

final report

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DRY AGED LAMB PROOF OF CONCEPT STAGE 2

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Executive Summary

In the red meat industry, limited work has been done on the dry ageing on sheepmeat. As sheepmeat has similar physical properties to beef, in that it has a generous outer fat layer covering deep red colored meat, it is indeed peculiar that dry aged lamb has not featured at any level in the food industry.

This project aims to investigate the effect of dry ageing on lamb, hogget and mutton meat, and if it has any relevance in the food sector.

Lamb, hogget and mutton, were dry aged in sides for 39 days at the South Australian Cattle Co. Pty Ltd's state of the art dry ageing facility in the Adelaide Hills. This meat was then tasted at the A Hereford beefstouw restaurant in Adelaide by a sensory panel of 19 people.

Results of the trial can be summarised as follows:

- We confirmed the results of the previous dry aged lamb trial V.RMH.0038, in that dry Aged Lamb could sell for a 20-30% price premium over wet aged lamb based on the significant positive characteristics it imparts on the flavour of the lamb.
- Dry ageing of hogget and mutton could also add a significantly premium to these traditionally lower value types of sheepmeat – to a point where certain hogget and mutton cuts may be able to be sold for more than wet aged lamb. This is due to the findings of this trial that demonstrates dry ageing transforms hogget and mutton into a better eating product than wet aged lamb.

Dry ageing all classes of sheepmeat (lamb, hogget and mutton) increases tenderness, roasted and buttery flavours, and decreases negative traits such as bloodiness, boiled, livery and metallic flavours.

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1 Background

The popularity of Dry Aged Beef on restaurant menus and in retail outlets continues to grow as consumer demand for artisan, hand crafted premium food increases. In the red meat industry, this consumer demand has translated into many processors, butchers and restaurants experimenting in the production of dry aged beef.

To date though, limited work has been done on the dry ageing of lamb, hogget or mutton. Sheepmeat has similar physical properties to beef in that it has a generous outer fat layer covering deep red colored meat. It is thus indeed peculiar that dry aged lamb/hogget/mutton has not featured at any level in the food industry.

This project aims to follow on from a previous project conduction by the South Australian Cattle Co. Pty Ltd (Dry Aged Lamb Proof of Concept V.RMH.0038) that investigated the effect of dry ageing on lamb meat. This initial project saw very beneficial effects of dry ageing on lamb. The aim of this project is to test the effect of dry ageing on lamb vs hogget vs mutton, and to see if there is any relevance in the food sector for dry ageing hogget and mutton.

This project will analyse yields and sensory profiles for proof of concept for dry aged lamb, hogget and mutton.

The results and recommendations from this project will initially be presented internally to MLA's insights2innovation team and the Sheep Meat Council peak body to seek input into potential next step opportunities.



2 Project Objectives

1. Design and deliver several proof of concept dry aged lamb products and identify key differences to dry aged beef protocols and profiles. Coordinate external laboratory to complete initial microbial assay on the lamb concepts.
2. Evaluate difference between larger lamb , muttons, and hoggets for yield and quality differences.
3. Present key findings – including yields, process flow chart and specifications, shelf life, menu concepts and indicative costs for various proof of concepts

3 Methodology

The lamb dry ageing research in this project was undertaken by the South Australian Cattle Co. Pty Ltd, who are a vertically integrated beef business. They are a leading beef producer, dry aged beef specialist, and also own and operate the successful A Hereford Beefstouw restaurants in Adelaide, Melbourne and Scandinavia.

Lamb (for dry ageing) and Mutton used in the trial was purchased from RGFM Pty Ltd, and Lamb (for wet ageing) and Hogget were purchased from Swan Hill Abattoir under their Murray Valley Gold brand.

The trial was conducted at SA Cattle Co Pty Ltd's dry ageing facility at Mt Barker in the Adelaide Hills. Specifications of the dry ageing process were:

Length of Dry Ageing:	39 days
Temperature:	0-2 deg C
Relative Humidity:	70%-80%
Lighting:	Aged in the dark with UV Ozone lights

All meat for dry ageing were half bodies (split down the spine) and were hung from a galvanised steel rail system.

The wet aged lamb was cut into its primals and vacuum sealed. The wet aged lamb was aged in cryovac bags in cardboard boxes in the same cool room as the dry ageing meat.

For the three different types of sheep meat that were dry aged (lamb, hogget and mutton), eight replicates of each side were aged, and eight replicates of each lamb primal were wet aged (vacuum sealed bags).

Each meat sample was weighed at the beginning and conclusion of the trial for yield loss.

At the conclusion of the ageing period, the meat was weighed and then boned out.

Microbial analysis was also taken on the dry aged lamb, hogget and mutton at the conclusion of the dry ageing trial.

After boning and trimming, the dry aged sheep meat was sent via refrigerated transport to the A Hereford Beefstouw restaurant in Adelaide, where it was cooked for the tasting trial.

All meat cuts were grilled to a medium rare level, with no seasoning or oil used. The tasting panel consisted of 19 food tasters who tasted each piece of meat and recorded their results.

The different sheep meat cuts were coded and tasted by the sensory panel, who were asked to score in intensity for the lamb, hogget and mutton based on a variety of flavours on a score sheet. For purpose of this trial, the flavour parameters used were adapted to Lamb flavours from the Beef Flavour Lexicon (from the Research Guidelines for Cookery, Sensory Evaluation and Instrumental Tenderness Measurements of Meat and Development of a Beef Flavor Lexicon and its Application to compete Flavor Profiles and Consumer Acceptance of Grain- and Pasture Finished Cattle).



4 Results

4.1 WEIGHT LOSS AND YIELD DATA

START DATE: 21st April 2016

FINISH DATE: 30th May 2016

MEAT DESCRIPTION		AGEING ANALYSIS			TRIMMED ANALYSIS						
CLASS	AGEING TYPE	START (kg)	FINISH (kg)	AGEING YIELD LOSS (%)	FRENCH RACK OF LAMB (kg)	SHORT LOIN ROAST (kg)	BONELESS LEG (kg)	NECK CUTLETS (kg)	TOTAL ALL TRIMMED WEIGHT (kg)	BONE & TRIM WASTAGE WEIGHT (kg)	TOTAL TRIMMED YIELD FROM START WEIGHT (%)
LAMB	Wet Aged	9.4	9.4	0.0	0.69	1.03	2.78	0.51	5.01	5.39	53.5%
LAMB	Dry Aged	12.6	10.8	14.2%	0.76	1.16	2.45	0.34	4.71	8.48	37.6%
HOGGETT	Dry Aged	12.6	10.7	15.2%	0.81	1.04	2.25	0.43	4.53	8.61	36.1%
MUTTON	Dry Aged	15.1	12.9	14.8%	0.91	1.26	2.99	0.44	5.61	10.10	37.2%

DAYS AGEING: 39

FIGURE 1. SUMMARY OF WEIGHT LOSS AND YEILD ANALYSIS

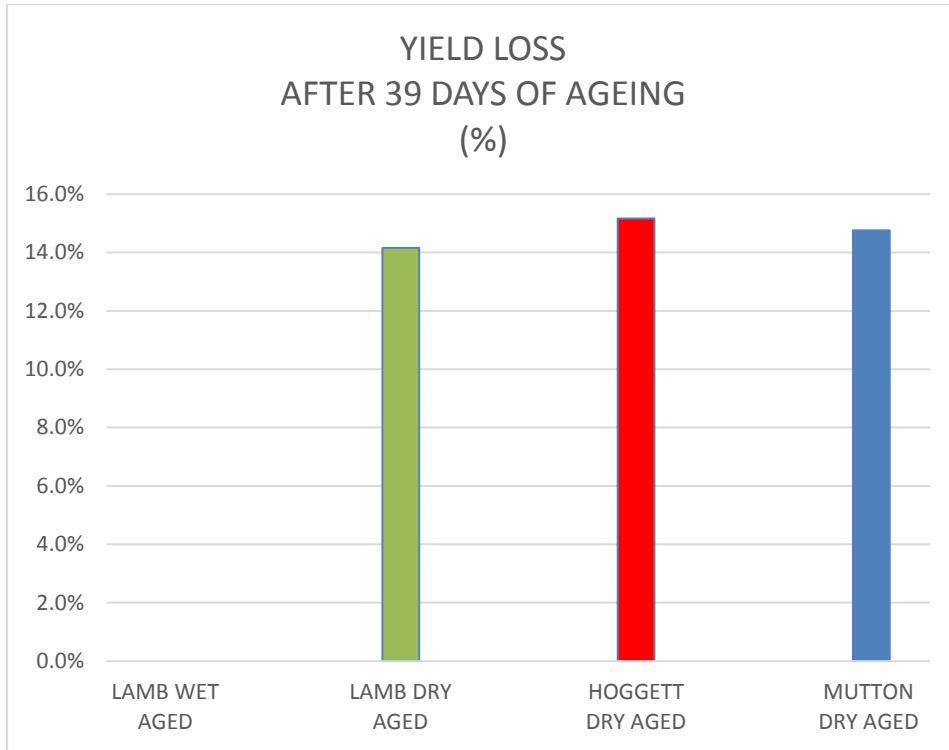


FIGURE 2. WEIGHT LOSS OF SHEEP MEAT TYPES AFTER 39 DAYS AGEING

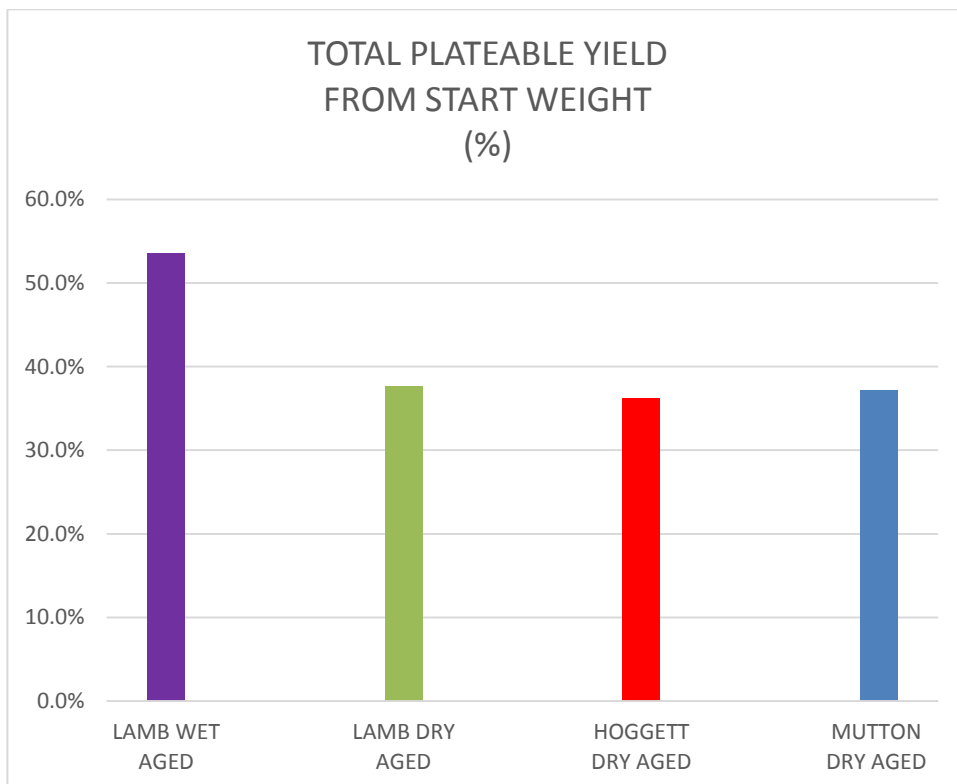


FIGURE 3. FINAL PLATEABLE YIELD OF SHEEP MEAT TYPES

4.2 MICROBIAL ANALYSIS DATA

FIGURE 4. Microbial Analysis of DRY AGED SHEEP MEATS

SAMPLE & LRN 100cm² area swabbed	TVC cfu per cm²	E.coli cfu per cm²	Yeast cfu per cm²	Mould cfu per cm²	Pseudomonas cfu per cm²	Salmonella cfu per cm²
DAYS DRY AGEING	39	39	39	39	39	39
DRY AGED LAMB	2.5	ND**	ND**	0.25	ND**	ND**
DRY AGED HOGGET	2.5	ND**	ND**	ND**	ND**	ND**
DRY AGED MUTTON	ND**	ND**	ND**	ND**	ND**	ND**

Note ** - Not detectable <0.25 /cm²

SENSORY DATA

FIGURE 5. Dry aged Lamb, Mutton and Hogget Loin



FIGURE 6. Overall likeness for Dry aged Lamb, Hogget and Mutton Loin

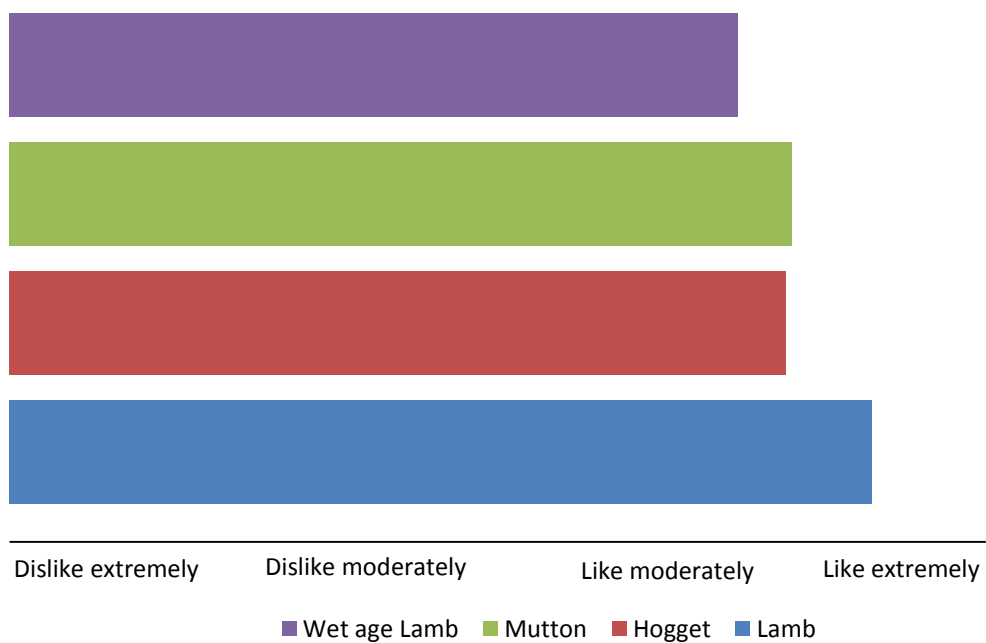


FIGURE 7. Dry aged Lamb, Mutton and Hogget Leg



FIGURE 8. Overall likeness for Dry aged Lamb, Hogget and Mutton Leg

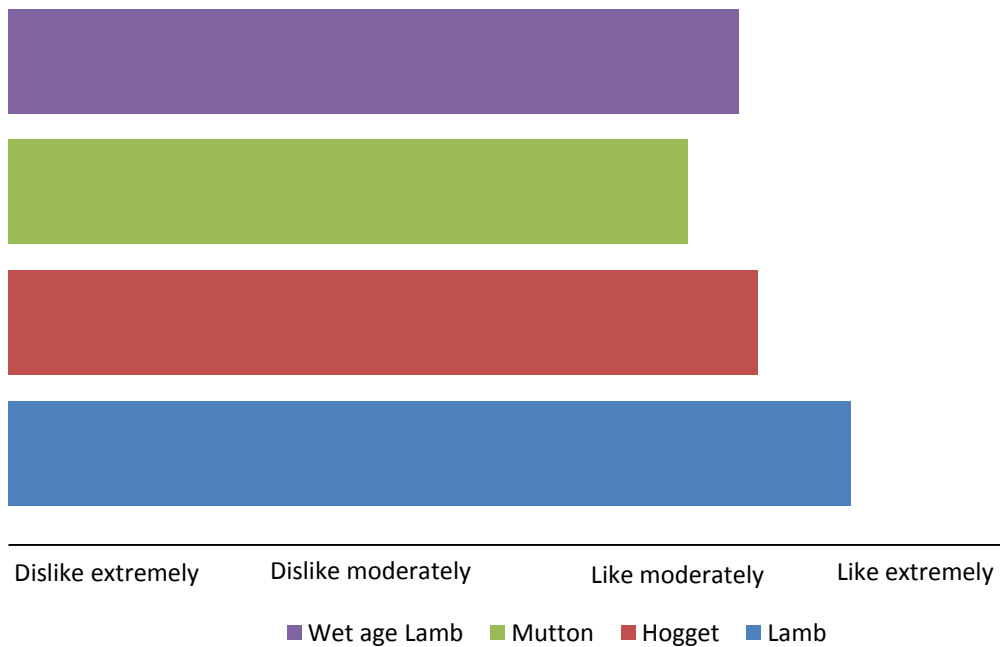
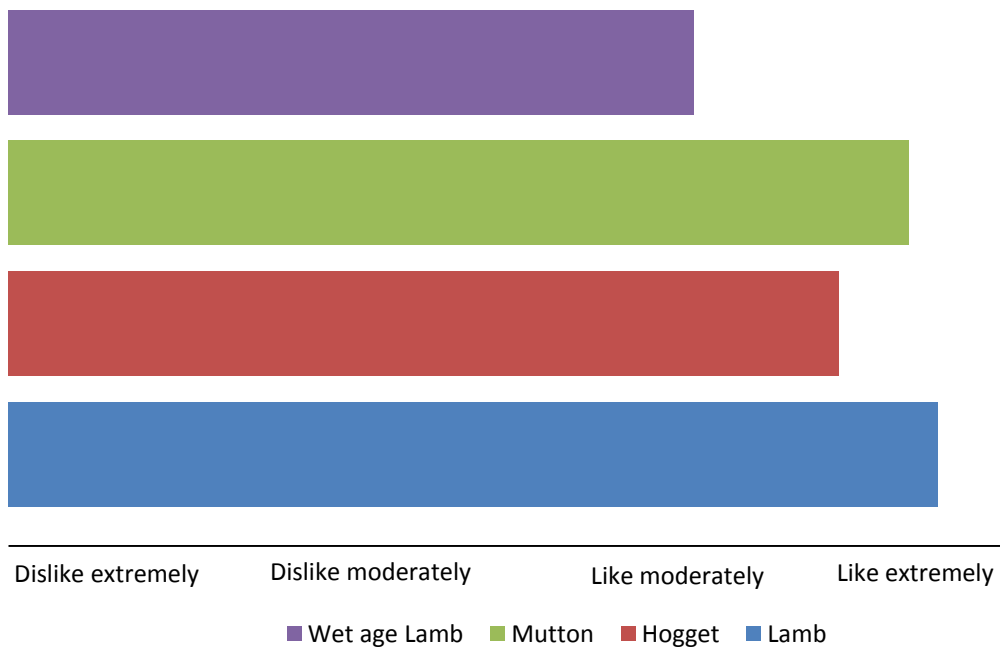


FIGURE 9. Dry aged Lamb, Mutton and Hogget Forequarter



FIGURE 10. Overall likeness for Dry aged Lamb, Hogget and Mutton Forequarter



5 Discussion

5.1 WEIGHT LOSS AND YIELD

As expected, there were no significant weight loss on the wet aged lamb primals, besides the small purge naturally found in wet age product. This is due to the lamb being encased in a vacuum sealed bag that did not allow the transfer of atmosphere between the inside and the outside of the bag.

In this experiment, the sheep meat was dry aged in whole sides. This was done to reduce the drying losses that were experienced when dry ageing the lamb in primals as per the previous project that was conducted (V.RMH.0038). This approach seems to work, with total losses over a 39 day period being:

LAMB in Primals:	18.0%
LAMB in Sides:	14.2%
HOGGET in Sides:	15.2%
MUTTON in Sides:	14.8%

The approach of dry ageing the lamb in sides creates less interfaces for the meat to be exposed to the dry air and strong airflow in the dry ageing room. As a result, we saw a 3.8% reduction in dry ageing losses in the lamb dry aged in primals vs lamb dry aged in sides (from the previous trial). It is also worth noting that the lamb in sides was dry aged for 39 days vs 33 days for the dry aged lamb in primals. Therefore, the weight loss of the lamb in sides would have been even less if aged for only 33 days.

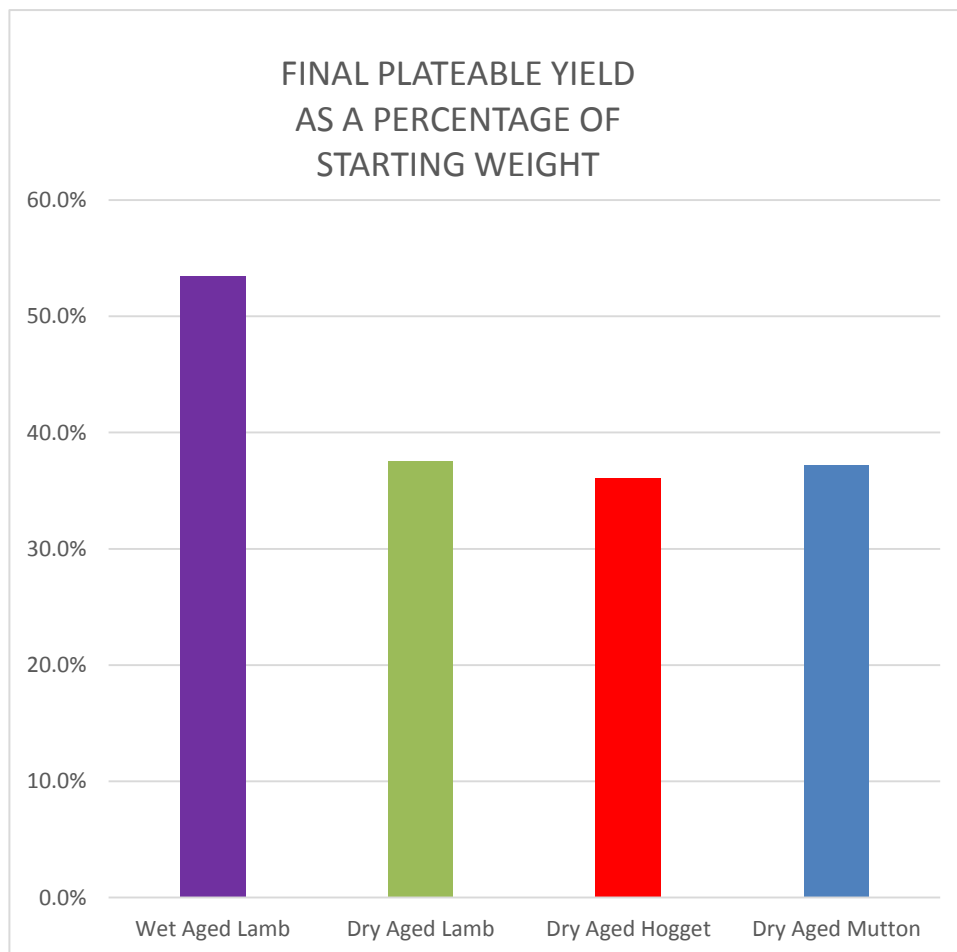
The differences in weight losses of the sides between the lamb, hogget and mutton over the 39 day period were very similar, with only a 1.0% difference between the sheepmeat type with the least dry ageing loss (lamb) vs the sheepmeat type with the greatest dry ageing loss (hogget).

Beef sides lose on average approximately 10% during a similar dry ageing period. So, whilst sheep meat will lose 5% more yield when aged in sides compared to beef, the yield losses experienced in no way make the dry ageing of lamb/hogget/mutton unviable from a yield loss perspective.

When comparing final plateable yields of the dry aged sheepmeats as a percentage of the starting weight, the results of the lamb, hogget and mutton were once again very similar to each other as seen in the table below. The dry aged hogget had the lowest yield at 36.1% and the lamb had the highest yield at 37.6%. This is only a difference of 1.5% in yield between all three treatments. The mutton was very similar to the lamb with a final yield of 37.2%

WET AGED LAMB:	53.5%
DRY AGED LAMB:	37.6%
DRY AGED HOGGET:	36.1%
DRY AGED MUTTON:	37.2%

When comparing final plateable yield of the wet aged lamb versus the dry aged lamb, the difference in final plateable yield was 15.9%. This is in line with the weight loss experienced in the dry aged lamb vs the wet aged lamb (14.2%). In fact, the final yields of the other dry aged treatments closely correlate to the weight loss from dry ageing. The Hogget lost 15.2% in weight during the dry ageing and gave a final plateable yield of 17.4% below that of the wet aged lamb. The Mutton lost 14.8% in weight during the dry ageing and gave a final plateable yield of 16.3% below that of the wet aged lamb.



5.2 MICROBIAL ANALYSIS

Visually, all of the sheepmeat treatments behaved extremely similar to beef in terms of the rate of change (outer drying) and the physical appearance of the meat during all stages of the dry ageing process. No mould growth was observed on the dry ageing lamb at any time during the dry ageing process.

The microbial analysis of the dry aged sheepmeat are once again extremely encouraging in terms of its suitability for dry ageing, and closely replicate the results achieved in the first dry aged lamb trial.

Total Viable Count (TVC) was Not Detectable in the Dry Aged Mutton or negligible in the Dry Aged Lamb and Hogget (only 2.5 cfu/cm²)

E. Coli and Yeast results were also very encouraging with all samples recording Not Detectable readings after 39 days of dry ageing.

Mould was also not detectable in the Dry Aged Hogget and Mutton, and only a negligible was recorded in the dry aged lamb (0.25 cfu/cm²).

Salmonella and pseudomonas were both Not Detectable in all dry aged sheepmeat treatments.

Most microbes require moisture to survive, hence the rapid and effective drying of the surface during the dry ageing process, as evident by the virtual absence of any microbes on the surface of the lamb, hogget and mutton, strongly indicates that lamb is suitable for dry ageing in terms of safety for human consumption.

It is worth noting that the facility in which the sheepmeat was dry aged was a state of the art purpose built room. Thus replication of these results will vary between dry ageing facilities, depending on the level of sophistication of the facility, starting with raw material and processing hygiene during and after the process.

5.3 SENSORY ANALYSIS

The major findings of the sensory analysis by the tasting panel are summarised below.

DRY AGED SIGNIFICANT OBSERVATIONS

1. OVERALL LIKENESS

One of the most significant findings of the sensory results from this trial is that, with the exception of the dry aged mutton leg, all the dry aged lamb, hogget and mutton cuts were more liked by the sensory panel than the Wet Aged Lamb. This is truly a remarkable finding. It appears that dry ageing of hogget and mutton, in addition to dry ageing lamb, has significant beneficial sensory properties over wet aged lamb.

Dry aged lamb was the clear winner in the sensory trials. The dry aged lamb was the most liked over all the other types of sheepmeat in each of the 3 cuts tasted (loin, leg and forequarter).

The dry aged hogget was the second most liked treatment in the trial, followed by the dry aged mutton, and the least liked overall was the wet aged lamb.

Interestingly, the most liked cut of the whole trial was the dry aged forequarter. The dry aged lamb, hogget and mutton all scored in the Like Extremely rating for this cut – and surprisingly these were higher ratings than were given to the loin cuts.

2. TENDERNESS

One of the most commonly used and desired descriptors of lamb is in reference to its tenderness. Therefore the tenderness sensory results of this trial are of high relevance.

Dry aged lamb matched the tenderness of wet aged lamb in the loin and leg cuts, and was rated significantly more tender than any other treatment in the forequarter.

Dry aged hogget was also rated more tender than wet aged lamb in the loin, forequarter and leg.

Dry aged mutton was rated more tender in the forequarter, equal to the wet aged lamb in the loin, and the least tender in the leg.

The well documented increase in tenderness effect of dry ageing in beef, certainly appears to be the case in all classes of sheepmeat.

3. BUTTERY CHARACTER

The butter/fried character was used to describe the richness and palate weight of the meat samples, and is considered a positive attribute associated to dry aged meat.

In the loin cut, all treatments gave a similar result for Butter/Fried. In the leg cut, the dry aged lamb was rated significantly higher than the other 3 treatments. In the forequarter, all three dry aged classes of sheepmeat scored significantly higher in this character over the wet aged lamb.

4. ROASTED

The roasted flavour was also seen as a positive flavour attribute as it contributes to overall richness and depth of flavour.

In the forequarter, all dry aged sheepmeats were rated higher in the Roasted attribute over the wet aged lamb. Roasted scores were slightly higher for the dry aged sheepmeats in the loin cuts compared to the wet aged lamb, and in the legs, all treatments rated the same for Roasted.

WET AGED LAMB SIGNIFICANT OBSERVATIONS

1. LIVERY

Livery flavour in lamb are a negative flavour.

In probably the most clear finding of the this trial, is the effect of dry ageing on the livery character.

The wet aged lamb heavily out-rated all other dry aged classes, across all three cuts in this negative trait. It was a clear two levels higher than all the dry aged sheepmeat in the forequarter and loin, and two levels higher than the dry aged lamb and hogget in the leg

2. BLOODY

Blood flavours in lamb would be considered a negative flavour description, and thus not desirable in dry aged meat.

In all of the cuts, the wet aged lamb rated significantly higher in bloody flavours over the dry aged sheepmeats.

3. METALLIC

Metallic flavours in lamb would also be considered a negative flavour description, and thus not desirable.

The wet aged lamb was rated significantly higher in the negative metallic character in the forequarter and loin cuts.

4. BOILED

The boiled flavour of meat is not considered desirable.

Wet aged lamb was rated much higher in the boiled character in the loin and leg.

It appears from the sensory results that the effect of dry ageing on lamb, hogget and mutton, significantly impacts in a positive manner on the eating quality of sheepmeat.

Dry aged lamb becomes a clear winner in terms of eating quality over wet age lamb. However, the most surprising, and exciting findings of this trial is that, dry ageing hogget and mutton, also makes them a more preferred to wet aged lamb.

In summary, dry ageing increases the positive flavour attributes in lamb, hogget and mutton of tenderness, roasted and buttery fried characters in all cuts, and increased tenderness in the forequarter cuts.



6 Conclusions/Recommendations

The exciting results of this trial have indicated a very positive impact of dry ageing on all classes of sheepmeat. We have observed the following key points:

- Lamb, Hogget and Mutton are suitable for dry ageing from a microbial and food safety perspective.
- Lamb, Hogget and Mutton dry age in a very similar way to beef, although the weight losses as a percentage of the starting weight are approximately 5% higher than beef. This is due to the higher surface area to volume ratio in lamb over beef.
- The plateable yield of dry aged lamb, hogget and mutton are less than wet aged lamb. On average, the plateable meat yields are 16.5% lower than wet age lamb.
- Dry ageing of lamb, hogget and mutton has many beneficial flavour impacts, most notably in tenderness, roasted and buttery flavour.
- Dry ageing of hogget and mutton makes them more preferred flavourwise over wet aged lamb.
- Dry Aged Lamb could sell for a 20-30% price premium over wet aged lamb based on the impact on the flavour of the lamb.
- Additionally, dry ageing of hogget and mutton could add a significant premium to these traditionally lower value types of sheepmeat – to a point where certain hogget and mutton cuts may be able to be sold for more than wet aged lamb.

In summary, main thrust of this trial was to ascertain whether dry ageing can be applied to hogget and mutton (as it was proven in project V.RMH.0038 that dry ageing imparts beneficial effects to lamb). The results of this trial are an emphatic yes. The effect of dry ageing transforms hogget and mutton into a product that is preferred in sensory trial to that of wet aged lamb. The potential implications of this to the sheepmeat industry are significant.