BRIEF COMMUNICATION: Comparison of castrate and entire ram-lambs for meat quality and skatole in the fat

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Introduction

Ram lambs are favoured in sheep production systems for their faster growth rates compared to ewe, castrate and cryptorchid lambs (Fisher et al. 2010). The meat from ram lambs has been associated with poorer tenderness and colour characteristics when compared to the meat from ewe lambs of the same breed (Johnson et al. 2005; Craigie et al. 2012) but, the results across studies are inconsistent with some studies reporting no difference in meat quality between the sexes (Navajas et al. 2008, Kerslake et al. 2012). In a study by Rousset-Akrim et al. (1997), seven-month old male lambs had undesirable meat quality characteristics compared to three-month old male lambs suggesting that age of the lambs and the attainment of puberty are likely to influence the meat quality when comparing between sex classes.

Boar taint is a negative flavour attribute of pork caused by the presence of the sex steroid, androstenone, and also skatole, in the meat (Babol et al. 2002). In the pig, skatole is produced from tryptophan by hind-gut bacteria (Deslandes et al. 2001). Bacteria in the rumen of sheep also produce skatole indicating a potential for a skatole-based taint with sheep meat. To-date, there is no scientific evidence of a 'ram taint' with lamb meat.

Most studies considering meat quality between the sexes compare female and male (Johnson et al. 2005; Craigie et al. 2012). The comparisons between castrated ram lambs and entire ram lambs are not as numerous. For lamb production, it could be argued that a more important consideration of meat quality between sexes would be between castrate or cryptorchid rams and entire rams as the implication of the results would be a management decision at docking and a compromise on growth rates.

The objective of this study was to compare the meat quality of castrated and entire ram lambs. A component of this objective was to compare the skatole concentration in the fat to investigate if skatole could be acting as a precursor for undesirable flavour of meat from ram lambs.

Materials and methods

Weaned, entire (n = 19) and castrated Romney ram lambs (n = 19) were obtained from local saleyards prior to the trial. The entire and castrate lambs came from different sale lots so were given a two-week on-farm adaptation period before beginning the experiment. The lambs were weighed (Start live weight) and the entire and castrate lambs grazed together on autumn ryegrass-based pasture for 70 days. The lambs were approximately five-months old at the start of the grazing period. A final unfasted live weight of the lambs directly off pasture was obtained on the day prior to slaughter (End live weight). The lambs were slaughtered at a commercial abattoir (Bernard Matthews, Feilding) and dressed to standard commercial procedures. The GR (tissue depth 11 cm from the midline on the 12th rib) measurement and hot carcass weight was recorded on the day of slaughter. The carcasses were chilled at 4°C for 24 hours prior to removing the loin from the left side. The loin was vacuum-packed, chilled for another 24 hours at 4°C then stored at -20°C. Intermuscular fat from the popliteal fat depot in the hind legs of the carcasses was collected and stored at -20°C.

After thawing, the ultimate pH of the loin was measured using a pH spear (Eutech Instruments, Singapore) calibrated to pH 4.01, 7.00 and 10.01 using standard buffers. Muscle lightness (L^*), redness (a^*) and yellowness (b^*) were measured on a fresh loin slice after 30 minutes exposure to air (Minolta CR-200 chromameter). Tenderness was assessed using the Warner-Bratzler device by measuring the peak force required to shear 13 mm^2 cores made from 25 mm loin steaks which were cooked in a water bath at 70°C for 90 minutes. Skatole concentration in the intermuscular fat was measured by GC-MS following the method described by Schreurs et al. (2007).

Rate of liveweight gain was calculated as the difference between the start and end live weight divided by the number of experimental grazing days. Skatole concentration and Warner-Bratzler peak shear force data required a log transformation to achieve a normal distribution. Data were analyzed by t-test using SAS software.

Results and discussion

Growth performance

The ram lambs had a greater pre-slaughter live weight ($P < 0.001$) and carcass weight ($P < 0.01$) due to a greater live weight at the start ($P < 0.05$) and a greater growth rate ($P < 0.01$ Table 1). This was expected given the growth promoting effects of

Table 1 Growth performance (mean ± standard error of mean) of five-month old entire (n = 19) and castrated (n = 19) ram lambs grazed together on autumn ryegrass-based pasture for 70 days. Bold type indicates significance at P <0.05.

Measurement	Status		P value
	Entire	Castrate	
Start live weight (kg)	40.3 ± 0.7	37.7 ± 0.6	**0.012**
End live weight (kg)	51.5 ± 1.1	46.6 ± 0.5	**<0.001**
Liveweight gain (g/d)	160 ± 10	127 ± 5	**0.006**
Hot carcass weight (kg)	22.0 ± 0.3	20.5 ± 0.3	**0.004**
GR tissue depth (mm)	10.4 ± 0.8	13.5 ± 0.8	**0.009**

testosterone produced by the testes of the entire ram. Testosterone also supports leaner growth. This was evident in this study where the GR was lower for the entire ram compared to the castrate (P <0.01; Table 1) despite the higher carcass weight. An increased GR is indicative of increased carcass fatness. These results agree with other studies which have looked at the effect of castration status on growth performance and carcass composition (Fisher et al. 2010, Kerslake et al. 2012).

Meat quality

The ultimate pH, meat colour parameters and the Warner-Bratzler shear force were the same for the two sex classes (Table 2). This suggests that the consumer will not be able differentiate lamb as coming from male or castrate animals by the colour of the lean at the time of purchase or by tenderness at the time of consumption. When castrate and entire ram lambs were slaughtered at the same slaughter weight it was also found that there was no difference in meat quality (Okeudo & Moss 2008). The meat pH is a driver of some meat quality characteristics (Purchas & Aungsupakorn 1993). The similarity in meat quality for lamb from castrate and entire rams is likely to be partially a consequence of no difference in the ultimate pH. Previous studies have also considered the sex of the lamb to be a poor contributor to variation in meat colour, tenderness and pH (Navajas et al. 2008; Bain et al. 2009; Kerslake et al. 2012).

Skatole concentration in the fat

The skatole concentration was greater in the fat of the entire compared to castrate ram lamb (P <0.05; Table 2). Ram lambs slaughtered at seven months of age compared to lambs slaughtered at three months of age had stronger 'sheep' and 'animal' flavour attributes (Rousset-Akrim et al. 1997). Potentially this could have been a consequence of a greater skatole concentration in the meat (Young et al. 2003). The threshold concentration for skatole to be a contributor to boar taint in pork is 0.25 µg/g of fat (Babol et al. 2002). A recent study with a Norwegian taste panel considered the threshold to be only 0.1 µg/g of pork (Lunde et al. 2010) and a taste panel in Singapore was even more sensitive with a flavour detection threshold for skatole at 0.03 µg/g of pork (Leong et al. 2011). It is unknown if the threshold used for pork is translatable to sheep meat. Nevertheless, these data for pork provide some guide to the potential for skatole creating undesirable flavours with lamb. The mean skatole concentration of the lambs in this study was well below the standard detection threshold of 0.25 µg/g of fat. It is unlikely that consumers would be able to differentiate meat samples with a mean fat skatole concentration difference of 0.027 µg/g of fat, as in this study. However, variation around the mean and the tendency for a higher skatole content in the fat of entire ram lambs could be of concern for sensitive markets (Farouk et al. 2007).

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Table 2 Meat quality characteristics and skatole concentration in fat (mean ± standard error of mean) of five-month old entire (n = 19) and castrated (n = 19) ram lambs grazed together on autumn ryegrass-based pasture for 70 days. Bold type indicates significance at P <0.05.

Measurement	Status		P value
	Entire	Castrate	
Ultimate pH	5.68 ± 0.02	5.70 ± 0.02	0.32
Colour *L** (Lightness)	39.5 ± 0.4	39.3 ± 0.4	0.70
Colour *a** (Redness)	13.0 ± 0.3	12.5 ± 0.3	0.23
Colour *b** (Yellowness)	4.0 ± 0.2	3.7 ± 0.2	0.34
Warner-Bratzler shear force (log kgF)	2.0 ± 0.1	1.9 ± 0.1	0.28
Back-transformed Warner-Bratzler shear force (kgF)	7.2	6.5	-
Skatole (log ng/g fat)	4.4 ± 0.1	3.9 ± 0.1	**0.03**
Back-transformed Skatole (µg/g fat)	0.079	0.052	-

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