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Dry matter intake, body condition score, and grazing behavior of nonlactating, pregnant dairy cows fed on kale or grass once versus twice during winter

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ABSTRACT

The objective of this study was to examine the effect of wintering pregnant, nonlactating dairy cows outdoors on either kale or grass, fed in 1 [11 kg of dry matter (DM) of kale or grass + 3 kg of DM of baled barley straw offered in the morning] or 2 allocations (5.5 kg of DM of kale or grass grazed + 1.5 kg of DM barley straw offered morning and afternoon) per day. The body condition score (BCS) gain over the 47-d winter feeding period was higher for grass-fed (0.5 BCS units) than kale-fed cows (0.3 BCS units), but was unaffected by feeding frequency. Forage DM utilization was higher for kale-fed (97%) than grass-fed cows (76%), leading to higher estimated dry matter intake (DMI) in kale-fed (10.7 kg of DM/cow per day) than grass-fed cows (7.7 kg of DM/cow per day). Forage DM utilization and estimated DMI were not affected by feeding frequency. Prehension bite rate was greater for grass-fed (37.3 bites/min) than kale-fed cows (7.6 bites/min), but more mastication bites were required for kale-fed cows. Cumulative DMI after 2, 3, and 6 h was greater in cows allocated forage once than twice a day and for kale than grass after 3 and 6 h. Mean eating time was greater for cows offered forage once (477 min) than twice (414 min) per day. In conclusion, increasing feeding frequency from once to twice per day decreased the intake rate within the first 6 h after allocation, but did not affect total daily DMI, DM utilization or BCS gain. Thus, moving cows more frequently would not have any significant advantage. It may increase labor requirements, thereby creating a more challenging wintering management than feeding once per day.

Key words: *Brassica oleracea* L., *Lolium perenne* L., body condition score, prehension bite rate, mastication bite

INTRODUCTION

There has been increasing interest in the use of forage brassicas as supplementary feed crops in temperate grazing production systems at times of feed shortfalls (Barry, 2013; Chakwizira et al., 2014). In New Zealand, the forage brassica kale (*Brassica oleracea* L.) is mainly used in the cold and wet South Island winters for feeding pregnant, nonlactating dairy cows away from the pasture-based area where dairy cows are grazed during lactation (Judson et al., 2010). The forage brassica kale has been widely used because it provides high DM yield at low cost and nutritive value relative to grass in winter (Rugoho et al., 2014). Further, utilization and estimated DMI of grass is low during winter due to wet soil conditions, which causes grass to be trampled into the soil surface when break fed on a daily basis (Keogh et al., 2009a; Rugoho et al., 2014).

Regaining BCS lost through lactation is an important goal for feeding of nonlactating, pregnant dairy cows (Edwards et al., 2014). Traditionally nonlactating, pregnant dairy cows were offered the industry standard allocation of 11 kg of DM/cow per day of kale and 3 kg of DM/cow per day of a high-fiber supplement, such as barley straw (*Hordeum vulgare* L.; Rugoho, 2013). However, concerns exist that cows may not regain adequate BCS when wintered on the recommended allocation of kale (Greenwood et al., 2011; Rugoho et al., 2014). S-Methyl-L-cysteine sulphoxide (**SMCO**) is a nonprotein AA found in all brassicas species that is normally converted to toxic dimethyl disulfide by ruminal microorganism (Gustine, 1985); SMCO has been associated with poor growth in young sheep grazing forage kale (Barry and Manley, 1985) and methods to improve performance are sought. Previous research indicated that kale allowance affects animal performance (Keogh et al., 2009b; Rugoho et al., 2014). For example, high DM utilization of kale crops due to low allocation have been associated with low DMI, reduced diet quality, and lower BCS (Rugoho et al., 2014).

A further possibility to improve BCS gain may be to alter the frequency of feeding. Typically, winter forage

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crops are offered once a day in the morning and with prior hay or silage feeding in an attempt to minimize gorging. This feeding regimen often results in high rates of DMI (Rugoho et al., 2010; Thompson and Stevens, 2012). For example, Rugoho et al. (2010) reported that dairy cows offered kale once a day at high (14 kg of DM/cow per day) or low (11 kg of DM/cow per day) allocation consumed an average of 8.4 kg of kale over the first 3 h. Intake rate and ruminal fill have been found to control DMI (Forbes and Barrio, 1992), with infrequent feeding associated with lowering the rate of digestion and utilization of nutrients (Gibson, 1984). It is plausible that alternative feeding regimens may give improved ruminal function. Examples include reducing the diurnal variation in ruminal pH and ammonia (Cabrita et al., 2006), thereby benefiting ruminal digestion and tissue metabolism. Also, offering forage twice per day may potentially improve performance, as less trampling and improved crop utilization may occur. This may be particularly important when grass is offered, as DM utilization and, thus, DMI of grass has been found to be low with a single daily allocation (Keogh et al., 2009a; Rugoho et al., 2014).

Dalley et al. (2001) and Kennedy et al. (2009) have shown that altering feeding frequency from 1 feeding per day to 6 feedings per day had no benefit in daily herbage DMI or milk yield. Bite mass was smaller when feeding frequency was increased from 2 to 4 feeds per day (Gregorini et al., 2009). No literature has been published on the effect of feeding frequency of winter forage crops on BCS gain, grazing behavior, and forage DMI. The objective of our study was to examine the effect of once versus twice per day allocation of kale or grass on BCS gain, cow behavior, forage DMI, and DM utilization of nonlactating, pregnant dairy cows during the winter feeding period.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted from May 30 to July 23, 2010, with the forage crops grown at the Lincoln University dryland research farm (Ashley Dene), located on the Canterbury plains, New Zealand (43°39′S, 172°19′E). The site is approximately 35 m above sea level, with an Eyre shallow stony loam soil (Yeates et al., 2006). All procedures were approved by the Lincoln University Animal Ethics Committee and licensed in accordance with the Animal Welfare Act, 1999, section 100. Following ploughing and cultivation, the kale crop cultivar 'Regal' and Italian ryegrass (*Lolium multiflorum* L.) cultivar 'Feast' were sown at rates of 4 and 25 kg/ha on December 15, 2009, and February 15, 2010, respectively.

Meteorogical Data

Air and soil temperatures (°C) for the winter feeding were recorded at Lincoln meteorological station, 13 km northeast of the trial, during the months of June and July and are presented in Figure 1. Over the winter forage crop trial period, the mean air temperature was 6.0°C and ranged from −4.4 to 17.1°C. The total rainfall over the trial period was 146 mm, which occurred on 25 d. Ground frosts were recorded on 29 d. The climate data were sourced from NIWA (2016).

Experimental Design and Treatments

The experiment design was 2 replicate groups of 2 × 2 factorial, with treatments being forage type (kale or grass) and feeding frequency (once or twice per day allocation). A total of 48 animals (40 multiparous cows, and eight 2-yr-old heifers) were used. All animals were pregnant, nonlactating Friesian × Jersey, from the Lincoln University Research Dairy Farm and were used from late May 2010 after drying off. Animals were sorted into 6 sets of 8 similar animals, based on mean calving date (August 20 ± 20 d; mean ± SE), BCS (4.5 ± 0.5; mean ± SE), BW (530 ± 9.5 kg; mean ± SE), and age (5.3 ± 4.7 yr; mean ± SE). One set comprised the 8 heifers. These were used to construct 8 similar groups by assigning 1 animal from each set to each group. Finally, 2 replicates of the 4 treatments were assigned to the 8 groups at random. The 4 treatment groups were 11 kg of DM of kale grazed + 3 kg of DM of barley straw offered once per day (**K1**), 5.5 kg of DM of kale grazed + 1.5 kg of DM of barley straw offered twice per day (**K2**), 11 kg of DM of grass grazed + 3 kg of DM of barley straw offered once per day (**G1**), and 5.5 kg of DM of grass grazed + 1.5 kg of DM of barley straw offered twice per day (**G2**).

In the once-per-day treatments, straw was offered at 0800 h and kale or grass at 0900 h. In twice-per-day treatments, straw was offered at 0800 and 1400 h and kale or grass at 0900 and 1500 h. To minimize animal health disorders, such as nitrate poisoning, kale cows were adapted to crops over a period of 6 d (May 30 to June 6), with full allocation given on June 7, 2010. During this period, kale DMI started at 2 kg of DM/cow per day, with the rest being grass. The kale component was progressively increased by 2 kg of DM/cow per day for the first 4 d and then by 1 kg of DM/cow per day up to d 7. Cows were grazed on the full allowance for 47 d until July 23, 2010, when they were returned to the pasture-based dairy farm for calving.