

SELECTION FOR INCREASED INTRAMUSCULAR FAT AND LEAN MEAT YIELD CAN IMPROVE THE BLOOMED COLOUR OF LAMB MEAT

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The impact of increasing lean meat yield and intramuscular fat on freshly bloomed lamb meat colour is unclear. Meat lightness (L^*) and redness (a^*) were measured in the *m. longissimus* of 8165 lambs produced across Australia. Increasing intramuscular fat (2 - 8%) increased L^* and a^* ($P < 0.01$). In contrast selection for lean meat yield, via increasing relative shortloin muscle weight and reducing shortloin fat weight, reduced meat L^* and a^* ($P < 0.01$), however these impacts were largely accounted for by associated changes in intramuscular fat. Therefore independent selection for high intramuscular fat levels with concurrent selection for lean meat yield can substantially improve bloomed lamb meat colour.

Key Words – Color, Lightness, Redness.

I. INTRODUCTION

The colour of lamb meat on display is critical to consumer appeal. Discoloured meat is associated by consumers with spoilage and reduced quality, deterring their purchase and causing economic losses for the industry [1]. When lamb meat is bloomed, its colour changes from purple to red as myoglobin pigments bind oxygen, increasing meat lightness (L^*) and redness (a^*) [1]. Increasing the concentration of myoglobin in muscle increases the absorption of certain wavelengths of light, reducing meat L^* and increasing a^* [2]. Selection for lean meat yield indirectly influences myoglobin concentration [3] and may thus impact the bloomed colour of lamb meat.

Selection for lean meat yield has indirectly increased the proportion of glycolytic muscle fibres and thereby reduced the muscle oxidative capacity of lamb muscles [3], which is strongly related to myoglobin concentration. Selection for increased lean meat yield has also had the unintended impact of reducing intramuscular fat concentration (IMF) [4], which is associated with muscle oxidative capacity [7]. Given that increased lean meat yield and reduced IMF are associated with reduced muscle oxidative capacity and thus myoglobin concentration, we hypothesise that increasing lean meat yield, indicated by increased relative shortloin muscle weight (SMW) and reduced shortloin fat weight (SFW), and reducing IMF will be associated with increased lamb loin L^* and reduced a^* .

II. MATERIALS AND METHODS

Lambs ($n = 8165$) were produced over 5 years at 8 sites across Australia and were the progeny of Merino and Merino-cross bred dams artificially inseminated by Terminal, Maternal and Merino sires. The lambs were grazed on extensive pasture with supplementary grain and ranged from 134 to 504 days of age when slaughtered at a target carcass weight of 21-22kg. Carcasses were measured for hot carcass weight (HCWT) and chilled for 24 hours before the *m. longissimus* was removed (from the 12th rib to the lumbar sacral junction) and weighed separately to the overlying fat layer (SMW and SFW). A 40g sample of muscle was used to measure IMF as a % of wet tissue weight. Bloomed colour of the loin muscle was measured using a Minolta Chromameter (Model CR-400) at the level of the 12th rib, after 30 minutes of atmospheric exposure, within the chiller at 2-4°C. A closed cone, D65 illuminant, 2° standard observer and 10mm aperture were used to take three measures of meat L^* and a^* that were averaged for analysis.

L^* and a^* were initially analysed as dependent variables in a multivariate model in SAS, including fixed effects for site, year, slaughter group within site and year, sire type, sex and dam breed. Non-significant terms ($P > 0.05$) were regressed to reach a model that was used to analyse L^* and a^* separately in linear mixed effects models, with the same fixed terms and random terms for sire and dam by year. IMF was incorporated into each of the models along with all significant interactions with fixed effects, while shortloin muscle weight and shortloin fat weight were each analysed along with HCWT to ensure the impact of composition (relative muscling and fatness) on L^* and a^* were represented.

III. RESULTS AND DISCUSSION

Lamb loin IMF was positively associated with L^* and a^* . Across the IMF range (2% to 8%) L^* increased by 3.1 units and a^* by 1.3 units ($P < 0.01$, Fig. 1). The positive association between IMF and L^* does not support our hypothesis and suggests that IMF influences bloomed lamb colour independent of its association with muscle oxidative capacity and myoglobin concentration. Alternatively, light reflection from white fat may be having a greater effect on meat L^* . These are encouraging findings for industry given the importance of these traits for visual appeal and eating quality.

Increasing lean meat yield via increasing SMW and reducing SFW was associated with reduced meat L^* and a^* ($P < 0.01$, Fig. 1). These associations with meat L^* are contrary to our hypothesis, countering the perception that increasing lean meat yield would reduce myoglobin and thereby increase meat L^* . Alternatively, correcting these models for IMF changed the association between SMW and L^* entirely (increasing SMW from 100-500g causing a 0.4 unit increase in loin L^* ($P < 0.05$)), while the 0.9 unit impact of SFW on loin L^* was reduced to a 0.1 unit impact ($P < 0.05$). The impact of SMW and SFW on loin a^* was reduced by around 50% when IMF was accounted for, suggesting that the effect of lean meat yield selection on a^* may be underpinned by a combined reduction in IMF and myoglobin.

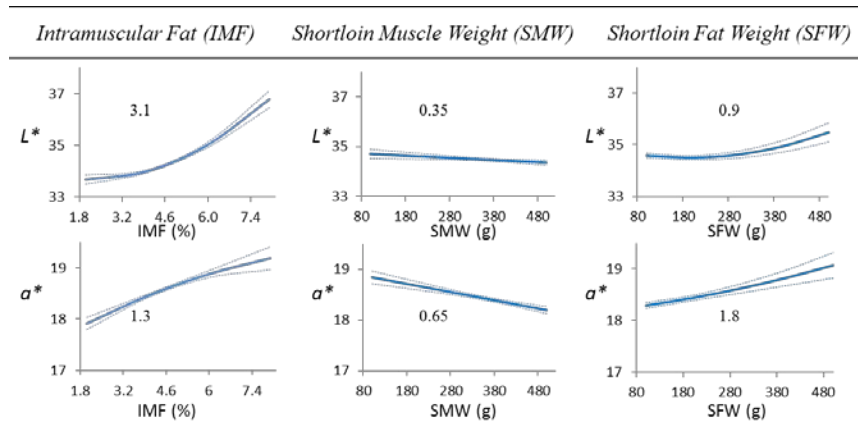


Figure 1. The impact of intramuscular fat, shortloin muscle and fat weight on lamb loin L^* and a^* . Solid lines represent the predicted mean, dotted lines the standard error of the mean and the value on each figure represents the unit change in L^* and a^* across the listed range in IMF, SMW and SFW.

IV. CONCLUSION

Increasing IMF will increase L^* , a^* and thereby consumer appeal of bloomed lamb meat. The negative impact of increasing lean meat yield (indicated by increasing shortloin muscle weight and reducing shortloin fat weight) on meat L^* were accounted for by reductions in IMF, suggesting that independently selecting for high IMF levels with selection for lean meat yield can substantially improve bloomed lamb meat colour.

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