The impact of wrapping and ageing hot boned sheep meat on eating quality

E.S. Toohey[1, 2*], D.L. Hopkins[1, 3] & T.A. Lamb[1, 3]
[1]Australian Sheep Industry Cooperative Research Centre, Armidale, NSW 2350, Australia.
[2]NSW Department of Primary Industries, Dubbo, NSW 2830, Australia.
[3]NSW Department of Primary Industries, Centre for Sheep Meat Development, Cowra, NSW 2794, Australia.
*E-mail: edwina.toohey@dpi.nsw.gov.au.

Abstract

Previous experimental evidence has indicated that hot-boned sheep meat that is frozen on the day of boning has a less than desirable eating quality. The aim of this study was to evaluate the effect of wrapping and aging hot boned sheep meat on eating quality traits. To examine this 30 sheep from 1 consignment were assessed. Both left and right loins were removed from each carcase pre-rigor and one side was prepared for consumer testing onsite (control) and the other was wrapped firmly in cling wrap and aged for 7 days (wrapped/aged). The wrapped/aged treatment had a significantly ($P < 0.05$) lower final pH and ($P < 0.001$) shear force when compared to the control. The control treatment had a significantly ($P < 0.001$) lower drip loss percentage, but there was no differences for cooking loss percentage or sarcomere length. However there were significant differences between treatments for all consumer sensory traits measured. The wrapped/aged treatment had significantly ($P < 0.001$) higher scores for tenderness, juiciness, flavour and overall liking and was thus a more desirable and accepTable product for consumers. The results suggest that it was the aging component that improved the eating quality and not the wrapping aspect of the treatment as there was no difference in sarcomere length which would have been expected if wrapping prevented shortening.

Introduction

Hot boning can be defined as the removal of muscle from the carcase prior to chilling. There are clear long term economic advantages for hot boning such as a reduction in carcase weight loss, reduction in drip loss, reduction in chilling space, thus saving in refrigeration energy inputs, faster turnover of meat, labour savings, and transport costs (primal cuts verses carcases) (Pisula & Tyburcy, 1996). However there are also disadvantages to this type of system including; initial costs, changes in cut shape, marketing of product, tenderness (Pisula & Tyburcy, 1996), increased risk of shortening thus leading to toughening (Devine *et al.* 2004). There has been limited research into eating quality of hot boned sheep meat however Toohey & Hopkins (2006) examined the eating quality of hot boned sheep meat under commercial conditions after the application of high voltage electrical stimulation. From this study it was determined that there was a critically low compliance for consumer overall liking score to achieve a rating of 'good to every day'. Only 13.5% of carcases complied hence from this study it was determined that other processing interventions would be required to increase consumer compliance. The objective of this study was to examine whether intervention techniques such as wrapping and ageing the loin would offer potential to increase the eating quality of hot boned sheep meat as opposed to the normal process of boxing and freezing soon after death.

Materials and methods

30 mixed aged Merino wethers were selected from 1 consignment which were sourced directly from farm and delivered to the processor. The animals were kept off feed and water for 24 hours prior to transport, they were then transported for 5 hours and held in lairage for 12 hours prior to slaughter. All carcases were exposed to a full suite of electrical stimulation as outlined by Toohey *et al*, (2008).

Carcases were trimmed according to the specifications of AUS-MEAT (Anon, 1992). Hot carcase weights were recorded and the GR measured (total tissue depth over the 12th rib, 110 mm from the midline) using a GR knife. The pH and temperature measurements were taken from the left portion of the m. *longissimus lumborum* (LL) as described by Toohey & Hopkins, (2006) and measurements were taken at approximately 40 and 120 mins after death. The carcases were hot boned under the normal procedures of the abattoir. During this process both entire loins (n=60) were completely removed from each carcase. One side was prepared for consumer testing onsite and samples were collected for final pH, sarcomere length, shear force (tenderness) and drip loss %. The remaining loin was wrapped in cling wrap and aged at approximately 4ºC for 7 days then it was prepared for consumer testing and comparative samples were collected. Samples for shear testing were prepared into 65-gram blocks and then were frozen (-20°C) either 3 hours after death or 7 days after death and subsequently tested for peak shear force as described by Thompson *et al.* (2005a).

Sarcomere length was tested using laser diffraction as described by Bouton *et al.* (1973). A 1 gram sample of loin muscle was also taken for determination of pH, using an iodoacetate method adapted from that described by Dransfield *et al.* (1992). Drip loss was measured using a method adapted from that described by Christensen (2003). The consumer assessment samples were either prepared on site or after they were aged for 7 days where the subcutaneous fat, connective tissue and the epimysium were removed. Each sample cut was prepared to cook size and then kept frozen (-22°C) until testing. The testing regime has been described previously and sample preparation for consumer testing has been outlined by Thompson *et al.* (2005b).

Carcase and meat quality traits were analysed using a residual maximum likelihood (REML) procedure (Genstat 7.1, 2004), which contained a fixed effect for treatment to estimate the means and standard errors of the differences. Weight was used as a covariate for GR. A linear regression was used to derive the relationship between overall liking and overall rating score, tenderness and overall rating score and shear force and overall rating score.

Results and discussion

Based on the mean initial pH and temperature recorded on average muscles were in the rigor phase with an initial pH of 5.95 (± 0.10) and initial temperature of 35.6 (± 1.79). The results show that there is a significant difference ($P > 0.05$; Table 1) between treatment groups for final pH with the control having a higher pH when compared to the wrapped and aged treatment this is most likely due to the increased aging time. There are significant differences ($P > 0.001$) between treatments for drip loss with the wrapped and aged treatment having a higher drip loss %. Sarcomere length showed no difference shown between treatments. However there was a significant ($P > 0.001$) difference between treatments for shear force with the wrapped and aged treatment showing lower values. Such that the wrapped and aged treatment resulted in a 30N reduction in shear force. Cooking loss % was not significantly different between treatments.

Table 1. Predicted means for final pH, drip loss percentage, sarcomere length (µm), shear force (N), tenderness, flavour and overall liking for the control and wrapped/aged treatment

Trait	Control	Wrapped/Aged	Av SED
Final pH (iodoacetate)	5.74b	5.66a	0.04
Drip Loss %	1.73a	4.80b	0.58
Sarcomere length(µm)	1.77a	1.79a	0.03
Shear force (N)	61.95b	29.39a	2.65
Cooking loss %	14.56a	12.91a	1.06
Tenderness	52.1a	64.7b	2.47
Juiciness	54.5a	63.0b	2.40
Flavour	57.9a	63.2b	2.14
Overall liking	56.6a	64.3b	2.09

From Table 1 it is shown that there is a significant difference ($P > 0.001$) between treatments for tenderness, juiciness and overall liking and ($P > 0.05$) difference for flavour. These differences show the wrapped and aged product having the significantly better eating quality. In comparison to the study of Toohey and Hopkins (2006) the control samples in the current study exhibited a higher compliance indicative of a higher baseline. Nevertheless the wrapping ageing treatment lifted the compliance to above 80% which is similar to the level reported by Hopkins and Toohey (2006) for conventionally boned sheep meat aged for 7 days.

Based on data a relationship between overall liking and the overall rating score was derived, where; Overall liking score = -2.79 + 19.61 (Overall rating score) $R^2 = 0.77$, r.s.d. = 4.2, r = 0.88. Predicted overall liking scores at each rating score were derived and from this it is determined that to achieve a rating score of 3 (good every day) then the overall liking score of 56 must be achieved. The proportion of samples that had an overall liking score > 56 was 53 % as shown in Table 2. These predictions were also made for tenderness and shear force. The tenderness model was; Tenderness score = -21.88 + 24.87 (overall rating score) $R^2 = 0.75$, r.s.d. = 5.62, r = 0.86. This resulted in a prediction of 52.7 to achieve a rating score of 3 (good every day). The shear force model was; Shear force = 81.8 – 11.1(overall rating score), $R^2 = 0.04$, r.s.d. = 18.8, r = 0.2. From this it was determined that to achieve a rating score of 3 (good every day) the shear force value had to be > 48.5 as shown in Table 2, but it should be noted that the relationship between shear force and overall rating score was poor and thus the accuracy and precision of estimates is low. The wrapped and aged treatment showed a much higher rate of compliance with consumers when compared with the control.

Table 2. Score needed to achieve a SMEQ ranking of "good to everyday" derived from the relationship between the overall rating score and each trait – tenderness, overall liking and shear force with percentage above or below

Trait	**Control**		**Wrapped/Aged**	
Score needed to achieve 'good to everyday'	Above	Below	Above	Below
Tenderness (52.7)	60%	40%	83%	17%
Overall Liking (56.0)	53%	47%	83%	17%
Shear Force (48.5)	10%	90%	97%	3%

Conclusion

The wrapped and aged treatment showed significantly improved meat quality for all traits measured except sarcomere length where there was no difference, when compared to the control. However it is not possible to definitely determine whether this was due to the wrapping or the ageing, but given the sarcomere measures it can be assumed that the wrapping actually did nothing to prevent shortening and therefore the improvements in tenderness would mostly be due to ageing. Further investigations would have to be conducted to quantify this in order to fully understand the potential benefits of other intervention techniques such as stretching to develop a cost effective methods.

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