BRIEF COMMUNICATION: High ultimate pH in short-scrotum male lambs processed during the breeding season

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Introduction

Historically in New Zealand male lambs were castrated at the time of docking, however, there has been a move to instead create short-scrotum males, in which the testes are pushed within the body cavity and the scrotum removed (Johnson et al. 2007). This results in short-scrotum males, having similar physiological characteristics to entire ram lambs, except that they are almost always infertile and, therefore, do not present a management risk if they are accidently mixed with ewes or ewe lambs during the mating season. The normal ultimate pH of lamb meat is considered to be 5.50 to 5.80, with values above 5.8 and in particular above 6.0 considered high, and resulting in negative meat quality outcomes. There have been a number of studies that have investigated whether or not sex differences in the ultimate pH of lamb exist. The results are not always consistent with some studies reporting elevated ultimate pH in non-castrated male lambs (Johnson et al. 2005; Bain et al. 2009), whilst others have shown no differences (Kerslake et al. 2012; Schreurs 2013). In commercial farming operations there is a mix as to how farmers manage their lambs of different sexes during the finishing period prior to slaughter, and in many farming operations this period coincides with the on-set of the breeding season.

Given the most recent papers in this area have concluded that there is no sex-effect on ultimate pH, the purpose of this paper is to report on data collected from a trial that set out to invoke high ultimate pH (to investigate potential live-animal predictors of high ultimate pH) in short-scrotum male lambs during the breeding season.

Materials and methods

Animals Used

Animals for this study were sourced from a commercial property in Southland, New Zealand in mid-April 2015. Ethical approval for the trial was obtained from the AgResearch Invermay Animal Ethics Committee (Application: AGR13507).

The experimental design required to investigate live-animal predictors for *M. longissimus lumborum* ultimate pH required a sample size of 22 animals with high ultimate pH. In previously obtained data sets, it was determined that the proportion of animals with ultimate pH above 5.8 could be as low as 10% (Johnson et al. 2015), and therefore a data set consisting of 220 animals was generated.

A group of short-scrotum male lambs of maternal-composite breeding with a minimum live weight of 40kg were placed in a paddock adjacent to ewes and entire rams during the autumn mating period with the assumption that at least a proportion of the ewes would be cycling on any given day. The lambs were grazed next to the ewes from April 8th for 8 day then held overnight in the yards prior to trucking to the abattoir. The lambs were loaded onto a truck at approximately 9.30am and transported for approximately 60 minutes to the Alliance Lorneville plant (near Invercargill). The lambs were held overnight at the abattoir and slaughtered on the morning of April 17th.

Measurements made

From their time of arrival at the abattoir, the lambs and subsequent carcasses were processed according commercial procedures of Alliance Group Ltd. And underwent accelerated conditioning and ageing processes (Chrystall et al. 1989) designed to maximise meat-quality outcomes. The ultimate pH was measured 72 hours after slaughter by insertion of a pH meat probe, attached to a WTW pH330i pH Meter calibrated for temperature, into the *M. longissimus lumborum* muscle.

Additional carcass data as routinely generated by Alliance Ltd. included carcass weight, and measurements reported from their VIAscan two-dimensional imaging system (Hopkins et al. 2004) which included VIAscan GR (an estimate of carcass fatness), and VIAscan estimates of the lean meat yield in the leg, loin and shoulder regions, summed to give total lean meat yield.

Analysis

Summary statistics were prepared, and the distribution of the ultimate pH values plotted using the box plot procedure in the statistical programme R. The relationship between ultimate pH and the carcass data set was assessed using the correlation procedure in SAS (SAS, 2011).

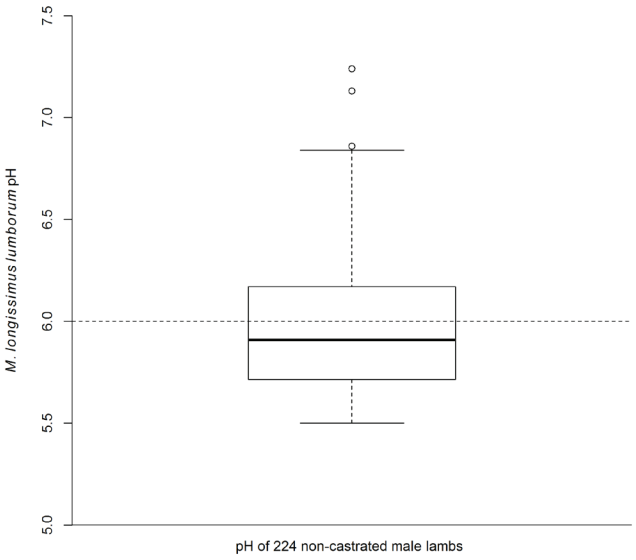
Results and discussion

In studies where the sex contrast has been between ewe and non-castrated male lambs, significant differences in ultimate pH have been reported (Johnson et al. 2005; Bain et al. 2009), whilst in studies that have compared non-castrated lambs to castrated lambs no differences have been observed (Kerslake et al. 2012; Schreurs 2013). In commercial farming operations, grazing and finishing of lambs occurs with lambs in mixed- or single-sex groups.

Table 1 Ultimate pH and carcass characteristics of 225 maternal-composite short-scrotum lambs slaughtered in mid-April

	n	Average ± StdDev	Range (Min- Max)
Ultimate *M. longissimus lumborum* pH measured three days post mortem	224	5.98 ± 0.31	5.50-7.24
Carcass weight (kg)	225	18.7 ± 1.49	14.9-22.8
VIAscan GR (mm; measure of fatness)	219	4.0 ± 2.07	1-10
VIAscan lean meat yield leg (%)	219	22.5 ± 1.2	19.7-25.8
VIAscan lean meat yield loin (%)	219	15.3 ± 0.8	13.3-17.5
VIAscan lean meat yield shoulder (%)	219	17.1 ± 0.8	14.8-19.4
VIAscan lean meat yield total (%)	219	55.0 ± 2.3	50.0- 60.7

Figure 1 Distribution of pH values from 224 non-castrated male lambs slaughtered in mid-Autumn. The box represents 25-75% of the values, with the solid middle bar the median. The top whisker represents two times the interquartile range, with the circles representing outliers. The bottom whisker represents the bottom 25% of values.



In this study, the impact of non-castrated males running adjacent to mature ewes that were running with rams during their breeding season is reported. During mustering, the night before trucking, the shepherd made a notable observation that although the lambs were in a paddock adjacent to the yards, it took him over 40 minutes to muster them into the yards as a proportion of the flock continually doubled back to the fence line adjacent to the ewes. Additionally, mounting behaviour continued in the pre-trucking period.

The summary data for the carcasses is provided in Table. 1. From this summary it can be observed that given the normally acceptable lamb *M. longissimus lumborum* ultimate pH range is 5.5 to 5.8, and the range in the current study was 5.50 to 7.24 (Figure 1) with an average value of 5.98 indicates that the overall ultimate pH of the mob was very high. Over 45% of the lambs had ultimate pH of 6.0 or greater.

Minimum levels of glycogen are required to achieve a full post-slaughter drop in muscle pH (Immonen & Puolanne 2000). A low glycogen concentration with the post-mortem muscle will reduce production of lactic acid reducing the drop in pH in the muscle, such that it does not achieve the expected range of 5.5 to 5.8. Once pubertal, ram lambs together with adult rams are responsive to the behavioural and physiological characteristics of oestrus ewes, and studies have shown that adult rams in mating mob situations can lose up to 12% of their body weight as a result of decreased feeding and increased activity, activities that were observed in the lambs in this study. The impact of reduced feeding, increased activity and sexual activity on reducing muscle glycogen levels pre-slaughter have been reviewed by Carragher and Matthews (1996), and are considered to be cumulative.

There was no correlation between pH and the carcass traits ($P>0.05$) for all trait combinations, with no Pearson correlation co-efficient greater than 0.08. This indicates that no attribute of the animal in terms of its size or level of maturity as indicated by carcass fatness were predictive of whether or not the animal would exhibit high pH.

This data set has demonstrated that high ultimate pH can be an issue in non-castrated male lambs, retained through the mating season. As such, management practices need to ensure that non-castrated male lambs are well-segregated from mature and pubertal ewes in order to prevent muscle glycogen depletion and elevated ultimate pH. This should also include ensuring that no cull ewe lambs are accidently incorporated into non-castrated male finishing mobs.

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