concerns the very low fat content of both breeds. This is a favourable aspect from a dietetic point of view, also in virtue of a relatively high content of polyunsaturated fatty acids (B: 26.14%; P: 23.30%).

Concerning colour (table 2), lightness of B subjects was higher than that of P subjects (38.10 *vs* 37.27), while there were no relevant differences for the other parameters. Lightness and yellowness proved higher in St (43.67 and 9.82) and lower in PP (34.35 and 7.72) in comparison with that of LL and Ss ($P<0.01$). Finally, redness of PP and Ss resulted higher than that of the remaining muscles.

For the drip loss (table 2) the interaction breed x muscle was significant ($P<0.01$). In accordance with the literature (Monin, 1990), the variability among muscles was large,with values ranging from 1.72% (PP) to 4.44% (St); particularly the drip of the latter was about 2/3 higher than that of LT. On the contrary, the mean value of the two breeds was almost similar. In this study the drip of P breed resulted slightly higher than that we observed in a previous investigation (Destefanis *et al.*, 1994), where Piemontese normal and hypertrophied subjects were compared: in normal animals the mean of the same four muscles proved approximately (but not significantly) 10% lower than that of hypertrophied subjects. By considering only LT muscle, a similar trend, even if in different experimental conditions, was observed by Uytterhaegen *et al.* (1993) for Belgian Blue and White breed, in which the drip loss of normal young bulls was about 25% lower than that of hypertrophied. The cooking loss of B (table 2) differed from P (32.16% *vs* 32.77%; $P<0.05$). Compared to variability between breeds, the variability among muscle was large, but not to the extent observed for the drip loss. The cooking loss resulted significantly higher in Ss (34.95%) and St (34.27%) compared to PP (31.81%) and in this latter in comparison with LL (28.83%).

No significant differences were observed between the two breeds for the shear force: 8.73 kg for B; 8.58 kg for P. However this difference proved higher in LL (6.64 *vs* 6.19 kg; -6.8%), whereas the shear force of Ss in B subjects was lower than that of the P subjects. The shear force resulted lower ($P<0.01$) in LL compared to the other muscles and in Ss in comparison with St and PP. The values ranged from 6.41 kg to 10.33 kg. Compared to the mean values of shear force on raw meat observed in a previous investigation (Destefanis *et al.*, 1993), the cooking produced in the hypertrophied Piemontese subjects a lowering of the shear force of about 30%. For LT muscle values of 6.1 kg for Belgian Blue and White (Uytterhaegen *et al.* 1993) and 5.7 kg for Charolais (Crouse *et al.* 1991) have been reported. However it is important to point out that for shear force and cooking losses it is difficult to compare the results of different trials because of the different methodology adopted (cooking system, size and shape of the sample, the shear device).

With regard to sensory analysis (table 4), significant differences between breeds were observed for the three tenderness characteristics, sustained juiciness and overall acceptability, for which P obtained better scores. The significance level was 5% for all the parameters.

except for the ease of sinking (1%). It is important to emphasize that the results regarding tenderness were consistent with those obtained for the shear force of LL. On the whole the scores were in any case high, with values around 6. It is well known that the hypertrophied cattle are appreciated for their eating quality and at the same time for their very low fat content. However, based on our experience we can suppose that in such lean animals a further reduction in fat content could affect the organoleptic characteristics of meat. In fact the lower scores for tenderness and prolonged juiciness were obtained for B subjects, which also had fat percentage lower than subjects of the Piemontese breed in all muscles, but especially in LT (0.34% *vs* 0.45%).

Conclusions

The results indicate that the breed affected to a limited extent the examined parameters. The Belgian Blue and White subjects had lower ether extract content and cooking losses, while the Piemontese young bulls showed lower shear force for the *longissimus lumborum* and better sensory characteristics. On the contrary, the muscle was an important factor of variability, for all but one the considered parameters.

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Table 1: chemical composition

	Water (%)			Protein (%)			Ether extract (%)		
		B	P		B	P		B	P
LT	mean	76.24	76.16	mean	21.68	21.50	mean	0.38a	0.45b
St	75.27a	75.30	75.24	22.59d	22.64	22.54	0.39	0.34	0.45
Ss	75.96b	75.96	75.96	21.97c	22.03	21.90	0.42	0.41	0.42
Pp	77.40c	77.43	77.37	20.38a	20.56	20.20	0.46	0.42	0.49
	76.18b	76.27	76.08	21.43b	21.50	21.36	0.39	0.36	0.43

Table 2: colour and water holding capacity

	Lightness			Redness			Yellowness			Drip losses (%)			Cooking losses (%)		
		B	P		B	P		B	P		B	P		B	P
LTL	mean	38.10b	37.27a	mean	22.21	22.61	mean	8.46	8.50	mean	2.80	2.86	mean	32.16a	32.77b
St	36.39b	36.81	35.98	22.02a	21.70	22.34	8.18b	8.19	8.17	2.64	2.33	2.95	28.83a	28.35	29.31
Ss	43.67c	43.50	43.84	22.00a	21.88	22.13	9.82c	9.65	10.00	4.44	4.86	4.02	34.27c	33.96	34.59
Pp	36.32b	37.47	35.18	22.75b	22.76	22.74	8.19b	8.42	7.96	2.51	2.48	2.54	34.95c	34.67	35.24
	34.35a	34.62	34.07	22.87b	22.51	23.22	7.72a	7.57	7.87	1.72	1.51	1.93	31.81b	31.65	31.97

Table 3: shear force (kg)

		B	P
LL	mean	8.73	8.58
St	6.41a	6.64	6.19
Ss	9.62c	9.93	9.30
Pp	8.26b	7.91	8.60
	10.33c	10.44	10.21

Table 4: sensory characteristics

	Appearance	Tenderness			Juiciness		Overall acceptability
		ease of sinking	friability	residue after chewing	initial	sustained	
B	6.11	6.43a	6.19a	5.96a	5.83	5.44a	6.14a
P	6.24	6.67b	6.40b	6.17b	6.01	5.67b	6.34b

a, b, c, d: means in the same row or column with different letters differ (P<0.05)