Effect of winter crop and dry matter allocation on colostrum quality of dairy cattle.

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Short Title: Winter crop and colostrum quality

Abstract

During winter 2017 320 mixed-age cows were assigned to four treatments (80/treatment) at the Southern Dairy Hub, in Southland, New Zealand, to investigate early lactation performance of cows wintered on fodder beet (FB) or kale. Immediately prior to the first milking following calving, foremilk samples were collected from each quarter of each cow and a Brix measurement made to assess colostrum quality.

Average Brix content did not differ significantly between treatment groups but there was significant variation between cows and quarters within cows. Cows wintered on FB had a numerically higher proportion of samples with a Brix > 22 (adequate quality). It is as yet unknown if the colostrum quality range differences were due to differences in calf colostrum removal prior to sampling or to the nutrition of the dam during winter.

Additional keywords: fodder beet, kale, immuno-globulin

Introduction

Winter-grazed forage crops continue to be an important aspect of farming in southern regions of New Zealand. Brassica crops (kale, turnips, and swedes) and fodder beet (FB) are an essential source of winter feed on farms in the southern regions of NZ (Nichol et al. 2003; Dalley, 2010), with FB use increasing exponentially in recent years (Waghorn et al. 2018). Following this rapid increase, farmers and veterinarians are becoming increasingly concerned about negative carryover effects on animal performance. Increased body condition score at calving in cows wintered on FB has resulted in more metabolic disease, e.g. milk fever and liver disfunction at parturition which may affect colostrum quality.

To ensure good health and future production potential, newborn calves need to absorb immunoglobulins (IgG) by ingestion of colostrum, during the first 24 hours of life. The concentration of IgG in colostrum varies according to many factors including a cow's health history, volume of colostrum produced, age of cow and breed (Gulliksen et al. 2008). The gold standard test for measuring IgG in colostrum, radial immunodiffusion, is expensive and technically difficult to measure, so IgG is often indirectly assessed using a Brix refractometer (Bielmann et al. 2009; Quigley et al. 2013). The purpose of the experiment was to determine if winter crop type and dry matter (DM) allocation affected colostrum quality, as assessed with Brix, in mixed-aged cows at their first milking.

Materials and methods

In May 2017 320 mixed-aged Friesian-cross cows were randomly allocated to four treatments in a 2x2 factorial design with crop type (FB or kale) and level of DM allocation (target for 0.7 body condition score unit gain (Target) or ad libitum (Ad Lib)), as the factors (Table 1). Treatments were balanced for age (4.6 ± 0.09 years), expected calving date (22 Aug 2017) and breeding worth (91 ± 1.99). Cows were transitioned onto their winter diet following recommended good management practice for each crop type. Ten days before expected calving date the cows were drafted off crop and offered 10 kg DM of pasture and baleage until calving.

During calving calves were removed from the dams once per day in early afternoon. Prior to the first milking a foremilk sample was collected from each quarter of all cows and stored frozen. Quarters that visually exhibited signs of suckling were included and noted. Following the completion of calving samples were removed from the freezer and thawed before a Brix refractometer was used to measure colostrum quality.

Results were analysed using REML variance components analysis in Genstat with Brix as the response variate and crop type, DM allocation and crop type x DM allocation as the model factors. The proportion of cows with a mean Brix < 22 was analysed using generalised linear models with a binomial error distribution.

Results

There was no significant difference in mean Brix between treatment groups (Table 1). Numerical differences were observed in the proportion of cows with an average Brix value greater than 22, however significant between-cow variability resulted in these differences being statistically non-significant. Numerically more cows on the Ad Lib feed allocation and FB treatments had a mean Brix greater than 22. Samples from suckled quarters had a lower Brix than quarters with no evidence of suckling (data not presented).

Discussion

Concentrations of IgG ≥ 50g/L or a Brix ≥ 22 are considered to indicate good quality colostrum (Bielmann et al. 2009; Quigley et al. 2013). The current study demonstrated significant variation in colostrum quality between quarters within a cow and between cows within treatments resulting in insufficient statistical power to detect statistically significant differences between treatments. Average concentrations at the first milking exceeded the 22 Brix threshold for all treatments except the Target kale treatment. Denholm et al. (2017) reported that only 10% of pooled colostrum samples from commercial farms in New Zealand had a Brix >22 and attributed this to pooling first milking colostrum with later milkings, once-daily collection of calves, and herd vaccination.

Brix values indicate that not all cows were producing colostrum of suitable quality for newborn calves and that at the time of sampling a higher proportion of kale cows had Brix values <22. Although cows and calves were collected at the same time each day the amount of colostrum suckled by the calf would have varied based on time between birth and collection and the suckling behaviour of the calf. Increasing the interval between calving and collection of first colostrum and an increase in colostrum volume are associated with decreased IgG concentration of colostrum (Moore et al. 2005; Pritchett et al. 1991).

The lack of effect of crop type during the non-lactating period on Brix in the current experiment is consistent with results reported by Nowak et al. (2012) and Winkelman et al. (2008). However, in the study of Nowak et al. (2012) calves from cows offered a high energy diet during the dry period had a better immunity status during their first weeks of life and increased daily body weight gain in the first three weeks of life.

Conclusions

Cows wintered on FB and kale had similar average colostrum Brix values, indicating there was no difference in average colostrum quality from cows wintered on these diets, despite numerically more cows wintered on kale having inferior quality colostrum at the first milking. Additional research is required to understand the relationship between IgG concentration and colostrum volume and to determine if crop type affects the immunity status of the calves in the first week of life.

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Table 1: Crop and supplement allocation (kg DM/cow/d), targeted metabolizable energy intake (MEI), pre-calving body condition score and colostrum quality of cows wintered on kale or fodderbeet (FB) at target DM allocation for 0.7 BCS gain (Target) or ad libitum (Ad Lib) for 8 weeks in winter 2017.

	Target Kale	Ad Lib Kale	Target FB	Ad Lib FB	SED	P value Diet	P value DM allocation	P value interaction
Kale allocation (kg DM/cow/d)	10.4	14.0			-	-	-	-
FB allocation (kg DM/cow/d)			9.1	11.9	-	-	-	-
Baleage allocation (kg DM/cow/d)	4.5	2.9	4.5	2.9	-	-	-	-
Total DM allocation (kg DM/cow/d)#	14.9	16.9	13.6	14.9	-	-	-	-
Targeted ME intake (MJ ME/cow/d)	140	160	140	160	-	-	-	-
Pre-calving body condition score	5.1	5.1	5.1	5.2	0.36	NS	NS	NS
Average Brix	21.6	22.9	22.2	23.1	1.08	0.61	0.16	0.75
Proportion of cows with a Brix > 22	0.45	0.53	0.53	0.57	0.058	0.26	0.32	0.69

Dry matter allocation to achieve the required MEI was based on estimated feed quality and the assumptions of 85% utilisation of the kale and baleage and 95% utilisation of fodder beet