SEASONAL INSULIN RESPONSE TO AN INTRAVENOUS GLUCOSE CHALLENGE IN RED DEER STAGS. A POSSIBLE ROLE IN THE SEASONAL GROWTH PATTERN?

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Red deer have a seasonal pattern of growth characterised by a faster growth rate during spring and summer than during winter, and by weight loss in autumn. Food intake parallels this pattern. It is not known how the changes in food intake and liveweight are related to nutrient partitioning. As insulin is associated with nutrient partitioning toward net liveweight gain, we hypothesised that the insulin response to a glucose challenge would be different with each season. In addition since seasonal changes in diet quality may limit growth in young stags, we fed two diets, each containing a different level of protected protein, to two groups of stags.

Stags were housed indoors in individual pens under ambient temperature and photoperiod. One diet had 5% protected protein (n = 5) and the second diet had 20% protected protein (n = 6). Diets were equal for both calories and the total amount of dietary crude protein. Food intake and liveweight were recorded weekly. At monthly intervals glucose (200 mg/kg) was administered by iv injection in the fed state and again 48 hrs later in the fasted state. Blood samples were collected by jugular venepuncture at -30, -20, -10, 0, 10, 20, 30, 45, 60, 90, 120 min (glucose administered at time zero). Glucose was measured by the glucose oxidase colourimetric method and insulin by RIA (Coat-A-Count), validated for deer plasma. For glucose and insulin, the peak (the maximum post-challenge sample minus the average baseline) and total area under the curve (AUC) were analysed as an indication of the insulin response and glucose clearance.

Both food intake and liveweight followed the typical seasonal pattern. A trend developed in the 20% protein group toward a faster rate of growth than the 5% protein group during spring and summer (303 vs 350 ± 48 g/d, mean ± SED, $P > 0.05$). Glucose peak was not affected by protein level and was low during summer (3.9 ± 0.1 mmol/l, mean ± SEM) and high during winter (4.8 ± 0.4 mmol/l) and autumn (5.0 ± 0.4 mmol/l). Glucose AUC had a similar seasonal pattern but during summer the 20% protein group had a greater AUC than the 5% protein group (32.65 vs 32.16 ± 0.33 mmol/l). Insulin peak response was not affected by protein level and was low at the end of winter (129.9 ± 34.5 nmol/l, mean ± SEM) and during autumn (130.7 ± 21.5 nmol/l) and high during spring and summer (194.6 ± 60.3 nmol/l and 234.0 ± 69.6 nmol/l). Insulin AUC exhibited a similar seasonal pattern but the 20% protein group had a greater AUC than the 5% protein group during spring (2490.7 vs 2276.1 ± 68.9 nmol/l, mean ± SED). In the fasted state animals had higher glucose peaks and AUC throughout the year associated with lower insulin peaks during late summer and higher AUC during summer.

These results indicate a faster removal of glucose from the blood during spring and summer compared with autumn and winter. This is consistent with the view that dietary derived substrates contribute to growth during spring and summer whilst body reserves are drawn upon during the autumn and winter. The slower glucose clearance in the fasted state indicates a similar change toward utilisation of body reserves. Supplementary dietary protein may be beneficial only during the rapid growth phase. Higher blood glucose during spring and summer may reflect the higher food intake at this time. We have shown that the insulin response to glucose is seasonal. Its response corresponds well with the annual phases of growth and food intake in stags, therefore may play a role in nutrient partitioning.