Invited Speaker Plenary 4: Animal Nutrition-CRCs

The impact of selection for muscling on carbohydrate metabolism

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Background - An adequate level of muscle glycogen at the time of slaughter is essential for ensuring the production of premium quality meat, and minimising the incidence of dark cutting in cattle and sheep. Muscle glycogen status is likely to reflect the rate of turnover, principally driven by the sensitivity of muscle to insulin/nutrition, and adrenalin/stress.[1] Breed indices for sheep and cattle are focused towards selection for muscling, potentially impacting on muscle glycogen metabolism and thus dark cutting.
Objective - Determine the impact of selection for muscling on insulin and adrenalin sensitivity in cattle and sheep.
Design - 12 steers from either Piedmontese (heavy muscling genotype), or Angus sires, and 20 5-month old lambs with sires selected for extremes (high v low) in Muscling Estimated Breeding Value (EBV) were maintained on a pelleted concentrate ration and challenged with adrenalin at 0.1, 0.2, 0.4, 0.6, 0.9, 1.2, and 1.6 μg/kg liveweight via indwelling jugular cathetars. In cattle these challenges were undertaken at 15 and 36 months. Blood samples were taken prior to, and up to 120 min following administration of challenges for the determination of plasma lactate concentration – an indicator of muscle response. Peak plasma lactate response was analysed for either difference between breeds (Angus or Piedmontese) or impact of Muscling EBV (sheep analysis) using a linear mixed effects model, with level of adrenalin challenge and basal lactate concentration as covariates, and animal as a random term.
Outcomes - Increasing adrenalin challenge lead to a linear (lambs) and curvilinear (cattle) increase in plasma lactate peak response (P <0.05; Fig. 1a & b). The slope of this increase for the low muscle EBV lambs (ie EBV = -2) was more than twice (P <0.05) that of the high, suggesting that high muscle EBV lambs are less sensitive to adrenaline at the level of the muscle. In cattle there was no difference between breeds at 15 months, but both breeds demonstrated increased adrenalin sensitivity at 36 months (P <0.05). In the Angus sired cattle, the increase in sensitivity (ie slope) was almost twice that of the more heavily muscled Piedmontese (P <0.05). Thus, as was the case in lambs, the more heavily muscled genotypes are less sensitive to adrenaline at the level of the muscle.
Conclusions - Selection for muscling will reduce stress sensitivity in muscle tissue potentially resulting in more muscle glycogen at slaughter, and less dark cutting in sheep and cattle.

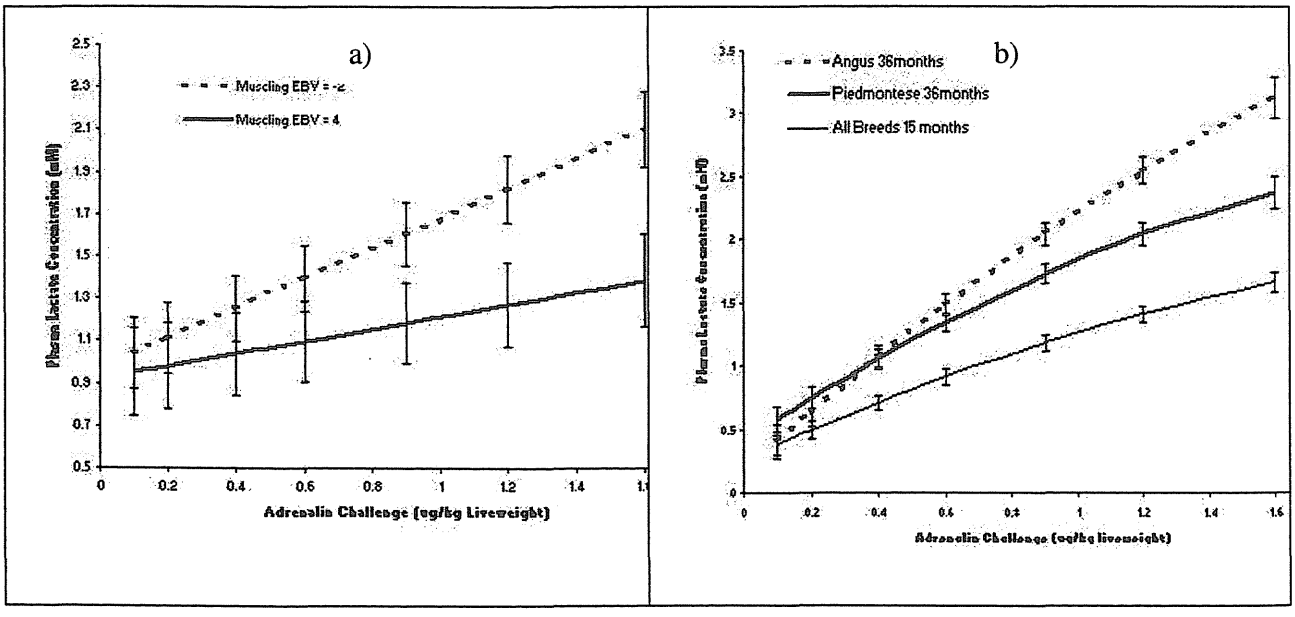

Figure 1. Plasma lactate peak response versus increasing adrenalin challenge for a) sheep with high and low muscling EBV and b) Angus, and Piedmontese sired cattle at 15 and 36 months of age. Values are least square means ± sem.

References

1. Price TB, Rothman DL, Shulman RG. Proc Nutr Soc1999; 58, 851-859.