The latest eating quality science - managing intramuscular fat and tenderness to improve the consumer experience

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Abstract

This paper discusses the new research and potential implementation phases associated with managing eating quality in Australian lamb. Firstly we discuss the need for electrical stimulation systems as part of lamb processing, especially for supply chains with a domestic focus. We then describe the new eating quality traits being developed in the Sheep CRC Information Nucleus program namely intramuscular fat, shear force tenderness and consumer evaluation using Meat Standards Australia taste panels. Finally we discuss future ways the Industry will underpin and guarantee eating quality of lamb cuts.

Introduction

The current recommendations for managing the eating quality of lamb meat are captured in the Meat Standards Australia (MSA) lamb system. The key elements of the recommended pathway for best practice are summarised in Figure 1 (MSA 2012). This requires meeting recommended growth rates, carcase and fat specifications, curfew and lairage times, pH x temperature windows (i.e. controlled with electrical stimulation) and meat aging. In addition there are cut x cook recommendations for commercial cuts of lamb. A key feature is that the pathways are not difficult to achieve and represent Industry best practice throughout the lamb production supplychain.

Lamb processing – it must be monitored

An important factor influencing lamb tenderness and consumer appeal is the processing conditions post slaughter, especially for domestic product undergoing relatively short aging periods. Optimal processing of lamb for the domestic market typically relies on electrical stimulation of the carcase to accelerate the pH decline and so meet the temperature @ pH6 targets described in Figure 1 (Pethick et al. 2005). To put this in context – poor processing would mean a lamb loin achieving good every day (3 star) rather better than every day or premium (4/5 star). This has resulted in the wide spread adoption of electrical stimulation units in most processing plants with a significant domestic market. However recent research by the Sheep CRC in collaboration with the Australian Meat Processors Corporation has clearly underpinned the need for processors to carefully monitor these stimulation units. Thus we measured the stimulator performance in 5 abattoirs as part of the Sheep CRC Information Nucleus project and found only 1 to be functioning effectively (Pearce et al. 2010). The reasons for poor electrical stimulation performance included changed chilling rates, electrical faults, increased chain speed and incorrect settings. The conclusion is to have an auditing procedure that is underpinned by regular checks on pH decline and the simplest way forward is for processors to utilise the MSA lamb systems to do this.

Incorporating measures of eating quality

The Sheep CRC Information Nucleus is a tool for both R&D and simultaneous adoption of many new traits including eating quality and lean meat yield. We have measured 3 aspects of eating quality namely intramuscular fat, shear force tenderness and consumer taste panel responses to lamb.

Shear force tenderness

This is a laboratory measure of tenderness and is based on the kg of force required to pass a blade through a cooked piece of lamb and a higher value means tougher meat. Animal factors influencing this phenotype include animal age (beyond lamb), level of intramuscular fat and sire. The trait has a moderate heritability in sheep and 2 genes effecting tenderness (calpain and calpistatin) have tough and tender variants (Knight et al. 2012) in a similar manner to beef cattle.

Intramuscular fat

Is the amount of fat within the meat and is called marbling in beef. Intramuscular fat effects tenderness, flavour and juiciness of lamb and ideally should be in the range of 4-6%. The current mean level in Australian lamb is 4.2%. This trait is highly heritable, has a large range (1.5-9.1%) and is favourably genetically correlated to shear force tenderness making it a key target trait for managing eating quality into the future.

Consumer taste panels

The MSA system for assessing the eating quality of lamb by untrained consumers is being used to quantify or calibrate the true effects of the laboratory measures (shear force tenderness, intramuscular fat) on eating quality. The average lamb loin grades as a 4 star but there are also loins that achieve 3 and 5 star grades. About 50% of the topsides are unsatisfactory (2 star) with the remainder as good every day (3 star) or higher. The taste panel work clearly shows the eating quality of the loin and topside is influenced by the level of intramuscular fat and shear force and also by the sire of the lamb. The overall size of the effects for intramuscular fat, shear force and sire are in the range of 8-15 consumer units (out of 100), more then enough to change the overall acceptability or star rating. Indeed these animal effects are comparable or larger than the effects of electrical stimulation and aging.

Figure 1. Summary of MSA Lamb and Sheepmeats pathways

MEAT STANDARDS AUSTRALIA

SHEEPMEAT PROCESSING GUIDE

MINIMUM REQUIREMENTS

STEP 1

RECOMMENDED GROWTH RATES

- 1st and 2nd cross - a minimum of 100grams/day for 2 weeks prior to consignment.
- Greater than 50% **Merinos** and **pure Merinos** at least 150grams/day for 2 weeks prior to consignment.

SUPPLY METHODS

- Direct consignment - All categories eligible.
- Saleyards - 1st and 2nd cross accepted through saleyards.
- Greater than 50% **Merinos** or **pure Merinos** accepted through saleyards providing processor can demonstrate that animals through this pathway meet pH/temp window requirements and pHu requirements as outlined in MSA Sheepmeat Standards Manual.

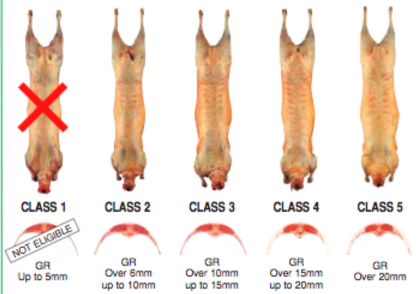
PRE - SLAUGHTER

- Minimum 2 weeks off shears (wool length ≥ 5mm).
- Fat score ≥ 2.
- HSCW ≥ 16kg for sucker (milk fed lamb), HSCW ≥ 18kg for all weaned lambs, hogget and mutton.
- Total time off feed not greater than **48 hours before slaughter**.
- Animals to have access to water at all times while not in transit.
- Minimum of 2 weeks at consignment property before dispatch.
- Maximum time in transit 24hrs.
- National Vendor Declaration (Sheep and Lambs) and Waybill to be correctly filled out and accompany consignment to saleyards or processor.

PROCESSING

- AUS-MEAT accreditation.
- Time spent in lairage yards at processing plant to be not greater than 24 hours with access to water.
- If livestock are held over in a holding paddock and fed at the processing plant, the processor must demonstrate that animals through this pathway meet pH/temp window requirements and pHu requirements as outlined in MSA Sheepmeat Standards Manual.
- Head only electrical stunning.
- No sick or injured animals to be included.
- Excessively damaged carcases to be excluded (eg leg removed from carcase).
- Maintain Carcase identification.

CARCASE FAT CLASS



STEP 2

CARCASE SPECIFICATIONS

Category / Cipher	HSCW	Fat Score	GR
Lamb (Milk fed) as declared on NVD or **Young Lamb " YL "**	≥ 16kg	≥ 2	≥ 6mm
Lamb " L "	≥ 18kg	≥ 2	≥ 6mm
Hogget " H "	≥ 18kg	≥ 2	≥ 6mm
Mutton " M ", " W ", " E "	≥ 18kg	≥ 2	≥ 6mm

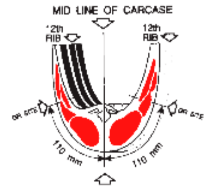
pH Temperature Window and Hang Options

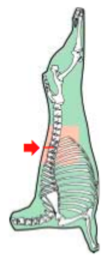
Hang Method	Temperature @ pH 6	Minimum ageing before: (consumption/display/sale)
AT	18-25°C	5 days
AT	8-18°C	10 days
TS	8-35°C	5 days

STEP 3

REFER: SHEEPMEAT PRIMAL CUTS CHART

GR MEASUREMENT SITE





The class is determined on the depth of tissue at the GR SITE. This site is located over the 12th rib, 110mm from the midline as shown in the diagram.

BASIC CATEGORY

DENTITION	DESCRIPTION	CATEGORY/CIPHER
0	**LAMB - female, castrate or entire male** animal that: ◆ Has 0 permanent incisor teeth. ◆ Milk Fed Lamb (Symbol 'MF'): Lamb that has not been weaned. Younger than 8 weeks.	LAMB " L " * 12 months (approx.)
1 - 8	**MUTTON - female or castrate male** animal that: ◆ Has at least one (1) permanent incisor tooth. ◆ In male has no evidence of Secondary Sexual Characteristics (SSC).	MUTTON " M " * Over 10 months

ALTERNATIVE CATEGORY

DENTITION	DESCRIPTION	CATEGORY/CIPHER
0	Carcase derived from **female or castrate male** ovine that: ◆ Has 0 permanent incisor teeth (in addition): ◆ Has no eruption of permanent upper molar teeth.	YOUNG LAMB " YL " * Up to 5 months only
1 - 2	Carcase derived from **female or castrate male** ovine that: ◆ Has 1 but no more than 2 permanent incisor teeth. ◆ In male has no evidence of Secondary Sexual Characteristics (SSC).	HOGGET " H " or YEARLING MUTTON * 10 to 18 months
1 - 8	Carcase derived from **female** ovine that: ◆ Has 1 or more permanent incisor teeth.	EWE MUTTON " E " * Over 10 months
1 - 8	Carcase derived from **castrate male** ovine that: ◆ Has 1 or more permanent incisor teeth. ◆ Has no evidence of Secondary Sexual Characteristics (SSC).	WETHER MUTTON " W " * Over 10 months

** Chronological age as shown is approximate only*

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Putting it all together

The eating quality traits discussed above are of course influenced by carcase breeding values and a summary of the important genetic correlations are shown below in Table 1. There is clearly an antagonistic relationship between lean meat yield and eating quality. However these are the average relationships across all sires and there are many sires where these relationships are not as strong or in fact are reversed – for example some sires will have high lean meat yield and high intramuscular fat. The modern genetic tools currently available - both traditional and genomic – can easily be used to develop an eating quality index that can be used to manage simultaneous genetic improvement of lean meat yield and eating quality.

Table 1. Some important genetic correlations (Sheep CRC discussion paper)

Traits correlated	Direction	Comment
Lean meat yield vs		
Intramuscular fat	-ve	High yield = low intramuscular fat
Shear force tenderness	+ve	High yield = tougher meat
GR tissue depth	-ve	Higher GR fat = lower yield
Eye muscle area	+ve	Higher muscularity = higher yield
Eye muscle area vs		
Shear force tenderness	+ve	More muscle = tougher meat
Intramuscular fat	-ve	More muscle = lower intramuscular fat
Intramuscular fat vs		
GR tissue depth	+ve	Higher GR = more intramuscular fat
Shear force tenderness	-ve	Higher intramuscular fat = more tender meat

Making claims and Summary

Research to test new imaging systems that can automatically measure the intramuscular fat of the slaughter lambs is currently under discussion and if both accurate and cost effective would allow more refined grading of individual lamb carcases for yield and at least one measure of eating quality. However, currently no commercial systems are available for lamb grading beyond yield.

So how can we guarantee an eating quality experience to the consumer using a genetic index system ? It is proposed that the simplest and most cost effective way is to use the eating quality index predicted for the sire and maintain integrity/traceability of this through the supplychain. So for example, we are testing the concept that a sire with an eating quality index sufficient to assure a 4 star loin and 3 star topside can indeed consistently deliver this outcome and be used in a new MSA lamb model.

References

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