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Short communication

Effect of increasing pasture allowance and grass silage on animal performance, grazing behaviour and rumen fermentation parameters of dairy cows in early lactation during autumn

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ABSTRACT

The aim of the present study was to determine the effect of daily pasture allowance and grass silage supplementation on milk production performance, grazing behaviour, rumen function, and blood and urinary metabolites in early lactation of dairy cows grazing on low herbage mass pastures. The study was conducted with 32 Holstein–Friesian cows over a time period of 63 days. Prior to experimental treatment, milk production, body weight, and days in milk averaged 23.8 ± 0.70 kg/day, 537 ± 9.6 kg, and 37.1 ± 1.02, respectively. Four dietary treatments resulted from the combination of two pasture allowances above ground level (low 17 vs. high 25 kg of dry matter (DM)/cow/day) and grass silage supplementation offered at levels of 4.5 and 9.0 kg DM/cow/day. All of the cows received 2.6 kg DM of concentrate supplementation. Total DM intake was determined using the controlled-release chromium capsules method and milk composition was analysed weekly using infrared spectroscopy (Foss 4300 Milko-scan). Pasture allowance and grass silage supplementation had no significant effect on milk production (average 23.4 kg/day) or on milk composition. Grazing time and ruminating time were not significantly affected by pasture allowance. The rate of intake was significantly reduced ($P<0.001$) from 32.0 to 19.1 g DM/min by increasing grass silage supplementation. Increasing pasture allowance increased ($P<0.001$) daily live weight change (−0.061 and 0.553 kg/day for low and high, respectively). High pasture allowance decreased plasma β-hydroxybutyrate ($P<0.05$) and increased plasma urea–N ($P<0.05$) (3.95 and 4.10 mmol/L for low and high, respectively). Supplementation with grass silage had no significant effect on blood and urinary metabolites. Rumen ammonia and total volatile fatty acid concentrations were not significantly affected by increasing pasture allowance or increasing grass silage supplementation. This value, the lowest measured, is below the range recommended for optimal microbial growth. Rumen microbial nitrogen efficiency did not appear to be affected by pasture allowance or grass silage supplementation in that the purine derivative/creatinine ratio was similar for the four dietary treatments.

1. Introduction

Milk production in the south of Chile is based on systems where calving is concentrated mainly in spring and autumn in order to meet the demand of the industry to achieve a uniform milk supply pattern throughout the

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year. However, in pasture systems under which dairy cattle are kept grazing in pasture for much or all of the year, cows are exposed to large seasonal variations in pasture growth and nutritional quality, thereby exposing them to variable pasture allowances (PAs) (Chilibroste et al., 2007). Pasture availability usually decreases ($\leq$1800 kg DM/ha) in autumn because of weather conditions (Pulido et al., 2010); non-irrigated permanent pastures reduce their growth rate to 30–50 kg DM/ha/day during autumn (Poff et al., 2011) compared with 60–90 kg DM/ha/day during spring. Studies conducted with low herbage mass pasture ($\leq$1800 kg/ha) have reported that pasture intake increases 0.12 kg/kg PA above ground level (offering PAs of 25 and 35 kg DM/cow) (Pulido et al., 2010).

Grass development in autumn is based on vegetative growth, i.e. grass species only develop new tillers and leaves (Poff et al., 2011), thus increasing the probability of grazing short sward characterised by high amounts of crude protein (CP) (200–300 g/kg DM) and low amounts of non-structural carbohydrates and DM. As a consequence of autumn grazing conditions, the main factors limiting milk production are low pasture DMI, low energy intake, and a lack of synchrony in the release of nutrients in the rumen between the degradable CP and the energy supply of the herbage.

Increasing pasture allowance and supplementation with concentrate and/or other conserved forages is essential for autumn grazing dairy cows in order to maintain an adequate level of total DMI and milk production, especially in early lactation (Pulido et al., 2010). The response to supplementary grass silage depends on herbage availability, the relative nutritive values of grazed herbage and the supplementary forage, and the duration of each feed (Phillips and Leaver, 1985). Forage supplementation decreases pasture DMI more than concentrate supplementation, including both low and high PAs, (Mayne and Wright, 1988). Diets based on grass silage are characterised by a high level of rapidly degraded CP in the rumen, and for successful nutritional synchrony, the supply of corresponding fermented carbohydrates is of great importance for microbial metabolism (Hall and Huntington, 2008).

The measurement of purine derivatives (PD) as specific markers for rumen microbial biomass has been suggested. Therefore, it can be used to estimate rumen microbial protein (Tas and Susenbeth, 2007). Limited research has been conducted to evaluate the effect of supplementation with grass silage and daily PA on milk production and rumen microbial protein efficiencies of autumn-calving cows in early lactation. Our hypothesis was that the animal performance and microbial protein production in grazing dairy cows fed on low herbage mass pasture offered at two contrasting PA, are modified by supplementation with grass silage offered at two levels, by increasing total DMI.

This study evaluates the influence of daily PA and silage supplementation levels on animal performance, grazing behaviour, and rumen microbial yield of autumn-calving dairy cows in early lactation grazing low herbage mass pasture.

2. Material and methods

2.1. Site research and experimental procedures

The experiment was conducted at the Vista Alegre Experimental Research Station of the University Austral of Chile in Chile (latitude 39° 47′46″ and longitude 73° 13′13″) from April 14th to June 7th 2010. The sward was a 12-year-old permanent ryegrass (*Lolium perenne*) pasture that had been subjected to rotational grazing management. The soil type has been classified as a medial, mesic, typic Hapludand (Soil Survery Satt, 1992). Grazing took place on a 13.5-ha ryegrass-dominant pasture, with each treatment herd grazing at the same paddock, but separated by an electric fence according to the correspondent PA. All animals were given access to new pasture after each milking.

Thirty-two multiparous Holstein–Friesian dairy cows from the University's dairy herd (milk yield 23.8 ± 0.70 kg/day; calving 2.48 ± 0.31; days in milk 37.1 ± 1.02; body weight (BW) 537 ± 9.6 kg) were grouped according to milk yield, days in milk, and BW. They were randomly assigned to four dietary treatments resulting from the combination of two PAs and two levels of grass silage supplementation.

Four lactating dairy cows were ruminally cannulated to allow measurement of ruminal pH, volatile fatty acids (VFA), and ammonia concentration in rumen.

All of the cows received 2.6 kg DM of concentrate supplementation. The base concentrate comprising (% on DM basis) 43 corn, 43 sugar beet pulp, 9 soybean meal, and 5 beet molasses was offered at 06:00 h and 15:00 h during each milking time. A mineral mix (Anasal Alta Producción, ANASAC: Ca 140 g/kg, P 100 g/kg, Mg 60 g/kg, Na 40 g/kg, S 2 g/kg, Zn 5.000 mg/kg, Cu 1.500 mg/kg, Co 20 mg/kg, I 200 mg/kg) was offered with the concentrate at a rate of 0.25 kg/cow/day to avoid mineral deficiency.

The experiment was conducted over nine weeks. Principal measurements including daily milk production, weekly milk composition, live weight, and body condition score (on a scale of 1–5; emaciated–fat) were determined, and measurements of intake in conjunction with behavioural observations were recorded between weeks 4 and 6. Blood and urine samples were obtained from week 2 to week 9 to determine metabolites and estimate rumen microbial growth.

2.2. Measurements and samplings

The grazing areas were calculated daily on the basis of herbage mass, estimated from 100 measurements made with a rising plate meter (RPM, Ashgrove Plate Meter, Hamilton, New Zealand). Measurements were made by walking the paddocks in a 'W' pattern and this was repeated post-grazing, enabling grass disappearance of each individual herd to be calculated.

Samples of grass silage, concentrate, and pasture were collected three times a week during the study, pooled by week, and dried for 48 h at 60 °C for analysis. Once a week, samples of the pasture consumed were obtained by hand-plucking at the approximate height to which the cows grazed. Pasture samples were frozen and freeze-