IMPACT OF AGE OF AUSTRALIAN MERINO'S ON CONSUMER SENSORY SCORES

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Abstract – A Merino lamb versus Merino yearling sheep comparison study was conducted to test sensory differences of untrained consumers. Tenderness, juiciness, flavour, overall liking and odour scores (1-100 score) were generated on five day aged grilled steaks from the m. *longissimus lumborum* (loin) and m. *semimembranosus* (topside) from 185 Merino lambs (average age 354 days) and 206 Merino yearling sheep (2-4 permanent incisor teeth, average age 685 days). On average within a cut, for all sensory traits yearling samples had lower values by as much as 1.2 and 7.9 scores for loin and topside tenderness respectively compared to lamb samples, except for juiciness within the loin were yearling had 0.8 scores more than lambs. When comparing lambs and yearlings born in the same year and reared at the same research site, the differences in magnitude of all sensory scores of the topside were greater (up to 5 fold) than for the loin. Intramuscular fat and shear force accounted for some of the sensory differences between lambs and yearlings. The results highlight the better eating quality of lamb but show a very acceptable eating quality of the yearling loin, which opens the possibility of developing a high quality yearling product.

Key Words – Lamb, Yearling, Eating Quality.

I. INTRODUCTION

In Australia lambs have no erupted incisors and are typically 5-9 months of age. Slower growing animals, such as Australian Merino's, can have erupted permanent incisor teeth by the time they reach slaughter weights and therefore do not make the lamb category. However these sheep in the age bracket of 12-24 months (yearling sheep) may still produce consumer acceptable eating quality meat.

It is generally believed that meat from older animals has a reduced overall consumer acceptance and previous studies have shown that consumers rate grilled loin samples from older animals as having lower sensory scores [1,2]. This may be associated with higher shear force values (less tender) in older animals [3]. Yet contrary to this, older animals also have more intramuscular fat [3] which has been shown to improve consumer sensory scores [4]. Hence it is assumed that the impact on shear force is the greater driver of consumer satisfaction. Therefore, we hypothesised that meat from yearling Merino sheep will have lower sensory scores compared to lamb meat, and that this will be reflected through their differences in tenderness (shear force).

II. MATERIALS AND METHODS

Experimental design and slaughter details

All animals were from the Information Nucleus Flock experiment of the Australian Cooperative Research Centre for Sheep Industry Innovation [5,6]. The wethers used in this study were (i) Merino lambs (n = 185) born in 2009 and 2010 at Kirby (NSW) and Katanning (WA) research sites, and (ii) Merino yearlings (n = 206) born in 2009 at Kirby (NSW), Cowra (NSW), Struan (SA), Turretfield (SA), Rutherglen (VIC) and Katanning (WA) research sites. The sheep were slaughtered at a commercial abattoir and the m. *longissimus lumborum* (loin) and the m. *semimembranosus* (topside) were dissected from both lamb and yearling carcasses. Both muscles were aged for 5 days and 5 steaks from each muscle (15 mm thick) were cut for sensory testing. The other loin and topside of the carcass were also dissected and used for subsequent objective meat quality measurements of intramuscular fat and shear force. Details of the sensory testing protocol were described in detail by Pannier et al. [4]. Each steak (n = 5) was halved and the ten samples were grilled using a Silex griller. All samples were

assessed by untrained consumers who scored the samples for tenderness, overall liking, juiciness, liking of flavour, and liking of odour, using a score from 1 (worse) to 100 (best). In total 10 consumer responses per cut were obtained.

Statistical analyses

Linear mixed effects models in SAS were applied on the mean of 10 consumer answers. The base model for each sensory trait included fixed effects of age-class-site-year as one combined term (lambs at Kirby and Katanning born in 2009 and 2010, or yearlings at Kirby, Cowra, Struan, Turretfield, Rutherglen and Katanning born in 2009), cut (loin, topside), birth and rearing type (combined term representing animals born as single (S) or multiple (M) and reared as single or multiple; SS, MS, MM). Random terms included sire identification, animal identification, and the consumer session when samples were tasted. All relevant first order interactions between fixed effects were tested and non-significant ($P > 0.05$) terms were removed in a stepwise manner.

Intramuscular fat (of loin) and shear force (of loin and topside) were individually tested as covariates in the base models described above to determine if the impact of age class on sensory scores could be explained by these traits. These models included all relevant first order interactions between fixed effects and covariate, and the covariate quadratic effect. Non-significant ($P > 0.05$) terms were removed in a stepwise manner.

Given the confounding structure of the dataset (year and research site confounding), all results were presented according to the four lamb and five yearling groups. The mean values of those groups were compared as a possible overall lamb versus yearling comparison. Where possible, direct comparisons were also made between lambs and yearlings born in the same year (2009) and at the same site (Kirby or Katanning) where the greatest similarity could be found in environmental and management conditions and genetic background.

III. RESULTS AND DISCUSSION

There were significant ($P<0.01$) effects for age-class-site-year, and cut for all sensory scores. The age-class-site-year by cut interaction was also significant ($P<0.01$) for tenderness, overall liking, juiciness and flavour with the predicted means (± SE) of the interaction presented in Table 1. When comparing the mean of all lamb groups versus the mean of all yearling groups for a given cut, there were lower values for yearling samples compared to lamb samples for most sensory traits. These differed by as much as 1.2 and 7.9 scores for loin and topside tenderness. The only variation to this trend was for juiciness within the loin, where yearlings had a slighter higher value (+0.8 score) than lambs (Table 1). These results support our hypothesis that meat from older sheep has reduced sensory scores compared to lamb meat. However the age-class-site-year effect differed for both the loin and the topside samples ($P<0.01$) with these differences being minimal (almost all non-significant) for the loin samples compared to the topside samples (almost all significant) when compared within the same site and year (Table 1). For example, when comparing lambs and yearlings born in 2009 at the Kirby site, lamb topside had 10.0, 7.8, 2.9 and 5.0 more sensory scores for tenderness, overall liking, juiciness and flavour than yearling topside samples, whereas the lamb loin had only 2.2, 1.2, 0.8 and 0.6 more sensory scores for tenderness, overall liking, juiciness and flavour than yearling loin samples. The lack of difference between lamb and yearling loin sensory scores is in contrast to the results of Hopkins et al. [1,2], yet are in part in agreement with some other studies which found no significant difference in sensory scores of grilled loin samples between lambs (8.5 months) and yearlings (20 months) [7]. In this case an age effect was only seen with older sheep from 22 months onwards after 2-4 permanent incisor teeth had erupted. Within the same study [7], topside samples were also tested and while lamb topside was preferred over yearling topside, this result is not directly comparable as the samples were roasted rather than grilled. The different sensory responses observed between the 2 cuts may be explained by their differing collagen levels. The topside has been shown to become less tender as animal age increases [3], due to less soluble forms of collagen when animals get older [8]. The collagen content of the loin is less [9], explaining why this effect is less evident.

Table 1 Predicted means (± SE) of the base model for tenderness, overall liking, juiciness and flavour sensory scores for the Merino lambs and yearlings for the loin and topside samples.

Ageclass / Cut	Site Year	Tenderness	Overall liking	Juiciness	Flavour
Lamb / Loin	Kirby 2009	80.6i ± 1.4	78.7j ± 1.2	75.6h ± 1.2	76.6i ± 1.1
	Kirby 2010	75.1gh ± 1.6	75.0hij ± 1.4	69.5fgi ± 1.4	73.5ghi ± 1.3
	Cowra 2009				
	Rutherglen 2009				
	Struan 2009				
	Katanning 2009	75.8gh ± 1.7	73.5ghi ± 1.5	68.9fgi ± 1.5	71.6fgh ± 1.4
	Katanning 2010	71.0ef ± 1.3	70.5fg ± 1.1	63.9e ± 1.1	70.1ef ± 1.0
	Average	*75.7 ± 1.5*	*74.5 ± 1.3*	*69.5 ± 1.4*	*73.0 ± 1.3*
Yearling / Loin	Kirby 2009	78.4hi ± 1.5	77.5ij ± 1.3	74.9h ± 1.4	76.0i ± 1.2
	Kirby 2010				
	Cowra 2009	72.4fg ± 1.5	71.8fgh ± 1.3	67.7fi ± 1.4	70.5efg ± 1.2
	Rutherglen 2009	77.5hi ± 1.5	76.4ij ± 1.3	70.3gi ± 1.3	74.5hi ± 1.2
	Struan 2009	75.8gh ± 1.6	75.3ij ± 1.4	72.0gh ± 1.4	73.7hi ± 1.3
	Katanning 2009	68.4e ± 1.5	69.3f ± 1.3	66.5ef ± 1.3	68.0ef ± 1.2
	Katanning 2010				
	Average	*74.5 ± 1.6*	*74.1 ± 1.4*	*70.3 ± 1.4*	*72.5 ± 1.3*
Lamb / Topside	Kirby 2009	57.1d ± 1.4	58.5e ± 1.2	54.4d ± 1.2	60.0d ± 1.1
	Kirby 2010	46.1c ± 1.6	49.7bcd ± 1.4	43.7ab ± 1.4	53.5bc ± 1.3
	Cowra 2009				
	Rutherglen 2009				
	Struan 2009				
	Katanning 2009	44.7bc ± 1.7	51.0d ± 1.5	47.9bc ± 1.5	55.8c ± 1.4
	Katanning 2010	47.7c ± 1.3	50.3cd ± 1.1	43.9a ± 1.1	53.3bc ± 1.0
	Average	*48.9 ± 1.5*	*52.4 ± 1.3*	*47.5 ± 1.4*	*55.7 ± 1.3*
Yearling / Topside	Kirby 2009	47.1c ± 1.5	50.7d ± 1.3	51.4cd ± 1.4	55.0c ± 1.2
	Kirby 2010				
	Cowra 2009	41.3b ± 1.5	46.8ab ± 1.3	44.3ab ± 1.4	49.7a ± 1.2
	Rutherglen 2009	40.9ab ± 1.5	47.0abc ± 1.3	44.4ab ± 1.3	50.8ab ± 1.2
	Struan 2009	38.4ab ± 1.6	45.0a ± 1.4	44.1ab ± 1.4	49.5a ± 1.3
	Katanning 2009	37.5a ± 1.5	44.6a ± 1.3	44.0ab ± 1.3	49.0a ± 1.2
	Katanning 2010				
	Average	*41.1 ± 1.6*	*46.9 ± 1.4*	*45.7 ± 1.4*	*50.9 ± 1.3*

Column means within tenderness, overall liking, juiciness and flavour sensory scores without common superscript letters differ significantly (P<0.05).

When loin intramuscular fat was included as a covariate (P<0.05), it accounted for only a small portion of difference (about 1 unit) in tenderness and overall liking scores between lambs and yearlings born in Katanning in 2009. This suggests that the age effect in the loin is not strongly driven by differences in intramuscular fat. None-the-less, for both lambs and yearlings increasing levels of loin intramuscular fat across a 4.5% range were associated with increasing sensory scores (P<0.05), of 5.3 for overall liking, 5.0 for juiciness and 5.3 for flavour. This confirms intramuscular fat as a strong indicator of consumer acceptance [4].

In contrast to the intramuscular fat covariate, when shear force was included in the model this accounted for all differences in tenderness and overall liking at the Katanning site in 2009. Likewise, in the topside, the shear force correction accounted for the age class differences in overall liking and juiciness at the Kirby site 2009. This suggests that shear force and its correlated effects on collagen quality are the key drivers of

consumer acceptance in sheep meat. In addition, shear force did show a negative association with tenderness, overall liking and juiciness for both lambs and yearlings, confirming that shear force is a good predictor of consumer scores [4].

III. CONCLUSION

This study indicates the superior eating quality of lamb meat compared to meat from the yearling animals, but most importantly demonstrates that the loin from yearlings has similar acceptability to lamb among Australian consumers. This highlights the potential to develop a high quality yearling based product. Shear force was the key factor explaining the sensory differences seen between lambs and yearlings, with intramuscular fat less influential in explaining this contrast.

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