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BRIEF COMMUNICATION: Does calf genotype influence milk yield of red deer hinds?

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INTRODUCTION

New Zealand deer farming systems utilise *Cervus elaphus* subspecies and crossing genotypes is a common tool to gain a productive advantage. One of the most common crosses is that of a stag with a high content of North American Wapiti (*C. e. manitobensis, nelsoni, roosevelti*) over the traditional New Zealand (NZ) red hind of English or Scottish origin (*C. e. scoticus*) for venison production, with on the aim of attaining slaughter live weight ≥93 kg, (≥50kg carcass) at approximately 10 months of age when premium prices for the seasonal European market are obtained. This system potentially increases productivity by utilising the biologically and economically more efficient system of genotypically larger stags over red deer hinds to produce offspring with greater early growth potential (Fennessy & Thompson 1988; Nicol *et al.,* 2003). On New Zealand deer farms calf growth from birth to six months is often considerably below biological potential (Stevens *et al.,* 2003) and improving growth rates during lactation provides an opportunity to raise overall industry productivity.

A pasture-based experiment was conducted during the 2003/04 lactation period to better understand the drivers of calf growth and calf-hind interactions throughout lactation and to determine if higher growth rates of Wapiti crossbred calves relative to red calves are due to increased milk intake from their red deer dams.

MATERIALS AND METHODS

The experiment involved 17 multiparous NZ red hinds inseminated by either purebred Wapiti or NZ red stag semen to produce first cross Wapiti x NZ red (F1) or NZ red x NZ red (red) calves. Eight hinds reared singleton red calves (3 male, 5 female), seven hinds reared singleton F1 calves (2 male, 5 female), and two hinds reared twin F1 calves (3 male, 1 female). These animals were all calved together and run as one mob on a predominantly ryegrass pasture diet at Invermay. Dawn to dusk suckling observations (Ward *et al.,* 2007) were performed for 11 periods, from 18 December 2003 to 3 September 2004, inclusive. Calves were weighed at birth and thereafter from 15 December 2003 all hinds and calves were weighed at least monthly. The double isotope (^3H, ^2H) labelled water dilution technique (Dove, 1988) was used to estimate the daily water intake of calves from milk (MWI) on 7 occasions between 15 December 2003 and 24 July 2004. On Day 1 of each measurement hinds and calves were yarded and separated. The hinds were weighed, blood sampled to determine the level of residual tritium and injected intramuscularly with approximately 16 MBq (1.6 mL @ 10MBq/mL) tritiated water (^3H_2O). At two hours post-separation the calves were weighed, blood sampled to determine residual levels of tritium and deuterium and orally dosed with 99.92% deuterium oxide (^2H_2O) at 1.5 g/kg live weight. To determine an "isotope equilibration level", calves were blood sampled two hours post deuterium administration and the hinds sampled six hours post tritium administration. Five days (four days for 15 December 2003) after isotope administration, animals were yarded and hinds and calves separated. All hinds and calves were weighed, and blood sampled two hours post separation to assess the "Day 5" isotope level. Blood serum was measured for tritium (^3H) level by liquid scintillation counting. A sub-sample of whole milk samples were also scintillation counted to ensure blood serum and milk levels of ^3H were equivalent. The deuterium (^2H) concentrations in serum were determined using mass spectroscopy. The isotope levels determined for the hinds and calves were used to calculate estimated body water turnover and MWI consumed by the calves using a modification of the method of Dove (1988). The estimated MWI was analysed by residual maximum likelihood (REML) with dam as the random effect and fixed effects given by calf genotype/rearing rank (single or twin), date and their interaction, hind live weight, total time spent suckling and calf birth weight. Calf sex and live weight were also fitted, but were not used in the final model as they did not make a significant contribution ($P > 0.05$).

RESULTS AND DISCUSSION

There were significant ($P < 0.001$) effects of calf genotype/rearing rank, date and their interaction on MWI (Table 1). Figure 1 shows the relationship obtained for MWI and genotype/rearing rank, with the F1 singletons consuming the most and individual F1 twins the least. In December F1

FIGURE 1: The mean intake of milk (water content only) of single red and single and twin F1 Wapiti x red calves suckling red hinds over the first 7 months of lactation. Error bars = Standard error of difference between single red and F1 Wapiti calves.

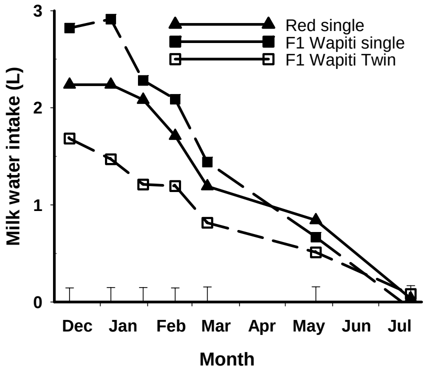

TABLE 1: Estimates of water intake of deer calves from milk (MWI) (L/d), including the mean at the December sampling and the linear contrast over date, both classified by calf genotype and rearing rank, and the slopes for hind live weight, total time suckling, and birth weight. SE = Standard error.

Parameter	Estimate	SE	Significance
Initial value (December)			***
Red singleton	2.24	0.09	
F1 Wapiti singleton	2.82	0.11	
F1 Wapiti twin	1.68	0.18	
Linear contrast over date (slope)			***
Red singleton	-0.36	0.025	
F1 Wapiti singleton	-0.51	0.026	
F1 Wapiti twin	-0.28	0.035	
Hind live weight (kg)	0.011	0.0037	**
Total time spent suckling (s)	-0.00040	0.00015	**
Calf birth weight (kg)	0.052	0.0224	*

singleton calves consumed 0.58 (SED 0.15) litres more water contained in milk than red calves and individual twin F1 calves consumed 0.55 (SED 0.21) litres less (Table 1). The highest observed mean values for milk intake were in early January when approximately six weeks of age, for singletons. Thereafter, milk intakes decreased and the differences in milk intake between calf classes diminished. There were also significant effects of hind live weight ($P < 0.01$), total time spent suckling ($P < 0.01$), and calf birth weight ($P < 0.05$) on MWI.

The growth rates of the singleton F1 calves in this study were significantly larger (Ward *et al.,* 2007) than those of their red singleton cohorts, for example in March for F1 singletons mean growth rate was 39% greater and mean live weight 30% greater than for the red singletons. These results demonstrate that the smaller red deer hind has the ability to increase milk production significantly in response to rearing a genetically larger crossbred calf. The increased milk intake by the F1 calf, above that of the red calf, is presumably driven by increased calf demand, although a putative prenatal influence of calf genotype on mammogenesis/lactogenesis cannot be ruled out from this experiment. G.K. Barrell (Personal communication) has used an alternative model; administering bovine somatotrophin to lactating red hinds, rearing red calves to also demonstrate that calf demand was the primary determinant of milk intake. We found a significant, small negative regression relationship (Table 1) between total time spent suckling and MWI ($P < 0.01$), contrary to the generally assumed positive association. This suggests that larger calves consumed more milk by faster ingestion. High growth rate genotypes have an important role to play in venison production systems, and will have a large future influence. This system utilises a smaller maternal animal to produce larger offspring, maximising the growth advantage available during lactation. However, Stevens *et al.* (2007) reported the red deer dams of the F1 calves in this study had about 30% greater feed intake than those rearing red deer calves. It is clear that the additional performance attained from a red hind rearing a Wapiti crossbred calf results in a greater lactational output from hinds and consequently needs to be supported by higher levels of inputs.

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