Final report

Resource Flock Limited Cut x Cook Sensory Evaluation and MSA Mark II Model Development

Project code: L.EQT.2106

Prepared by: Dr Jarrod Lees and Dr Peter McGilchrist
University of New England

Date published: December 2023

PUBLISHED BY
Meat & Livestock Australia Limited
PO Box 1961
NORTH SYDNEY NSW 2059

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

This project aimed to conduct sensory testing on MLA Resource Flock (RF) lambs based at Kirby, Armidale NSW as well as hoggets from a known Merino genetic base. The RF lambs are a representation of industry sires across all breeds with a first cross or merino ewe base. This is indicative of industry. All the hoggets were from a Merino sire evaluation trial in southern NSW. All animals had fixed-effect genomic tests and performance tests; which will enable genetic linkage of sensory traits to productivity and profitability traits e.g. growth and eating quality. Furthermore, the cuts collected will provide implications for all major muscles in the carcase for a number of cook methods, some of which have not been tested by Australian consumers to date, from animals with measured/known phenotypes and genotypes. This data will allow for the expansion of the MSA Sheepmeat cut by cook model.

Whole lamb (n = 109) and hogget (n = 56) carcases were collected from populations of known pedigree. Animals were processed at Gundagai Meat Processors and carcases were transported to the University of New England, where they were CT scanned and portioned into sensory samples. Sensory samples were fabricated for various cook methods from the shanks – front and hind as slow-cook; heel – slow-cook; topside – grill, stir-fry and slow-cook; silverside – grill, slow-cook and stir-fry; knuckle – grill, slow-cook and stir-fry; rump – roast; loin – grill; rack (boneless) – grill and roast; rolled shoulder (banjo cut) – roast and low n' slow BBQ; and forequarter rack – roast. This project developed and ratified sensory protocols for sheepmeat slow-cooks, Texas Low 'n Slow BBQ and stir-fry.

The sensory testing for this work was delayed due to a backlog of sensory testing that was put on hold by COVID-19 restrictions. The UNE sensory team have completed 31 grill, 24 roast, 22 slow-cook, 10 stir-fry and 7 Texas low n slow BBQ sessions. These numbers are in excess of what was contracted, except for the roasts where some product was transferred into Low n slow BBQ picks.

The results showed that across each of the cook methods there was minimal difference between hoggets and lambs, with hoggets numerically higher for grill and slow-cook cook methods, slightly lower for roasts and the same for stir-fry and Low 'n Slow BBQ. The slow-cooked samples had the highest MQ4 scores of all cook methods, particularly the shanks and heel meat. It was also evident that the slow-cooked samples showed the least variability between samples within an age group. The Texas Low 'n Slow performed worse than expected, and the reason why isn't understood however this may be due to the small size of the muscles and high intermuscular fat content. The Topside performed best as a stir-fry, however, overall stir-fry showed the greatest variability between samples. The knuckle performed well as a grill, slow-cook and stir-fry, but poorly as a Texas Low 'n Slow BBQ. The forequarter rack, loin rack and loin performed well as grills and roasts as expected. The minimal difference between age classes suggests that the industry should trade sheepmeat on eating quality, not dentition, sooner than later.

Executive summary

Background

The research project was designed to collect eating quality information from animals of known performance and genetic linkage to:

i) build the reference population to ensure effectiveness of genomic tools in industry, and
ii) expand the current, limited, cut x cook model for sheepmeat eating quality.

Objectives

To conduct sensory testing on 108 lambs and 54 hoggets and understand the relationship between muscle, cook method and animal age.

Methodology

The project utilised 109 Lambs and 56 hoggets from known populations that were CT scanned, boned out and sensory samples were fabricated. Cuts collected included hindquarter shank, heel, topside, silverside, knuckle, rump, loin, rack, forequarter rack, roll boneless banjo cut forequarter and forequarter shank muscles. Consumer sensory panels were conducted for grill, roast, slow-cook, stir-fry, and Texas Low 'n Slow BBQ using existing or newly developed MSA protocols. New sensory protocols were developed for slow-cook, stir-fry, and Texas Low 'n Slow BBQ using the current MSA lamb protocols and the MSA beef protocols, these were ratified by the MSA Sheepmeat Scientific Pathways Committee. Data was provided to expand the MSA sheepmeat eating quality prediction model.

Results/key findings

Across each of the cook methods there appeared to be minimal difference between hoggets and lambs. It appears that slow-cooked samples ate the best giving the highest MQ4 scores, particularly the shanks and heel meat. The Texas Low 'n Slow performed worse than expected, however this may be due to the small size of the muscles. The Topside performed best as a stir-fry and the knuckle performed best as a grill and roast.

Benefits to industry

This research has further built the reference population for sheepmeat, which is essential for genomic tools to work in industry. The cuts collected from the lambs and hoggets have provided implications for all major muscles in the carcase based on grill, roast, stir-fry, slow-cook and low n' slow cook methods. In turn, this has increased industry's ability to accurately predict eating quality at a cut level and provides an avenue to improve the marketing of sheepmeat.

Future research and recommendations

Based on the results of the project, the MSA Sheepmeat model can be updated with better predictions for more cuts, for more cook methods from a wider range of animal ages. This research will allow expansion of the MSA sheepmeat model for cut x cooks and for animal ages, allowing industry to extract greater value out of a wider range of animals. Further research is required on more cuts still not well understood (riblets, neck, tenderloins) and also expanding the age range into animals with 4 and 6 teeth. The desire is that Australian sheepmeat is traded in future on meat quality not on dentition. There is a desperate need to have a central data system for sheepmeat that is easy to

access, easy to extract data files from and enter data into. At present the data generation and compilation is inefficiently managed across 2 different systems.

Table of contents

1. Background

This project aimed to conduct sensory testing of the MLA Resource flock based at Kirby, Armidale NSW. The Resource flocks are a representation of industry sires across all breeds with a first cross merino base. This is indicative of industry. All animals had fixed effect genomic tests and performance tests which will enable genetic linkages of sensory traits to productivity and profitability traits e.g. growth and eating quality.

This research will build the reference population which is essential for genomic tools to work in industry. The cuts collected from the lambs and hoggets will provide implications for all major muscles in the carcase based on grill, roast, stir-fry, slow-cook and low n' slow cook methods. Some of these cook methods are yet to be tested by Australian consumers for lamb.

2. Objectives

In conjunction with the MLA funded Resource Flock measurements, this project was tasked to conduct sensory testing on 108 lambs and 54 hoggets. Cuts collected included hindquarter shank, heel, topside, silverside, knuckle, rump, loin, rack, forequarter rack, roll boneless banjo cut forequarter and forequarter shank muscles and were cooked by grill, roast, stir-fry, slow-cook or low n' slow cook methods.

The project was designed to deliver results on a total of 74 picks (sensory sessions) which were conducted by both UNE and Tastepoint Pty Ltd. The number of sessions were to include approximately 4,440 consumers. The costs associated with this project were to be put towards: cut collection, CT scanning, butcher labour, sample processing, picking and posting labour (sensory session preparation) and sensory testing.

Results provided will allow direct inclusion in further development of the MSA Mark II sheepmeat model.

3. Methodology

3.1 Carcases

Whole lamb (n = 109) and hogget (n = 56) carcases were collected from known populations of lambs and hoggets. The lambs were processed at Gundagai Meat Processors and carcases were trucked to UNE, Armidale. Carcase attributes for each kill group are presented in Table 1 (below).

Table 1. Carcase attributes for each kill group.

KILL	HCWT (KG)	GR FAT (MM)	SF (N)	IMF (%)
KILL 1 (LAMB)	25.72 ± 0.31	21.31 ± 0.48	25.34 ± 0.95	4.82 ± 0.11
KILL 2 LAMB)	22.69 ± 0.29	17.06 ± 0.54	23.87 ± 0.94	5.95 ± 0.17
KILL 3 (HOGGET)	27.79 ± 0.45	12.75 ± 0.49	30.31 ± 0.87	5.56 ± 0.2

3.2 Cuts collected

Multiple cuts were collected from each carcase for various cook methods (Table 2). Some cuts were presented across multiple cook methods where appropriate.

Table 2. Number of cuts cooked for each cook method for inclusion into the expanded sheepmeat model.

CUT	GRL	RST	SC2	SFR	TBQ
LOIN (BKS045)	165	-	-	-	-
FOREQUARTER RACK (FQR999)	-	144	-	-	-
FOREQUARTER SHIN (FQSHIN)	-	-	118	-	-
HINDQUARTER SHIN (HQSHIN)	-	-	118	-	-
KNUCKLE (KNU999)	165	-	75	122	52
HEEL (OUT029)	-	-	118	-	-
OUTSIDE (OUT999)	165	78	49	117	35
RACK X 2 (RAK045)	161	144	-	-	-
RUMP X 2 (RMP031)	-	144	-	-	-
ROLLED BANJO CUT SHOULDER (SHD999)	-	144	-	-	165
TOPSIDE (TOP073)	165	-	218	86	-

3.3 Sensory testing

There were 5 cook methods utilised in this project: grill, roast, slow-cook, stir-fry and Texas low ‘n slow BBQ. The last three are new or revised protocols and were passed by the Meat Standards Australia Scientific Pathways Committee for Sheepmeat. Sensory testing of all samples followed the beef protocols for that particular cook method.

Below is a list of the cook methods completed for the project;

- 31 of the 22.5 Grills
- 24 of the 26 Roasts (8 x UNE, 16 x Tastepoint)
- 22 of the 18 Slow-cook
- 10 of the 9 Stir-fry
- 7 of the 4.5 Texas BBQ

3.3.1 Grill and Roast

Grill and roast samples were cooked as per the current MSA sheepmeat sensory testing protocols. Grills were cut from whole muscles into 5 sensory steaks at 15 mm thick. Roasts were cooked as whole primals and sliced (4 mm thick) prior to service. The entire roasts were sliced and then 10 slices from across the whole roast primal were consumer tested.

3.3.2 Stir-fry

The stir-fry protocol was similar to the MSA Beef Protocol aside from a number of small changes which have been ratified by the MSA Sheepmeat Pathways Committee. Firstly, portion size was adjusted to 6 x 15 x 60 mm for two reasons; i) to mimic the size and shape of stir-fry strips as seen in retail and food service; and ii) to ensure that the 22 samples required for sensory testing could be cut from each lamb primal (Fig. 1). The 6mm dimension of the strips were cut perpendicular to the grain. Additionally, the lamb samples were also browned off in a pan (for 1:30 minutes) with a surface temperature of 200 °C as measured by an infrared thermometer. Furthermore, the glaze utilised in the MSA Beef protocol utilises honey, however for this protocol it was decided to use an equal amount (1/2 cup) of brown sugar to negate the difference in flavour profiles of honey. Samples were stir-fried for 1:30 minutes to achieve the desired degree of doneness.

Figure 1. Stir-fry samples showing size (left) and prepared and ready for cooking (right)

3.3.3 Slow-Cook

Slow-cook samples were cut from individual muscles (topside, outside) or whole primals (heel, forequarter shank, hindquarter shank). Each set of samples included 22 individual cubes, with the size dependent on the size of the primal. The number of samples was considered more important that the size of the samples to ensure there was enough to fulfil the sensory requirement of feeding 10 people two pieces. Forequarter (FQS) and hindquarter (HQS) shanks were cooked with the bone-in and had to be tipped at the carpal end of the radius and ulna, and the tarsal end of the tibia respectively (example in Fig. 2 below) to ensure a good fit into the bain-marie pots. Shanks and heel muscles were paired for cooking. Shank meat was portioned post cooking and cooling (Fig. 3).

Figure 2. Shanks prepared at boning (left) and then with the head of the bone removed for cooking to ensure they fit into bain-marie pots (right)

For cooking, a broth was made from 1200g frozen sliced onion (defrosted), 1200g frozen sliced carrots (defrosted), 400g frozen sliced celery (defrosted), 4 tablespoons of fine salt and 12L of boiling water. The ingredients were simmered for 45 minutes. All vegetable matter was then strained from the broth, and hot liquor was maintained at 95°C in an electric urn. A 9 pan (3 x 3) bain-marie was heated to 100°C and 300mL of broth was added to each steamer pan, ready for the addition of meat. An additional 200mL broth was required for shanks to cover as much meat as possible throughout the cook. Stainless steel fry pans were heated to 220°C using induction hot plates. Once temperature was reached, 30mL of olive oil was added to the pan. Cubed meat and shanks were browned in the fry pans by constantly turning for 90 seconds, ensuring Maillard reaction on all surfaces. At 90 seconds, samples were transferred to the bain-marie. Heel muscle, FQS and HQS were cooked for 4 hours at 100°C, while all other muscles tested were cooked for 2 hours as per the MSA Beef Protocol.

Figure 3. Portioned shank meat prepared post cooking

3.3.4 Texas Low 'n Slow

Texas Low n Slow BBQ was cooked and served using the Beef testing protocol (See MLA project L.EQT.1814 for details). Fig. 4 shows the equipment used for cooking.

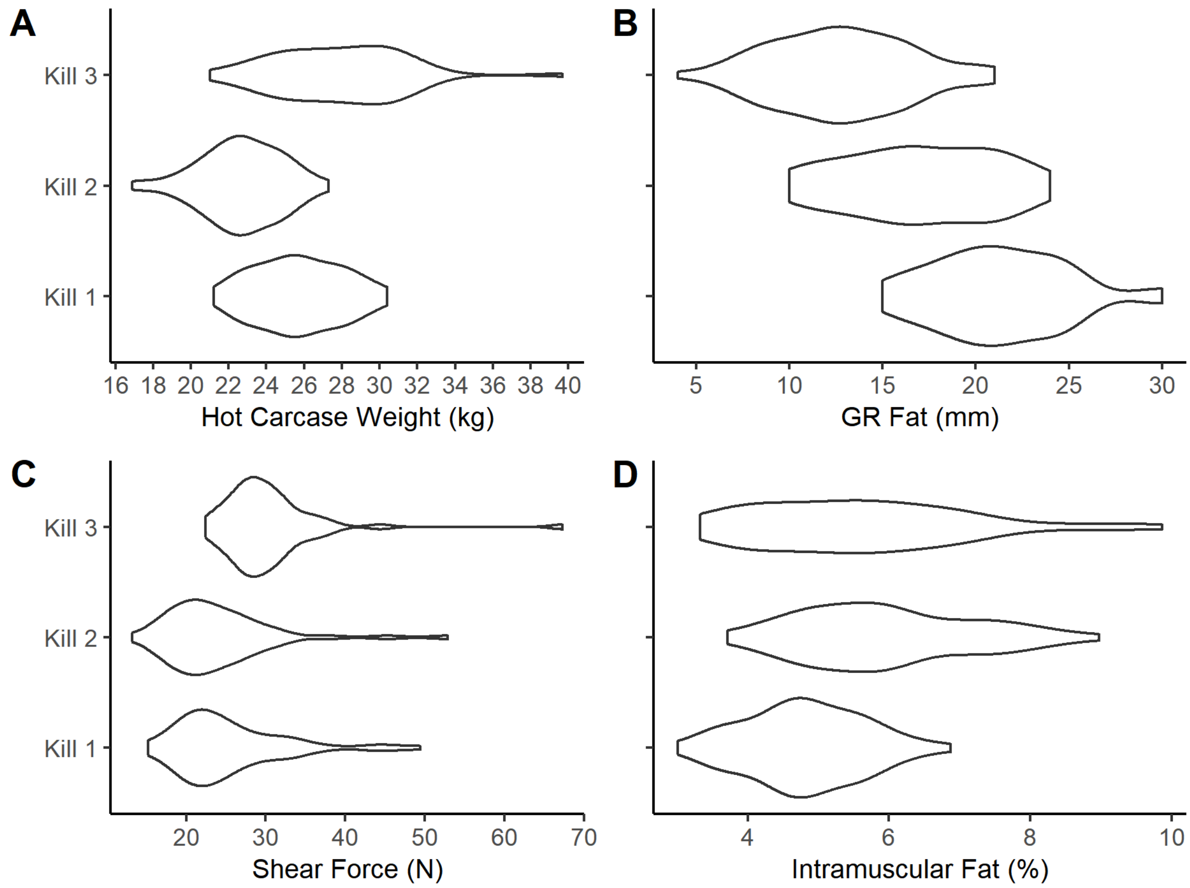
Figure 4. Lamb samples cooking on Greenmountain Grill at 120°C (left) and checking internal temperature for wrapping meat (right)

4. Results

4.1 Carcase attributes

Fifty-five (55) carcases were collected from kill 1; 54 carcases from kill 2; and 56 carcases from kill 3. Fig. 5 visualises each kill group to outline the variation observed within and between each group.

Figure 5: Raw hot carcase weight, GR fat, shear force and intramuscular fat of carcases



4.2 Sensory outcomes

The sensory outcomes for each cook method, by the muscles tested for both lambs and hoggets are presented below in Fig. 6 to 10. These outcomes are the Mean ± Standard Deviation for each sensory trait. These outcomes and associated data have been provided for the expansion of the lamb cut x cook eating quality model.

Figure 6. Mean ± standard deviation of tenderness, juiciness, flavour, overall liking and meat quality score for grilled lamb samples

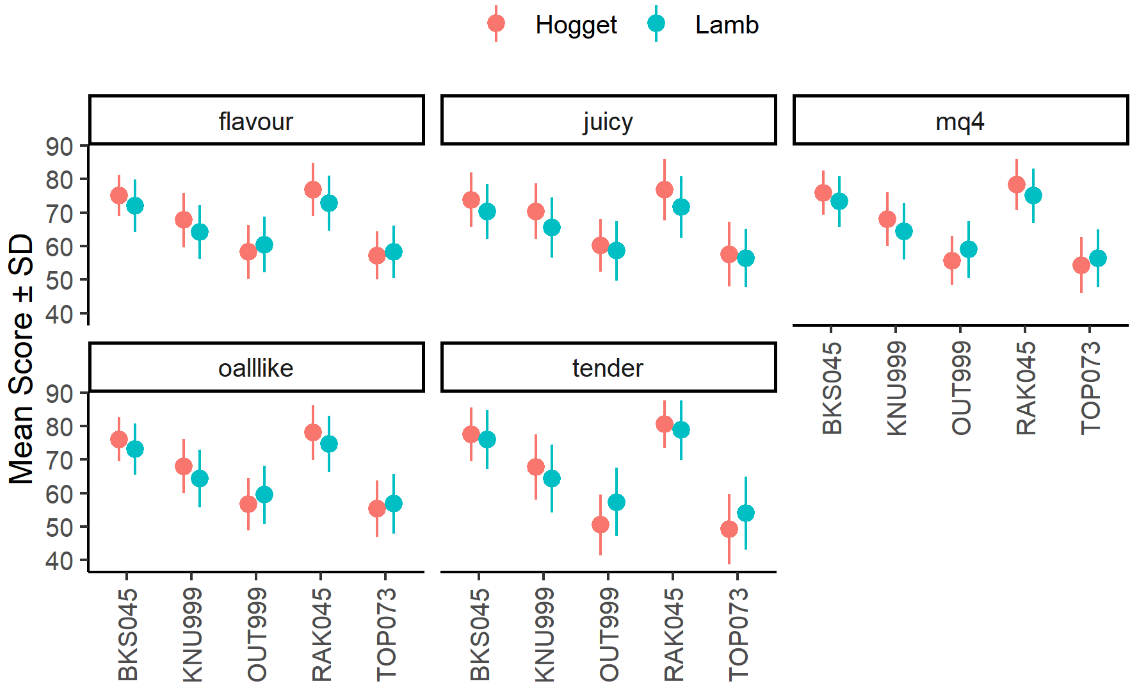


Figure 7. Mean ± standard deviation of tenderness, juiciness, flavour, overall liking and meat quality score for roasted lamb samples

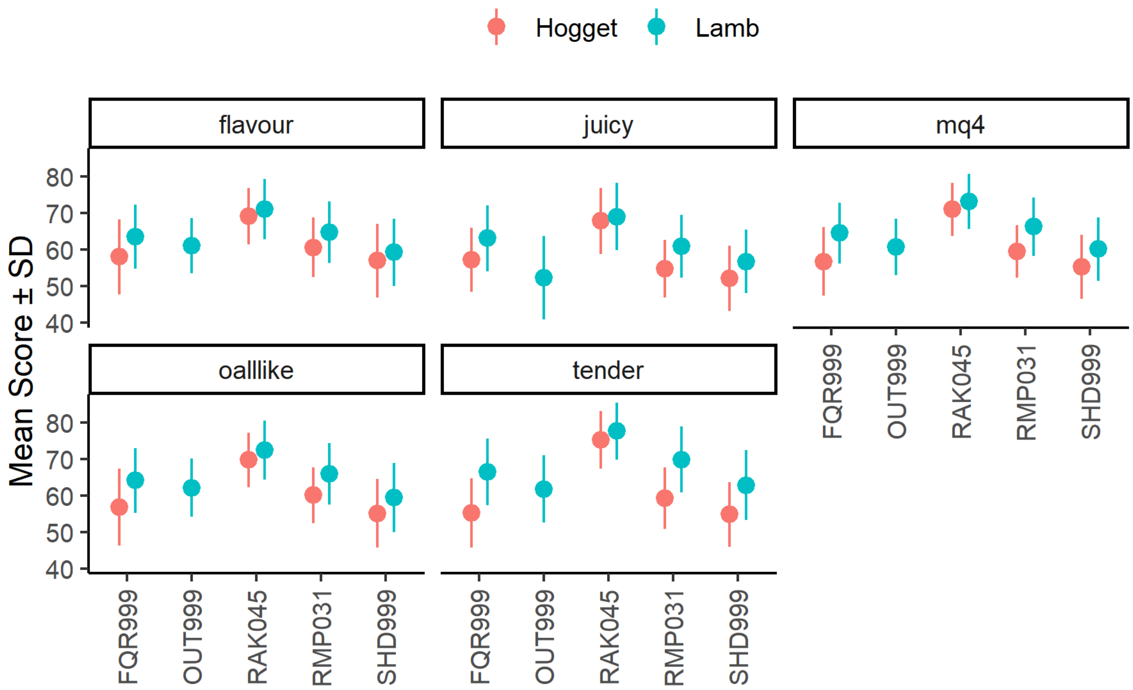


Figure 8. Mean ± standard deviation of tenderness, juiciness, flavour, overall liking and meat quality score for stir-fry lamb samples

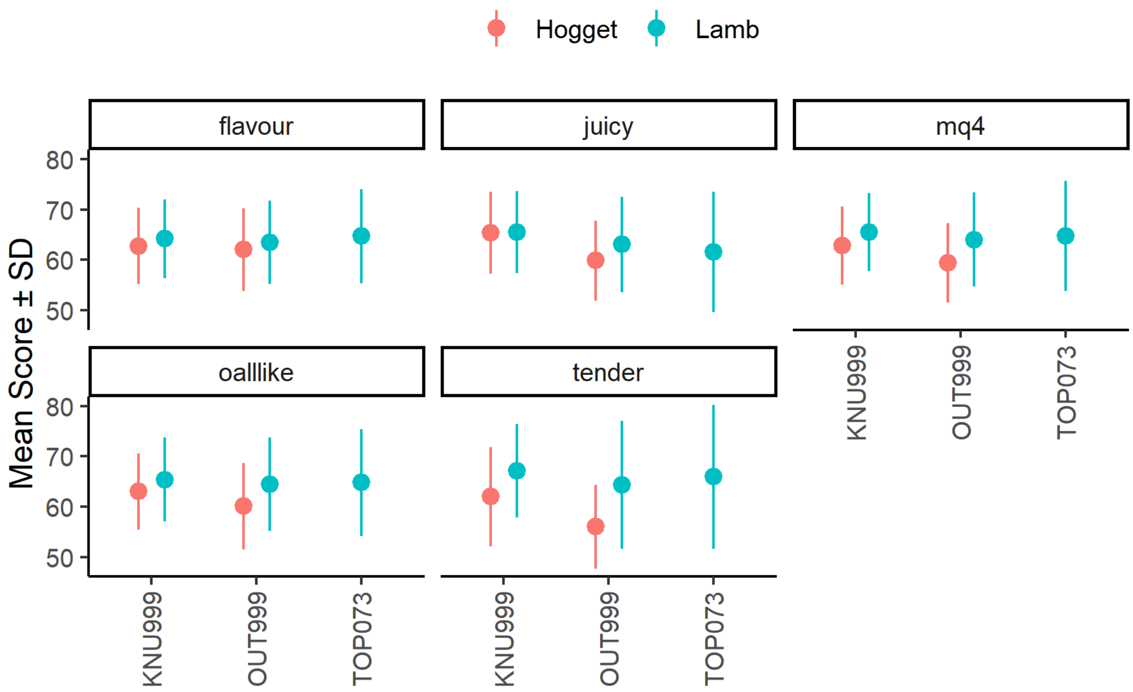


Figure 9. Mean ± standard deviation of tenderness, juiciness, flavour, overall liking and meat quality score for slow-cooked lamb samples

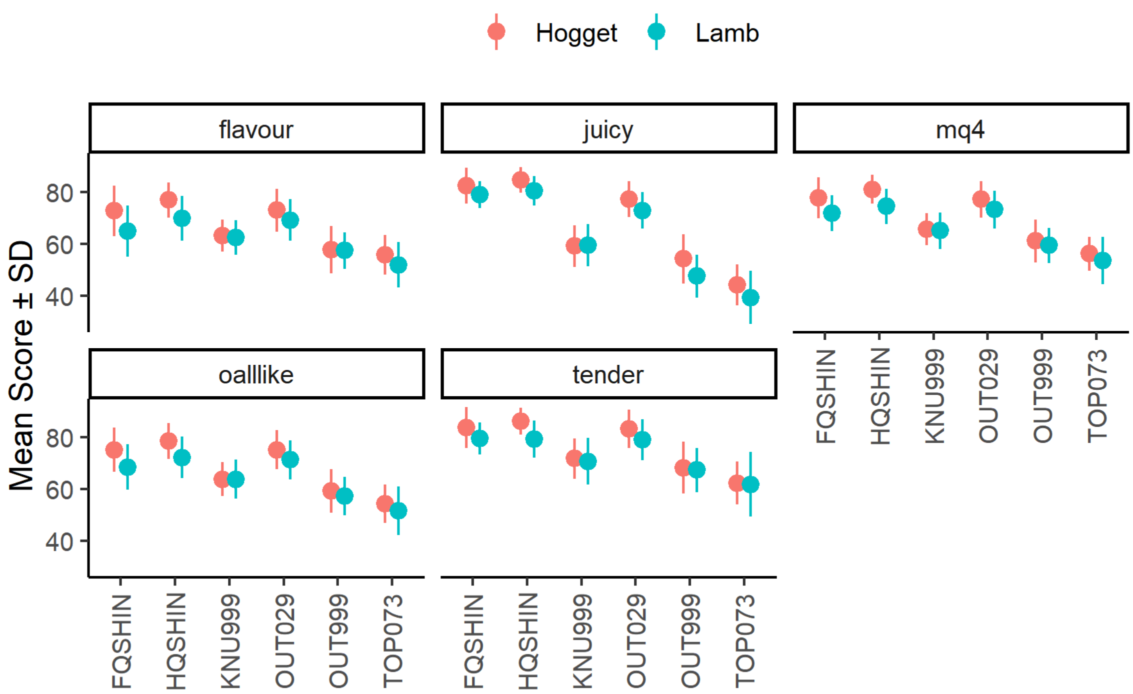
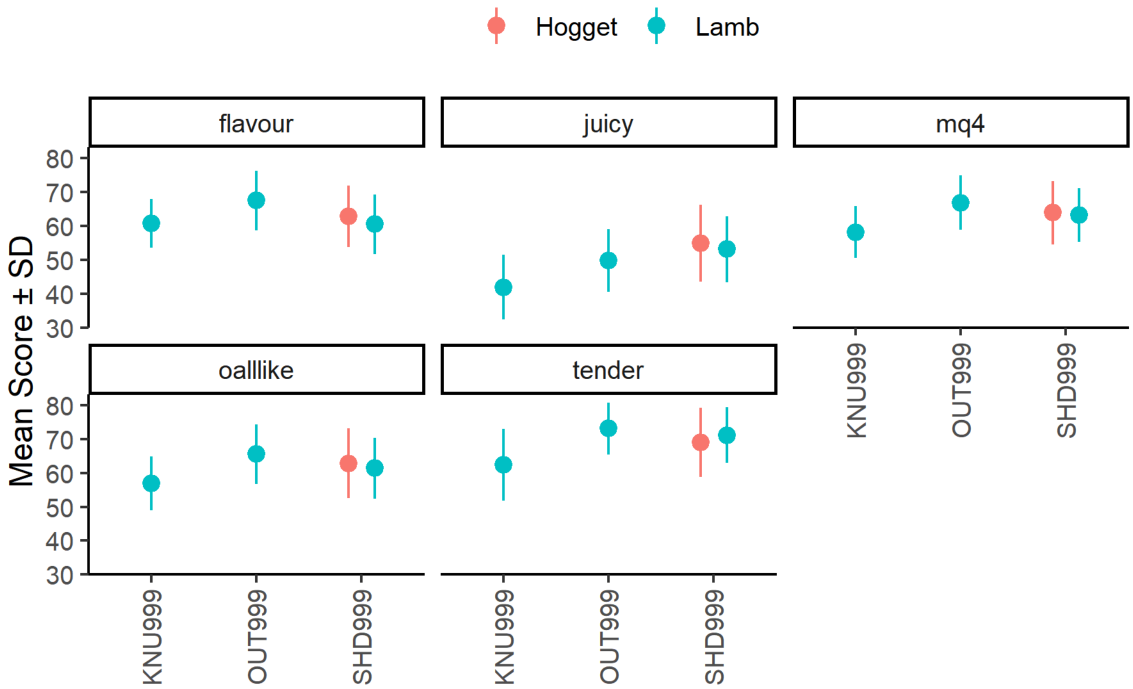


Figure 10. Mean ± standard deviation of tenderness, juiciness, flavour, overall liking and meat quality score for Texas low 'n slow BBQ lamb samples



5. Conclusion

5.1 Key findings

- Across each of the cook methods there appeared to be minimal difference between hoggets and lambs. Hoggets were numerically higher (not statistically) for grill and slow-cooks and lower for roasts, however there was little difference at all for stir-fry and low n' slow BBQ. This suggests that good quality hoggets or yearlings with 2 teeth have very good eating quality and supports trading sheepmeat on quality, not dentition.
- It appears that slow-cooked samples scored the highest MQ4 scores, particularly the shanks and heel meat. It was also evident that they showed the least variability between samples across all cook methods.
- The Texas Low 'n Slow performed worse than expected, however this may be due to the small size of the muscles and high fat content.
- The topside performed best as a stir-fry, however overall stir-fry showed the greatest variability between samples.
- The knuckle performed well as a grill, roast and stir-fry, but poorly as a Texas Low 'n Slow BBQ
- The forequarter rack, rack and loin performed well as grills and roasts as expected.

5.2 Benefits to industry

This research has further built the reference population for sheepmeat, which is essential for genomic tools to work in industry. The cuts collected from the lambs and hoggets have provided implications for all major muscles in the carcase based on grill, roast, stir-fry, slow-cook and low n' slow cook methods. In turn, this has increased industry's ability to accurately predict eating quality at a cut level and provides an avenue to improve the marketing of sheepmeat.

6. Future research and recommendations

Based on the results of this project, the MSA Sheepmeat model can be updated with better predictions for more cuts, and more cook methods from a wider range of animal ages. Improvements to the MSA sheepmeat model for more cut x cooks and for more animal ages will allowing industry to extract greater value out of a wider range of animals. Further research is required on more cuts still not well understood (riblets, neck, tenderloins) and also expanding the age range into animals with 4 and 6 teeth. The desire is that Australian sheepmeat is traded in future on meat quality not on dentition. There is a desperate need to have a central data system for sheepmeat that is easy to access, easy to extract data files from and enter data into. At present the data compilation is inefficiently managed across 2 different systems.