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Comparison of meat quality for pasture and grain finished lambs

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Abstract

There is a lack of comparative information on the effects of grain feeding or feedlot finishing of lambs on carcase measurements related to meat quality compared with pasture feeding. This experiment investigated carcase fat and muscle measurements in pasture and grain fed lambs finished from 34kg live weight to a pre-slaughter weight of around 50kg. Breeds included Merino, Poll Dorset – Merino and Poll Dorset – Maternal crossbreds. Grain fed lambs grew faster than pasture fed, particularly in Merinos, and this was partly due to a relatively dry season and limited quantities of good quality pasture. Dressing percentage was 4-6 units greater for grain than pasture fed lambs in all breed types. When breed groups were statistically adjusted for carcase weight grain fed lambs had 20% (Merinos) and 50% (Poll Dorset crosses) greater levels of GR fat than pasture fed. C-site fat depth was 30% (Merinos) to 100% (Poll Dorset crosses) greater in grain compared to pasture fed groups. Eye muscle area measurement on the other hand was 8% (Poll Dorset crosses) to13% (Merinos) greater in pasture than grain groups. These results indicate that excessive carcass fatness is more likely in grain fed lambs, particularly for terminal crosses, while pasture fed lambs may have comparatively better lean meat yield than grain fed lambs.

Executive summary

The objectives of this project were to:

a) measure carcase traits (weight, fat - GR and C, and eye muscle width and depth) differences between lambs finished on grain versus pasture, and

b) produce meat samples for consumer sensory testing through taste panel assessment.

Merino, first cross and second cross lambs were allocated to grass or grain finishing treatments at approximately 34kg liveweight and grown to a pre-slaughter finished weight of around 50kg liveweight.

In summary:

- Grain fed lambs grew faster than pasture fed, particularly in Merinos, and this was partly due to a relatively dry season and limited quantities of good quality pasture.

- Dressing percentage was 4-6 units greater for grain than pasture fed lambs in all breed types.

- When breed groups were statistically adjusted for carcase weight:
  - grain fed lambs had 20% (Merinos) and 50% (Poll Dorset crosses) greater levels of GR fat than pasture fed.
  - C-site fat depth was 30% (Merinos) to 100% (Poll Dorset crosses) greater in grain compared to pasture fed groups.
  - Eye muscle area was 8% (Poll Dorset crosses) to13% (Merinos) greater in pasture than grain groups.

These results indicate that excessive carcass fatness is more likely in grain fed lambs, particularly for terminal crosses, while pasture fed lambs may have comparatively better lean meat yield than grain fed lambs.

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1 Background

Feedlot finishing of lambs to slaughter on grain based diets is showing an increasing trend in Australia (Martin *et al.* 2011), particularly in Mediterranean climates with dry summers and limited ability to finish lambs on pasture. However, grain feeding is still much less significant than pasture finishing in Australia. There appears to be limited published direct comparisons of carcase measurements related to meat quality for grain vs pasture finished lambs (Watkins *et al.* 2013).

2 Design

Lambs bred in the Meat & Livestock Australia (MLA) Resource Flock at the University of New England's Armidale properties, which were already destined for slaughter, were allocated to be finished on a pasture or grain based ration from approximately 35kg liveweight to a slaughter weight of around 50kg liveweight, over a period of at least 60 days.

The breed types were Merino x Merino, Poll Dorset x Merino and Poll Dorset x Maternal with 5 sires per breed type, each having at least three lambs per finishing treatment; i.e. 3 x 15 = 45 lambs per treatment. As the lambs were slaughtered hot standard carcase weight, fat and muscle measurements were taken at the abattoir.

3 Objectives

Objectives of this project were to measure the carcase traits listed above in grain versus pasture fed lambs. Later projects will investigate meat quality, including taste panel assessment, of the pasture and grain finished lambs.

4 Methodology

In the design outlined above the lambs were finished according to industry best practice including standard industry grain feeding procedures and access to the best quality grass/clover pastures available in a comparatively dry season. All lambs were trucked and slaughtered using industry guidelines at Thomas Foods International meat works at Tamworth as part of the normal meat groups program for the Resource Flock. All lambs were slaughtered on two kill dates during July and September at the same average liveweight of ~50kg and age of ~300-350 days. Standard carcase measurements including weight, fat GR and C, and eye muscle width and depth were taken at the abattoir.

Statistical models fitted included lamb sire, sex, birth type, slaughter age, slaughter date, breed type and treatment group with pre-slaughter liveweight and carcase weight as covariates.

5 Results

The average composition of pasture and grain diets are summarised in Table 1.

Table 1: Nutritional information for diets

	Pasture	**Grain**	**Oaten chaff****
Physical composition	80% mixed perennial grasses - ryegrass, paspalum & cocksfoot 15% legumes and herbs - red & white clover and plantain 5% mixed weeds	75% whole barley grain 21% cracked lupins 4% concentrate pellets containing minerals, vitamins and a rumen buffer	Chaffed oaten straw
Nutritional composition*			
Dry matter (%)	39 - 25	91	90
Dry matter digestibility (%)	66 - 79	82	71
Metabolisable energy (MJ/kg DM)	9.7 – 11.9	12.9	10.7
Crude protein (%)	12 - 21	16.4	12
Neutral detergent fibre (%)	53 - 21	23	50

* range in values for pasture from first half of feeding period (mid March – mid June) to second half (mid June –l ate August)

** oaten chaff was offered in separate feed troughs to the grain diet at about 10% of the total diet

Due to an abnormally dry season pasture quality and quantity was not always at the desired levels, however growth rates ranged from 120-185 g/d compared with 160-200 g/d for the grain fed group. Due to lower growth rates than anticipated the actual time period on the different rations ranged from 120-160 days.

The number of lambs in pasture and grain groups, and by breed, are summarised in Table 2.

Table 2: Numbers of lambs overall and by breed type, treatment and slaughter group

	Pasture	Grain
July slaughter	27	30
Sept slaughter	26	22
Overall	53	52

	PDxMer*		MerxMer*		PDxMat*	
	Pasture	Grain	Pasture	Grain	Pasture	Grain
July	10	15			17	15
Sept	4	1	20	20	2	1

*PDxMer – Poll Dorset x Merino; MerxMer – Merino x Merino; PDxMat – Poll Dorset x Maternal

Descriptive statistics with means by treatment group and breed are given in Table 3.

Table 3: Descriptive statistics

Trait*	Breedtype	Group	Count	Mean	SD	Min	Max
PSLWT	**MerxMer**	Grain	20	50.5	6.8	40.0	67.4
	MerxMer	Pasture	20	45.4	3.5	40.6	51.8
	PDxMat	Grain	16	53.4	5.8	44.6	62.8
	PDxMat	Pasture	19	48.9	5.1	39.8	57.2
	PDxMer	Grain	16	49.5	6.2	39.0	64.4
	PDxMer	Pasture	14	48.0	4.0	41.2	55.2
HCWT	**MerxMer**	Grain	20	23.1	2.5	19.4	29.8
	MerxMer	Pasture	20	18.1	1.9	15.6	22.0
	PDxMat	Grain	16	26.8	3.4	21.4	32.2
	PDxMat	Pasture	19	22.7	3.0	16.6	27.8
	PDxMer	Grain	16	24.3	3.7	18.2	33.8
	PDxMer	Pasture	14	21.0	2.8	17.0	26.0
DP	**MerxMer**	Grain	20	0.46	0.02	0.42	0.50
	MerxMer	Pasture	20	0.40	0.02	0.36	0.43
	PDxMat	Grain	16	0.50	0.02	0.47	0.54
	PDxMat	Pasture	19	0.46	0.02	0.42	0.51
	PDxMer	Grain	16	0.49	0.02	0.45	0.53
	PDxMer	Pasture	14	0.44	0.03	0.39	0.48
HGRFAT	**MerxMer**	Grain	20	15.9	3.3	8.0	23.0
	MerxMer	Pasture	20	8.0	2.5	4.0	13.0
	PDxMat	Grain	16	21.8	5.8	13.0	30.0
	PDxMat	Pasture	19	11.2	2.4	6.0	16.0
	PDxMer	Grain	16	19.0	5.1	12.0	30.0
	PDxMer	Pasture	14	9.1	2.7	5.0	14.0
CCFAT	**MerxMer**	Grain	20	4.8	2.3	1.0	8.0
	MerxMer	Pasture	20	1.7	1.2	1.0	5.0
	PDxMat	Grain	16	8.8	4.5	4.0	20.0
	PDxMat	Pasture	19	2.9	1.2	1.0	5.0
	PDxMer	Grain	16	5.6	1.9	2.0	9.0
	PDxMer	Pasture	14	2.0	1.2	1.0	5.0
CEMA	**MerxMer**	Grain	20	12.3	2.0	7.9	15.7
	MerxMer	Pasture	20	11.9	1.6	10.2	16.4
	PDxMat	Grain	16	15.3	2.2	12.5	21.4
	PDxMat	Pasture	19	14.7	1.7	10.4	17.4
	PDxMer	Grain	16	15.5	2.4	12.8	20.5
	PDxMer	Pasture	14	15.3	3.6	10.6	25.4

*PSLWT – pre-slaughter live weight (kg); HCWT – hot carcase weight (kg); DP – dressing percent (fraction); HGRFAT – fat measurement GR on hot carcase (mm); CCFAT – fat measurement C on cold carcase (mm); CEMA – eye muscle area on cold carcase (cm^2)

Least squares means for pre-slaughter weight and carcase measurements by treatment group and breed type, adjusted for carcase weight, are given in Table 4 and in Figs. 1 & 2.

Table 4: Least squares means for pre-slaughter weight and carcase measurements by treatment group and breed type.

	PDxMat		PDxMer		MerxMer	
	Pasture	Grain	Pasture	Grain	Pasture	Grain
PSLWT	48.53 (1.44)	53.12 (1.63)	47.55 (1.46)	48.91 (1.59)	45.16 (1.63)	50.22 (1.62)
HCWT	21.83 (0.74)	25.97 (0.84)	20.39 (0.75)	23.24 (0.82)	18.82 (0.84)	23.76 (0.84)
DP	0.45 (0.01)	0.49 (0.01)	0.43 (0.01)	0.47 (0.01)	0.42 (0.01)	0.48 (0.01)
HGRFAT	12.02 (0.90)	18.28 (1.14)	11.62 (1.00)	17.97 (1.01)	11.70 (1.18)	14.10 (1.03)
CCFAT	2.92 (0.65)	7.35 (0.83)	2.86 (0.72)	4.90 (0.73)	3.31 (0.85)	4.46 (0.74)
CEMA	14.24 (0.55)	13.22 (0.70)	15.82 (0.61)	14.21 (0.62)	14.01 (0.72)	12.42 (0.62)

PSLWT – pre-slaughter live weight (kg); HGRFAT – fat measurement GR on hot carcase (mm); CCFAT – fat measurement C on hot carcase (mm); CEMA – eye muscle area measurement on hot carcase (cm^2)

Treatment effects are not presented across all breeds as a significant interaction was observed between treatment and breed type making it only appropriate to examine treatment effects within breed type.

At slaughter grain fed lambs were from 1.5 kg (PDxMer) to 5 kg (MerxMer) heavier than pasture fed at similar ages. Carcase dressing percentage was 4-6 units greater for grain fed lambs in all breed types with the same curfew periods. After adjustments for carcase weight differences between groups, all breed types showed greater carcase fat measurements for grain compared to pasture fed while eye muscle area was greatest for pasture fed lambs in all breed types. The fat measurement differences were greatest in the Poll Dorset crosses with HGRFAT being around 50% higher for grain than pasture fed compared with a difference of only 20% for Merinos. Likewise CCFAT was over 100% greater in grain than pasture groups for the Poll Dorset crosses but only 30% higher in Merinos. Eye muscle area measurements were greater in pasture fed groups by 8-13%, being highest for Merinos.

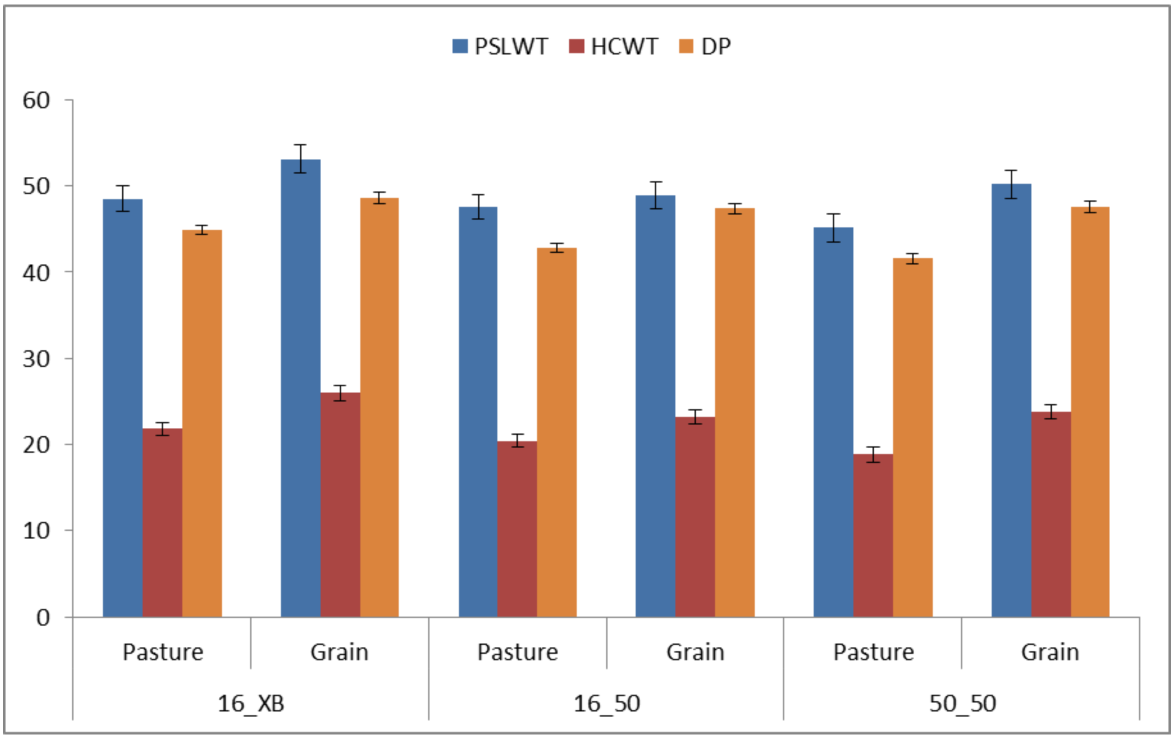

Fig. 1: Means for pre-slaughter liveweight (PSLWT, kg), hot carcase weight (HCWT, kg) and dressing percentage (DP, %). 16_XB – Poll Dorset x maternal; 16_50 – Poll Dorset x Merino; 50_50 – Merino x Merino

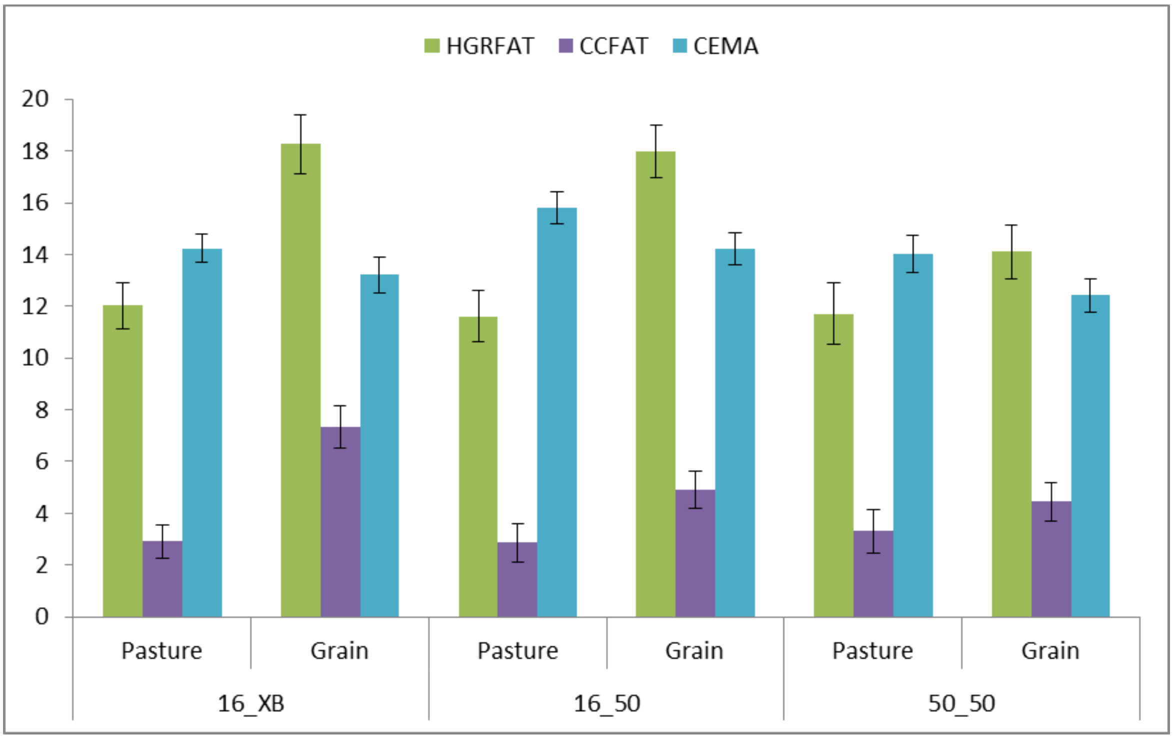

Fig. 2: Means for carcase fat measures GR (HGRFAT) and C (CCFAT) and eye muscle area (CEMA) by breed and treatment group. 16_XB – Poll Dorset x maternal; 16_50 – Poll Dorset x Merino; 50_50 – Merino x Merino

Significance levels for all fixed effects are summarised in Table 5.

Table 5: Summary of significance of fixed effects (significant effects in bold)

Trait	sex	bt	Age/sage	sdate	breed.group	HCWT	PSLWT
PSLWT	**P<0.001**	**0.046**	0.172	0.125	**0.002**		
HCWT	**P<0.001**	**0.019**	0.137	**0.011**	**P<0.001**		
DP	**0.036**	0.202	0.644	**0.003**	**P<0.001**		
HGRFAT	0.057	0.585	0.887	0.173	**P<0.001**	**P<0.001**	0.097
CCFAT	**0.044**	0.502	0.999	0.886	**P<0.001**	**0.013**	0.109
CEMA	0.207	0.088	0.503	0.216	**0.02**	**0.007**	0.241

Breed x treatment group interactions were highly significant for all traits tested. Sire by treatment interaction was tested and was not significant for any trait

6 Discussion

Pasture fed lambs grew considerably slower than grain fed mainly due to a relatively dry season. Nutritional quality of the pasture for most of the grazing period would not have supplied the minimum energy and protein requirements of 12.5 MJ ME/kg DM and 13% CP for growth rates of 200 g/d (Anon. 2007). In particular, Merinos took considerably longer to reach slaughter weights than the Poll Dorset crosses, hence most of the crossbreds were in the first slaughter group in July while all Merinos were in the second slaughter group in September. Consequently pre-slaughter weights were greater for grain fed lambs, particularly for Merinos where the difference was 5 kg. The larger weight difference with Merinos may be due to the fact that Merino lambs competed less favourably with crossbreds at pasture than in the feeding pens.

Fat measures adjusted for carcase weight were greater in grain than pasture fed lambs, particularly for the Poll Dorset crosses, whereas eye muscle area measurements were larger in pasture fed groups, particularly for Merinos. This greater rate of fat deposition associated with a propionate rumen fermentation with grain feeding appeared to be at the expense of protein deposition which was relatively greater in the pasture fed lambs where an acetate fermentation would have been more prevalent. There appears little published information on relative rates of fat and protein deposition in grain vs pasture fed lambs however Watkins *et al*. (2013) suggest forage composition can influence fat and protein deposition while Warner *et al.* (2010) found that relative fat deposition in particular varied across a range of genotypes on similar or varied diets.

Implications of these results are that grain feeding or feedlot finishing is more likely than pasture feeding to lead to excessive carcase fat levels, particularly in terminal cross lambs. On the other hand pasture finished lambs will tend to have a greater meat yield than grain fed and this is more marked in Merinos than terminal crosses.

7 References

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