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MSA sensory testing of Fletcherview cattle

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Abstract

This project was undertaken to test the eating quality of three cuts: striploin, eye round and topside aged for four times; 7, 28, 49 and 70 days from entire and castrated male *Bos indicus* cattle that were either homozygous positive or homozygous negative for the calpastatin gene. The clipped data for the MSA sensory attributes of tenderness, juiciness, like of flavour, overall likeability, satisfaction and MQ4 scores demonstrated that consumers could not detect a difference between entire and castrated treatments in the eating quality of the striploin, eye round and topside cuts used in this study. Consumers could detect differences in eating quality between homozygous positive and homozygous negative calpastatin genotypes from *Bos indicus* male cattle. Consumers could detect differences due to the amount of time beef cuts were aged. Ageing beef cuts increased the clipped scores for tenderness, juiciness, like of flavour, overall likeability, and MQ4 and satisfaction sensory scores.

Executive summary

The use of young entire male cattle for beef production is uncommon in Australia. However, the AUSMEAT standards for grass and grain fed yearling cattle allow for the use of young entire male cattle provided that the animals are not showing signs of secondary sexual characteristics. The production benefits of utilising entire male cattle for beef production are considerable (Wainewright 2012; Fitzpatrick 2012).

Consumer sensory analysis could not differentiate between the entire male or castrate treated animals for the following beef cuts: striploin, topside and eye round for any of the clipped sensory scores: tenderness, juiciness, flavour, overall likeability, MQ4 and overall satisfaction.

Animals that were homozygous positive for the calpastatin gene marker produced topside cuts that were less tender than striploin and eye round cuts from all other genotypes for calpastatin. Ageing increased the tenderness score by 9 points from 7 to 28 days and by 13.5 points from 7 days to 70 days.

Eye rounds from animals that were homozygous positive for calpastatin produced greater juiciness scores than eye rounds from animals that were homozygous negative for calpastatin. Ageing increased juiciness scores with increasing time aged.

Consumers ranked the cuts for flavour from greatest to least as; striploin, eye round and topside. There was a difference of 8.7 points for flavour between the striploin and the topside cuts. Ageing the cuts increased the score given by the consumers by 7.3 points from day 7 to day 70.

Overall likeability for the cuts was ranked in the order of greatest to least score as; striploin, eye round and topside by consumers with 12.6 points between the striploin and topside cuts. Ageing the cuts from 7 to 70 days increased the consumers overall likeability score by 9.8 points. There was no effect due to genotype for overall likeability scores.

The consumer MQ4 scores for the cuts were ranked in the order from greatest to least MQ4 score as; striploin, eye round and topside. Ageing the cuts from 7 to 70 days increased the consumers MQ4 score by 9.4 points.

Eye rounds from animals that were homozygous positive for calpastatin produced greater satisfaction scores than eye rounds from animals that were homozygous negative for calpastatin. Ageing increased satisfaction scores with increasing time aged. There was no effect due to genotype for satisfaction scores.

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1 Background

There is significant potential to value add to entire male cattle, from northern breeding properties through grain finishing. In addition, the removal of castration from the production system carries significant animal welfare benefits to the beef cattle industry (Wainewright 2012). A recent study in north Australia demonstrated that entire male *Bos indicus* cattle produced carcasses that were 15 kg heavier than *Bos indicus* steers. This live weight advantage equated to an increase in value to the producer of $53.00/carcass (Wainewright 2012). However, the eating quality of these entire male cattle compared to the castrated animals is unknown. There is a purported perception among consumers that beef from entire male cattle is of a lower eating quality. This perception is partially supported by a known increase in the variation in meat tenderness from entire male cattle and the fact that the chronological age of entire male cattle strongly influences objective and sensory meat quality traits (Field et al. 1966). However, there is evidence that young entire male cattle may not be different to castrates for meat quality traits (Woodward et al. 2000). It has been suggested that the variation in meat tenderness from entire male cattle is due to elevated calpastatin concentrations when compared to castrates at slaughter (Morgan et al. 1993). Calpastatin is an endogenous inhibitor of calpain enzymes that are responsible for the degradation of structural proteins post-slaughter. A commercial genetic test for beef tenderness (GeneSTAR; Pfizer Animal Health 2009) that includes the calpastatin gene marker (*CAST:c2832A > G*; Barendse, 2002) is available to producers in Australia as a selection tool for beef cattle breeding programs. The CAST gene marker allowed us to test the hypothesis that homozygous positive CAST genotypes will produce lower MSA eating quality scores than homozygous negative CAST genotypes.

2 Project objectives

- To quantitatively determine if MSA consumer sensory panels can differentiate between the eating quality of *Bos indicus* calpastatin genotypes?
- To quantitatively determine if MSA consumer sensory panels can differentiate between the eating quality of *Bos indicus* entire or castrated male cattle?
- To provide increased industry knowledge on the causes of variation in the eating quality of *Bos indicus* cattle from northern Australian production systems

1. Recruited consumers, arranged test venues, conducted sensory testing to allow the comparison of Fletcherview project beef samples (264), and submitted data to MLA in accordance with MSA protocols (Books 4 & 5, Version 5.1, June 2006) as supplied by MLA.
2. Submitted DNA marker and other relevant data for the muscle samples to MLA as required by MLA.

3 Materials and methods

Animals and management

The animals were sourced from James Cook University's *Fletcherview* research station north west of Charters Towers, Queensland (20°04.603´ S / 146°15.812´ E) At weaning, *Bos indicus* calves were identified as either positively (++) or negatively (--) homozygous for the calpastatin gene marker (*CAST:c2832A > G*; Barendse, 2002), using a commercial gene marker test for beef tenderness (GeneSTAR; Pfizer Animal Health 2009). The animals were then randomly allocated to either entire or castrated treatment groups. The animals were grown out on buffell grass (*Chenchus ciliaris*) pastures at *Fletcherview* until the group reached a mean feedlot entry live weight of ≈300 kg. The animals were then relocated to the Wallumba feedlot at Miles (26°39.747´ S / 150°9.906´ E), where a finishing phase of 70 days followed. The cattle consumed a barley and sorghum based diet at the Wallumba feedlot to comply with the Ausmeat standard for Grain Fed Yearling (GFYG) beef.

Abattoir management and processing of samples

At the completion of the 70 day finishing phase, entire and castrated male cattle were transported approximately 300 km to a commercial processing facility (JBS Swift Australia, Ipswich QLD). Each carcass was electrically stimulated following slaughter and exsanguination. Carcasses from each treatment group were then processed in accordance with standard AUSMEAT carcass protocols and hung in the chiller at 1ºC using the Achilles tendon method. The time between the animal being slaughtered and entering the chiller was ~40 minutes.

In complying with MSA protocols, temperature and pH decline of the *muscularis Longisimus lumborum* adjacent to the 12th rib were measured on the left side of each carcass at approximately one hour intervals for six hours post-slaughter.

On the afternoon of processing at the abattoir, MSA graders identified the sex (entire or castrate) and genotype (Homozygous positive or Homozygous negative for the calpastatin gene markers) treatments of the carcasses by placing colored dots on the body tags. All graders had knowledge of the treatment x colour allocation prior to grading the carcasses.

The certified MSA graders collected information from individual carcasses in the chiller on a data capture unit, 24 hours after slaughter. Research staff observed and manually recorded this data. Ultimate pH and ultimate loin temperature was also recorded at 24 hours post-slaughter. When ultimate pH was known for each of the carcasses MSA personnel allocated the carcasses for sampling. A total of 24 carcasses were identified for sample collection that represented the treatment groups of sex and calpastatin genotype (entire homozygous ++, n = 6; entire homozygous –-, n = 6 and castrate homozygous ++, n = 6; castrate homozygous –-, n = 6). Primal cuts were identified on the required carcass prior to boning in accordance with MSA protocols. The cuts taken for sampling included the AUSMEAT identified cuts; HAM 2140 - Striploin, HAM2000 - Topside and HAM 2040 - Eye round. The cuts were vacuum packaged, boxed and chilled at 2°C for transport to Cosign Pty Ltd, Coffs Harbor, NSW where samples were prepared for the consumer panel assessments.

Consumer sensory testing

The consumer sensory testing was performed by Sensory solutions Pty Ltd, Sydney NSW. The recruitment of consumers and the sensory testing of 264 muscle samples were conducted in accordance with MSA protocols (MSA Protocol Books 4 & 5, Version 5.1 2006).

4 Statistical analysis

A REML model was used to analyse sensory score variables (Genstat 2012) with carcass as the random effect. The variables included in the models were sex (entire or castrate), genotype (negatively homozygous (--) or positively homozygous (++) for calpastatin), cut (eye round, striploin and topside) and ageing times in days (7, 28, 49 and 70). Two-way interactions between all of these factors were also considered and removed if they were not significant. All of the sensory score data satisfied the assumptions of normality and homogeneity of variance for the model. Differences were considered significant at P = 0.05.

5 Results

Clipped sensory scores

Clipped Tenderness

The clipped tenderness sensory score demonstrated a significant interaction between genotype and cut ($P = 0.017$). Animals that were homozygous positive for the calpastatin gene marker produced topside cuts that were less tender than striploin and eye round cuts from animals that were homozygous positive or negative for calpastatin. There was an overall effect of age ($P < 0.001$) demonstrating an increase in tenderness with increasing days aged. There was no effect of sex on tenderness score ($P = 0.6$; Table 7).

Table 1. Fitted means and SEM for MSA clipped tenderness sensory scores from an untrained taste panel consuming three beef cuts aged at four times from entire and castrated *Bos indicus* cattle that were either positively or negatively homozygous for the calpastatin gene

Factor	Level	Mean	SE
Sex	Entire	40.9	1.66
	Castrate	39.7	1.66
Age (days)	7	31.8	1.59
	28	40.8	1.59
	49	43.4	1.59
	70	45.3	1.59
Genotype x Cut	(++) x Striploin	47.8	1.95
	(++) x Eye round	44.6	2.39
	(++) x Topside	29.8	1.95
	(--) x Striploin	49.4	1.95
	(--) x Eye round	37.9	2.39
	(--) x Topside	32.5	1.95

Clipped Juiciness

The clipped juiciness sensory score, demonstrated a significant interaction between genotype and cut (P = 0.022). Eye rounds from animals that were homozygous positive for calpastatin produced greater juiciness scores than eye rounds from animals that were homozygous negative for calpastatin. There was an overall effect of age (P < 0.001) demonstrating an increase in juiciness score with days aged. There was no effect of sex (P = 0.15; Table 8) on the clipped juiciness score.

Table 8. Fitted means and SEM for MSA clipped juciness sensory scores from an untrained taste panel consuming three beef cuts aged at four times from entire and castrated *Bos indicus* cattle that were either positively or negatively homozygous for the calpastatin gene

Factor	Level	Mean	SE
Sex	Entire	42.2	1.34
	Castrate	39.4	1.34
Age (days)	7	36.7	1.41
	28	40.1	1.41
	49	42.7	1.41
	70	43.6	1.41
Genotype x Cut	(++) x Striploin	44.4	2.15
	(++) x Eye round	46.8	1.68
	(++) x Topside	32.6	1.68
	(--) x Striploin	44.6	2.15
	(--) x Eye round	40.7	1.68
	(--) x Topside	35.6	1.68

The order of cuts have changed between tables. Are you sure that the order is correct.

Clipped Flavour

The clipped flavour sensory score demonstrated no significant interactions between the four variables. There was an overall effect of age ($P < 0.001$) demonstrating an increase in flavour score with increasing days aged. There was an effect of cut ($P < 0.001$) demonstrating a ranking of cuts from greatest to least for the clipped flavour score as; striploin, eye round and topside. There was no effect of sex ($P = 0.067$) or genotype ($P = 0.4$; Table 9) for the clipped flavour score.

Table 9. Fitted means and SEM for MSA clipped flavour sensory scores from an untrained taste panel consuming three beef cuts aged at four times from entire and castrated *Bos indicus* cattle that were either positively or negatively homozygous for the calpastatin gene

Factor	Level	Mean	SE
Sex	Entire	48.2	1.04
	Castrate	45.4	1.04
Age (days)	7	42.7	1.17
	28	46.2	1.17
	49	48.2	1.17
	70	50.0	1.17
Genotype	(++)	46.1	1.04
	(--)	47.4	1.04
Cut	Striploin	51.2	0.97
	Eye round	46.7	1.27
	Topside	42.5	0.97

Clipped Overall Likeability

For the clipped overall likeability sensory score, there were no significant interactions between the four variables. There was an overall effect of age ($P < 0.001$) demonstrating an increase in likeability score with increasing days aged. In addition there was an overall effect of cut ($P < 0.001$) whereby overall likeability for the cuts was ranked by consumers in the order of greatest to least score as; striploin, eye round and topside. There were no effects of sex ($P = 0.14$) or genotype ($P = 0.70$; Table 10).

Table 10. Fitted means and SEM for MSA clipped overall likeability sensory scores from an untrained taste panel consuming three beef cuts aged at four times from entire and castrated *Bos indicus* cattle that were either positively or negatively homozygous for the calpastatin gene

Factor	Level	Mean	SE
Sex	Entire	45.1	1.29
	Castrate	42.4	1.29
Age (days)	7	37.5	1.35
	28	44.1	1.35
	49	46.1	1.35
	70	47.3	1.35
Genotype	(++)	43.5	1.29
	(--)	44.1	1.29
Cut	Striploin	49.7	1.14
	Eye round	44.5	1.45
	Topside	37.1	1.14

Clipped Meat Quality 4

For the clipped MQ4 sensory score, there were no significant interactions between the four variables. There was an overall effect of age ($P < 0.001$) demonstrating an increase in the MQ4 score with increasing days aged. In addition there was an overall effect of cut ($P < 0.001$) whereby the MQ4 scores for the cuts were ranked in the order from greatest to least MQ4 score as; striploin, eye round and topside. There was no effect of sex ($P = 0.2$) or genotype ($P = 0.8$; Table 11).

Table 11. Fitted means and SEM for MSA clipped MQ4 sensory scores from an untrained taste panel consuming three beef cuts aged at four times from entire and castrated *Bos indicus* cattle that were either positively or negatively homozygous for the calpastatin gene

Factor	Level	Mean	SE
Sex	Entire	44.5	1.24
	Castrate	42.3	1.24
Age (days)	7	37.5	1.28
	28	43.5	1.28
	49	45.5	1.28
	70	46.9	1.28
Genotype	(++)	43.2	1.25
	(--)	43.6	1.25
Cut	Striploin	49.3	1.09
	Eye round	44.0	1.37
	Topside	36.8	1.09

Clipped Overall Satisfaction

For the clipped overall satisfaction sensory score, there was a significant interaction between genotype and cut ($P = 0.002$). There was also an overall effect of age ($P < 0.001$) demonstrating an increase in overall satisfaction scores with increasing days aged. There was no effect of sex ($P = 0.5$; Table 12).

Table 12. Fitted means and SEM for MSA clipped satisfaction sensory scores from an untrained taste panel consuming three beef cuts aged at four times from entire and castrated *Bos indicus* cattle that were either positively or negatively homozygous for the calpastatin gene

Factor	Level	Mean	SE
Sex	Entire	2.78	0.045
	Castrate	2.74	0.045
Age (days)	7	2.58	0.046
	28	2.78	0.046
	49	2.84	0.046
	70	2.84	0.046
Genotype x Cut	(++) x Eye round	2.98	0.069
	(++) x Striploin	2.91	0.055
	(++) x Topside	2.48	0.055
	(--) x Eye round	2.70	0.069
	(--) x Striploin	2.94	0.055
	(--) x Topside	2.56	0.055

6 Discussion

Untrained consumers could not detect a difference due to sex in the eating quality of the striploin, eye round and topside steaks used in this study, from entire male and castrated *Bos indicus* cattle. The overall clipped MQ4 scores for entire males (44.5 ± 1.24) and castrates (42.3 ± 1.24) was lower than the required score of 46.5 for every day eating quality. However, topside steaks appear to have significantly contributed to the reduced MQ4 score for the sex treatments. Wainewright (2012) using the same carcasses as in the present study demonstrated no difference in Warner Bratzler shear force (WBSF) values for the *M. Longissimus dorsi* between entire male (5.65 kg) and castrated (5.53 kg) *Bos indicus* cattle at seven days of ageing at 4°celcius. However, entire males produced WBSF values that were greater than WBSF values for steers at 14 days (5.62kg vs. 4.79kg) and 28 days (4.28 kg vs. 3.74 kg) of ageing at 4°celcius. The striploin steaks in the present study had a mean clipped MQ4 score of 49.3 ± 1.09 aged between 7 and 70 days indicating that consumers would rank the cut from *Bos indicus* cattle as everyday eating quality. Eye round and topside steaks were not considered to be of a standard acceptable as everyday eating quality according to the MQ4 scores.

Meat quality 4 scores demonstrated no difference between homozygous positive 43.2 ± 1.25 and homozygous negative 43.6 ± 1.25 genotypes. Untrained consumers could not detect differences between calpastatin genotypes from *Bos indicus* male cattle using the MSA protocols for the cuts consumed in this study. In addition, Wainewright (2012) using the same carcasses as in the present study demonstrated no difference due to genotype for WBSF values of the *M. Longissimus dorsi.* This is in contrast to other studies that reported an increase in MQ4 scores with an increase in the number of favourable alleles for the calpastatin (*CAST*) gene (Robinson et al. 2012). Perhaps the point of differentiation between the study of Robinson et al. (2012) and this study is that Robinson et al. (2012) compared Braham cattle with no favourable *CAST, CAPN3 and CAPN1-4751* alleles with Brahman cattle with 2 favourable *CAST, CAPN3* and either 1 or 2 *CAPN1-4751* alleles. The principal investigators in the present study allocated the genotypes to the treatment groups at weaning for homozygous positive (unfavourable) *CAST* alleles or homozygous negative (favourable) *CAST* alleles and attempted to balance the treatment groups for *CAPN3 and CAPN1-4751* (0,1 or 2) alleles. It is possible that the improvement in eating quality seen by Robinson et al. (2012) with a favourable *CAST* genotype and the lack of a genotype effect in the present study may be due to an interaction between the calpastatin and calpain alleles in the treatments from both studies.

Ageing steaks from 7 to 70 days improved the clipped sensory scores of tenderness, juiciness, flavour, overall likeability and MQ4. This is to be expected as the calpain/calpastatin enzyme system causes an increase in tenderization of meat cuts with the number of days aged. Different muscles are known to age at different rates primarily due to the concentration of calpastatin in individual muscles. Hence, there was genotype x cut interactions for some of the clipped sensory scores. Homozygous positive genotypes (unfavourable *CAST* alleles) produced topside steaks that were rated as less tender than striploin and eye round steaks from both homozygous positive and homozygous negative genotypes. Eye round steaks from

homozygous positive genotypes produced greater juiciness scores than homozygous negative genotypes for eye round and topside steaks and homozygous positive topside steaks.

7 Conclusion

Untrained consumers could not detect differences in eating quality due to beef cuts derived from entire male or castrated male Bos indicus cattle.

Untrained consumers could not detect differences in meat cuts derived from homozygous positive or homozygous negative calpastatin genotypes.

Untrained consumers could detect differences in beef cuts due to ageing. As the number of days aged increased the sensory scores by untrained consumers improved.

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