SENSORY TENDERNESS OF THREE BEEF CUTS FROM CARCASSES OF DIFFERENT AGE CLASSIFICATIONS, DIETS AND AGED OVER TWO AGING PERIODS

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Abstract – MEATCO export extensively aged loin to South Africa and Europe that originates from cattle of varying ages and kept under different feeding regimes (grain fed vs. pasture) as a single product line. Age, feeding regime and aging can all affect tenderness which is an important part of the consumers eating experience. This study investigates the effect of these factors on eating quality by means of sensory evaluation. Six age groups/feeding scenarios namely, pasture finished AF (0 tooth), ABF (1-2 teeth), B-4 teeth and B-6 teeth and feedlot finished AG (0 tooth), ABG (1-2 teeth) were defined. Within each age/feeding scenario two post-mortem aging groups (36 and 55 days) were specified. The sensory panel clearly distinguished between the 2 grain fed groups (AG and ABG) and the young free range group (AF) on one side and the older free range groups (ABF, B4 and B6) on the other with the first groups scoring higher for tenderness. From this study it can be suggested that even though extreme post-mortem aging results in acceptable tenderness levels for all age groups and feeding regimes, the consumer may still pick up differences between the different age groups and feeding regimes.

Key Words – Animal age, Grain fed, Pasture, Tenderness

I. INTRODUCTION

The Meat Corporation of Namibia (MEATCO) export beef to South Africa and Europe that originates from cattle of ages varying from 2 years and less (A age- 0 tooth) to 4 years (B age- 4 to 6 teeth) [1] and kept under different feeding regimes (grain fed vs. pasture) as a single product line. In this project we focused on 3 beef cuts, namely the loin, rump and rib eye produced for a specific market in South Africa and which would normally be aged for a minimum of 36 days and a maximum of 55 days before being consumed. Tenderness is internationally accepted as the most important attribute for consumer satisfaction [2] and it has been shown that consumers can distinguish between tough and tender meat [3] and are also willing to pay a premium for meat which is guaranteed to be tender [4][5].

Three factors which would affect tenderness under the conditions mentioned above are age of the animal, diet and post-mortem aging [6]. As pasture feeding most often implies older animals and potentially tougher meat than grain fed animals, combining age groups into a single product line could have an effect on the eating experience of the consumer and may increase the risk of customer complaints. Our hypothesis is that long term post-mortem aging may overcome most of the age effect since the cuts are classified as low connective tissue cuts and an increase in age has been shown to have the highest effect on high connective tissue cuts by changing the connective tissue properties [7] [8]. Most scientific reports on aging of meat however, make comparisons between short aging (2 days) and 14, 21 or 28 days and very few if any give results on post-mortem aging beyond 28 days. In addition, no reports were found on the interaction between extreme post-mortem aging of beef and animal age.

We have therefore investigated at what age connective tissue properties, even when low in concentration, will start affecting tenderness when post-mortem aging was maximised. In addition the effect of growth path was integrated into the younger age groups.

II. MATERIALS AND METHODS

Six age groups/feeding scenarios namely, pasture finished AF (0 tooth), ABF (1-2 teeth), B-4 teeth and B-6 teeth and feedlot finished AG (0 tooth), ABG (1-2 teeth) were defined. Within each age/feeding scenario two post-mortem aging groups (36 and 55 days) were specified. The loin

(caudal end of the *m. longissimus lumborum*), rump (*m. gluteus medius)* and rib eye (cranial end of *m. longissimus*) were sampled from the left side for 36 days vacuum-packed aging and from the right side for 55 days vacuum-packed aging.

Samples were frozen and processed into 30mm steaks, vacuum-packed again and thawed at 3°C for 24h before preparation. Thawed steaks were prepared according to an oven-broiling method using direct radiant heat (200°C) [9] to an end temperature of 70°C. Coded, wrapped samples were presented to 10 trained panel members to evaluate the following: "*First bite*" (the impression of tenderness that is formed on the first bite), "*Overall tenderness*" (impression of tenderness while chewing with a light chewing action) and "*Residual connective tissue*" (the amount of residue in the mouth while chewing). Panelists had to score an 8 for extremely tender and extremely low amounts of connective tissue residue. A score of 1 was given for extremely tough and extremely high amounts of connective tissue residue.

Excel 2010 with add-on software XLSTAT was used to perform multivariate analyses (PCA) and draw frequency distributions for scores [10].

III. RESULTS AND DISCUSSION

Frequency distributions for *Overall tenderness* scores can be seen in Fig. 1 for the loin cut. Other tenderness attributes followed the same pattern (Fig. 2) and their charts are not displayed. Scores of 5 and higher described samples that are progressively more tender (5 = "slightly tender"). For the loin more than 77 to 85% of the scores in each age category of 2 grain fed groups and the A free range group (AF) were between 5 and 7 (slightly to very tender) in contrast to 47 to 57% of the older free range groups, ABF, B4 and B6. The difference between the 2 AB classes is noteworthy considering the call by parts of the industry to combine the AB and A-age classes irrespective of growth path or diet.

The other 2 cuts showed similar patterns (results not shown), with the rib eye showing the same contrast between AG, ABG and AF on the one side and ABF, B4 and B6 on the other. In addition,

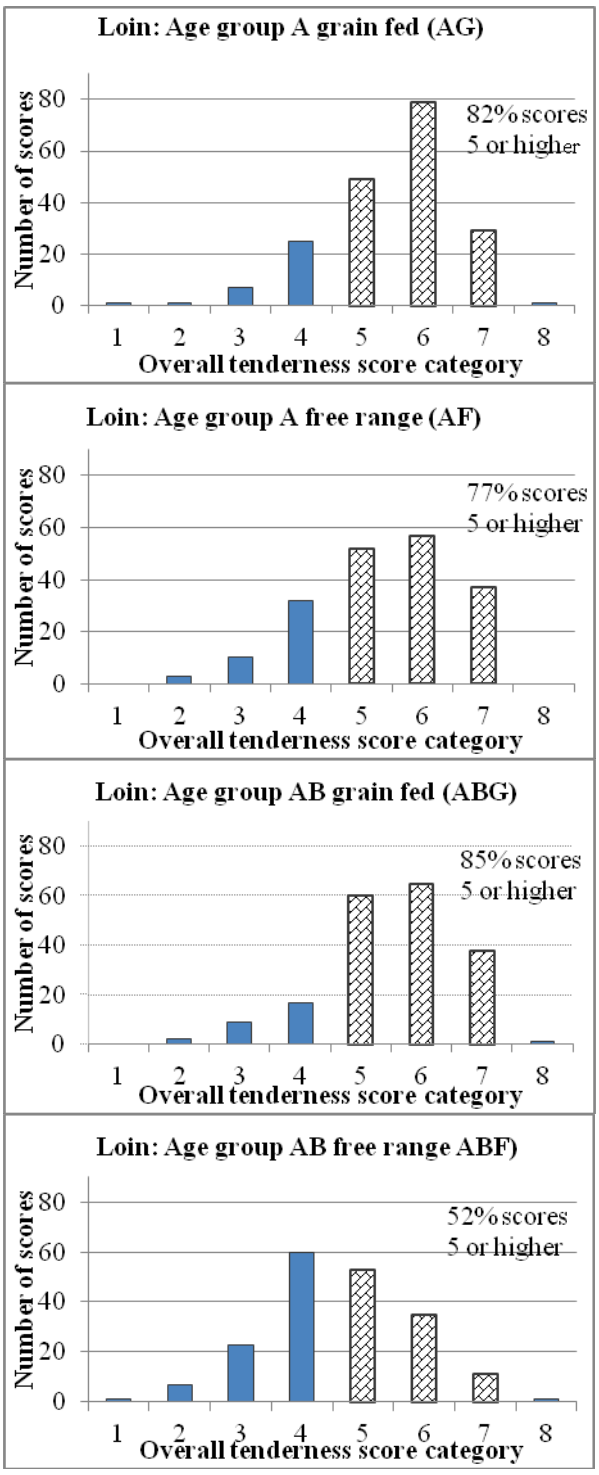

Fig. 1 Frequency distributions for overall tenderness scores (1-8) of the loin cut of 6 age/feeding regime groups

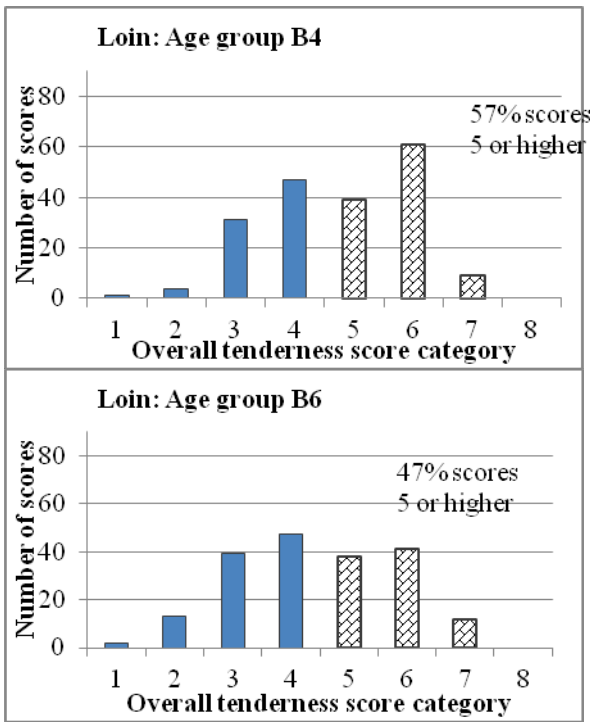

Fig. 1 (continued) Frequency distributions for overall tenderness scores (1-8) of the loin cut of 6 age/feeding regime groups

slightly fewer scores of 5, and less of 6 and 7 were recorded in AF in contrast to AG and ABG, hence the slightly lower % scores in 5, 6 and 7 (74% vs. 82 and 85%) for AF steaks compared with AG and ABG. It was also surprising that B6 had slightly more scores in categories 5 to 7 than B4 and ABF (56% vs. 49% and 51%). The rump showed higher percentages of scores of 5 and higher for both A groups (AG = 81%, AF = 71%) compared with the other 4 older groups. Both AB groups had lower average tenderness scores than their younger counter parts (results not shown) and correspondingly showed lower numbers of scores for 5 and higher. However, the grain fed AB group scored higher scores (59%) than the free range AB group (44%). B4 and B6 scored 51% and 41% scores of 5 and higher, respectively.

The differences in tenderness between the older free range groups (and in some cases ABF) and particularly the feedlot groups suggest that the collagen structure of all 3 cuts of the older free range groups developed a greater heat stability due to age than meat from the grain fed animals as reported by Bouton *et al.* [7] and Horgan *et al.* [8]. Lower growth rate of free range cattle as opposed to grain fed cattle could also have contributed to heat stability of collagen according to Allingham *et al.* [11].

The effect of post mortem aging showed significantly higher scores for *Residual connective tissue* ($P = 0.029$, results not shown) for the loin but no other tenderness related differences were found for *First bite* or *Overall tenderness* of the loin or for any tenderness related attribute of the other 2 cuts. This means that aging from 36 to 55 days did in general not improve sensory tenderness significantly. There are however two exceptions when considering the PCA biplot in Fig. 2. When only considering the 3 tenderness attributes, 98.83% of the variation could be described by the first component (F1). On this level, the loadings for the 3 sensory attributes had the same direction and magnitude indicating that treatment groups (scores) on the right side of the score chart would have higher tenderness related scores than those to the left lower. In agreement with Fig. 1,

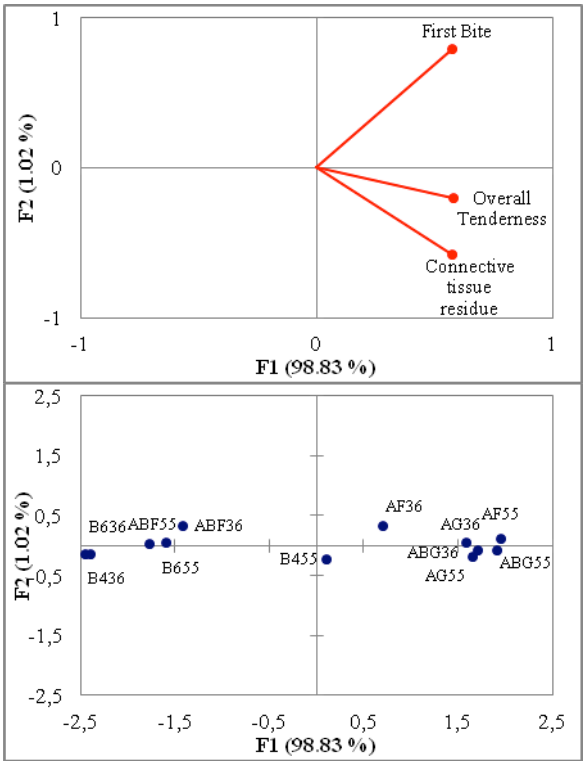

Fig. 2 Principal component analyses: Biplots showing scores (treatment groups) and loadings (attributes) for F_1 and F_2: loin

older free range groups (left) were separated from the young free range group (AF) and 2 grain fed groups (right). Within age groups, only B4 aged for 55 days seemed to score better scores than its 35 day aged counterpart. In addition, AF aged for 36 days seemed to record poorer scores than 55 day aged steaks of the same group.

IV. CONCLUSION

The sensory panel clearly distinguished between the 2 grain fed groups (AG and ABG) and the young free range group (AF) on one side and the older free range groups (ABF, B4 and B6) on the other, except for the rump where the older grain fed group (ABG) also performed poorer than the 2 A-age groups. There was no clear distinction between B4 and B6 for any tenderness attribute. The young free range group (AF) performed slightly poorer than the 2 grain fed groups for the loin and ribeye cuts.

From this study it can be suggested that even though extreme post-mortem aging results in very acceptable tenderness levels for all age groups and feeding regimes, the consumer may still pick up differences among age/feeding regime groups. A single product line may therefore result in an inconsistent eating experience for the consumer.

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