THE EFFECT OF BREEDING ON WARNER-BRATZLER SHEAR FORCE VALUES FROM FOUR DIFFERENT GENOTYPES OF BEEF CATTLE

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Background

Brazil has the larger commercial herd of cattle of the world. The *Bos indicus* cattle and his breeding are predominant in Brazilian production system, considering the tropical climactic conditions of the most part of the national territory. These animals are well adapted to adverse environments conditions, high levels of parasites and especially to an extensive pasture feed system. Meat tenderness has been reported by consumers as one of the most important sensorial attributes in beef. According to Koohmaraie (1994), the variation in meat tenderness at the consumer level is one of the biggest problems of industry. Retailers and restaurateurs also rated tenderness as one of their top quality concerns. Previous studies have shown that the meat quality of high *Bos indicus* content animals is often inferior to that of *Bos taurus* cattle (Hearnshaw et al., 1998). Researchers have indicated the importance of *Bos indicus* content on beef tenderness and palatability. According to Thompson (1998), the MSA – Meat Standards Australia database shows that for cattle that are being processed under commercial conditions *Bos indicus* content has a large effect on palatability. Those carcasses which had greater than 75% *Bos indicus* content had a palatability failure rate of 63% compared with those carcasses with less than 25% *Bos indicus* content, which only had a failure rate of 11%. Many experiments results have shown increasing proportion of *Bos indicus* content to be associated with decreased tenderness (Newsome et al., 1999; Thompson, 1999). This decreased tenderness is related to a higher activity of calpastatin, the natural inhibitor of the calpains, the most important proteolytic system associated to the aging process (Pringle et al., 1997). The magnitude of breed effect tends to vary considerably between studies and may interact with processing conditions (Thompson, 1998).

Objectives

The objective of this study was to investigate the effect of breeding on Warner-Bratzler shear force in beef from four different genotypes.

Methods

Forty-eight bull calves, weighing approximately 200 kg at twelve months of age in the beginning of the study, divided into four genetic groups, were used in the experiment. The animal groups were compounded by 12 Nelore (NE), 12 three cross ½ Santa Gertrudes ¼ Angus ¼ Nelore (TR), 12 ½ Bonsmara ½ Nelore (BN) and 12 5/8 Nelore 1/8 Simmental ¼ Belmont Red (MN). The food was basically pasture (*Brachiaria decumbens* and *Brachiaria brizantha*) with a protein-mineral supplementation. The slaughter happened as they reached a mean live weight of 430 kg. The carcasses were chilled for 24 hours, at 0° ± 1°C, prior to boning. After chilling, a section of one inch thick approximately from the *longissimus dorsi* muscle, between the 12/13th vertebras, was removed from one side of each carcass. The cuts were individually vacuum-packaged and immediately frozen to –20°C. The samples were thawed in a refrigerator at 2 to 5°C. The steaks were cooked on electric oven to a final internal temperature of 71°C. The steaks temperatures were controlled by an insertion of a thermocouple wire. The data of thawing and cooking losses were recorded. The Warner-Bratzler shear force measurements were made following the procedures described by Wheeler et al. (1998). After cooking, the samples were chilled overnight wrapped with plastic, at 2 to 5°C, before coring. Eight cores of 1.27 cm in diameter were removed parallel to the longitudinal orientation of the muscle fibers, from each steak. The cores were sheared by using a Warner-Bratzler meat shear machine (G-R Manufacturing Co., Manhattan, KS). Analysis of variance (ANOVA) was performed using PROC GLM of SAS (SAS, 1991), and least squares means were generated and separated using a pairwise *t*-test (i.e. PDIFF).

Results and Discussion

There was no significative effect of genetic group (P>0.05) on Warner-Bratzler shear force values (Table 1). Although this result has demonstrated the absence of significance, the ANOVA (Table 1) shows that the effect of genetic group approached the significance (P=0.08). The evidence of differences on Warner-Bratzler shear force between genetic groups is confirmed by a significative difference on mean values of the groups MN and BN (P<0.05), presenting 6.29 and 8.88 kg respectly, although high standards deviations were observed (Figure 1). The mean values for W-B shear force, thaw loss and cooking loss are presented in Table 2. There were no significative effect of genetic group on thaw loss and cooking loss (P>0.05), although the groups TR and MN had presented a significative difference on the means values for cooking loss (p<0.05). In general the results for shear force were considered high, since the global average found were of 7.61kg and the lowest value were 6.29 kg for MN group. Considering the criterion of "tender" longissimus reported by Wheeler et al. (1999), a Warner-Bratzler shear force value of 5.0 kg corresponds to a trained sensory tenderness rating of 5.0 or "slightly tender", so values above it cannot be classified as tender. The general low tenderness found in this study can be attributed to many factors, usually reported as responsible for meat quality decreases, as the high percentage of *Bos indicus* content of all genotypes used, the intact males gender conditions of the animals and to the absence of an aging period of the steaks and electrical stimulation of the carcass sides. Shackelford et al. (1995) evaluating the shear force of ten major muscles from *Bos indicus* and *Bos taurus* cattle, found that for 5 of the 10 muscles evaluated, *Bos indicus* inheritance increased shear force significantly and also that shear force of *longissimus dorsi* was not highly related to shear force of other muscles. The results reported by Ferguson et al. (2000), whose worked with *longissimus* samples from three genotypes (100% Hereford, 50% Brahman x 50% Hereford and 100% Brahman) showed a significant reduction in tenderness with increasing *Bos indicus* content and a increased calpastatin activity

Table 1. Analysis of variance for Warner-Bratzler shear force in beef from four genetics groups.

SOURCE	DF	Pr > F
Treatment	3	0.084
Error	40	--
Total	43	--
CV	30.57	

Table 2. Means and SD of shear force, thaw loss and cooking loss of longissimus steaks from four genetic groups.

	NE	TR	BN	MN
SHEAR FORCE, kg	8.05^{ab}	7.22^{ab}	8.88^{a}	6.29^{b}
SD	1.11	2.06	2.91	2.94
THAW LOSS, %	4.23	4.54	4.31	3.53
SD	2.58	1.74	2.07	2.50
COOKING LOSS, %	24.95^{ab}	26.88^{a}	24.93^{ab}	22.65^{b}
SD	2.69	5.29	4.29	5.71

[a,b] Means within a line that do not share a common superscript letter differ (P<0.05).

Figure 1. Mean value of Warner-Bratzler shear force from different genetic groups.

associated with higher proportions of *Bos indicus*. Generally the decrease in beef tenderness is particularly evident in case of the taste panel tenderness scores. Rubensam et al. (1998) whose studied steers from three different genotypes (Hereford, ¾ Hereford ¼ Nelore and 5/8 Hereford 3/8 Nelore), reported higher values ($P<0.05$) for Warner-Bratzler shear force (8.12 kg) and for calpastatin activity (2.65 U/g) for genotypes 5/8H3/8N than the others groups in the first day of aging. Although the most of reports have demonstrated the negative influence of the genotype *Bos indicus* on the beef quality, it is indispensable to comprehend the need to use some artifices to improve the beef eating quality to the consumer. Many authors have reported some processes and management conditions that promote benefits on quality, especially on tenderness consistency (Thompson, 2003; Ferguson et al., 2000; Newsome et al., 1999). The improvement of pre-slaughter conditions and the use of some post-slaughter processing, as electrical stimulation, tenderstretch and particularly a correct aging process, can reduce the effect of the genetic tough tendency of tropical beef, approaching to the internationals standards of quality and tenderness.

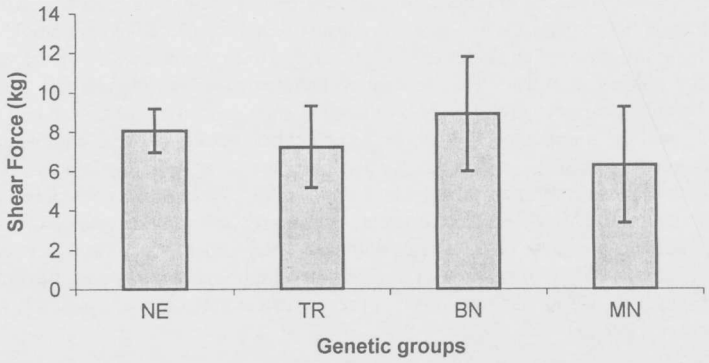

Figure 1. Mean value of Warner-Bratzler shear force from different genetic groups.

Conclusion

There were no effects of genetic group on Warner-Bratzler shear force, thaw loss and cooking loss. The predominance of *Bos taurus* content in the TR group was not determinant on reducing the shear force values. The high *Bos indicus* content in all genotypes used, associated to the gender conditions and to the absence of an aging period were implicated as a probable cause of the high Warner-Bratzler mean values observed.

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