Dalley et al. - Winter crop and colostrum quality

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

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Abstract

Increased health issues and perceived underperformance of dairy cattle in fodder beet feeding systems has raised concerns about potential negative cumulative effects of diets containing fodder beet. 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 kale or fodder beet (FB). 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% did not differ significantly between treatment groups but there was high variation between cows and quarters within cows. Cows wintered on FB had a numerically higher proportion of samples with a Brix% ≥22 (adequate quality) at the time of sampling as compared with cows wintered on kale. It is unknown if the colostrum quality ranges observed were due to variation in calf colostrum removal prior to sampling, the volume of colostrum produced or to the nutrition of the dam during winter.

Keywords
fodder beet, kale, brix value, colostrum quality

Introduction

Winter-grazed forage crops continue to be an important aspect of farming in southern regions of New Zealand. Brassica crops (e.g. 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) and farmers and veterinarians have reported less udder development immediately prior to calving in cows wintered on fodder beet. Both these factors could impact on the amount and quality of colostrum produced.

To ensure good health and future production potential, newborn calves need to absorb sufficient immunoglobulins (IgG) via the ingestion of colostrum, during the first 24 hours of life (Weaver et al., 2000). 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. 2010; Quigley et al. 2013). Concentrations of IgG ≥50g/L, equivalent to Brix values of ≥22, are considered to indicate good quality colostrum (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 2×2 factorial design comparing two crop types (FB or kale) and two levels of DM allocation (target for 0.7 body condition score unit gain (Target) or *ad libitum* (Ad Lib)). Treatments were balanced for age (4.6 ± 0.09 years), expected mean calving date (22 Aug 2017 ± 2.0 days) 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 a combined pasture and baleage diet 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 (Bielmann et al. 2010). Quarters that visually exhibited signs of suckling were included and noted. Following the completion of calving, samples were removed from the freezer and thawed, whereupon a Brix refractometer (Digital Brix/RI Check, Reichert Technologies Analytical Instruments) was used to measure colostrum quality (Brix%).

Results were analysed using REML variance components analysis in GenStat with Brix% as the response variate and crop type, DM allocation, and their interaction as modelling factors. The proportion of cows with a mean Brix value of ≥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 from each treatment with an average Brix% ≥ 22, however, high between-cow variability resulted in these differences being statistically non-significant (Table 1). Numerically more cows on the Ad Lib feed allocation and FB treatments had a mean Brix% greater than 22. Crop type did not affect mean BCS at calving (P=0.32), however cows offered Ad Lib allowances were in better BCS at calving (P=0.03). There was no difference in the incidence of metabolic disorders at calving between the treatment groups.
Table 1. Crop and supplement allocation, targeted metabolizable energy intake (MEI), pre-calving body condition score (BCS), ad colostrum quality of cows wintered on kale or fodder beet at a target DM allocation for 0.7 BCS gain (Target) or ad libitum (Ad Lib) for 8 weeks.

<table>
<thead>
<tr>
<th></th>
<th>Kale</th>
<th>Fodderbeet</th>
<th>P-values¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Target Ad Lib</td>
<td>Target Ad Lib</td>
<td></td>
</tr>
<tr>
<td>DM allocation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(kg/cow/d)²</td>
<td>10.4 14.0</td>
<td>0.0 11.9</td>
<td>-</td>
</tr>
<tr>
<td>Kale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fodderbeet</td>
<td>0.0 0.0</td>
<td>9.1 4.5</td>
<td>-</td>
</tr>
<tr>
<td>Baleage</td>
<td>4.5 2.9</td>
<td>4.5 2.9</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>14.9 16.9</td>
<td>13.6 14.9</td>
<td>-</td>
</tr>
<tr>
<td>Targeted MEI</td>
<td>140 160</td>
<td>140 160</td>
<td>-</td>
</tr>
<tr>
<td>(MJ/cow/d)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-calving BCS</td>
<td>5.06 5.12</td>
<td>5.07 5.18</td>
<td>0.03</td>
</tr>
<tr>
<td>Average Brix%</td>
<td>21.6 22.9</td>
<td>22.2 23.1</td>
<td>0.61</td>
</tr>
<tr>
<td>Proportion of Brix% ≥22</td>
<td>0.45 0.53</td>
<td>0.53 0.57</td>
<td>0.26</td>
</tr>
</tbody>
</table>

¹The effect of winter crop (diet), dry matter allocation (DM), and their interaction (Diet × DM) are presented.
²Dry matter allocation to achieve the required ME intake was based on estimated feed quality and the assumptions of 85% utilisation of the kale and baleage, and 95% utilisation of fodder beet.

Discussion

Average Brix% at the first milking exceeded the 22% 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% of ≥22 and attributed this to pooling first milking colostrum with later milking’s, 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, 6% more kale cows had Brix values less than 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 and could have differed between treatment groups. Collection of colostrum samples immediately following birth and prior to suckling would be required to get a true indication of treatment differences in colostrum quality. 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 original hypothesis of poorer quality colostrum from cows wintered on fodder beet was based on reports from farmers and veterinarians of cows not coming into milk well i.e. bagging up before calving. However, the lack of diet effect on Brix in the current experiment is consistent with results reported by Nowak et al. (2012) and Winkelman et al. (2008). Nowak et al. (2012) did however observe that 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

High variation in Brix% between quarters within cows and between cows resulted in no statistically significant differences between treatments in colostrum quality. Additional measurements that would have strengthened the design of the current study include milk volume from the first milking and the IGG status of the calves on arrival to the calf shed. Additional research is required to understand the relationship between colostrum IgG concentration and volume and to determine if crop type affects the immunity status of the calves in the first week of life.

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References