EFFECT OF BREED ON MEAT QUALITY ATTRIBUTES OF CRYPTORCHID AND EWE LAMBS

H.A. CHMNON[AB], *P.A. KENNEY*[A] *and C.L. PLANT*[A]

[A]Dept of Agriculture, Rutherglen Research Institute, RMB 1145, Ruthcrglen, Vic. 3685
[B]Current address: Don Smallgoods Co. Pty. Ltd., Altona North, Vic. 3025

SUMMARY

The use of different terminal sire breeds and the production and management of cryptorchid lambs are areas of major interest in the Australian prime lamb industry. Tenderness and meat colour from 871 tender-stretched lamb carcases, slaughtered at mean treatment liveweights of 30 and 35 kg for ewes and 35 and 45 kg for cryptorchids, were determined. Differences in meat tenderness and meat colour were small but were found to be influenced by lamb breed and slaughter group whilst lamb age within slaughter groups, muscle pH, freezer time or fat depth at the GR site were not significant ($P > 0.05$) factors.

Keywords: cryptorchid lambs, breed, tenderness, meat colour, age.

INTRODUCTION

Market studies, conducted to determine reasons for declining domestic lamb consumption, identified increasing requirements for leaner, meatier lamb cuts by consumers (Thatcher and Couchman 1983; Hopkins and Congram 1985; Backhouse 1989). Lean lamb carcases, weighing 22 kg and above with a fat score of 2 to low 3, were recognised to be ideally suited for economical preparation of versatile and interesting lamb cuts (Currie 1986).

To provide leaner and meatier lamb cuts, lean lambs of heavier carcase weights are required. Significant opportunity exists for prime lamb producers to reduce fat levels while increasing the number of lamb carcases weighing more than 22 kg. Genetic selection of appropriate terminal sires for improved leanness and growth rate characteristics, using schemes such as LAMBPLAN (Banks 1990) is a long term management strategy available to producers of lean, high yielding second cross prime lambs. However, the more immediate strategy, to maximise the likelihood of producing lean lambs, is to mark suitable male progeny as cryptorchids and encourage producers to selectively market lambs (selling ewe lambs before they become overfat). Management options, such as these, provided the basis of the Terminal Sire Evaluation Project, conducted at Rutherglen Research Institute from 1986 to 1989, which aimed to determine the amount of genetic and phenotypic variation existing within and between breeds when used as terminal sires with Border Leicester x Merino ewes.

It is known that cryptorchid lambs are leaner at any given carcase weight than ewe and wether lambs (Lee *et al.* 1990) but it is perceived by both the processing (Hopkins 1993) and retailing (Channon 1990) sectors of the Australian lamb industry that meat obtained from cryptorchid lambs is of lower quality, tougher and darker in colour than that from wether and ewe lambs. Little data has been published that compares tenderness, meat colour and muscle pH of meat from cryptorchid and ewe lambs grazing annual pastures in south eastern Australia. This paper discusses the influence of lamb breed on the meat quality attributes of tenderness, meat colour and muscle pH, determined as part of the Terminal Sire Evaluation Project in 1988.

MATERIALS AND METHODS

Male and female progeny (n = 871) of Border Leicester x Merino ewes joined to 32 sires from 6 studs (3 Poll Dorset, 2 Merino and 1 Meridale) were randomly allocated to 1 of 2 slaughter groups within sex (Kenney *et al.* 1992). All male lambs were marked as cryptorchids.

All lambs grazed annual pasture, containing grasses and subterranean clover (*Trifolium subterraneum),* at Rutherglen Research Institute situated in north eastern Victoria. Ewe lambs were slaughtered at mean liveweights of 30 kg (EWE30, n = 210) and 35 kg (EWE35, n = 216) at an average age of 88 and 135 days respectively. Cryptorchid lambs were slaughtered at a mean liveweight of either 35 kg (CRYPT35, n = 221) or 45 kg (CRYPT45, n = 224) at an average age of 115 and 178 days respectively.

All lambs were slaughtered at a commercial domestic abattoir. All carcases were tender-stretched by pelvic suspension within 60 minutes of slaughter, enclosed in stockinettes and chilled at 4°C for 10 hours prior to freezing at -20°C. Carcases, as required for dissection, were thawed for 24 hours at 4°C. Cold carcase weight (CCW) and fat depth at the GR site, which is situated 110 mm from the backbone over

the 12th rib, were then measured. The *M. Zongissimus lumborum* (LL) and *M. semimembranosus* (SM) were removed, wrapped separately in Goodyear Vitafilm® and frozen at -20°C until required for tenderness assessment. The *M. Zongissimus thoracis* (LT) was also removed and meat colour determined, using a Minolta Chromameter CR 200 set on the L*, a*, b* system (where L* denotes relative lightness, a* relative redness and b* relative yellowness), on the cut muscle surface adjacent of the 13th rib, after allowing it to bloom for 30 minutes. Muscle pH was also measured on the LT using a direct pH probe fitted to a Jenco Micrometer pH Vision Model 6007 (Jenco Instruments, San Diego CA).

Objective tenderness assessment of the LL and SM was conducted according to the method of Bouton *et al.* (1971). Tenderness of samples with a cross sectional area of 1 cm^2 was measured at Rutherglen Research Institute, using a Warner Bratzler (WB) Shear Blade fitted to an Instron Universal Testing Machine Model 4301.

Data was analysed using Harvey's mixed model least squares and maximum likelihood program PC-1 (1988) using the following model:

$Y = \mu$(overall mean) + a ST + b SI + c G + d F + e pH + f GR + g A + residual;

where ST refers to stud, SI - sires within studs, G - slaughter group, F - time carcase spent in freezer, pH - muscle pH of the LT, GR - fat depth (mm) and A - lamb age within slaughter group (due to a 56 day variation in age). Corrections were made for twins and management group (Kenney *et al.* 1992). Dependent variables (Y) analysed in separate equations were WB shear force values for the LL (WBLL) and SM (WBSM) muscles and L*, a*, and b* colour coordinate values.

This model was used, with F, pH and GR omitted, to analyse in separate equations, CCW, fat depth at the GR site (GR) and muscle pH of the LT.

RESULTS

At similar carcase weights, cryptorchids were leaner than ewes (EWE35 cf CRYPT35, Table 1). In addition, lambs sired by Merino and Meridale rams produced leaner, lighter weight carcases than lambs sired by Poll Dorset rams.

Table 1. Least mean squares (standard error in parenthesis) of cold carcase weight (CCW, kg), fat depth at the GR site (mm), and muscle pH between slaughter and stud groups

	CCW	GR	Muscle pH
Slaughter group			
EWE 30	11.6 (0.12)	5.4 (0.15)	5.50 (0.01)
EWE35	14.2 (0.12)	7.7 (0.15)	5.52 (0.01)
CRYPT35	13.8 (0.12)	4.4 (0.15)	5.49 (0.01)
CRYPT45	19.5 (0.12)	8.8 (0.15)	5.58 (0.01)
Stud group			
Poll Dorset 1	16.2 (0.15)	8.5 (0.18)	5.47 (0.01)
Poll Dorset 2	15.9 (0.15)	8.4 (0.19)	5.51 (0.01)
Poll Dorset 3	16.2 (0.15)	8.8 (0.19)	5.49 (0.01)
Merino 1	13.1 (0.19)	3.8 (0.23)	5.55 (0.01)
Merino 2	13.1 (0.18)	4.2 (0.23)	5.55 (0.01)
Meridale	14.1 (0.15)	5.6 (0.18)	5.55 (0.01)
R^2	0.77	0.63	0.24

Age within slaughter group, freezer time, muscle pH and fat depth at the GR site were not significant factors affecting tenderness of lamb. Values for WBLL for CRYPT45 and EWE35 lambs were higher than those recorded for lambs slaughtered at lower liveweights. Values for WBSM were similar across all slaughter groups. Muscles from CRYPT45 lambs were darker (lower L* value), less red (lower a* value) and less yellow (lower b* value) than that produced from lambs in treatments EWE30, EWE35 and CRYPT35.

Tenderness and meat colour was found to vary slightly, both within and between each breed type (Table 2).

Table 2. Least mean squares (standard errors in parenthesis) of tenderness as indicated by WB shear force values of the *M. longissimus lumborum* (WBLL, kg) and *M. semimembranosus* (WBSM, kg) and L*, a* and b* colour co-ordinate values of the *M. longissimus thoracis* between slaughter groups and studs

	WBLL	WBSM	L* value	a* value	b* value
Mean	1.86	2.81	34.73	15.90	3.40
Slaughter group					
EWE30	1.78 (0.02)	2.82 (0.02)	34.62 (0.10)	16.20 (0.06)	3.94 (0.06)
EWE35	1.90 (0.02)	2.79 (0.02)	35.52 (0.10)	15.60 (0.06)	3.65 (0.06)
CRYPT35	1.78 (0.02)	2.82 (0.02)	35.13 (0.10)	15.96 (0.06)	3.67 (0.06)
CRYPT45	1.96 (0.02)	2.80 (0.02)	33.66 (0.10)	15.85 (0.06)	2.32 (0.06)
Stud group					
Poll Dorset 1	1.93 (0.02)	2.83 (0.02)	34.86 (0.13)	15.88 (0.08)	3.45 (0.08)
Poll Dorset 2	1.76 (0.03)	2.83 (0.02)	34.96 (0.13)	15.98 (0.08)	3.47 (0.08)
Poll Dorset 3	1.85 (0.02)	2.83 (0.02)	34.65 (0.13)	15.69 (0.08)	3.18 (0.08)
Merino 1	1.87 (0.03)	2.73 (0.03)	34.62 (0.17)	15.94 (0.10)	3.42 (0.10)
Merino 2	1.90 (0.03)	2.82 (0.03)	34.45 (0.16)	16.08 (0.10)	3.46 (0.10)
Meridale	1.82 (0.02)	2.80 (0.02)	34.83 (0.12)	15.84 (0.09)	3.40 (0.10)
R^2	0.11	0.22	0.32	0.20	0.45

DISCUSSION

Average WB values for the LL and SM between both slaughter and stud groups were considerably lower than the benchmark of 5 kg, above which Shorthose *et al.* (1988) stated that lamb may be regarded as tough by many Australian consumers. These results may highlight both the effect of thawing and subsequent refreezing of both the LL and SM prior to tenderness assessment and the advantages of tender-stretching lamb carcases from the pelvic region post-slaughter. Those factors capable of influencing the post-slaughter cooling rates of lamb carcases, including subcutaneous fat depth and carcase mass (Smith *et al.* 1976), and therefore the incidence of cold shortening, may have been minimised due to restraint from post-slaughter shortening.

The 90 day difference in age between EWE30 and CRYPT45 lambs was not a major factor influencing tenderness as only small differences between predicted least mean squares between slaughter groups were observed.

Although muscle pH values recorded for LT muscles from CRYPT45 lambs were higher ($P < 0.05$) than the other slaughter groups, ultimate pH values for lamb normally range from 5.4 to 5.8. With increasing age and carcase weight, differences in meat colour were found between cryptorchid and ewe lambs averaged across all stud groups. However, lower L* and a* values recorded for LT muscles from CRYPT45 lambs suggest that the concentration of myoglobin in muscle may have been higher in CRYPT45 lambs than lambs in the other slaughter groups, rather than due to differences ($P > 0.05$) in muscle pH. These findings, however, do not support those of Ledward and Shorthose (1971) and Pinkas *et al.* (1972), who reported higher myoglobin concentrations in muscles of ewe and wether lambs than cryptorchid or ram lambs.

Young *et al.* (1993) found that Merino lambs were slightly more tender than Poll Dorset-sired lambs, however, studs within breeds were not compared. The results from this study indicated that meat quality differences between studs may be greater than those between breeds. It is unlikely, therefore, that meat processors will select specific lamb breeds for slaughter to fulfil colour or tenderness requirements of consumers. Although sufficient genetic variation in this trait may exist within breeds to permit genetic progress to be made once selection pressure is applied, there are no direct financial incentives to warrant such selection by prime lamb breeders. The small differences in both tenderness and meat colour of lambs in different stud groups, as observed in this study, would also not warrant such a breeding program.

CONCLUSIONS

Although it is recognised that lamb carcase conformation, retail yield and fatness can be influenced by lamb breed, the results from this study indicate that lamb breed was not a major factor influencing meat quality of lamb. In addition, the relatively low R^2 values for degree of fit to the model for tenderness

and meat colour parameters indicate that difficulties in predicting tenderness from genetic, nutritional and pre-slaughter management factors exist.

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