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BRIEF COMMUNICATION: Voluntary food intake of pregnant and non-pregnant red deer hinds during the gestating period

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INTRODUCTION

Efficient venison production systems rely on maximum growth of deer calves before their first winter. This is facilitated by an early conception in March for an October/November calving so that the nutritional demands of lactating hinds and their offspring are better aligned with pasture growth and quality under New Zealand lowland farming conditions. However, Scott *et al*. (2008) have shown that for every 10 days advance in conception date, gestation length increases by about three days, negating some of the gains achieved by early conception. Asher *et al*. (2005) demonstrated that a moderate energy intake imbalance over the last trimester of pregnancy in red deer was compensated for by varying gestation length to ensure optimal birth weight at the time of parturition. A photoperiod-mediated reduction in voluntary food intake (VFI) during winter (Loudon, 1994) would exacerbate an energy imbalance in early-conceiving hinds as they enter the third trimester of pregnancy. It is not known if pregnant hinds have a reduced VFI during winter as has been shown to occur in non-pregnant adult red deer hinds (Loudon, 1994). In this study we tested the hypothesis that pregnancy status does not affect the photoperiod-mediated reduction in VFI during winter.

MATERIALS AND METHODS

All animal manipulations were approved by the AgResearch Invermay Animal Ethics Committee. The animals used were rising 4 year-old *Cervus elaphus scoticus* x *C. e. hippelaphus* hinds of mixed parity. Eight pregnant (P) hinds were generated by artificial insemination with *C. e. hippelaphus* semen on 1 April and eight hinds were not mated (non-pregnant (NP)). Hinds were housed indoors in individual pens (6 m^2) from mid-April to early-December. A commercial pelleted deer food (Reliance Deer Nuts, Combined Rural Traders, Yaldhurst, Christchurch) plus lucerne chaff at a ratio of 95:5 (pellets:chaff) was fed *ad libitum*. Water was available *ad libitum*. Hinds were released into large outside pens for approximately two hours each day while rations were prepared. Hinds were initially offered 0.95 kg deer pellets (12.7 MJME/kg DM; 15 % crude protein) plus 0.05 kg lucerne chaff (10.5 MJME/kg DM; 22.9% crude protein). The food ration was then adjusted to appetite daily according to the rule: if the refusal was <10 %, the next ration was increased by 200 g; if the refusal was >10% the ration remained the same as that on the previous day. Once per week a sample of the residual feed was collected and weighed before and after drying for 24 hours at 65°C to ascertain dry matter (DM) percentage. The value obtained was used to calculate daily DM intake of the hinds for that week. Hinds were weighed and body condition scored (BCS: 1-5 where 1 = Lean and 5 = Fat, as per Audigé *et al*. (1998)) fortnightly throughout the study. P hind and calf pairs were weighed and turned out to pasture within 24 hours of parturition; NP hinds remained indoors until parturition of the final P hind. A complete data set was available for analysis from 7 P and 7 NP hinds. Data from before 27 April, while hinds were building up to an *ad libitum* food intake, were not included in any of the analyses. Live weight (LW), BCS and VFI data were analysed separately for each time period after fitting a term for reproductive status using Genstat (Payne *et al.*, 2009). Time frames for VFI analyses were synchronised about day of parturition to compensate for the large variation in parturition date. Day 0 for NP hinds was taken as the mean parturition date of P hinds. To allow for variation in daily intake of individual hinds, mean VFI over three days around specified dates was used. For example, for Day -200, the mean VFI of Days -201, -200 and -199 was used. Gestation length was regressed on mean LW, BCS and VFI during the study period for each P hind.

RESULTS AND DISCUSSION

Mean LW (± standard error of the mean (SEM)) of P and NP hinds on 27 April (Day 117) was 117 ± 6 kg and 124 ± 10 kg respectively. Mean LW of P hinds increased, but that of NP hinds decreased, during autumn (27 April – 8 June; 3.1 vs. -1.1 kg respectively; P = 0.02). Mean LW of both groups then increased for the remainder of the study with no significant difference in mean LW gain between groups during winter (8 June – 31 August;

TABLE 1: Mean and standard error of difference of change in hind live weight and body condition score during specific time periods. Bolding of P values indicates significance (P <0.05).

Time period	Treatment		Standard error of difference	P value
	Pregnant	Non-pregnant		
Autumn (27 April - 8 June)				
Live weight (kg)	3.1	-1.1	0.9	**0.02**
Body condition score (units)	0.59	0.21	0.17	0.14
Winter (8 June – 31 August)				
Live weight (kg)	9.1	10.3	3.0	0.68
Body condition score (units)	0.17	0.17	0.08	1.00
Spring (31 August – 9 November)				
Live weight (kg)	16.1	14.5	4.3	0.72
Body condition score (units)	-0.07	0.42	0.14	**0.02**

TABLE 2: Mean and standard error of difference of change in hind daily voluntary food intake (MJME/kg live weight$^{0.75}$) during specified time periods during the gestating period. Data have been normalised around days from calving (Day 0 = Day of parturition) to compensate for the wide variation in calving dates. Day 0 for non-pregnant hinds was taken as the mean parturition date of pregnant hinds. Bolding of P values indicates significance (P <0.05).

Days before parturition	Treatment		Standard error of difference	P value
	Pregnant	Non-pregnant		
200 - 150	-0.20	-0.25	0.10	0.65
150 - 100	0.00	0.04	0.07	0.54
100 - 50	0.05	0.11	0.05	0.28
50 - 20	0.07	0.00	0.08	0.45
20 - 5	-0.07	-0.04	0.12	0.79
5 - 0	-0.24	0.17	0.09	**0.001**

P = 0.68) and spring (31 August – 9 November; P = 0.72; Table 1). Both P and NP hinds gained BCS during autumn and winter, but whereas mean BCS of P hinds decreased in spring, that of NP hinds increased (-0.07 vs. 0.42 BCS units respectively; P = 0.02; Table 1).

Pregnancy status of the hinds had no significant effect on mean VFI throughout the study except for the last five days before parturition when that of P hinds decreased dramatically (Table 2).

Mean ± SEM for VFI of hinds over three consecutive days was 0.72 ± 0.05 MJME/kg LW$^{0.75}$ in early-autumn, 0.58 ± 0.03 MJME/kg LW$^{0.75}$ in mid-winter and 0.69 ± 0.03 MJME/kg LW$^{0.75}$ in late-spring. On average, hind intake decreased significantly by 0.15 ± 0.06 MJME/kg LW$^{0.75}$ from autumn to winter (P = 0.03) and increased significantly by 0.11 ± 0.04 MJME/kg LW$^{0.75}$ from winter to spring (P = 0.01), seemingly aligned with the seasonal change in daily photoperiod.

Mean gestation length ± SEM was 233.0 ± 2.3 days and was negatively correlated with mean VFI during the study period (P = 0.04) such that, for every 0.1 MJME/kg LW$^{0.75}$/day increase in mean VFI, gestation length decreased by 6.4 days. Gestation length was not associated significantly with mean LW (P = 0.60) or BCS (P = 0.51).

These data support the hypothesis that pregnancy status of red deer hinds has no significant effect on the photoperiod-mediated reduction of VFI during winter. VFI of both P and NP hinds decreased by about 20% from autumn to mid-winter (1 May – 1 July) and then had increased a similar amount by the end of spring (1 November). The amplitude of the VFI change is similar to that reported previously for non-pregnant red deer hinds (Loudon, 1994). The energy, above maintenance, required for growth of the fetus during the entire pregnancy was calculated to be 533 MJ, which is only 6 MJME less than the estimate of Nicol and Brookes (2007). However, such a calculation for the entire gestation is rather simplistic and does not reflect the true dynamics of energy demand throughout pregnancy. During the last third of pregnancy the fetal and maternal components of pregnancy gain about 70% of their final mass in red deer (Adam *et al*., 1988a), when it was estimated that the additional energy requirements for pregnant above non-pregnant hinds increased from 1.7 to 5.0 MJ ME/day during that period (Adam *et al*., 1988b). In the present study, the VFI of the P hinds did not increase significantly above that of NP hinds and LW change of both groups was similar throughout winter and spring. However, BCS of NP hinds increased during spring, but that of P hinds decreased, indicating a moderate energy imbalance during the last trimester of pregnancy. Also, gestation length was associated significantly with VFI such that gestation length was longer in hinds that had a lower VFI during gestation. Taken together, this supports the hypothesis that an endogenous reduction in food intake during winter mediates a moderate energy imbalance during the last trimester of pregnancy, influencing fetal growth trajectory and thus gestation length (Scott *et al*., 2008).

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