Serum Cortisol Responses in Sheep of Known Feed Conversion Efficiency

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An animal's response to a stressor is to increase metabolic rate, and thus energy consumption through the activation of the hypothalamic-pituitary-adrenal (HPA) axis (Moberg, 2000). Changes in the pattern of energy use by an animal are likely to influence the efficiency in which is it utilised. In order to identify animals that are more efficient than their counterparts within a defined population, feed intake (FI) and liveweight gain (LWG) are measured over a defined period of time. However, by increasing our understanding of the physiological processes that underpin the variation in feed efficiency it may be possible to identify alternate methods of selecting superior animals. Two studies were undertaken in sheep to explore the relationship between serum cortisol concentration and feed efficiency measured as residual feed intake (RFI).

In the first study, adrenocorticotropin hormone (ACTH, 2.0µg/kg LW) stimulated serum cortisol concentrations were measured using a commercially available RIA kit (Orion, Spectria Cortisol RIA), in 50 cross-bred rams (mean ± S.D. LW 84.5±5.3kg; mean ± S.D. age 439±1.3days) of known feed conversion efficiency (RFI). The ACTH was injected intramuscularly into the rump of the sheep, and two blood samples were collected, one immediately before and one 45 min after the injection for analysis of cortisol. The data were analysed by linear regression (adjusted R^2 presented in percentage form) to determine how much of the variation in RFI could be attributed to serum cortisol concentrations.

In the second study, ACTH (2.0µg/kg LW) stimulated cortisol levels were measured in 100 maternal sire cross-bred rams (liveweight 52.9±4kg; age 415±17days) using the same 2-sample protocol. The extreme responders were selected (n=11 high cortisol, HC; n=11 low cortisol, LC) and then *ad libitum* FI and LWG measured for 40 days in order to calculate RFI and FCR. The data were analysed as described for the first study.

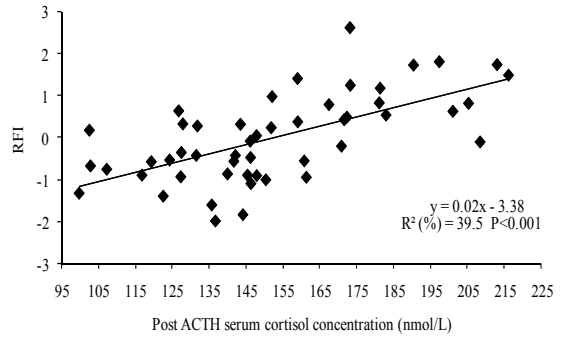

Figure 1. Linear regression model that predicts RFI based on serum cortisol levels post-ACTH

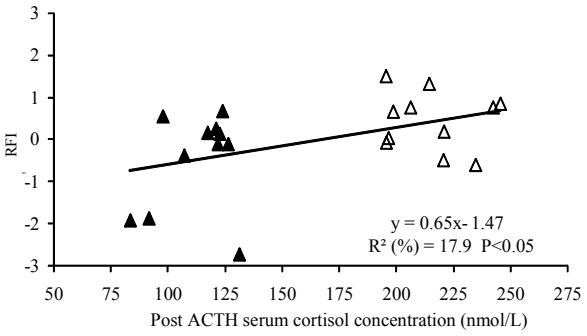

Figure 2. Linear regression model that predicts RFI based on serum cortisol levels post-ACTH. Low cortisol sheep (▲) High cortisol sheep (Δ)

Less efficient sheep had a greater increase in cortisol concentration in comparison to more efficient animals (Figure 1). In the second study LC sheep were significantly different ($P<0.05$) to the HC sheep for both the serum cortisol concentration after administration of ACTH (mean ± S.D.113.3±15.80 versus 215.6±18.03nmol/L for LC and HC sheep respectively), and the incremental change in serum cortisol concentration (53.9±21.15 versus 129.8±153.80nmol/L for LC and HC sheep respectively). LC sheep (low response to ACTH) were found to be more efficient that HC sheep when cortisol response to exogenous ACTH was used as a selection tool to identify animals more likely to differ in feed efficiency measured as RFI (mean ± S.D. RFI; -0.49±1.144 and 0.45±0.690 for LC and HS sheep respectively; $P<0.05$) (Figure 2). We conclude that the efficiency of energy use for growth, when measured as RFI, is significantly related to an animal's ACTH stimulated cortisol release, and possibly to the overall animal stress response. These findings have important implications for understanding the physiological mechanisms underpinning efficiency of energy use, and may be useful in successfully identifying superior animals.

Moberg, G.P. (2000). *In* "The Biology of Animal Stress" (Eds G.P. Moberg and J.A. Mench) p.1 (CABI Publishing: Wallingford)
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