THE RELATIONSHIP BETWEEN BEEF TENDERNESS AND AGE CLASSIFICATION IN THE SOUTH AFRICAN BEEF CARCASS CLASSIFICATION SYSTEM

CROSLEY R.I., HEINZE P.H. and NAUDÉ R.T.

Meat Industry Centre, Irene Animal Production Institute, Republic of South Africa

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SUMMARY

The relationship between the bovine's permanent incisor status and age classification of beef carcasses in South Africa was investigated for its accuracy in terms of the legitimacy of current tenderness classes. Results of Sensory analysis (SA), Shear Force (SF) and Collagen Solubility (CS) of the M. biceps femoris (BF) and M. longissimus thoracis (LT) from 100 carcasses (20 each of 0, 2, 4, 6 and 8-"tooth" animals) indicate that the current age classification used in South Africa (0-tooth: A Class; 1 to 6-tooth: B Class; 7 to 8-tooth: C Class) is reliable and accurate in reflecting expected relative tenderness of beef from carcasses so grouped.

Introduction

Beef carcasses produced and marketed in South Africa are classified chiefly according to animal age and degree of carcass fatness. Each of the three age classes (A, B and C) is subdivided into 7 fatness classes (0-6). The slaughter animal's permanent incisor status (numerical) determines the age class of its carcass: carcasses of animals which have not yet cut any permanent incisors are placed in the 'A' age class (0-tooth); those of animals with between 1 and 6 permanent incisors belong to the 'B' class (2, 4 and 6-tooth); and those with 7 or more permanent incisors fall into the 'C' class (8-tooth) (Department of Agriculture, 1992).

Age class and producer price are inversely related, which naturally affects the gross returns per animal. Even under conditions of high quality natural or planted pastures (and depending on genotype: early vs. late maturing) by the time beef animals are market-ready they have often just cut their first pair of permanent incisors. As a result, many young animals are classified in the B-age class, and therefore return relatively lower prices. In contrast, feedlot animals are generally marketed considerably younger than these "veld-produced' counterparts and will thus mostly yield A-age carcasses, which are the most sought after.

Consequently, many farmers producing beef off natural grazing have questioned whether the tenderness qualities of the 2-tooth bovine are sufficiently different from those of 0-tooth animals to warrant the present age class grouping. Equally, they argue, is the tenderness quality of the 2-tooth not significantly better than that of either the 4 or 6-tooth animal?

The aim of this research was to compare the sensory and objective tenderness characteristics of beef from carcasses of all incisor groups (within and between the three age classes), regardless of genotype.

Materials and methods

Research material and experimental design

A total of 100 carcasses (20 each of 0, 2, 4, 6 and 8-tooth bovines) were selected, irrespective of genotype, off the slaughter line of Johannesburg abattoir, City Deep, according to sex condition (heifers and steers), pH_{1h}<6, mass (180-200 kg and 220-240 kg) and fatness (low and medium). In terms of permanent incisor status, only those carcasses of specifically 0, 2, 4, 6 and 8-incisor animals were selected. The pH (measured in the M. longissimus thoracis, 25 mm from the midline, between ribs 11 and 13) was monitored to ensure that each selected carcass had been successfully electrically stimulated.

Carcasses were chilled overnight (4 °C), following which the M. biceps femoris (BF) of the silverside and the M. longissimus thoracis (LT) of the prime and wing ribs were removed from each right and left side. These muscles of right and left sides were then individually vacuum-packaged and aged at 4°C for an additional 2 and 6 days respectively. Cuts were deep frozen (-20°C) until required for analysis.

Sensory analysis

The BF was prepared under moist heat and the LT (prime rib) under dry heat (both cuts at an oven temperature of 160°C, to an internal end-point temperature of 70°C) prior to SA and SF determinations. Each cooked muscle (BF and LT) was allowed to cool for 10 min. after removal from the oven and then halved. One half was portioned for the sensory panel and the other wrapped in tin foil and stored overnight at 4°C for SF evaluations.

Amongst other sensory attributes, 10 trained panellists evaluated the samples for sustained tenderness using an 8-point scale. The most favourable score for each attribute was denoted by an 8 and the least favourable by a 1. Samples were tasted across age class, but within muscle, ageing, mass and fatness treatment groups.

Shear force determinations

A shear force test, conducted on a standardised 25,4 mm core of cooked BF and LT (prime rib) sample, generated a SF resistance curve using a Warner Bratzler (WB) shear attachment fitted to an Instron Series IX Automated Materials Testing System. Sample cores were cut perpendicular to the fibre direction. Tests were done 24 h after sensory analysis, with the samples at room temperature (18-22°C).

Collagen solubility

Collagen solubility (CS) was determined by a combination of the methods of Hill (1966) and Bergman and Loxley (1963). Standardised portions of BF and LT (wing rib) were evaluated. The hydroxyproline remaining in the filtrate is expressed as a percentage of total hydroxyproline (filtrate plus residue).

Statistical analysis

Multifactorial analysis of variance was done using the statistical programme Statgraphics Version 5 (Statistical Graphics Corporation, USA).

Results and Discussion

Multifactorial ANOVA (Table 1) shows the effect of muscle to be highly significant for all major parameters. Therefore, further analyses were performed according to muscle (Tables 2a and 2b).

Sensory analysis showed the BF samples of the 0-tooth (Class A) animals to be significantly more tender ($P \leq 0,05$) than those of 2, 4 and 6-tooth (Class B) bovines (Table 2a). BF samples of Class B were also significantly more tender ($P \leq 0,05$) than those from the 8-tooth (Class C) animals; there were no significant differences between tenderness values of 2 and 4-tooth and between 4 and 6-tooth animals. However, there were significant differences ($P \leq 0,05$) between SA values of the 2 and 6-tooth animals. The SA results of the LT (Table 2b) showed a similar tendency to those of the BF, the only difference being that tenderness values of the 6 and 8-tooth animals did not differ significantly from each other.

The ANOVA of the SF results of the BF (Table 2a) shows that beef of the 0-tooth bovine was of the lowest SF values ($P \leq 0,05$). Beef of 2 and 4-tooth animals had significantly ($P \leq 0,05$) lower SF values than that from 6 and 8-tooth animals, the 6-tooth values also significantly lower than those of 8-tooth animals. Corresponding ANOVA results for SF of the LT (Table 2b) indicate that values of all age classes did not differ significantly ($P \leq 0,05$) from each other.

The generally accepted pattern of decreasing collagen solubility with advancing age was indicated by the ANOVA of both the BF and LT values (Tables 2a and 2b). The BF results showed the collagen of 0-tooth beef as significantly ($P \leq 0,05$) more soluble than all other age classes; 2 and 4-tooth values significantly ($P \leq 0,05$) higher (more soluble) than 6 and 8-tooth values, the latter two classes being insignificantly different. LT values showed 0-tooth collagen the most soluble, although not significantly higher than that of 2 and 4-tooth animals. Collagen solubility of the LT of 6 and 8-tooth animals differed significantly ($P \leq 0,05$) from that of 0, 2 and 4-tooth animals, but did not differ significantly from each other.

The LT has been commonly used by scientists as an index muscle for carcass quality work, probably due to its popularity as an oven roast and the ease with which it can be removed from the carcass (Shorthose and Harris, 1990). However, such reasoning should not form the basis of muscle choice for carcass quality studies. Correlation coefficients (r) of muscle SA and SF values with the respective carcass values are higher and more reliable for the BF than for the LT (Shorthose and Harris, 1990; Crosley et al., 1994). In addition, Crosley et al. (1994) found that the individual cuts (prime rib, wing rib and loin), of which the Mm. longissimus thoracis et lumborum (LTL) is a part, indicated wide and inconsistent variation between them in their r-value rankings. This complicates the situation when using the LTL as an index muscle.

Therefore, in the light of the high positive correlation that the BF has with the carcass values for SA and SF (Crosley et al., 1994: r=0,76; R2=57,17 and r=0,81; R2=66,01 respectively), the age class tendencies indicated by both the SA and SF values of the BF are particularly noteworthy.

Conclusion

The SA and SF results of the BF can be taken to reflect the tendencies of the musculature of the carcass with a high degree of accuracy and repeatability, in view of results obtained by Shorthose and Harris (1990) and Crosley et al. (1994). The BF results would therefore suggest that the current age class grouping of carcasses in the S.A. Beef Carcass Classification System is accurate and reliable in reflecting expected relative tenderness value of carcasses so grouped. Although the SA results of the LT support those of the BF, the LT has been shown by Shorthose and Harris (1990) and Crosley et al. (1994) to be an unsuitable index muscle for carcass tenderness studies

References

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Tables

Table 1. Results of multifactorial analyses of variance on various parameters measured: main factors

Table 2a. Mean values and standard deviations of the various parameters of the M. biceps femoris as influenced by age class

Table 2b. Mean values and standard deviations of the various parameters of the M. longissimus thoracis as influenced by age class