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THE INFLUENCE OF BREED TYPE ON TEXTURE AND SENSORY CHARACTERISTICS OF BEEF MEAT

G. DESTEFANIS, A. BRUGIAPAGLIA and M.T. BARGE

Dipartimento di Scienze Zootecniche, via Genova, 6, 10126, Torino, Italy

INTRODUCTION

It is well known that double muscled cattle have higher dressing percentage and lean meat yield (Ménissier, 1980). Also the heterozygotes for the double-muscling gene seem superior to normal cattle for most carcass traits (Baker and Lunt, 1989).

The evaluation of meat quality is more complex because of the difference in the used criteria and consumers' customs, especially when muscular hypertrophy is concerned. In Europe the meat of double muscled animals, although with colour and taste less intense, is particularly appreciated for tenderness (Boccard, 1981), while in the United States, according to Thiessen and Rollins (1982), a real advantage of hypertrophied animals for meat quality is controversial. Recently, Tatum et al. (1989) showed that F_1 Piemontese steers produce lean carcasses with superior muscle yield of very tender beef and suggested that the use of Piemontese sires in crossbreeding could meet U.S. consumer desires for lean, palatable beef.

The aim of this work is to contribute to a better knowledge on the organoleptic properties of the longissimus thoracis from young bulls with variable expression of double muscling and to analyze the shear force of different muscles in the same subjects.

MATERIALS AND METHODS

A total of 46 young bulls, of which 12 hypertrophied (H) and 12 normal (N) Piemontese, 10 F_1 hypertrophied Piemontese x Friesian (H x F) and 12 Friesian (F), were reared at live weight of 458, 459, 470 and 479kg respectively. The animals were fed with mixed grass hay and concentrate in order to meet the nutritive requirement for 1kg daily gain, according to feeding standard for late maturing cattle (INRA, 1988).

After slaughtering, the right sides were refrigerated seven days at 2°C. From each side the following samples were taken: longissimus thoracis (LT), between 12th and 13th thoracic vertebra, for sensory analysis; longissimus lumborum (LL), between 13th thoracic vertebra and 1st lumbar vertebra, dorsal portion of semitendinosus (St) and supraspinatus (Sp), cranial portion of pectoralis profundus (PP), for Warner-Bratzler shear measurement.

Sensory analysis was performed by seven assessors, selected and trained according to the procedures outlined by AMSA (1978), already employed in previous experiences of beef meat evaluation. The panel in 10 sessions gave a total of 263 judgements.

Sensory characteristics concerned the appearance of raw meat, the tenderness (ease of sinking, friability and residue after chewing), the initial and sustained juiciness and the overall acceptability. These parameters were evaluated using an 8-point structured scale, where 1 and 8 were minimum and maximum score.

The steaks were cooked on a grill, preheated at 250°C, to an internal temperature of 70°C, monitored with a thermometer carefully placed and maintained in the centre of the sample. After cooking, the steaks were cut into cubes of 1.3x1.3x1.9cm (AMSA, 1978), two of which were immediately served to each assessor.

The shear force was determined with an Instron model 1011 equipped with a Warner-Bratzler shear attachment; the maximum force required to shear cylindrical cores of 2.54cm in diameter was expressed in kilograms. Eight cores, taken parallel to the muscle fibres, were removed from each sample. The measurement was carried out on raw meat for a practical reason and because previous research (Destefanis et al., 1990) showed that the correlation between shear force and sensory characteristics was higher when the analysis was performed on the raw meat rather than cooked meat.

The data were analyzed with the SAS procedure GLM type III (SAS, 1985). The model used to estimate the means was the following:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk}$$

where:
- μ = general mean;
- α = fixed effect of ethnic group (i = 1 to 4);
- β = fixed effect of assessors (j = 1 to 7) or muscles (j = 1 to 4);
- $\alpha\beta$ = interaction ethnic group x assessor or ethnic group x muscle;
- ϵ = random error.

RESULTS AND DISCUSSION

The results of sensory analysis are reported in Table 1. Concerning appearance, significative differences among the groups were observed, except between H and HxF. The three parameters of tenderness showed the same trend. The scores of F group were always lower ($P<0.01$) then those of other group, while H differed from N. The H group significantly differed ($P<0.05$) from F in the initial and sustained juiciness. The F group showed an overall acceptability lower than the other groups, except N, which differed from H.

It should be pointed out that the `assessor' factor was statistically significant for all parameters, likely depending on the different number of scores expressed by each assessor for each group; on the other hand the interaction ethnic group x assessor was never significant.

The results indicate that the meat of the hypertrophied Piemontese young bulls appeared better than that obtained from Friesian subjects for all sensory characteristics and also better than that of the normal Piemontese for appearance, tenderness and overall acceptability.

The HxF subjects were not significantly different from the hypertrophied Piemontese, although they had a bit lower scores; they were always better than the Friesian young bulls, except for the juiciness. These results partially confirm those of previous research (Destefanis and Barge, 1988), showing that hypertrophied Piemontese young bulls had scores significantly better than those of HxF and Friesian and very similar to the ones obtained in this work.

It is worth noting that the chemical analysis on the same samples (Barge et al., 1993) showed that the longissimus thoracis of H group had a very low intramuscular fat content (0.29%). In this respect, it is known that high lean/fat ratio, together with the colour and the water holding capacity, is one of the factors positively affecting the visual judgement of raw meat, but on the other hand the fat has a favourable influence on the eating qualities of the meat. Our results seem to confirm that the fat content is an important but not determining factor for the organoleptic quality of the meat in double muscled animals (Destefanis et al., 1990; Barge et al., 1992).

Table 2 reports the values of the shear force and shows the existence of differences ($P<0.01$) among groups and muscles, but not a significative interaction between these factors. The lowest value was observed for the H group, which significantly differed from the others. HxF was better than the N and F groups.

Therefore the shear force discriminated the groups characterized by different expression of muscular hypertrophy. The mean values observed in the normal subjects (Friesian and normal Piemontese) and in HxF were respectively 50% and

15% higher than the value of hypertrophied animals.

With regard to the single muscles, in all groups the shear force was lower for LL compared to that of the other muscles, while it was higher for PP in comparison with St and Sp, which were similar. It can be observed that for H group the increase of the shear force from LL (8.72kg) to PP (14.90kg) was considerably lower than in the other groups; the corresponding increase was 13.88kg for the Friesian and 10.88kg for the HxF. It is interesting to point out that groups H and HxF differed mainly for PP, less for St and Sp, and were similar for LL. This last finding can explain the similar results they displayed in the sensory analysis.

CONCLUSIONS

The results confirm that the muscular hypertrophy affects the shear force and the organoleptic characteristics of the meat: the hypertrophied Piemontese young bulls gave a higher grade product than the normal Piemontese and especially Friesian subjects, while a relevant improvement of the product has been obtained in the subjects with a hypertrophy of intermediate degree.

It was also observed that the double muscling affects the shear force of the considered muscles, although to a different extent.

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Table 1. Sensory characteristics.

	Groups H	N	HxF	F
n	69	64	59	71
Appearance	7.29^{a}	6.29^{b}	7.02^{a}	5.25^{c}
Tenderness:				
ease of sinking	6.78^{a}	6.19^{b}	6.58^{ab}	5.69^{c}
friability	6.57^{a}	6.02^{b}	6.42^{ab}	5.54^{c}
residue	6.38^{a}	5.81^{b}	6.25^{ab}	5.27^{c}
Juiciness				
initial	6.26^{a}	5.94^{ab}	5.92^{ab}	5.76^{b}
sustained	6.13^{a}	5.84^{ab}	5.72^{ab}	5.49^{c}
Overall acceptability	6.56^{a}	5.90b^{c}	5.90^{bc}	5.52^{c}

^{a,b,c} Means in the same row with different superscripts differ (P<0.05).

Table 2. Shear force values (kg).

	Groups H	N	HxF	F	Mean
n	12	12	10	12	
Muscles:					
LL	8.72	11.85	8.67	11.51	10.19^{a}
St	12.69	17.97	14.34	18.72	15.93^{b}
Sp	13.00	20.62	14.25	18.26	16.54^{b}
PP	14.90	21.54	19.55	25.39	20.34^{c}
Mean	12.33^{a}	18.00^{c}	14.20^{b}	18.47^{c}	

^{a,b,c} Means with different superscripts differ (P<0.05).