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BRIEF COMMUNICATION: Feeding fodder beet to ewes in mid-to-late gestation: impact on lamb size, rectal temperature, and live weights from birth to weaning

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Introduction

New Zealand ruminant livestock production is largely pasture-based and aligned to seasonal pasture supply. Despite pasture providing a complete diet for grazing pregnant ewes when fed in sufficient quantities, there is a growing trend for farmers to use supplementary feeds to maintain production in times of feed shortages such as during winter, or to facilitate increased stocking rates (McCoard et al. 2015). Due to its high dry matter (DM) yield, and low cost per unit of feed, compared to other supplementary feeds (Gibbs et al. 2015), fodder beet (FB: *Beta vulgaris*) is a winter feed option. Fodder beet is characterised by its high sugar (energy rich) and low nitrogen (N) contents and although live weight (LWT) responses in finishing beef cattle fed FB have been measured (Gibbs et al. 2015), there is less knowledge on the nutrient-supply profile and performance of offspring when fed to pregnant animals. Knowledge of potential nutritional deficiencies, and the implications for the pregnant ewe and her offspring are essential in order to develop feeding recommendations for farmers. The objective of this study was to determine the effects of feeding FB vs. ryegrass dominant pasture (RG), to ewes in mid-to-late gestation, on offspring performance through the measurement of lamb size, rectal temperature and pre-weaning growth.

Materials and methods

The trial was conducted at Aorangi Research Farm, Manawatu (latitude 40°19’S, longitude 175°29”, 13 m above sea level) and was reviewed and approved by the Grasslands Animal Ethics Committee (Approval #13911). Two hundred twin-bearing mixed-age ewes were sourced from two farms and randomly allocated according to farm source, estimated lambing date, ewe LWT and body condition score (BCS). Ewes grazed dietary treatments of either (1) FB plus hay (n=100) or (2) RG plus hay (n=100), from pregnancy d 100-110 (P100-110) to lambing. Lambing date was estimated via transabdominal ultrasonography of the ewes at approximately 75 d after the start of the breeding period (23 March 2016), and ewes were identified as being bred in first, second or third cycle. Ewe BCS (scale 0–5 including half units) for treatment allocation was recorded at the same time as pregnancy scanning. Ewes allocated to FB were adapted to the diet over 21 d (i.e. P80-90 through to P100-P110).

Ewes grazed FB (cultivar ‘Rivage’) which had an estimated yield of 30 t DM/ha. Electric fencing allowed a sufficient allocation of fresh FB every second day to ensure both leaf and bulb were consumed. Using electric fencing, ewes grazed RG at an average pasture cover of 2800 kg DM/ha, to a minimum of 1200 kg DM/ha. No back fencing was used for animals on either treatments. Ewes on both treatments were provided water and supplemented with ryegrass hay *ad libitum*, which was measured into hay racks and its disappearance over time calculated. All ewes were treated for clostridia, campylobacter and salmonella at P100, and for iodine deficiency at P120.

Measurements included sampling of FB and RG diets (at P80 and P150) and hay (at P80) for analysis of DM and chemical composition, and determination of estimated feed offered. The samples used for analysis were based on composite samples made up of over 50 individual samples taken at various sites within each paddock/hay bales. The ratio of FB bulb to leaf was also determined. Triplicate sub-samples from each feed composite were dried at 105^{0}C for 48 h for DM determination. Further triplicate sub-samples were freeze dried and ground through a 1 mm screen for analytical analyses by the Massey University Nutrition Laboratory (Palmerston North).

Around the time of lambing, animals on FB were transitioned back to RG over 7 d and managed together with ewes on ryegrass dominant pasture. Lambing was spread over a five-week period (17 August to 20 September 2016). Within 24 h of birth, each lamb was tagged, weighed and sexed. At the same time, body dimensions of crown rump length (CRL), hind-leg length (HLL), and girth were measured, and rectal temperature recorded. Lambs were weighed at docking (10 October) and weaning (8 December).

Statistical analysis

Data were analysed using a linear mixed model (via REML, GenStat 18th edition 2015, VSN International Ltd.). The fixed effects were diet (FB and RG), farm origin and lamb gender, and the random effect was ewe. Lamb response variables included body dimension, weight at birth (using the ewe weight at scanning and the number of days pregnant at the commencement of the transition period as covariates), docking and weaning (using lamb birth weight and age of the lamb as covariates).

Results and discussion

The chemical composition of the diets are given in Table 1. Compared to RG, the FB treatment had lower

Table 1 Chemical composition of fodder beet, ryegrass dominant pasture and ryegrass hay that was offered to twin-bearing ewes in mid-to-late gestation

g/kg DM#	Fodder beet treatment				Ryegrass hay only	Ryegrass treatment
	Bulb only	Leaf only	Bulb + Leaf (78:22 ratio)	Fodder beet + Hay (72:28 ratio)		Ryegrass only*
n	2	2	4	5	1	2
DM, g/kg	148	119	142	334	828	157
Ash	68.7	185	94.3	95.6	99.2	171
CP	91	210	117	118	119	224
Fat	3.12	19.2	6.7	8.6	13.7	41.1
ADF	53.6	191	83.9	177	417	256
NDF	103	329	152	293	655	429
Lignin	4.16	68.4	18.3	31.2	64.3	17.4
Soluble sugars	605	155	506	372	26.5	70.2
Starch	1.04	5.33	2.00	2.90	5.27	2.63
DOMD, g/kg	840	678	804	729	537	675
ME, MJ/kg DM	12.5	10.9	12.1	11.1	8.60	10.8

g/kg DM unless stated
* Ewes on the ryegrass treatment did not consume any hay offered
DM, dry matter; CP, crude protein; ADF; acid detergent fibre; NDF, neutral detergent fibre; DOMD, organic matter digestibility; ME, metabolisable energy
ME, by calculation; DOMD, based on ME estimation.

concentrations of crude protein (CP), fat, acid detergent fibre (ADF) and neutral detergent fibre (NDF), and greater concentrations of soluble sugars. Estimated feed offered (kg DM/ewe/d) for ewes on the FB treatment were 1.8 of FB and 0.5 of hay, with the hay contributing to about 28% of total feed offered. Ewes on the RG treatment were estimated to be offered about 1.2 kg DM/ewe/d, with no hay consumed. Compared to lambs from RG-fed ewes, lambs from ewes fed FB had lower ($P<0.01$) LWTs at birth, docking and weaning, a shorter ($P<0.01$) CRL and HLL, a smaller ($P<0.01$) girth, and a lower ($P<0.01$) girth:CRL ratio (Table 2). Both HLL:CRL ratio and rectal temperature did not differ among treatment groups.

Table 2 Body dimensions, rectal temperature and live weight within 24 h of birth, and live weight at docking and weaning for lambs born to twin-bearing ewes fed dietary treatments of either fodder beet or ryegrass dominant pasture in mid-to-late gestation.

	Fodder beet	Ryegrass	SEM	P value
No. lambs born alive	193	190		
Body dimensions, cm				
CRL	49.6	49.8	0.465	0.005
HLL	36.8	37.6	0.330	<0.001
Girth	37.7	38.6	0.356	<0.001
Girth:CRL ratio	0.76	0.77	0.007	0.008
HLL: CRL ratio	0.74	0.76	0.006	0.217
Rectal temperature, °C	39.4	39.1	0.124	0.124
Live weight, kg				
Birth	4.87	5.16	0.113	<0.001
Docking	16.6	17.4	0.361	0.004
Weaning	32.0	33.7	0.604	0.005

CRL, crown rump length; HLL, hind-leg length; SEM, standard error of the means

These results indicate that feeding ewes FB in mid-to-late gestation can reduce skeletal growth and lamb performance up to weaning. This is in contrast to the conclusions of Bryant and Pirat (2011) who found that feeding kale or FB diets to dairy cows in late gestation had no apparent long-term effects on growth or the ability of calves to meet their pre-weaning LWT targets. The effect observed in the current trial may have been due to the inability of the FB treatment to meet fibre and protein requirements of the pregnant ewes. The hay was offered in this experiment as a fibre source, given the expected high sugar content of the FB, however, the FB + hay combination (Table 1) did not meet the recommended minimum NDF content of 35% of DM (Waghorn et al. 2007). Further, despite the CP offered in this study being within NRC (2007) recommendations for non-lactating ewes in late pregnancy (i.e., no less than 11% CP), it has been identified that low-N diets may alter the profile of circulating amino acids (AA). Such nutrient-limiting effects would be exacerbated if feed intake was limited by DM content. Pacheco et al. (2016) reported that lactating cows fed FB had lowered proportions of arginine, citrulline and ornithine in plasma AA compared to cows fed RG, suggesting the possibility of insufficient AA supply/synthesis. Arginine, in particular, has been found to have a key role, where supplementation to twin-bearing pregnant sheep in the last trimester increased foetal brown-fat reserves and core body temperature at birth (McCoard et al. 2014), increased female lamb birth weight (McCoard et al. 2013), and improved postnatal growth rate and muscle mass (Sales et al. 2016). Further research into the potential unintended consequences of feeding FB to ruminants in late pregnancy and the role of specific AA for offspring performance is needed.

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