BRIEF COMMUNICATION: Effect of offering differing levels of milk and plant extracts on feed intake, growth and development of New Zealand Holstein-Friesian and Jersey crossbred dairy cattle

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INTRODUCTION

Calving dairy heifers at 2 years of age at 85 to 90 % of their mature live weight and being mated at 65% of their mature live weight, has been found to increase lifetime productivity (Margerison & Downey, 2005). Recent research has focused on increasing dairy calf liveweight gain and development, while minimising body fat deposition, particularly in mammary parenchyma (Sejrsen, 2005; Brown *et al.,* 2005), by increasing feeding levels during the prepubertal period with differing sources and levels of energy and protein, and the use of probiotics and natural plant extracts to replace antimicrobials (Hill, 2005; Tannan, 2005). The aim of this research was to compare the effect of offering differing levels of whole milk and a combination of plant extracts to increase the growth and development rate of New Zealand Holstein-Friesian and Jersey cross Holstein-Friesian dairy heifers.

MATERIALS AND METHODS

Animals, diets and measurements

Sixty Holstein-Friesian (HF) and Jersey cross Holstein-Friesian (JHF) calves were selected at random from the Massey University dairy units. At 48 hours-old they were randomly allocated according to birth date, breed, stature and live weight to one of three treatments. The common industry calf rearing practices were reviewed and the three most common commercial practices used as an experimental treatment. At 21 days of age calves were offered either; 4 L/h/d of whole milk (M); 4 L/h/d of whole milk plus 200 g of a plant extracts (M + B), or 2 L/h/d of whole milk, plus 200 g plant extract (0.5 M + B) from cereal and marine based plants. Between 4 days of age and weaning all the calves were offered individual rations of a straw and starter diet. Intake was calculated, by daily measurements of feed offered and feed remaining. All calves were weighed and the height at withers and hip, and the hip width and girth at the heart and last-rib measured weekly. The calves were weaned from milk and *ad libitum* access to starter at set target weights according to their breed. The HF calves were weaned from milk at 90 kg and from *ad libitum* starter at 100 kg whereas the JHF claves were weaned from milk at 75 kg and from starter at 80 kg. After weaning the calves from *ad libitum* supplement they were maintained on pasture and the supplement limited to 2 kg/hd/d.

Statistical analysis

The data was found to be normally distributed and analysed by ANOVA GLM and regression (Minitab, 2006) using individual animals as observations with diet and breed included as factors within the model. The existence of significant differences was assessed, with a confidence interval of 95%, using Tukey's test.

RESULTS AND DISCUSSION

The composition of the dietary components fed to the calves is given in Table 1.

Calves offered M + B had significantly higher live weight gains and shorter time to weaning (Table 2) than calves offered M alone. The calves offered 0.5 M + B had similar growth rates and length of time to weaning compared with calves offered M alone. There were no significant differences in supplement feed intake levels between treatment diets. Calves offered M + B took significantly less days to reach target weaning weights from milk than calves offered M alone. The M + B calves also took less days to reach weaning from the *ad libitum* starter

TABLE 1: Nutrient composition of whole milk, the plant extract and cereal based diet fed to the calves in this study. GE = Gross energy; NDF = Neutral detergent fibre; ADF = Acid detergent fibre.

Component	Whole milk	Plant extract	Cereal based starter supplement
Dry matter (%)	12.5	88.5	88.8
Fat (g/kg DM)	40.0	9.0	43.0
Protein (g/kg DM)	38.0	60.0	178.1
Ash (g/kg DM)	7.0	10.0	84.0
GE (kJ/g)	22.3 *	15.7	16.1
NDF (g/kg DM)	-	11.0	283.0
ADF (g/kg DM)	-	2.0	102.0
Lignin (g/kg DM)	-	-	29.0
Ca (mg/g)	1.19	1.1	12.4
P (mg/g)	0.93	1.6	5.6

* MJ/kg DM

TABLE 2: Mean growth rates, weaning weights and length of milk and supplementary feeding periods, feed intake, hip height, hip width and girth at last rib and heart girth for calves offered 4 L milk per day (M), 4 L milk plus 200 g of plant extract per day (M + P), or 2 L of milk plus 200g of plant extract per day (0.5M + P). SEM = Standard error of mean.

Component	Calf diet			SEM	P value
	M	M + P	0.5M + P		
Milk feeding period (d)	80.2[a]	72.1[b]	73.4[ab]	2.3	0.041
Total milk intake (L)	316	284	168	-	-
Live weight at weaning from milk (kg)	86.6	85.4	84.2	1.7	0.604
Weight gain in milk feeding period (g/d)	648[b]	757[a]	729[ab]	17	0.034
Ad libitum supplement feeding period (d)	87.3[a]	79.0[b]	82.5[a]	1.1	0.050
Total supplement intake (kg)	103.8	97.3	110.3	4.4	0.478
Live weight at weaning from *ad libitum* supplement (kg)	99.0	97.8	97.1	1.0	0.337
Weight gain in *ad libitum* supplement period (g/d)	1,253	1,237	1,190	70	0.809
Wither height[1] (m)	0.77	0.78	0.77	0.01	0.086
Hip height[1] (m)	0.81[b]	0.83[a]	0.82[ab]	0.04	0.005
Hip width[1] (mm)	18.7[b]	19.5[a]	19.0[b]	0.8	0.004
Heart girth[1] (mm)	90.3	92.6	91.6	0.7	0.057
Last rib girth[1] (mm)	95.0[b]	99.4[a]	99.1[a]	1.1	0.036

[1]Measurement at weaning from *ad libitum* supplement.

supplement than calves offered either M alone or 0.5M + B. There was no significant difference in the number of days to weaning from milk or weaning from *ad libitum* starter supplement for calves offered M alone and calves offered 0.5M + B.

Calves offered M + B had significantly higher growth rates, hip width, hip height and last rib girth than the other two treatments(Table 2) All calves offered plant extracts had significantly greater last rib widths (Table 2) than calves not offered plant extracts. The calves offered 0.5M + B had similar stature development at supplement weaning compared with calves offered M alone (Table 2). In this experiment the addition of plant extracts to calf diets of 4 L/d of whole milk significantly increased the growth rate and development, with higher hip width and hip height, of calves during the prepubertal period. In addition, the replacement of half the milk with 200 g/d of plant extracts resulted in similar growth rates to calves offered 4 L/d of whole milk.

Feeding plant extract, as in this study, had the effect of increasing the rate of calf growth and development between 0 and three months of age, potentially providing an opportunity to increase the lifetime productivity of the calves when they attain adulthood without increasing their daily milk allowance (Drackley *et al.,* 2007). This may be particularly useful in increasing cow productivity, within New Zealand and in Asia, to meet the increased in demand for dairy products from Asian markets (Wiley, 2007). The increased growth rate in the calves supplemented with plant extract suggests they exhibited an increased rate of protein deposition in the body which potentially may reduce the risk of fat deposition in mammary parenchyma associated with some diets (Sejrsen, 2005; Brown *et al.,* 2005). While the calves offered 200 g/d of plant extracts with 2 L of whole milk achieved equivalent growth rates to calves offered 4 L/d of whole milk daily recent research clearly indicates that higher calf growth rates have the potential to increase the milk yield potential of the calves during their productive life in the herd (Drackley *et al*., 2007). The economics of feeding the extract in a commercial herd would need to consider production and opportunity costs of the feeds, the effect of weaning date on labour inputs and the value of weaning calves on a date basis rather than a weight basis. The impact of the calf nutrition and growth rates in this experiment will be assessed during their first lactation when they calve at two years of age.

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