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LMY & EQ Producer Demonstration Sites – NSW Sites carcase measurement

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Executive summary

This project is providing data to the MLA project B.SCC.0144 - Proof of Concept of Lean Meat Yield and Eating Quality Producer Demonstration Sites. The overarching purpose of this, and other projects providing data to B.SCC.0144, is to deliver "proof of concept" for lean meat, eating quality and human health attributes within major lamb and sheep meat supply chains by facilitating, empowering and developing a common focus and normal trading mechanisms on these future key industry profit drivers right along the supply chain.

Twenty Producer Demonstration Sites were established to demonstrate the impact of new research breeding values (RBVs) for lean meat yield (LMY) and eating quality, particularly intramuscular fat (IMF) and shear force (SF5), will have on lamb production along the supply chain. Three of these sites are in New South Wales.

Within this project Meat Science UNE has:

- Coordinated the slaughter and data collection for the New South Wales sites for 617 lambs from 5 trials processed at 4 different abattoirs.
- Collected loin samples (n = 260) for determination of shear force (SF5) and intramuscular fat (IMF).
- Shipped samples for determination of SF5 to NSW DPI Cowra.
- Analysed samples from demonstration sites in NSW, South Australia and Tasmania for IMF.
- Submitted all data to the LM&EQ PDS national coordinator for analysis and presentation of results in the project report for B.SCC.0144.

The data collected regarding the shear force of the samples suggest that the processing conditions in some abattoirs are suboptimal regarding control of the rate of pH and temperature decline.

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1. Background

This project supports the national project to deliver "Proof of Concept" for lean meat yield, eating quality and human health attributes within major lamb and sheep meat supply chains by facilitating, empowering and developing a common focus and normal trading mechanisms on these future key industry profit drivers right along the supply chain. From the Sheep Genomics Program and the Information Nucleus Flock of the Sheep CRC, Poll Dorset, White Suffolk and Merino sires have been identified that have divergent research breeding values (RBVs) for dressing percent, lean meat yield (LMY) and eating quality, particularly Intramuscular Fat (IMF) and shear force (SF5). Producer Demonstration Sites were established to demonstrate the impact these new RBVs will have on lamb production along the supply chain.

Twenty Producer Demonstration Sites (PDS) were established across Australia involving 8 sires (2 high and 2 Low by 2 traits) per site, with the target of producing 200 lambs for measurement & processing and allowing 80 carcasses to be sampled for eating quality traits. The data from each site will be aggregated and used in major communications programs with Sheep Genetics, MLA and the Sheep CRC.

The data will contribute to the overall outcomes of the LMY & EQ Proof of Concept project (B.SCC.0144), which include:

1. Determining the value of 6 or more new research breeding values for ram breeders, lamb producers & processors at 20-30 sites.

2. Supporting development of suitable measurement technology and feedback mechanisms for these breeding values at processing.

3. Initiating a common focus and fostering the development of normal trading mechanisms, including potential value based trading, on these future key industry profit drivers along the supply chain.

This project encompasses the measurement of carcase and meat quality traits of lambs from three PDS located in New South Wales.

2. Project objectives

By 30 July 2014, for three New South Wales LMY and EQ Producer Demonstration Sites:

- Coordinated the slaughter and collection of carcase data in-plant for up to 600 lambs.
- Collected loin samples on up to 240 lambs for IMF and SF5 measurement – up to 80 lambs from the group of up to 200 from each site. (8 sires x 10 progeny/sire).
- Conducted measurement of IMF on up to 240 lambs from the NSW sites.
- Conducted measurement of IMF on up to 230 lambs from the South Australian sites. Samples provided by SARDI.
- Conducted measurement of IMF on up to 240 lambs from the Tasmanian sites. Samples provided by SARDI.
- Shipped loin samples for shear force (5 days aged) measurement to NSW DPI, Cowra, within three weeks of the final slaughter.

- Submitted all data in the standard data template to the LM&EQ PDS National Coordinator within six weeks of the final slaughter group from each site.

3. Methodology

Lamb identification was recorded in-plant from EID ear tags at all sites. In the cases were the identity of the lambs could not be verified due to missing ear tags, or carcases getting out of order between the point of ear tag collection and carcase labelling, muscle samples were collected for DNA extraction and the identity of the carcase was determined using a parentage test.

All carcasses were subjected to medium voltage electrical stimulation and trimmed according to AUS-MEAT specifications. At slaughter, hot carcass weight (HCWT) and abattoir fat measurement were recorded. GR depth, Cfat thickness, eye muscle depth (EMD) and eye muscle width (EMW), fresh colour at the 12th rib and ultimate pH of the loin (LL) and leg (ST) were measured using the standardised Sheep CRC protocol (Pearce, 2011). Eye muscle area (EMA) was calculated from EMW and EMD.

Muscle samples were collected from the left short loin. Samples for determination of IMF (about 40g) were collected, transported on ice to UNE and frozen at -20^{o}C prior to further processing for IMF measurement. A second sample from each carcase was collected, vacuum packed and delivered to DPI Cowra for determination of the shear force after 5 days of aging.

Samples for determination of IMF from the South Australian and Tasmanian demonstration sites were shipped frozen to UNE by SARDI and analysed according to the Sheep CRC protocol (Pearce, 2011).

4. Results

Slaughter, abattoir data and sample collection has been coordinated for the Yelds (PD11), Holding (PD12) and Manchester (PD13) sites (Table 1). Intramuscular fat analysis has been performed for the NSW, SA and Tas sites. All results regarding the NSW trials and IMF data for SA and Tas have been submitted to the project National Coordinator.

Table 1. Slaughter date, plant location, processor, number of lambs delivered and sample collection for SF5 and IMF (EQ) from PD11, PD12 & PD13.

	Date		***Location***	***Processor***	***N***	***EQ***
PD11	17 Dec 2013	(Trial 1)	Cootamundra	Scott G M	52	Yes
	31 Jan 2014	(Trial 3)	Cootamundra	Scott G M	143	Yes
PD12	10 July 2014	(Trial 5)	Cobram	JBS	134	Yes
PD13	20 Jan 2014	(Trial 2)	Gundagai	Gundagai Meat Processors	155	Yes
	11 Apr 2014	(Trial 4)	Tamworth	TFI	133	Yes

Simple statistics for the carcase measurements are presented in Table 2. In general, the collection of the carcase data was conducted without any noteworthy problems. An exception to this was the kill conducted in Tamworth. For 48 out of the total of 133 carcases, the identifier written on the carcases was removed by abattoir personnel.

Simple statistics for the meat quality traits are presented in Table 3, including measurements of intramuscular fat percentage (IMF) and shear force of the loin after 5 days of ageing (SF5) for a subset of 260 carcases.

Analysis of variance of the carcass and meat quality traits between the different trials are presented in Table 4.

Table 2. Simple statistics for HCWT, Fat Score, GR depth, CFAT, EMD, EMW, EMA of PD11, PD12 and PD13 lambs.

	PD11 (17/12/13)					PD11 (31/1/14)				
Variable	**N**	**Mean**	**SD**	**Min**	**Max**	**N**	**Mean**	**SD**	**Min**	**Max**
HCWT (kg)	52	21.4	1.2	19.0	24.1	143	20.5	1.5	16.9	24.5
Fat score	52	2.6	0.5	2	3	143	2.6	0.5	1	3
GRFAT (mm)	52	10.9	3.3	4	18	143	9.8	2.9	5	19
CFAT (mm)	52	3.2	1.4	1	8	141	3.8	1.4	2	9
EMW (mm)	52	62.0	4.2	53	71	141	55.4	3.4	48	63
EMD (mm)	52	32.6	3.3	25	40	141	29.5	2.6	22	37
EMA (cm^2)	52	16.2	2.2	12.0	22.2	141	13.1	1.5	9.2	16.8
	PD12 (10/7/14)					**PD13 (20/1/14)**				
HCWT (kg)	134	23.3	2.5	16.2	30.6	155	22.7	2.7	17.5	30.1
Fat score	134	3.1	0.4	2	5	155	3.5	0.8	2	5
GRFAT (mm)	134	12.0	4.1	3	22	155	11.4	3.6	5	22
CFAT (mm)	134	3.5	1.8	1	8	154	5.8	3.1	1	15
EMW (mm)	134	60.3	3.7	49	69	154	65.0	6.2	40	84
EMD (mm)	134	33.7	3.5	23	43	154	33.3	4.9	18	48
EMA (cm^2)	134	16.3	2.2	11.4	21.3	154	17.3	3.2	9.9	26.9
	PD13 (11/4/14)									
HCWT (kg)	133	24.9	2.7	20.0	31.8					
Fat score	133	2.4	0.7	2	4					
GRFAT (mm)	133	15.1	3.5	6	23					
CFAT (mm)	85	6.0	2.4	2	15					
EMW (mm)	85	61.0	4.6	36	72					
EMD (mm)	85	35.5	3.0	30	42					
EMA (cm^2)	85	17.3	2.1	9.8	22.7					

As shown in Table 2, carcase data (HCWT, Fat Score and GRFAT) were collected on a total of 617 carcasses. Data regarding abattoir measurements on the shortloin (CFAT, EMW, EMD and EMA) were collected on a total of 566 carcasses. As explained above, the discrepancy between the number of carcasses evaluated for gross carcass traits and shortloin measurements is due to the removal of carcass identifiers by abattoir personnel during the trial on 11/4/14.

Table 3. Simple statistics for fresh colour lightness (L*), redness (a*) and yellowness (b*), pH of the loin (pHLL), pH of the semitendinosis muscle (pHST), shear force of the loin (SF5) and intramuscular fat percentage (IMF) of the loin of PD11, PD12 and PD13 lambs.

	PD11 (17/12/13)					PD11 (31/1/14)				
Variable	**N**	**Mean**	**SD**	**Min**	**Max**	**N**	**Mean**	**SD**	**Min**	**Max**
L*	52	37.2	1.9	32.2	40.8	141	39.4	2.2	32.2	44.1
a*	52	18.0	1.6	14.1	22.1	141	17.9	1.6	12.8	21.5
b*	52	5.8	0.2	3.3	8.1	141	6.0	1.0	2.5	8.0
pHLL	52	5.61	0.11	5.45	6.01	140	5.65	0.19	5.38	6.39
pHST	52	5.82	0.22	5.60	6.67	143	6.10	0.28	5.66	6.93
SF5 (N)	46	32.4	6.1	23.0	49.6	33	28.3	8.5	17.6	51.1
IMF (%)	46	3.9	0.6	3.0	5.7	33	4.0	0.5	3.0	4.8
	PD12 (10/7/14)					**PD13 (20/1/14)**				
L*	134	35.0	1.7	30.7	40.4	155	34.9	2.9	27.7	45.9
a*	134	18.4	1.3	14.4	21.8	155	16.7	2.1	10.7	24.5
b*	134	6.7	0.8	4.3	8.6	155	5.9	0.2	3.5	9.2
pHLL	134	5.73	0.17	5.46	6.29	155	5.68	0.11	5.50	6.22
pHST	134	6.15	0.30	5.71	6.93	155	5.89	0.16	5.69	6.38
SF5 (N)	77	42.4	12.2	23.4	83.4	80	50.7	18.4	20.8	100.1
IMF (%)	77	4.6	0.8	3.4	8.0	80	4.1	0.7	2.7	5.9
	PD13 (11/4/14)									
L*	84	36.9	2.1	31.5	41.3					
a*	84	18.4	1.6	13.2	22.0					
b*	84	6.4	1.1	3.4	8.5					
pHLL	85	5.62	0.10	5.50	5.99					
pHST	85	5.89	0.21	5.61	6.59					
SF5 (N)	24	31.0	9.1	19.7	53.0					
IMF (%)	24	4.2	0.7	3.1	6.3					

As shown in Table 3, colour (L*, a* and b* values) and pH data on the LL and ST were collected on nearly all of the processed carcasses. Meat quality data (SF5 and IMF) were collected on a total of 260 samples.

Table 4. Analysis of variance for the carcass and meat quality traits between the different trials.

Trait	PD11 (17/12/13)	PD13 (21/1/14)	PD11 (31/1/14)	PD13 (11/4/14)	PD12 (10/7/14)	P-value
HCWT (kg)	21.4^{a}	22.7^{b}	20.5^{a}	24.9^{c}	23.3^{b}	0.000
Fat score	2.6^{ab}	3.5^{d}	2.6^{b}	2.4^{a}	3.1^{c}	0.000
GRFAT (mm)	10.9^{ab}	11.4^{b}	9.8^{a}	15.1^{c}	12^{b}	0.000
CFAT (mm)	3.2^{a}	5.8^{b}	3.8^{a}	6.0^{b}	3.5^{a}	0.000
EMW (mm)	62.0^{b}	65.0^{c}	55.4^{a}	61.0^{b}	60.3^{b}	0.000
EMD (mm)	32.6^{b}	33.3^{b}	29.5^{a}	35.5^{c}	33.7^{b}	0.000
EMA (cm^2)	16.2^{b}	17.3^{c}	13.1^{a}	17.3^{c}	16.3^{b}	0.000
L*	37.2^{b}	34.9^{a}	39.4^{c}	36.9^{b}	35.0^{a}	0.000
a*	18.0^{b}	16.7^{a}	17.9^{b}	18.4^{b}	18.4^{b}	0.000
b*	5.8^{a}	5.9^{a}	6.0^{ab}	6.4^{bc}	6.7^{c}	0.000
pHLL	5.61^{a}	5.68^{b}	5.65^{ab}	5.62^{a}	5.73^{c}	0.000
pHST	5.82^{a}	5.89^{a}	6.1^{b}	5.89^{a}	6.15^{b}	0.000
SF5 (N)	32.4^{a}	50.7^{c}	28.3^{a}	31.0^{a}	42.4^{b}	0.000
IMF (%)	3.9^{a}	4.1^{a}	4.0^{a}	4.2^{a}	4.6^{b}	0.000

^{abc}Means, not containing a common letter in the superscript, are significantly different ($P<0.05$).

Analysis of variance for the carcass and meat quality traits between the different trials revealed significant differences for all traits. With regard to the gross carcass and shortloin traits further analysis within national project (B.SCC.0144) is needed to determine to what extent these difference can be explained by differences in size, age and sire.

Regarding the meat quality measurements, large differences in tenderness (SF5) were observed between the trials. The most likely explanation for this is differences in the processing conditions and more specifically, the rate of pH and temperature decline in the shortloin. Although the rate of pH and temperature decline were not monitored in this project, one can speculate with a reasonable amount of confidence that the relatively high shear force values for PD12 (10/7/14) and PD13 (21/1/14) are due to cold-shortening conditions in some of the carcasses.

5. Discussion/conclusion

Within this project Meat Science UNE has largely met the project objectives:

- Coordinated the slaughter and collection of carcase data in-plant for 617 lambs.
- Collected loin samples on 260 lambs for IMF and SF5 measurement.
- Conducted measurement of IMF on 260 lambs from the NSW sites.
- Conducted measurement of IMF on samples from the South Australian sites and Tasmanian sites provided by SARDI.

- Shipped loin samples for shear force (5 days aged) measurement to NSW DPI, Cowra, within three weeks of the final slaughter.
- Submitted all data in the standard data template to the LM&EQ PDS National Coordinator.

The results regarding the shear force (SF5) of the loin samples suggest that processing conditions in some abattoirs are suboptimal regarding control of the rate of pH and temperature decline.

These data have been aggregated with data from other Producer Demonstration Sites for detailed analysis and reporting. Please see the Final Report for project B.LSCC.0144 - National Coordinator – Proof of concept of Lean Meat Yield and Eating Quality Producer Demonstration Sites

6. References

Pearce, K.L. (Ed.) (2011). Sheep CRC program 3: Next generation meat quality project 3.1. Phenotyping the Information Nucleus (2nd ed.) CRC for Sheep Industry Innovation. Publ. Murdoch University.