

# **MERINO MEAT EVALUATION**

## **Research Report**

**by**

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**July 2003**

**Report produced by Lincoln University  
under contract to  
Meat New Zealand and Merino New Zealand Inc**

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# ***Merino Meat Trial***

Report Written by Maree Clapham  
June 2003

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## **1.0 Introduction**

This project is funded by Meat New Zealand and Merino Inc. by 2/3 and 1/3 respectively. Professor Roy Bickerstaffe from Lincoln University is the Technical Manager and John Bates is the Project Manager. Robin Jamison supplied the merino sheep for the project, Peter Grant the Merino Cross animals and Lincoln University supplied the Coopworth animals.

The project objectives were:

1. To identify the technical attributes and consumer acceptance of merino meat.
2. To determine whether the age and weight of the animals affect eating characteristics and quality attributes of meat. Animals were aged 8 to 24 months of age and 17 and 23kg carcasses were the target weights for comparisons across the groups.
3. To compare meat from crossbred and merino cross lambs with meat from merino lambs and adults.
4. To identify whether a consumer market exists for meat from 12 to 24 month old merinos.

The project has now been completed. There have been 137 carcasses processed through the trial.

## 2.0 History of stock supplied

The stock were supplied in groups of 10 animals\* and were slaughtered over 5 separate trials. Below are the average statistics for each group.

<i>Trial 1</i>	<b>Group 1</b>	<b>Group 2</b>	<b>Group 3</b>	<b>Group 4</b>	<b>Group 5</b>
<b>Breed</b>	Coopworth	Merino/ Suffolk Cross (MX)	Merino Lamb (ML)	Merino Adult Light (MA-L)	Merino Adult Heavy (MA-H)
<b>Origin</b>	Lincoln	Rangitata	Hill country	Hill country	Hill country
<b>Sex</b>	Wether	Wether	Wether	Wether	Wether
<b>Age</b>	8 months	8 months	8 months	20 months	20 months
<b>Kill date</b>	29/04/02	29/04/02	29/04/02	29/04/02	29/04/02
<b>Carcass Weight</b>	18.9kg	20.2kg	19.7kg	19.3kg	22.2kg
<b>Carcass grade</b>	PX	PX	PX	HL2	HL2/3

<i>Trial 2</i>	<b>Group 6</b>	<b>Group 7</b>
<b>Breed</b>	Merino Lamb (ML)	Merino Adult Light (MA-L)
<b>Origin</b>	Hill country	Hill country
<b>Sex</b>	Wether	Wether
<b>Age</b>	10 months	22 months
<b>Kill date</b>	15/07/02	15/07/02
<b>Carcass Weight</b>	17.6kg	19.7kg
<b>Carcass grade</b>	YX	HL2-3 / HX2

<i>Trial 3</i>	<b>Group 8</b>	<b>Group 9</b>	<b>Group 10</b>
<b>Breed</b>	Merino Lamb (ML)	Merino Adult Heavy (MA-H)	Merino Adult Light (MA-L)
<b>Origin</b>	Hill country	Hill country	Hill country
<b>Sex</b>	Wether	Wether	Wether
<b>Age</b>	12 months	24 months	24 months
<b>Kill date</b>	09/10/02	09/10/02	09/10/02
<b>Carcass Weight</b>	18.15kg	21.85kg	20.35kg
<b>Carcass grade</b>	PX	HL2/HL3	HL2

<b>Trial 4</b>	<b>Group 11</b>	<b>Group 12</b>
<b>Breed</b>	Merino Adult Heavy (MA-H)	Merino Adult Light (MA-L)
<b>Origin</b>	Hill country	Hill country
<b>Sex</b>	Wether	Wether
<b>Age</b>	14months	14months
<b>Kill date</b>	08/11/02	08/11/02
<b>Carcass Weight</b>	21.07kg	19.21kg
<b>Carcass grade</b>	ML1 / ML2	YX / PX

<b>Trial 5</b>	<b>Group 13</b>	<b>Group 14</b>
<b>Breed</b>	Merino Adult Heavy (MA-H)	Merino Adult Light (MA-L)
<b>Origin</b>	Hill country	Hill country
<b>Sex</b>	Wether	Wether
<b>Age</b>	17months	17months
<b>Kill date</b>	10/02/03	10/02/03
<b>Carcass Weight</b>	20.91kg	17.41kg
<b>Carcass grade</b>	ML1/MX1	ML1/MX1

\*Group 13 n = 7 animals

In the subsequent sections in the report, the groups have been re-organised to display the results in the following groups:

- Control Lambs - Coopworth and Merino Cross (8 months, n=20)
- Merino Lambs - (8 – 12 months, n=30)
- Merino Adults - Heavy (14 – 24 months, n=37)
- Merino Adults - Light (14 – 24 months, n=50)

### 3.0 Product Yield

#### 3.1 Product yield – ex David Grahams boning out facility

The carcasses were held at the abattoir for 48 hours after slaughter before being transported to Dave Grahams boning out facilities in Christchurch for processing. Each carcass was cut into:

- Legs
- Forequarters
- Racks
- Mid-loins plus 4x chops for scientific testing
- Miscellaneous off-cuts

The carcasses were then transported to the supermarket (Pak'n Save) for further processing and packaging into retail cuts prior to selling to consumers. Apart from bone dust and minor trimmings, the complete legs, forequarters, racks and mid-loins were packaged for retail. The miscellaneous pieces were treated as wastage although, occasionally pieces such as the necks were packaged and sold. Some mince could have been made from leftover product.

Below are the average weights of each of the cuts for each group and the % yield of product suitable for retail sale to consumers. The yield is expressed as a percentage of the total carcass weight.

	<b>Group 1</b>	<b>Group 2</b>
	Avg Weight (kg) (yield %)	Avg Weight (kg) (yield %)
<b>Breed</b>	Coopworth	Merino/Suffolk
<b>Carcass Weight</b>	18.9kg	20.2kg
<b>2x leg weight</b>	5.56kg (29%)	6.00kg (30%)
<b>2x Forequarter</b>	6.01kg (32%)	6.20kg (31%)
<b>2x Racks</b>	1.57kg (8%)	1.59kg (8%)
<b>2x Midloin</b>	1.57kg (8%)	1.60kg (8%)
<b>Total % Yield</b>	<b>78%</b>	<b>76%</b>
<b>Miscellaneous</b>	3.52kg(19%)	3.72kg(18%)

	<b>Group 3</b>	<b>Group 6</b>	<b>Group 8</b>
	Avg Weight (kg) (yield %)	Avg Weight (kg) (yield %)	Avg Weight (kg) (yield %)
<b>Breed</b>	Merino Lamb	Merino Lamb	Merino Lamb
<b>Carcass Weight</b>	19.7kg	17.6kg	18.15kg
<b>2x leg weight</b>	5.87kg (30%)	5.26kg(30%)	5.28kg (29%)
<b>2x Forequarter</b>	6.36kg (32%)	5.63 (32%)*	5.74kg (32%)
<b>2x Racks</b>	1.53kg (8%)	1.93kg(11%)	1.24kg (7%)
<b>2x Midloin</b>	1.52kg (8%)	1.70kg(10%)	1.49kg (8%)
<b>Total % Yield</b>	<b>78%</b>	<b>83%</b>	<b>76%</b>
<b>Miscellaneous</b>	3.44kg(17%)	3.17kg(18%)*	3.49kg(19%)

	<b>Group 5</b>	<b>Group 9</b>	<b>Group 11</b>	<b>Group 13</b>
	Avg Weight (kg) (yield %)	Avg Weight (kg) (yield %)	Avg Weight (kg) (yield %)	Avg Weight (kg) (yield %)
<b>Breed</b>	Merino Adult Heavy	Merino Adult Heavy	Merino Adult Heavy	Merino Adult Heavy
<b>Carcass Weight</b>	22.2kg	21.85kg	21.07kg	20.91kg
<b>2x leg weight</b>	6.71kg (30%)	6.48kg (30%)	6.27kg (30%)	6.27kg (30%)*
<b>2x Forequarter</b>	7.11kg (32%)	7.14kg (33%)	7.10kg (34%)	6.90kg (33%)*
<b>2x Racks</b>	1.81kg (8%)	1.27kg (6%)	1.56kg (7%)	1.46kg (7 %)*
<b>2x Midloin</b>	1.83kg (8%)	1.63kg (7%)	1.79kg (9%)	1.67kg (8%)*
<b>Total % Yield</b>	<b>79%</b>	<b>76%</b>	<b>80%</b>	<b>78%*</b>
<b>Miscellaneous</b>	3.72kg(17%)	4.29kg (20%)	3.89kg(19%)	3.90kg(19%)*

	<b>Group 4</b>	<b>Group 7</b>	<b>Group 10</b>	<b>Group 12</b>	<b>Group 14</b>
	Avg Weight (kg) (yield %)	Avg Weight (kg) (yield %)	Avg Weight (kg) (yield %)	Avg Weight (kg) (yield %)	Avg Weight (kg) (yield %)
<b>Breed</b>	Merino Adult Light	Merino Adult Light	Merino Adult Light	Merino Adult Light	Merino Adult Light
<b>Carcass Weight</b>	19.3kg	19.7kg	20.35kg	19.21kg	17.41kg
<b>2x leg weight</b>	5.87kg (30%)	5.70kg(29%)	6.03kg (30%)	5.75kg (30%)	5.18kg(30%)*
<b>2x Forequarter</b>	6.32kg (33%)	6.50kg(33%)*	6.77kg (33%)	6.38kg (33%)	5.75kg(33%)*
<b>2x Racks</b>	1.49kg (8%)	1.55kg(8%)	1.14kg (6%)	1.60kg (8%)	1.31kg(8%)*
<b>2x Midloin</b>	1.49kg (8%)	1.58kg(8%)	1.39kg (7%)	1.66kg (9%)	1.39kg(8%)*
<b>Total % Yield</b>	<b>79%</b>	<b>78%*</b>	<b>75%</b>	<b>80%</b>	<b>79%*</b>
<b>Miscellaneous</b>	3.17kg(16%)	3.48kg(18%)*	3.97kg (19%)	3.44kg(18%)	3.08kg(18%)*

### Comments:

- i. In trial 5 (Group 13 & 14), the racks were trimmed to produce French Racks for distribution at the Wine & Food festival, and backstraps were the only product from the midloin. The shanks were also removed from the legs. All yield figures for these two groups were, therefore, low prior to adjustment.
- ii. During trial 2 (Groups 6 & 7) the forequarters were trimmed harder. This led to a low yield for this particular cut and a 10% difference appeared in the miscellaneous group.
- iii. With the exception of these issues, the yield for each cut is relatively consistent across all the groups, including the Coopworth control lambs. The following trends were noted:
  - Most animals consistently gave a yield of ~8% for both the Rack and Midloin. Group 6 (lightest group of Lambs) gave a slightly higher yield of 11% and 10% respectively for the Rack and Midloin.
  - Group 9 & 10 (adults 21.85kg/20.35kg, classified as heavy & light) recorded a slightly reduced yield in the Rack and Midloin cuts (6-7%).

*Foot note: There was some inconsistency between the different trials due to the method of trimming, which made direct comparisons between the groups difficult. Those figures marked with an astericks (\*) have been predicted by comparing the results to a similar group and adjusting to allow for the variations.*

### 3.2 Yield trial - Complete bone out to retail products

A complete retail product yield trial was performed on 3 selected carcasses from each of the Merino Adult Heavy and Merino Adult Light groups in trial 5 (six in total). The results were compared with the results from six control lambs from an external source. A table outlining the areas of variation and a summary of the findings is presented below:

Section	Cut	Control Lambs % of carcass (range)	Merino Adult (Heavy) % of carcass (range)	Merino Adult (Light) % of carcass (range)
Forequarters	Pair shoulder	38.2 (35.8-40.2)	38.0 (37.3-38.6)	37.2 (35.8-39.2)
	SQ Cut Shoulder	26.7 (26.2-28.6)	28.9 (28.7-29.1)	27.9 (27.1-29.3)
	Boneless Shoulder	16.5 (15.8-17.2)	17.6 (17.0-18.0)	17.0 (16.2-18.0)
Middle	Total Middle	28.7 (27.7-29.5)	28.1 (26.9-29.3)	30.1 (27.7-32.6)
	Flaps (breast on)	9.5 (8.3-10.6)	9.8 (9.0-10.3)	11.0 (9.5-12.6)
	6 vertebrae shortloin	8.5 (7.8-9.0)	8.0 (7.9-8.2)	8.5 (8.3-9.0)
	Rack saddle 75mm	8.7 (7.8-9.6)	8.1 (7.8-8.8)	8.5 (7.8-9.7)
	French Rack	5.1 (4.5-5.9)	4.8 (4.6-5.3)	4.7 (4.3-5.2)
Legs	Pair Legs	32.6 (32.1-33.0)	33.5 (32.9-33.8)	32.5 (31.5-33.2)
	Par boned leg	18.6 (18.5-18.7)	19.1 (18.8-19.5)	18.6 (18.4-18.9)
	Rump	2.5 (2.4-2.6)	2.8 (2.8-2.8)	2.5 (2.3-2.7)

#### Comments:

While there is variation in the results from each carcass, the general trends are:

- i. Although the total weights of the Light and the Heavy Merino shoulders were proportionately lighter than the control carcasses, once trimming was complete, the SQ cut shoulder and the boneless shoulder were proportionately heavier than the controls.
- ii. The Light Adult Merinos carried a higher proportion of their weight in the middle cut, and, in particular the flaps. The weight of the shortloin and rack was comparable to the same cuts obtained from Control Lambs and the Heavy Merinos.
- iii. The Heavy Adult Merino animals carried a higher proportion of carcass weight in their legs, compared to the Control Lambs and Light Merinos. This trend was still evident after trimming.

#### Summary:

There was some variation in the yield of some untrimmed and trimmed products from the carcasses. However, probably due to the small number of carcasses, the differences are not significant. The Control and Merino animals yielded similar amounts of trimmed retail products.

### 3.3 Market value of the retail products

The table below shows the market value of a carcass based on the retail value of specific cuts.

Section	Cut	Control Lambs		Merino Adult (Heavy)				Merino Adult (Light)			
		% of carcass	\$ <i>Lamb Price</i>	% of carcass	\$ <i>Lamb price</i>	\$ <i>Hogget price</i>	\$ <i>Mutton price</i>	% of carcass	\$ <i>Lamb price</i>	\$ <i>Hogget price</i>	\$ <i>Mutton price</i>
Fore-quarter	Neck	2.6	<b>5.17</b>	2.2	<b>4.37</b>	<b>3.93</b>	<b>3.49</b>	2.2	<b>4.37</b>	<b>3.93</b>	<b>3.49</b>
	SQ Cut Shoulder	26.7	<b>34.97</b>	28.9	<b>37.85</b>	<b>29.48</b>	<b>23.06</b>	27.98	<b>36.68</b>	<b>28.56</b>	<b>22.34</b>
Middle	Flaps (breast on)	9.5	<b>5.61</b>	9.8	<b>5.90</b>	<b>5.90</b>	<b>5.90</b>	11.0	<b>6.49</b>	<b>6.49</b>	<b>6.49</b>
	6 vertebrae shortloin	8.5	<b>21.16</b>	8.0	<b>19.92</b>	<b>15.92</b>	<b>6.32</b>	8.5	<b>21.17</b>	<b>16.91</b>	<b>6.71</b>
	Rack saddle 75mm	8.7	<b>29.49</b>	8.1	<b>27.12</b>	<b>20.72</b>	<b>17.52</b>	8.5	<b>28.81</b>	<b>22.02</b>	<b>18.62</b>
Legs	Par boned leg	18.6	<b>44.08</b>	19.1	<b>45.27</b>	<b>36.48</b>	<b>28.61</b>	18.6	<b>44.08</b>	<b>35.52</b>	<b>27.86</b>
	Rump	2.5	<b>7.47</b>	2.8	<b>8.37</b>	<b>8.37</b>	<b>8.37</b>	2.5	<b>7.47</b>	<b>7.47</b>	<b>7.47</b>
<b>Total</b>			<b>147.95</b>		<b>148.80</b>	<b>120.80</b>	<b>93.27</b>		<b>149.07</b>	<b>120.90</b>	<b>92.98</b>

#### Comments:

In deriving an average dollar value for each carcass, the current retail value for the retail cuts listed above has been used. The value of offcuts or any other miscellaneous trimmings have not been included. The market value is based on a 20kg carcass yielding retail cuts which are priced as lamb retail cuts, hogget retail cuts or mutton retail cuts.

## 4.0 Measured Meat Quality Characteristics

### 4.1. pH

Over the post-mortem period, the pH of meat in the midloin chop area of the carcass was measured at different times. The initial reading was immediately after slaughter. The final measurement was at 48hours post slaughter. A pH > 5.8 is considered as high and a pH < 5.8 as low.

The data for the animals from each group at 24 and 48hours is presented below:

		Group 1	Group 2
<b>Breed</b>		Coopworth	Merino/ Suffolk
<b>Weight</b>		18.9kg	20.2kg
<b>Carcass pH 24hours</b>	n=low pH	10	7
	n=high pH	0	3
<b>Carcass pH 48hours</b>	n=low pH	10	7
	n=high pH	0	3

		Group 3	Group 6	Group 8
<b>Breed</b>		Merino Lamb	Merino Lamb	Merino Lamb
<b>Weight</b>		19.7kg	17.6kg	18.15kg
<b>Carcass pH 24hours</b>	n=low pH	10	-	3
	n=high pH	0	-	7
<b>Carcass pH 48hours</b>	n=low pH	10	6	4
	n=high pH	0	4	6

		Group 5	Group 9	Group 11	Group 13
<b>Breed</b>		Merino Adult Heavy	Merino Adult Heavy	Merino Adult Heavy	Merino Adult Heavy
<b>Weight</b>		22.2kg	21.85kg	20.91kg	21.07kg
<b>Carcass pH 24hours</b>	n=low pH	9	3	5	6
	n=high pH	1	7	2	1
<b>Carcass pH 48hours</b>	n=low pH	8	3	6	7
	n=high pH	2	7	1	0

		Group 4	Group 7	Group 10	Group 12	Group 14
<b>Breed</b>		Merino Adult Light	Merino Adult Light	Merino Adult Light	Merino Adult Light	Merino Adult Light
<b>Weight</b>		19.3kg	19.7kg	20.35kg	17.41	19.21kg
<b>Carcass pH 24hours</b>	n=low pH	9	-	7	10	4
	n=high pH	1	-	3	0	3
<b>Carcass pH 48hours</b>	n=low pH	9	5	7	10	5
	n=high pH	1	5	3	0	2

**Comments:**

- i. The carcass pH stabilised by 24hours post slaughter. The majority of the carcasses in the first, fourth and fifth trial had low pH at 24 and 48hours post slaughter. Carcasses from trials two and three showed mixed results; some had high pH and some low pH.
- ii. It is possible that this pH effect is due to the fact that the animals from trial 2 were slaughtered at Pareora and those from trial 3 were slaughtered at Malvern. All the other animals were processed at PPCS Belfast.
- iii. Possible contributing factors, such as the carcasses not being electrically stimulated prior to chilling at Malvern or stress from the long journey may have influenced the final pH of the carcasses, since Merino sheep are known to be more susceptible to stress.
- iv. High pH meat is undesirable since it is associated with the reduction in shelf life of the retail product.

**4.2 Tenderness**

The tenderness of the midloin chop was tested at 48hours, and after being stored vacuum packed in the chiller for 3weeks.

The classification for tenderness has been divided into 4 groups according to the kgf value:

- < 4.9 = very tender
- 5.0 – 7.9 = tender
- 8.0-10.9 = Acceptable
- >11.0 = Tough

The number from each group of 10 assigned to each category is presented below:

		<b>Group 1</b>	<b>Group 2</b>
<b>Breed</b>		Coopworth	Merino/ Suffolk
<b>Weight</b>		18.9kg	20.2kg
<b>Tenderness 48hours</b>	<b>V. Tender</b>	2	1
	<b>Tender</b>	1	4
	<b>Acceptable</b>	7	4
	<b>Tough</b>	0	1
<b>Tenderness 3 weeks</b>	<b>V. Tender</b>	10	10
	<b>Tender</b>	0	0
	<b>Acceptable</b>	0	0
	<b>Tough</b>	0	0

		<b>Group 3</b>	<b>Group 6</b>	<b>Group 8</b>
<b>Breed</b>		Merino Lamb	Merino Lamb	Merino Lamb
<b>Weight</b>		19.7kg	17.6kg	18.15kg
<b>Tenderness 48hours</b>	<b>V. Tender</b>	1	4	0
	<b>Tender</b>	3	5	2
	<b>Acceptable</b>	5	0	7
	<b>Tough</b>	1	1	1
<b>Tenderness 3 weeks</b>	<b>V. Tender</b>	10	9	10
	<b>Tender</b>	0	1	0
	<b>Acceptable</b>	0	0	0
	<b>Tough</b>	0	0	0

		<b>Group 5</b>	<b>Group 9</b>	<b>Group 11</b>	<b>Group 13</b>
<b>Breed</b>		Merino Adult Heavy	Merino Adult Heavy	Merino Adult Heavy	Merino Adult Heavy
<b>Weight</b>		22.2kg	21.85kg	21.07kg	20.91kg
<b>Tenderness 48hours</b>	<b>V. Tender</b>	1	3	4	6
	<b>Tender</b>	5	1	2	1
	<b>Acceptable</b>	1	5	1	0
	<b>Tough</b>	3	1	0	0
<b>Tenderness 3 weeks</b>	<b>V. Tender</b>	8	9	7	7
	<b>Tender</b>	2	1	0	0
	<b>Acceptable</b>	0	0	0	0
	<b>Tough</b>	0	0	0	0

		<b>Group 4</b>	<b>Group 7</b>	<b>Group 10</b>	<b>Group 12</b>	<b>Group 14</b>
<b>Breed</b>		Merino Adult Light	Merino Adult Light	Merino Adult Light	Merino Adult Light	Merino Adult Light
<b>Weight</b>		19.3kg	19.7kg	20.35kg	19.21kg	17.41kg
<b>Tenderness 48hours</b>	<b>V. Tender</b>	0	1	0	6	4
	<b>Tender</b>	6	5	6	2	2
	<b>Acceptable</b>	1	4	1	2	1
	<b>Tough</b>	3	0	3	0	0
<b>Tenderness 3 weeks</b>	<b>V. Tender</b>	10	8	8	9	7
	<b>Tender</b>	0	2	2	0	0
	<b>Acceptable</b>	0	0	0	0	0
	<b>Tough</b>	0	0	0	0	0

**Comments:**

- i. The tenderness at 48hours varied significantly with between 2 and 9 animals in each group being “Very Tender” or “Tender” and the remainder “Acceptable” or “Tough”. There is no obvious trend between the different groups of animals.
- ii. At 3 weeks all of the samples from every group were either “Tender” or “Very Tender”. There was no “Acceptable” or “Tough” meat from any group.

## 5.0 Microbiological Testing

A small meat sample was taken from a selection of carcasses from trial 5 and analysed in an independent laboratory (EnviroLink Christchurch) for Aerobic Plate Counts and *e.coli*. Aerobic Plate Count is a measure of the level of contamination of a carcass and high counts can indicate an increased premature spoilage potential. The presence of *e.coli* can be a significant health risk and indicative of faecal contamination from humans or animals.

Control samples were taken from four unrelated carcasses killed and processed at an export plant. Ten samples were taken from Merino carcasses killed at an export plant and processed either at an export plant or a local plant.

The results are outlined in the table below:

Sample ID	Aerobic Plate Count (cfu/g)	<i>E. Coli</i> Count (cfu/g)
Control PPA	$2.5 \times 10^4$	-
Control PPB	$2.7 \times 10^4$	<5
Control PPC	$7.7 \times 10^4$	-
Control PPD	$5.1 \times 10^3$	-
Merino PPE	$5.5 \times 10^2$	<5
Merino PPF	$2 \times 10^3$	-
Merino PPG	$1.6 \times 10^3$	-
Merino PPH	$3.1 \times 10^3$	-
Merino PPI	$4.3 \times 10^3$	-
Merino DGJ	$7 \times 10^2$	<5
Merino DGK	$2.3 \times 10^4$	<5
Merino DGL	$2.1 \times 10^3$	-
Merino DGM	$2 \times 10^4$	-
Merino DGN	$2.8 \times 10^4$	-

### Comments:

- i. All of the Aerobic Plate Count results and *e.coli* results are within the standard limits used by the industry (ICMSF 1986).

## 6.0 Consumer Acceptance of Product

The consumer acceptance of the product was investigated in a variety of ways:

- Carcasses were processed, packaged into retail products, and sold at a local supermarket or distributed to staff at local organisations. The consumers were asked to cook the retail products normally and comment on the product as outlined in the survey form (Appendix 1).
- The Back-straps and French Racks of the Merinos and Control Lambs from the first trial were barbecued at the Mystery Creek Field Days and consumers were asked to rank the sample as per the survey form (Appendix 2).
- The Back-straps and French Racks of both Merinos and Control export quality Lambs were barbecued at the Christchurch Wine & Food Festival. Participants were asked to compare the two samples according to the survey form (Appendix 3).

### 6.1 Supermarket Trial

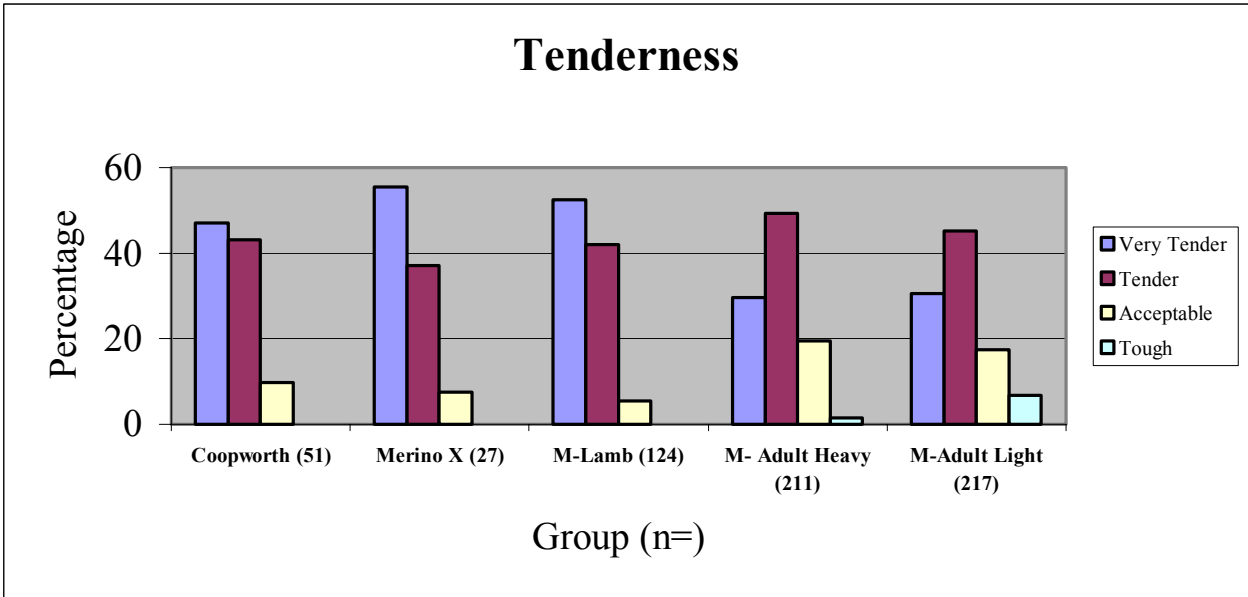
The carcasses were processed into a variety of retail products which were either sold at a local supermarket or distributed to staff in a variety of organisations which included Foodstuffs, PPCS and Lincoln University. The retail products were:

- Legs – Whole legs, half legs, leg chops
- Forequarters – whole forequarters, rolled forequarters, chops
- Loins – chops
- Racks – chops

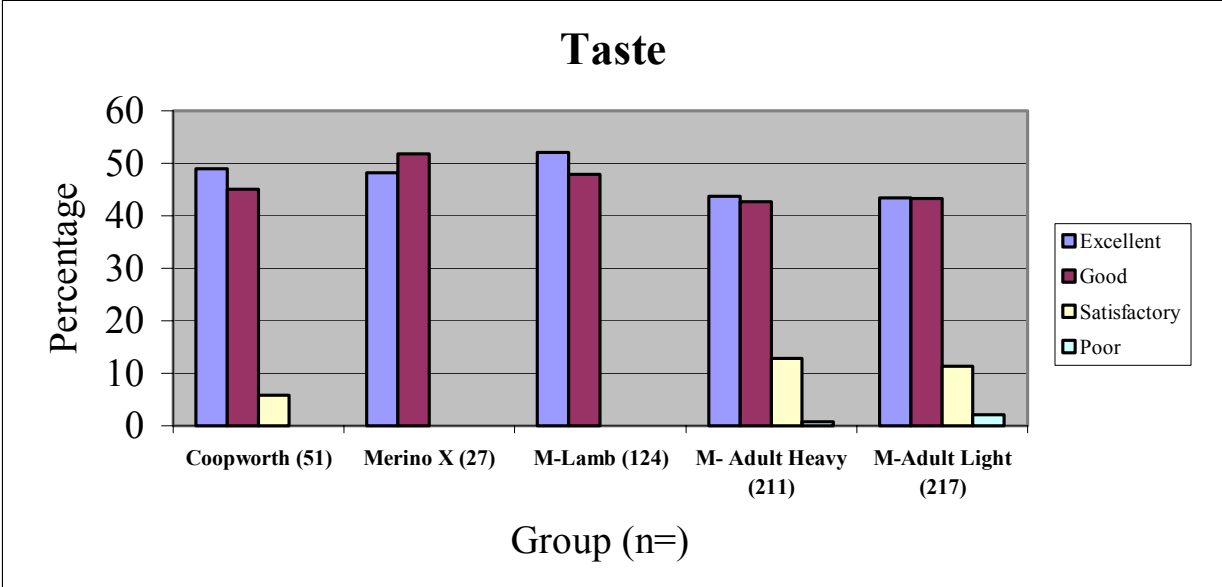
A questionnaire was included with each packaged product and the consumer was requested to complete the questionnaire after eating the product at home. There was an added incentive of a voucher as a prize for those who purchased the product in the supermarket. The questionnaire asked the consumer to rate the product in terms of tenderness and taste.

The results of the questionnaire are in Figure 1 and Figure 2.

**Figure 1: Tenderness of all the retail products as assessed by the consumers.**



**Figure 2: Taste of all the retail products as assessed by the consumers.**



**Comments:**

Statistical analysis of the tenderness results, using an ordinal response model,\* showed there was a clear difference between the groups. The Merino Adult groups (Heavy and Light) were significantly less tender than the Coopworth, Merino Cross and pure Merino Lambs.

The same statistical analysis on the taste results indicated that the Merino Lamb has a better taste profile than the Merino Adults. No other statistically significant trends were observed.

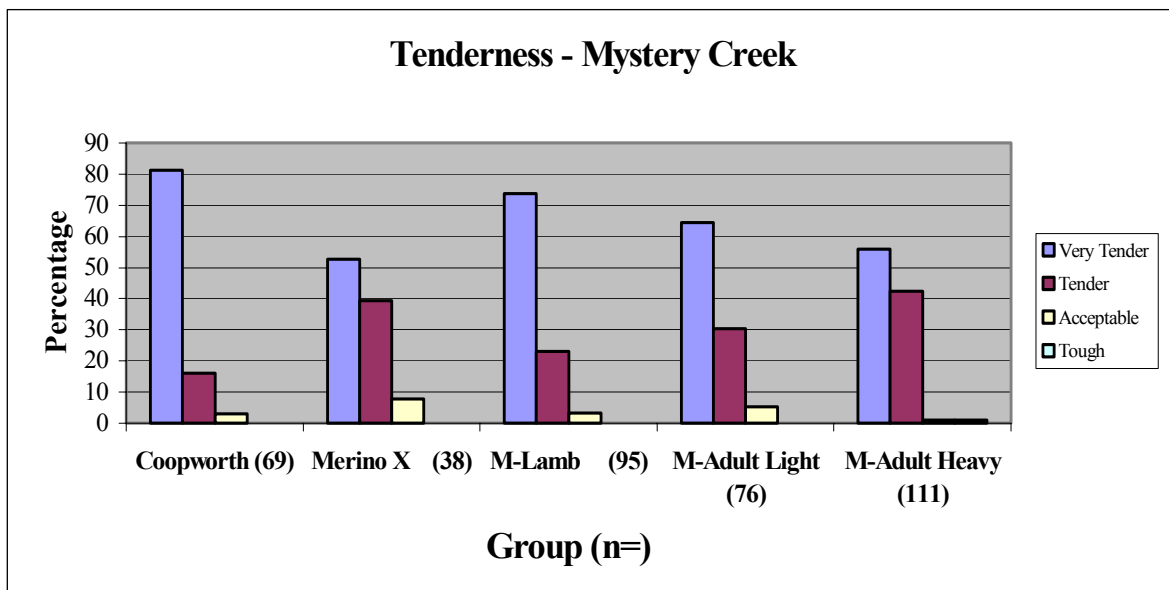
\* (Proportional-odds model, P McCullagh, & JA Nelder (1989) *Generalised Linear Models (Second Edition)* Chapman & Hall, London)

## 6.2 Mystery Creek Field Day

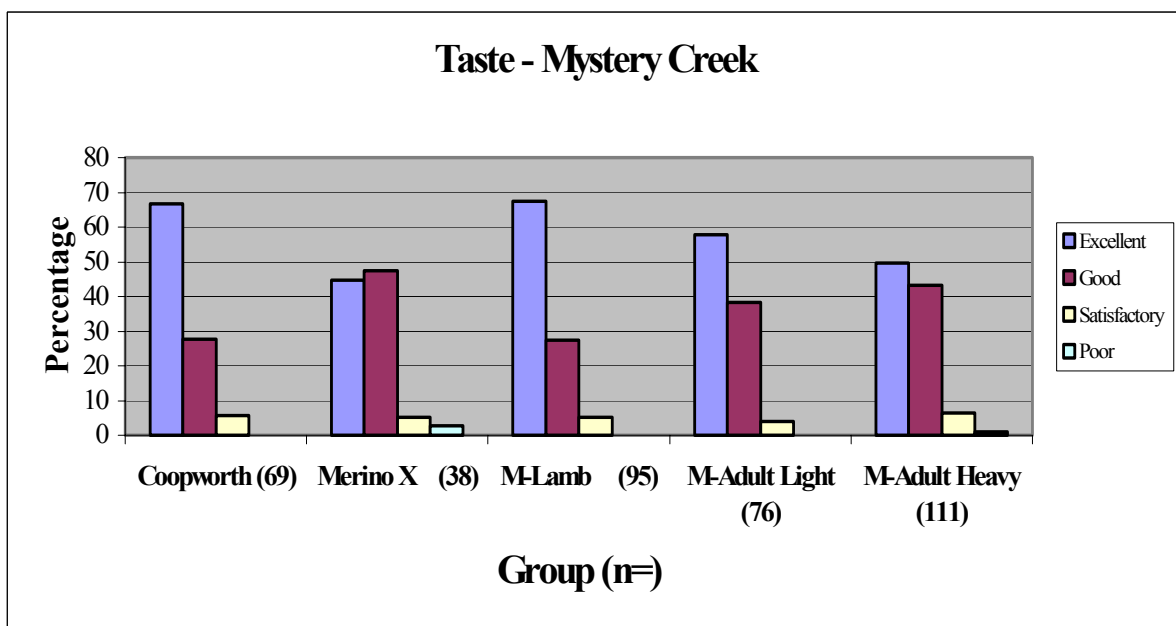
The back-strap and french racks from the Coopworth Lambs, Merino cross Lambs, Merino Lambs and Merino Adults (Heavy and Light) from the first trial were barbecued at the Mystery Creek Field Days and randomly given to interested participants. The participants were given one sample and asked to evaluate the tenderness and taste of the sample. They did not know which of the samples they had received.

The Tenderness and Taste profiles for each group are shown in Figures 3 and 4.

**Figure 3: Tenderness of back straps and french racks as assessed by Mystery Creek consumers.**



**Figure 4: Taste of back straps and french racks as assessed by Mystery Creek consumers.**



**Comments:**

Statistical analysis of the tenderness results, using the ordinal response model, showed a clear difference between the groups. Both the Merino Adult groups (Heavy and Light) and the Merino Cross were significantly less tender than the Coopworth control and pure Merino Lambs.

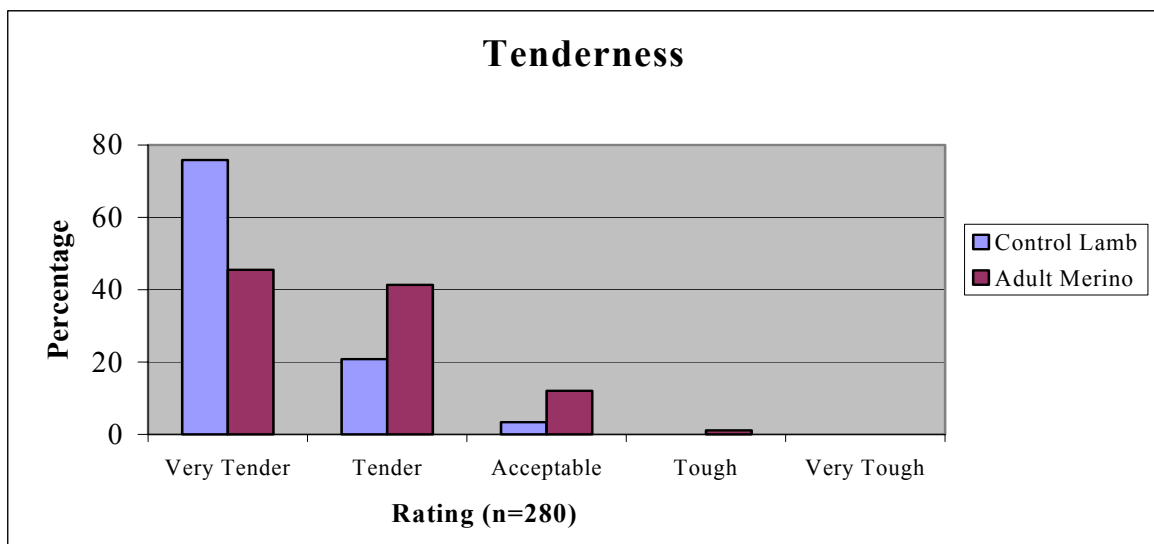
Statistical analysis of the taste results showed the same trend as the tenderness results except the difference were less pronounced.

**6.3 Christchurch Wine and Food Festival**

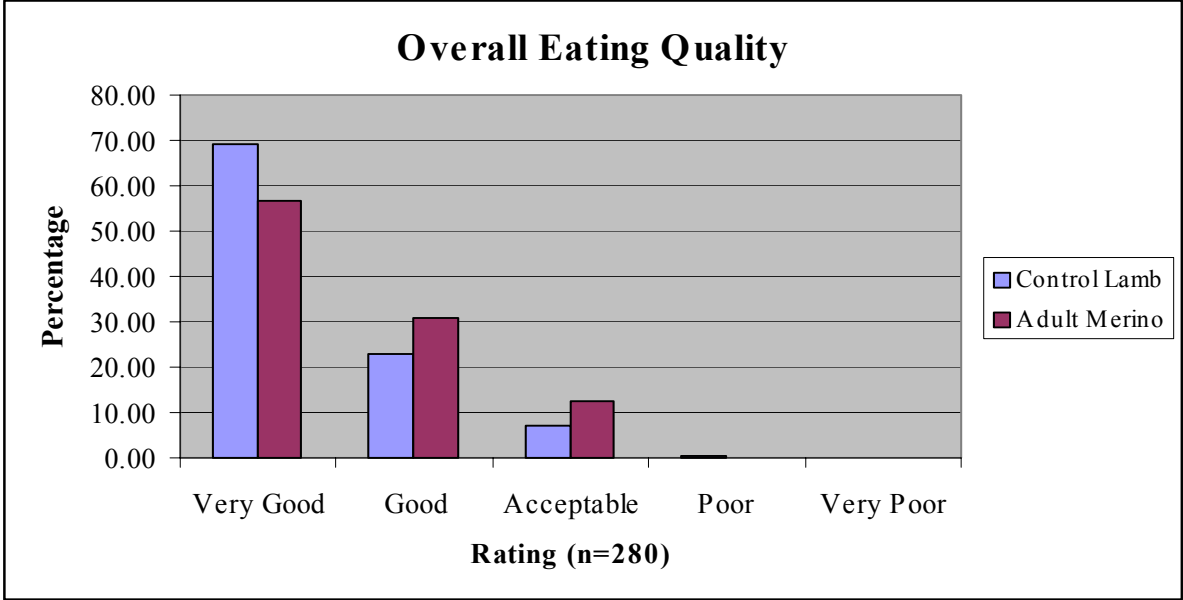
The back-strap and french racks of Merino Adult and Control Lambs were barbecued at the Christchurch Wine & Food Festival. Participants were asked to compare the Merino sample with the Control Lamb sample. In this instance, participants were given one sample and then the other (both samples were either back-strap or french rack) in no particular order. The consumers were asked to grade the tenderness and taste of each of the samples consumed. They did not know the identity of the samples prior to ranking them.

The Tenderness and Taste profiles for the two groups are shown in Figures 5 and 6.

**Figure 5: Tenderness of back-strap and french racks assessed at the Christchurch Wine and Food Festival.**



**Figure 6: Overall Eating Quality of back-straps and french racks assessed at the Christchurch Wine and Food Festival.**



**Comments:**

- i. Statistical Analysis of the tenderness profile, using the ordinal response model, showed there was a significant difference between the two groups. The Control Lambs were perceived to be significantly more tender than the Adult Merinos.
- ii. The same statistical trend was noted for eating quality. The Control Lambs rated more favorable than the Adult Merinos.
- iii. It should be noted, however, that the Merino samples rated very highly, although lower than the Control Lambs.

## 7.0 Fat Analysis

The fat content in meat influences some of the important meat quality parameters and meat marketability. Visible fat includes marbling (intramuscular) and intermuscular fat. A new technique to measure these parameters is being developed at Lincoln University\*\* and involves computer vision and image analysis techniques.

This technique was used to analyse a midloin chop from each of the experimental animals. A measure of the % of marbling (intramuscular) fat, the % external fat and the % of bone making up the surface of each chop was calculated. The results are summarised below:

Group	% External Fat (SEM)	% Intramuscular fat (SEM)	% Bone (SEM)
Coopworth	38.99 (3.03)	4.19 (0.457)	24.79 (3.06)
Merino Cross	36.15 (3.03)	4.96 (0.457)	31.53 (3.06)
Merino Lamb	25.10 (1.75)	4.57 (0.264)	37.75 (1.76)
Merino Adult – Heavy	33.95 (1.72)	4.34 (0.259)	30.54 (1.74)
Merino Adult – Light	32.76 (1.40)	4.52 (0.211)	30.85 (1.41)

Statistical analysis (ANOVA, Genestat) shows that although the trend is for the Control and Crossbred animals to have a higher percentage of external fat than the Merino animals, the only significant difference was with the Merino Lambs which had less external fat than all the other groups. The high SEM for the Coopworth and Merino Cross is mainly due to the low number of animals in each of these groups.

The ANOVA analysis of the intramuscular fat results showed there was no significant differences in marbling between the different groups. The results from all the groups lie well within the desired range of 2-8%.

The percentage of bone in each of the chops is significantly higher in the Merino Lambs compared to the other groups. The trend is for the Coopworth controls to have a smaller percentage of bone than the merino groups. The low number of animals in this group may have influenced the significance of the trend.

From a visual perspective, if both bone and external fat are considered together as ‘wastage’ by the consumer, and the remainder of the chop as % lean, then all groups have a very similar percentage of wastage and lean. See the table below:

Group	% Wastage	% Lean
Coopworth	63.78%	36.22%
Merino Cross	67.68%	32.32%
Merino Lamb	62.85%	37.15%
Merino Adult – Heavy	64.49%	35.51%
Merino Adult – Light	63.61%	36.39%

Given there are significant differences between these two parameters (bone and external fat) and between some groups, the significance of this on consumer selection needs to be investigated further.

**\*\**(Chandraratne, MR et.al. Determination of Fat Content in Retail Ready Meat Samples Using Image Analysis. 49<sup>th</sup> International Conference of Meat Science & Technology, Campinas, Brazil 2003)***

## 8.0 Potential benefits of alternative marketing strategies for merino sheep

The objective of the project was to assess the economic impact of changing the current practice of slaughtering merino hoggets for the spring market, at an average liveweight of 15kgs, compared to a year round supply system. Under the latter option the merino stock would be slaughtered between 12 to 24 months of age at 19 kgs. This option in many cases would require a specialist finisher to be involved to guarantee product volume and quality. Animals would be killed at 18 to 21 kg carcass weight and would either be shorn at the end of September (3kg wool weight), or prior to slaughter until the end of February and then, for those slaughtered later, shorn a second time at the end of February.

Therefore the key variables are: -

- value of extra meat from higher weight carcasses
- value of extra wool from a second clip or the extra wool from a single shearing (the later was not measured)
- cost of specialist fattening
- cost of harvesting a second clip of wool
- the timing when sheep are sent for slaughter under the second scenario
- additional stock losses (this was not measured)

### Scenario One – current management system

All sheep slaughtered at 15kg for \$60 per had

One clip of wool – 3.2 Kg per head - 10\$ per Kg (greasy)

Cost of shearing - \$4 per head

The net return per sheep is \$88 under the current management system.

**Table : Comparing scenarios (have a death rate of .2%/month for staged)**

Status quo	Current system	Staged Slaughter
Number of sheep	514,140	514,140
Cost of shearing	2,056,560	3,063,418
Wool revenue - cost	14,395,920	22,975,631
Meat Revenue	30,848,400	41,131,200
Extra Cost of upkeep		8,037,722
Total	45,244,320	64,106,831
Per sheep	\$88.00	\$124.69

### Scenario two – staged slaughter

Under the proposed system the animals would be sold from October 1 through to the following October. These animals would be sold as 20kg carcass at \$80. For the proposed system it was assumed that an equal amount of animals would be sold each month throughout the year. The shearing would either be at the first of October for hoggets either sold that month or those planned to be sold after 28<sup>th</sup> of February. For the balance they will be shorn once, 3 weeks prior to sale.

To obtain an estimate of the wool production per sheep before slaughter the wool production was divided by a proportion of 12 depending on the month killed, for example wool production for January was 16/12, being the shearing date plus the four months after the first animals were shorn. For those animals shorn a second time the wool production was based on a 4.5 kg wool clip and shearing costs were deducted. In addition the extra cost of keeping the stock was estimated at 70 cents per week.

Month	Wool production Kg	Value of wool
September	2313630	\$22,964,920.00
October	0	\$0.00
November	0	\$0.00
December	48201	\$482,006.25
January	64268	\$642,675.00
February	80334	\$803,343.75
March	96401	\$964,012.50
April	112468	\$1,124,681.25
May	128535	\$1,285,350.00
June	144602	\$1,446,018.75
July	160669	\$1,606,687.50
August	176736	\$1,767,356.25
TOTAL	3325843	\$33,087,051.25

The net returns under this system were \$125 per sheep.

Caroline Saunders 13<sup>th</sup> June 2003

## **9.0 Conclusions**

### **1.0 Stock Supply**

The mean carcass weights of all 14 groups of animals fell within the 17.4kg – 22.2kg range; a 4.6kg difference across the various groups of lambs and Adults.

### **2.0 Product Yield**

When analysing the yields of all the carcasses in the trial (n=137), as processed at David Grahams, the proportion of each carcass as legs, forequarters, racks and midloins was similar across the Control and Merino Groups.

During the in depth trial of measuring the yield of specific retail products, a general trend was noted. Heavy Merino Adults had a higher proportion of their carcass weight in untrimmed legs. This trend was also seen after trimming to retail cuts. For example, there was a higher percentage of the carcasses from Heavy Merino Adults in the retail rump and par-boned-shank free legs.

The light Adult Merinos had a higher proportion of their carcass weight in the less valuable middle flaps. However, the percentage of the more valuable retail cuts from the middle of the carcass were comparable to the Controls Lambs and Heavy Adult Merinos.

The forequarters from the Light Merinos yielded a higher percentage of the untrimmed forequarters. However, once trimmed to specific retail cuts, the yield for both the heavy and light merinos were slightly higher than from the Control Lambs.

Overall, due to the limited number of carcasses included in this yield trial, the noted trends cannot be regarded as statistically significant. Further investigation is warranted.

### **3.0 Meat Quality**

#### **(i) pH**

For beef to be marked “Quality Mark”, as specified by the NZ Beef and Lamb, the pH of meat at 48hours post slaughter must be less than 5.8. Some retailers are now specifying that sheep and lamb should match these same specifications. Of the twelve pure merino groups, only three groups (groups 3, 12 & 13) achieved a satisfactory pH profile. In the remaining nine groups, between 10 and 70% of the carcasses would have been rejected. The basic question is ‘why is the meat pH high?’ Possible explanations are that the breed is sensitive to stress, stock is in poor conditions on arrival, stock from the high country has not been exposed to people handling, low muscle glycogen levels, stock being held ‘off paddock’ more than 12 hours prior to transportation, or the endurance of long transport times between the paddock and slaughterhouse.

During this particular trial measures were taken to minimize these effects by having the stock arrive the night previous to slaughter and stock was usually first to be killed in the morning and dogs were not used to maneuver the animals in the yards.

### (ii) Tenderness

The 'Quality mark' specification is that at 48hours, the mean tenderness shear force should be <8kgf and 95% of the samples should be less than 11kgf ie. Not more than 5% of the carcasses should have shear forces higher than 11kgf at 48hours post-slaughter. In fact, 7 of the 12 merino groups would not have attained "Quality Mark" status because of a high number of animals yielding meat with a kgf greater than 11kgf at 48hours post-slaughter. On aging for 3 weeks, however, all the meat aged satisfactorily and would be classified as 'very tender'. Clearly the product needs to be aged, preferably, at least 4 days.

### (iii) Consumer acceptance

No product with a shear forces >11kgf was released onto the retail market for consumer evaluation. This was to avoid any negative reaction of the consumer to the product and to minimise the consumers judgement on the 'tenderness' of the product compared to the 'texture' or 'taste' differences. The average shear force of the carcasses released for consumer evaluation was 7.6kgf (Coopworth controls), 7.1kgf (Merino Cross), 7.4kgf (Merino Lambs), 6.4kgf (Merino Adults - light) and 5.8kgf (Merino Adults - heavy). The assumption in this work is that all the retail products evaluated by the consumer had received the same amount of post-slaughter aging.

There are some trends. Merino Adults (Heavy and Light) were considered significantly less tender than the other groups. The taste analysis showed similar trends with the Merino Lambs and Control groups having a better taste profile than the Merino Adults. This trend was evident in the supermarket trials as well as the Mystery Creek and Christchurch Wine and Food Festival. While the Merino Adults were outperformed by the Merino Lambs and Control groups, their performance was still good with the majority of ratings being favorable.

The difference between the Tenderness and Taste profiles of Merino Adults and the Control groups and Merino Lambs could be brought into perspective by further investigations which include Adult Control groups.

## 10.0 Summary

- The supplied Merino stock yielded the desirable heavy carcasses within the 17.5 – 22.5kg weight range.
- Irrespective of carcass weight and breed, the carcasses consistently yielded for retail 32% as forequarters, 30% as legs, 8% as racks and 8% as midloin chops.
- Nine of the twelve merino groups yielded meat with undesirable pH and would not receive ‘Quality Mark’ accreditation under the current 48hour post-slaughter pH specification requirements.
- Seven out of the twelve merino groups yielded meat with >11kgf shear forces at 48hours post-slaughter and would fail to receive ‘Quality Mark’ accreditation under the current shear force specification requirements..
- Vacuum packaged meat aged for 3weeks at 1°C from all of the groups yielded very acceptable tender product with shear forces <5.5kgf..
- Of the retail meat products released and evaluated by consumers, Merino Adults (Light and Heavy) were shown to have a significantly lower rating for both taste and tenderness than the Coopworth, Merino Cross and Merino Lambs.

### Recommendations

- Consumers have a very high acceptance rate of merino lamb retail products. These products have a potential to be marketed under a brand name.
- Merino Adults have a high consumer acceptance rate but whether the acceptance rate is satisfactory for retailers to market the product needs to be established. The results would indicate there is potential for marketing the product under a brand name as long as the quality is consistently delivered.
- The reasons for unacceptable high pH and toughness associated with meat from some of the merino groups needs further investigation.

## 11.0 Executive Summaries

- There are no significant differences between the yield of retail meat cuts between the sheep breeds at any weight or age investigated in this research. There is some indication that the hind leg of the merino are longer and not as ‘meaty’ as in other breeds.
- There is some concern in regards to meat pH in that there was a high number of merino animals which yielded high pH meat. This could lead to a lower shelf life for merino meat and the meat not receiving the ‘Quality Mark’ stamp.
- All groups of animals showed that very tender meat could be attained, if the meat was aged. However, this was counterbalanced by unacceptable tough meat being produced within 48hours post-slaughter and consequently, would not receive the ‘Quality Mark’ stamp.
- Meat from the Merino Lambs (up to 12 months) was evaluated by consumers to be as tender as that from another breed. Older animals, while still performing well, were judged less tender than the lambs.
- Consumer evaluation of the taste of the meat showed that the older merinos were less desirable than the young Merinos.
- Of all the groups tested the Merino Lamb yielded the maximum premium retail products compared to Merino Cross, Coopworth or Merino Adults.
- The preliminary data shows that merinos do yield retail meat products equivalent to any other meat breed in terms of consumer acceptance. It should be remembered, however, that the animals were managed by a specialist finisher of merino stock and were not representative of the normal cull hoggets sold to the works. In future, it will probably be necessary to have farmers like Robin Jamison supplying this type of stock to the market, if a sustainable supply of product to the market is to be developed.

## **Appendices**

**Appendix 1 – Eating Quality Survey Form – Supermarket Analysis**

**Appendix 2 – Eating Quality Survey Form – Mystery Creek**

**Appendix 3 – Eating Quality Survey Form – Christchurch Wine & Food Festival**