The feed intake and liveweight responses of hinds and calves grazing leaf turnip or pasture during late lactation

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Abstract

In breeding hind systems, summer is often a period when feed quality and quantity may compromise lactation in the hind and growth of the calf. The growth and feed intake of calves and hinds offered the leaf turnip Pasja were compared to those on a perennial pasture. Calves consumed 1.0 kg forage DM/head/d on pasture and 0.77 kg DM/d on Pasja. The higher digestibility of Pasja meant that the metabolisable energy intake of Pasja was only 1.7 MJ ME/head/d lower than pasture. Hinds grazing pasture consumed 4.8 kg DM/head/d compared with 3.7 kg DM/head/d when fed Pasja. The digestibility of the two diets was not significantly different resulting in an energy intake that was 13.2 MJ ME/d or 33% higher in pasture fed hinds. The weaning weight of calves was 58.3 and 55.2 kg on pasture and the Pasja crop respectively having gained 19.1 and 16.9 kg respectively. Using brassicas to shift feed of high quality from late spring into summer will be best suited to dry environments where the quantity and quality of pasture may not be able to meet the requirements of the lactating hind and her calf.

Keywords: calf, digestibility, hind, intake, liveweight gain, stocking rate

Introduction

New Zealand deer farming systems are built around maximising the use of pasture as it grows (Nicol & Stevens 1999). However, pasture quality and quantity can both be less than adequate for lactation of red deer during summer dry conditions (Stevens 1999). Brassicas can provide large quantities of high quality forage at this time of the year (Judson *et al.* 2000). However, there are many factors that may alter the whole system response to brassica crops. The time needed to adapt the rumen microbial population to effectively use a brassica crop, may pose a significant risk and production cost if not done correctly (Stevens & Corson 2003).

The type of crop may also alter the overall outcome. A crop that is used only once, such as a true turnip, has a high short term yield and needs a long crop growth period. Areas in these crops have an advantage in being able to be put back into pasture in the autumn. Crops that can be grazed more than once can provide feed over a longer time frame through repeat grazing and need less crop growth time before the first grazing than the crop that is used only once. These crops also provide the opportunity to add options like Italian ryegrasses that can provide feed as the crop runs out.

Before farmers can make decisions on crop use, information such as intake and calf liveweight gain needs to be quantified for summer brassicas. This experiment quantified the performance of hinds and calves fed the leaf turnip Pasja or perennial pasture during late lactation.

Materials and Methods

The performance of 40 hinds and their calves on either pasture (perennial ryegrass/white clover) (*Lolium perenne/Trifolium repens*) or leaf turnip (*Brassica campestris* × *Brassica napus* cv. Pasja) was compared during February 2002 at the AgResearch Invermay deer farm near Mosgiel, New Zealand (45° 58' S; 170° 04' E). Hinds and calves were allocated to grazing mobs and introduced to their respective grazing areas after weighing on 21 January 2002.

The Pasja was sown in a 2.3 ha paddock on 3 November 2001 at 4 kg/ha with 150 kg DAP fertiliser into a conventionally cultivated seedbed after a swede (*Brassica napus*) crop the previous winter. Also included at sowing was 8 kg/ha Italian ryegrass (*Lolium muliflorum* L. cv. Ceres Crusader) though this contributed less than 1% of the standing forage during the experimental period.

The pasture area of 8 ha was continuously grazed from the onset of calving in late October until mid December at a stocking rate of 11 hinds/ha, after which hinds and calves were mobbed together and shifted every 3 to 5 days to maintain the availability of a continuous supply of fresh forage with a residual herbage mass above 1800 kg DM/ha. Hinds and calves grazing the Pasja were allowed access to an adjacent pasture run-off of 1 ha for the first 14 days (Period One – January 21 or 22 to February 5) to allow the rumen to adjust to the crop. A new break of Pasja was offered approximately every 3 to 5 days.

Fifteen hinds and their calves per treatment were dosed on the 11 February 2002 with *n*-alkane controlled release capsules (Captec™, NuFarm Ltd, Auckland, NZ) that contained 1000 mg each of n-dotriacontane (C_{32}) and n-hexatriacontane (C_{36}). Hinds were dosed with two capsules while calves were dosed with 1 capsule. Rectal faecal samples were taken from each animal on the 19,

21, 25 and 27 February to determine intake and on the 1, 4 and 6 March 2002 to determine the end point of the capsules and hence their release rate , defined as 1 day before the faecal concentration of the dosed alkane dropped to half of its equilibrium value. The average release rate in the hinds was 58.8 and 62.5 mg/d/capsule for the pasture and Pasja respectively and in the calves was 52.6 and 50 mg/d for the pasture and Pasja respectively. The deer were weighed approximately every 7 days until weaning on the 6 March 2002.

Crop and pasture yields were measured during the intake measurement period (Period Two - 5 February – 6 March). The areas used were also recorded to estimate stocking rate. All samples were immediately deep frozen and freeze-dried before analysis for C_{31}, $C_{32,}$ and C_{33} alkanes (Stevens & Corson 2003), and acid detergent fibre (ADF), neutral detergent fibre (NDF), soluble sugars and starch (SSS), and crude protein (CP) by NIRS analysis (Corson *et al.* 1999).

Voluntary DM intake was calculated from alkane dilution in faeces (Dove & Mayes 1991), as the mean of that calculated from C_{31}:C_{32} and C_{33}:C_{32} ratios.

Apparent dry matter digestibility was also calculated from the mean of C_{31} and C_{33} as:

Digestibility = 1 - (herbage alkane concentration/faeces alkane concentration).

Metabolisable energy concentration of the forage portion of the diet was calculated from alkane derived digestibility using:

ME (MJ) = 18.4 * digestibility% * 0.81 (ARC 1980).

Liveweight gain was calculated using regression analysis of liveweights recorded from 21 January 2002 to 6 March 2002. Analysis of variance (GenStat 2005) was used to compare intake and liveweight gain between treatments.

No animal health treatments were given during this period. This experiment was assessed and approved for animal ethics considerations by the Invermay Animal Ethics Committee.

Results

The yield of the Pasja crop was significantly greater than the amount of pasture on offer (Table 1). The Pasja crop offered to the deer during the intake period averaged approximately 8.7 t DM/ha. The whole area provided grazing for 44 days from 2.3 ha while on pasture the same sized herd used approximately 8 ha. This translates into stocking rates of 17.4 hinds + calves/ha compared to 5.0 hinds + calves/ha or apparent consumption of 3,500 kg DM/ha compared to 1,250 kg DM/ha for the Pasja and pasture treatments respectively. However, the amount of feed offered to both herds was similar, being 11.3 and 13.3 kg DM/hind+calf pair per d (Table 1) for the Pasja and pasture treatments respectively. Both herds used approximately 3.6 ha from calving until mid-January.

The acid detergent fibre (ADF) concentration was similar for both the Pasja and pasture treatments, but the neutral detergent fibre (NDF) concentration was significantly lower in the Pasja crop compared with the pasture (Table 1). Crude protein (CP) concentration did not differ significantly between Pasja and pasture (Table 1) though soluble sugars and starch concentration was significantly higher in Pasja when compared with pasture (Table 1).

Table 1 Pasture and brassica yields on offer and forage chemical composition (NIRS), digestibility (alkane dilution), metabolisable energy concentration (calculated from digestibility) and alkane concentrations of pasture and Pasja during February.

		Pasture	Pasja crop	P value	LSD
Yield	(kg DM/ha)	2920	8670	<0.01	2140
Amount offered	(kg DM/ hind+calf pair/d)	13.3	11.3		
Chemical composition	(g/kg DM)				
	ADF	280	248	0.11	40.7
	NDF	467	248	<0.01	38.6
	CP	215	187	0.17	40.3
	SSS	73	174	<0.01	25.5
Digestibility	(g/kg DM)				
	Hinds	736	718	0.18	27
	Calves	659	709	<0.01	35
Metabolisable Energy	(MJ/kg DM)				
	Hinds	11.0	10.7	0.18	0.41
	Calves	9.8	10.6	<0.01	0.53
Alkanes	(mg/kg DM)				
	C_{31}	109	67	0.03	36.5
	C_{32}	8	5	<0.01	0.6
	C_{33}	56	9	<0.01	13.8

Table 2 Liveweight, weight changes, feed intake and digestibility of hinds and calves offered pasture or Pasja during late lactation.

		Pasture	Pasja crop	P value	LSD
Calf liveweight (kg)	22 January	39.2	38.3	0.20	1.81
	6 March	58.3	55.2	0.02	2.62
Overall gain (kg)		19.1	16.9	<0.01	1.45
Calf gain (g/d)	Period 1[1]	521	476	0.18	67
	Period 2[2]	408	352	0.02	48
Calf intake	kg DM/d	1.01	0.77	<0.01	0.16
	MJME/d	9.9	8.2	0.22	2.03
Hind liveweight (kg)	22 January	117	116	0.62	6.8
	6 March	121	112	0.01	6.9
Hind weight change (g/d)	Period 1[1]	121	-273	<0.01	137
	Period 2[2]	43	3	0.15	55
Hind intake	kg DM/d	4.82	3.72	<0.01	0.69
	MJME/d	53.0	39.8	<0.01	4.97
Forage utilisation	%	43.6	39.8		
DM offered/kg DM consumed		2.3	2.5		

[1] Period 1 was the diet change period from 22 January to 5 February
[2] Period 2 was the measurement period from 5 February to 6 March

The average calf liveweight was approximately 39 kg in late January (Table 2). At weaning on 6 March, the calves grazing pasture were significantly heavier than those on the Pasja (Table 2) with the liveweight gain of the calves being significantly greater during period two, after the diet change period.

Average hind liveweight was not significantly different at the beginning of the experiment, though hinds grazing Pasja lost weight during the diet change period (period one) compared to a weight gain in hinds grazing on pasture (Table 2). Hinds maintained their weight in period two with no significant difference in liveweight change between treatments (Table 2).

Voluntary DM intake (kg DM/d) was lower in both hinds and calves on Pasja compared with pasture (Table 2). The apparent DM digestibility of the forage (g/kg DM) was greater in calves fed Pasja than those fed pasture but was not significantly different in hinds (Table 1). Final energy intake from forage (MJ ME/d) was not significantly different in calves, but was significantly lower in hinds fed Pasja compared with pasture (Table 2). Calculated forage utilisation and amount offered per kg DM consumed was similar for both the Pasja and pasture herds (Table 2).

Discussion

The alkane dilution procedure has been used for estimating forage intake for over 10 years in sheep, cattle and deer (Bugalho *et al.* 2005; Champion *et al.* 1995; Dillon & Stakelum 1988; Dove & Mayes 1991; Dove *et al.* 1989; Dove *et al.* 2002; Ferreira *et al.* 2004; Fraser & Gordon 1997; Gedir & Hudson 2000; Hameleers & Mayes 1998; Stevens & Corson 2003). While it has some deficiencies, these are common to all indirect techniques of intake estimation (Dove & Coombe 1992; Dove & Mayes 1991; Elwert & Dove 2005; Ferreira *et al.* 2004; Gedir & Hudson 2000). Recently the extraction of alkanes from samples has been further investigated and noted problems with certain drying techniques (Burnham *et al.* 2003) which can significantly alter the accuracy of estimating intake (Swainson *et al.* 2005), especially of herbs such as plantain. This confirmed earlier research (Dove & Mayes 1991; Dove *et al.* 1989) that recommended freeze drying as the most appropriate technique to ensure maximum extraction of alkanes from plant and faecal samples. The investigations that used freeze dried samples has provided an acceptable relationship between intakes estimated by alkane and pen-fed intakes (Stevens & Corson 2003).

The use of Pasja for hinds and calves allowed much higher stocking rates to be maintained. However, lower calf liveweight gain was measured. This resulted from significantly lower feed intakes in both hinds and calves. The decrease in energy intake on Pasja was directly related to the decline in per animal performance (Stevens unpub. data).

Several factors may have influenced this outcome. The first is that of forage allowance. The comparison of forage offered and forage eaten per kg DM offered both suggest that the systems were offering enough forage to ensure maximal intakes could be achieved, and final utilisation estimates also confirm this. However, crops with high yields do have issues with feed utilisation and deer are particularly sensitive to soiling, often rejecting feed that is dirty. This may have had an influence on the final feed intake that was measured.

Another factor may be the low fibre of the Pasja crop. Brassicas do not have a significant hemicellulose

component, as seen in the lack of difference between the ADF and NDF contents (Table 1). While ADF is viewed as the important structural fibre required for rumen function (van Soest 1994) and the ADF concentration was within the range for normal rumen function (van Soest 1994), some research has suggested that adding fibre in the form of straw (Nichol & Garrett 2001) increased lamb performance by approximately 20 g/d (or 7%). Other anti-quality factors such as SMCO, glucosinolate and nitrate may also be present in brassicas, though Pasja is relatively free of these (Stewart & Judson 2004). Some variation in palatability has been observed between brassica crops (Millner 1993) and these variations inevitably lead to lower feed intake.

The change in rumen microbes associated with the change in feed may have also influenced feed intake. A period of 14 days was allowed for diet change, by which time the rumen microbial population should have adapted. One calf in the Pasja group was observed to have a watery scour indicative of a digestive tract upset, though others appeared to be normal during the faecal collection phase.

The lower performance in the calves was mainly related to lower intakes of the hinds on Pasja. While the calf intake of Pasja declined by 1.7 MJ ME/d relative to pasture during period two, the hind intake declined by 13.2 MJ ME/d. The high amount of feed on offer provided pasture fed deer with an opportunity to select a high quality diet with the hinds able to maintain a significantly higher intake on pasture than on Pasja. The intake in the hinds grazing Pasja resulted in near maintenance of liveweight in period two, after a significant liveweight loss during period one. Changes in hind liveweight during the first period may have been related to the higher rate of passage of Pasja through the gut of the hind. This would have reduced their relative gut-fill and resulted in the liveweight loss that was recorded during the diet change period. Experience in a drier environment has shown that Pasja maintained calf growth rates similar to that measured on perennial pastures while hind liveweight declined on pastures but was maintained on both Pasja and Winfred rape (Judson *et al.* 2000).

The results highlight the important ability of summer brassica crops to increase stocking rate and feed availability when pasture growth may be less than adequate. However, the reputed higher quality of Pasja (Formoso 2002; Nichol & Garrett 2000; Judson *et al.* 2000) was not able to be captured in improved animal performance in this trial where pasture quantity and quality was adequate. While this experiment was not designed to investigate the role of brassicas in the whole system, an important part of the impacts of brassica crops such as Pasja is their ability to transfer high quantities of feed from late spring into summer while still maintaining feed quality. Further advantages from the use of Pasja may be seen when the calves are weaned onto spelled pasture and from utilisation of the Italian ryegrass regrowth. These gains are more important in summer dry environments than in the summer moist situation measured here. While calf growth rate was reduced on Pasja, the final weaning weights were over 55 kg, which was similar to the average for pre-rut weaned red deer calves at that time (DeerSouth 2005).

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