AUSTRALIAN SHEEP MEAT 2. EFFECT OF SHEEP TYPE ON EATING QUALITY

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Background

Detailed testing of lamb tenderness purchased at the retail counter has shown that there is room to improve Australian lamb *(Safari, et al. 2002)*, but this also applies to New Zealand lamb *(Bickerstaffe et al., 2001)*. The Meat Standards Australia (MSA) program set in place a scheme to provide Australian consumers with a means to purchase beef of predictable eating quality *(Polkinghorne et al., 1999)*. Following this a major program of research and development has been undertaken to develop the basis for an eating quality scheme for sheep meat. A unique feature of both programs has been the use of consumers as the benchmark for establishing the impact of various pre- and post-slaughter factors on eating quality. Although the mode of operation will be different to that used in MSA, the approach of establishing the impact of production and processing factors on sheep meat eating quality has been similar.

Objective

This paper reports on a study, which examined the impact of "genotype" and age on eating quality. The only Australian work, which has reported on the impact of lamb genotype on eating quality, is that of *Safari et al. (2001)*, but in this case trained panellists were used. Further to this the eating quality of unweaned lambs has received little attention and not in the Australian context *(eg. Ellis et al., 1997)*.

Methods

Animals and management: One hundred and twenty animals were used in the experiment. These animals comprised five groups of 24 as follows; Poll Dorset or White Suffolk x Border Leicester x Merino (Second cross unweaned lambs, mixed sex, 3-4 months of age); Poll Dorset x Border Leicester x Merino (Second cross weaned lambs, mixed sex, 9 months of age); Border Leicester x Merino (First cross weaned lambs, mixed sex, 9 months of age); Merino x Merino (weaned wether lambs, 9 months of age) and Border Leicester x Merino (First cross hoggets, mixed sex, 20 months of age). Within each group 12 animals came from two different properties. All animals were run together on green pasture (grass and subterranean clover) and supplemented with lucerne hay for 5 weeks prior to slaughter.

Slaughter procedures: Animals were randomly allocated to slaughter day and slaughter group within slaughter day; they're being 2 slaughter days and 4 slaughter groups. All animals were yarded (13:00 h) on the day prior to the first slaughter and those allocated to the first slaughter day were trucked (15:30 h) to the abattoir a trip of 55 km's arriving at 17:00 h. Sucker lambs were weaned onto the truck and the mothers retained with the remainder of the animals, which were returned to the paddock. At the abattoir the animals were held in 2 pens (in slaughter groups) away from an undercover lairage area until the night slaughter of pigs had finished. Subsequently at 21:30 h they were placed in 2 pens (in slaughter groups) on grating and undercover. Remaining animals (second slaughter day) were handled in the same way and slaughtered 2 days after the first group.

Animals were slaughtered in 2 groups (n = 30) on each kill day to ensure that all carcasses could be electrically stimulated within 1 h of death. All animals were electrically stunned (head only) in a commercial abattoir and trimmed according to the specifications of *AUS-MEAT (Anon, 1992)*. Two carcasses were unsuitable for sampling, due to disease and 3 were trimmed during dressing. Hot carcass weights were recorded and the GR measured (total tissue depth over the 12th rib 110 mm from the midline) using a GR knife. Subsequently each carcass was individually subjected to high voltage stimulation (700 V, for 60 seconds at 14 pulses per second) and then chilled at 2-4°C.

Sampling and consumer testing: After 19-22 h of chilling the hindlegs (AUS-MEAT 1998 product identification number 4800) and the loin (4910) section were packed in double lined polystyrene boxes, along with bubble packs containing frozen water and then sealed and strapped for overnight refrigerated road transport. At the meat preparation laboratory the outside cut (2030) based on the m. biceps femoris was removed from the hindlegs and the full length of the loin muscle (5142) consisting of the m. longissimus et lumborum was removed from the verteberta. Subcutaneous fat and connective tissue were- removed from both cuts and the silver skin from the loin cut. Each sample cut was prepared into 5 slices of 15-mm thickness and these slices (steaks) kept frozen (-20°C) until testing.

Prior to cooking, the steaks were microwaved to raise the temperature to approximately -5°C and then allowed to thaw in foam boxes. Steaks were cooked on a Silex clam grill to an internal temperature of 65°C and each consumer presented with a total of seven warm steaks served over a 35-min session. The first sample is a link product (not from the experiment) designed to allow equilibration of the consumer scores and the data from this sample are subsequently discarded in the analysis. Following this, a further six samples were presented to each consumer. The tasting design was a Latin square, where five samples from each cut were presented in different presentational positions in a minimum of three different sessions to be each tasted by two consumers. Thus 10 consumers tested each sample. Samples of loin from 118 carcasses were tested and samples of outside from 110 carcasses giving a total of 2280 samples tested. Each consumer was asked to assess each steak for tenderness (very tough to very tender), juiciness (very dry to very juicy), liking of flavour (dislike extremely to like extremely), strength of aroma (weak to strong) and overall liking (dislike extremely to like extremely) on a continuous 100 point scale. A rating was given to each sample (unsatisfactory (no grade), good everyday (3 star), better than everyday (4 star), or premium quality (5 star)). To combine the four sensory dimensions into a single Sheep Eating Quality Score (SEQ), weighting's were formulated from a discriminant analysis. The weightings were 0.2, 0.1, 0.3 and 0.4 for tenderness, juiciness, flavour and overall acceptability, respectively. The top two and the bottom two consumer assessments for each sample were trimmed, this reducing the standard error.

Statistical analysis: Consumer scores were analysed using an analysis of variance procedure (Genstat 5.4.2, 2000) which contained fixed effects for group (second cross suckers, second cross lambs, first cross lambs, first cross hoggets or Merino), slaughter day (1 or 2), slaughter time within day (1 or 2) and the first order interaction. In a further analysis group was reduced to suckers, lambs and hoggets.

Results

Loin meat from hoggets was tougher ($P < 0.05$) than meat from sucker and first cross lambs (Table 1), but there were no other differences between groups for the sensory traits. Slaughter day or time also had no effect on the sensory traits. For the outside, the results were more complex (Table 2). Meat from hoggets and Merino lambs was tougher, less desirable (flavour and overall liking) and had a lower SEQ score ($P < 0.05$) than meat from the first and second cross lambs, but was the same as meat from sucker lambs. The differences for juiciness were less clear, but hogget meat had a score 10 points lower than meat from the first cross lambs. When suckers were compared to lambs (all

lambs) and hoggets there were no differences for the loin or outside for SEQ or rating scores. Overall meat from the first cross lambs had the highest rating, but was not rated higher than meat from the second cross lambs. Slaughter time had an effect on SEQ score, with meat from animals slaughtered in the second group within slaughter days having a lower score (57.2 vs 55.0; $P < 0.05$). This same effect ($P < 0.05$) was found for flavour liking (60.9 vs 56.3), overall liking (59.1 vs 53.9) and rating (3.16 vs 2.96) with no effect on tenderness, juiciness or aroma strength.

Table 1. Predicted means (av. s.e.d.) for sensory traits of the loin (m. *longissimus)* for animals (n = 118) according to group

Group	*n*	Tenderness	Juiciness	Flavour liking	Aroma strength	Overall liking	SEQ	Rating
Second cross, sucker	24	67.6a	52.9a	64.1a	64.9a	64.1a	63.7a	3.34a
Second cross, lamb	23	61.9ab	51.7a	62.7a	64.1a	61.8a	61.1a	3.25a
First cross, lamb	24	67.3a	53.5a	62.9a	62.9a	63.5a	63.1a	3.38a
First cross, hogget	24	60.1b	50.7a	61.1a	62.2a	59.9a	59.4a	3.17a
Merino	23	64.0ab	55.0a	65.0a	64.8a	64.6a	63.7a	3.33a
Av s.e.d.		3.04	2.64	2.61	1.78	2.85	2.63	0.11

Means followed by a different letter in a column (a, b) are not significantly different ($P < 0.05$).

Table 2. Predicted means (av. s.e.d.) for sensory traits of the outside (m. *biceps femoris*) for animals (n = 110) according to group

Group	*n*	Tenderness	Juiciness	Flavour liking	Aroma strength	Overall liking	SEQ	Rating
Second cross, sucker	23	52.8ab	50.6cb	58.6ab	63.1a	56.8ab	56.0ab	3.04cb
Second cross, lamb	20	57.6a	54.6ab	61.0a	64.3a	60.2a	59.4a	3.20ab
First cross, lamb	23	58.9a	57.3a	62.8a	66.3a	61.8a	61.1a	3.29a
First cross, hogget	23	48.4b	47.0c	56.8b	62.7a	52.7b	52.5b	2.91c
Merino	21	50.0b	50.0cb	54.5b	61.4a	51.7b	52.0b	2.88c
Av s.e.d.		3.61	3.16	2.67	2.14	3.06	2.88	0.12

Means followed by a different letter in a column (a, b) are not significantly different ($P < 0.05$).

Discussion

There was no impact of age on the SEQ or rating scores for loin meat with hogget meat (BLM) being comparable to that from the BLM lambs. Similarly there were no other differences between groups of animals, with meat from Merino lambs being of similar eating quality to first (BLM) and second cross lambs which is consistent with the report of *Safari et al. (2001)*. There was a difference in the tenderness score with hogget meat judged tougher than loin meat from second cross suckers and first cross lambs (BLM), but the difference did not affect the SEQ score and could not viewed as a consistent effect. *Young et al. (1993)* reported that Merino loin meat in their study was actually the most tender, but attributed this to a higher pH. There was no indication that unweaned lambs (ie suckers) produced loin meat of a superior eating quality, whereas at least for tenderness *Ellis et al. (1997)* found that meat from lambs at weaning was the most tender compared to weaned lambs slaughtered 1-3 months after weaning. There was no clear overall effect of increasing age (BLM hoggets compared to BLM lambs) on eating quality, because of the differences found for the outside. For this cut meat from sucker and Merino lambs had a similar SEQ score to the hogget meat. There is a lack of comparative data with which to compare these results because most studies have examined loin meat. Comparison of results for beef from the MSA program shows that the outside has a lower eating quality score than the loin *(Ferguson et al., 1999)* as found in our study.

Conclusions

Overall the consumer results indicate that hogget meat will provide a similar level of eating quality to lamb for the loin and the leg cut, the outside provided that "best bet" processing approaches such as electrical stimulation and ageing are applied.

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References

Anon. (1992). AUS-MEAT language (4th ed.). Sydney: Authority for Uniform Specification Meat and Livestock.
Bickerstaffe, R., Bekhit, A. E. D., Robertson, L. J., Roberts, N., & Geesink, G. H. (2001). Meat Science, **59,** 303-315.
Ellis, M., Webster, G. M., Merrell, B. G., & Brown, I. (1997). Anim. Sci. **64**, 77-86.
Ferguson, D., Thompson, J., & Polkinghorne, R. (1999). Proc. 45th ICoMST,, (pp. 18-19), Yokohama, Japan.
Genstat (2000). *Genstat 5 release 4.2.* (5th Ed.), Lawes Agricultural Trust (Rothamsted Experimental Station).
Polkinghorne, R., Watson, R., Porter, M., Gee, A., Scott, J., & Thompson, J. (1999). Proc. 45th ICoMST, (pp. 14-15), Yokohama, Japan.
Safari, E., Fogarty, N. M., Ferrier, G. R., Hopkins, D. L., & Gilmour, A. (2001). Meat Science, **57**, 153-159.
Safari, E. Channon, H.A., Hopkins, D.L. Hall, D.G., & van de Ven, R. (2002). Meat Science, **61,** *(in press).*
Young, O. A., Reid, D. H., & Scales, G. H. (1993). NZ J. of Agric. Res. **36,** 363-370.