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Short Communication

High pasture allowance does not improve animal performance in supplemented dairy cows grazing alfalfa during autumn–winter

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ABSTRACT

The aim of this study was to assess the effect of three alfalfa pasture herbage allowances on milk yield and composition during autumn–winter grazing season on early autumn calving dairy cows. Eighteen multiparous Holstein dairy cows were assigned to one of three treatments in a 3 × 3 Latin square design: low herbage allowance (14 kg DM/cow; LHA), medium herbage allowance (27 kg DM/cow; MHA) and high herbage allowance (41 kg DM/cow; HHA). Dry matter disappearance was lower at LHA although remained similar between MHA and HHA ($P<0.05$). However, as herbage allowance (HA) increased, lower grazing efficiencies (as the proportion of material removed) were registered ($P<0.05$). Total dry matter intake (DMI; kg/d) was also lowest for LHA and similar between the other two treatments ($P<0.05$). Milk yield, 4%FCM, milk fat (g/kg) and casein (g/kg) tended to increase from LHA to HHA ($P<0.10$). Cows at LHA tended to loss weight whilst cows at MHA and HHA had a tendency to increase BW according the season progressed ($P<0.10$). In summary, managing cows at HHA will allow cows to a slightly increase in individual milk production and BW gain but in detriment of herbage utilization and potentially, milk production per hectare.

1. Introduction

Pasture dry matter intake (DMI) is usually low in comparison to DMI achieved in total mixed ration (TMR) systems and is indicated as one of the most limiting factors for increasing individual milk yield (Bargo et al., 2002). Several factors affect DMI in grazing situations as grazing time, fibre content of the pasture, herbage mass and supplementation (McEvoy et al., 2009). Herbage allowance (HA) is in turn, one of the major factors affecting DMI and milk production in grazing dairy cows (McEvoy et al., 2008; Alvarez et al., 2006). An increase in HA has been reported to lead to an increase in DMI and individual milk yield (McEvoy et al., 2008). However, milk production per hectare and grazing efficiency (as a proportion of herbage mass removed over the total herbage mass offered) declines with increasing HA (Baudracco et al., 2014, Alvarez et al., 2006). It is important to note that many of these studies were carried out during the main grass growing season, i.e. spring, since grazing systems are usually based on a spring calving season in order to match the high grass supply with the high cow energy demand. Nevertheless, in some countries as Argentina, year-round calving is common and consequently, it is relevant to evaluate the effect of HA on early lactation dairy cows during the autumn–winter season. Additionally, there is evidence showing that dairy cows consume less DM from pasture in autumn compared to spring (Dillon, 2006). To our best knowledge, there is a lack of studies available about the effect of HA on milk performance under alfalfa grazing during autumn–winter time. Alfalfa pasture is one of the most important feeds for dairy cows in Argentina (Baudracco et al., 2014). The aim of this particular study was to assess the effect of combining three herbage allowances with only one level of concentrate supplementation (flat rate) on milk yield and composition during autumn–winter grazing season on early autumn calving dairy cows.

2. Materials and methods

The study was carried out from March to July at the Rafaela Agricultural Experiment Station, (INTA, 31° 15' S, 61° 21' W), Argentina, on a permanent alfalfa pasture sown in an Argiudol typical soil, well-drained of silt loam.

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2.1. Weather data

Total monthly precipitations were 58, 89, 15, 54 and 39 mm between March and July 31st, coincident with data from previous 50 years. Average monthly maximum temperatures were 27, 24, 21, 19 and 18 °C, and average low temperatures were 16, 12, 11, 8 and 7 °C for the same period, normal for the region and similar to the previous recorded 50-yr average.

2.2. Experimental design, animals and treatments

Eighteen multiparous Holstein dairy cows (613 ± 58.4 kg body weight (BW); 87 ± 22 days in milk (DIM); previous lactation yield ≈ 5600 kg of 4% fat-corrected milk (FCM)) were assigned to one of three treatments during 3 periods (5 weeks per period, 2 weeks adaptation period and 3 weeks for data collection) in a 3 × 3 Latin square design. Cows were divided into 6 squares (block) of 3 animals each according to previous lactation yield, BW, parity and calving date. Within square, each animal was randomly assigned to each experimental treatment: low herbage allowance (14 kg DM/cow; LHA), medium herbage allowance (27 kg DM/cow; MHA) and high herbage allowance (41 kg DM/cow; HHA). Levels of herbage allowance were selected in order to provide one, two or three times the expected herbage daily intake. Dairy cows were allocated in a 12 ha single paddock of a 2nd year alfalfa pasture (*Medicago sativa L.*) which was strip-grazed daily. Cows were milked at 05:30h and 16:30h and received in the milking parlour 5 kg/day (fresh weight, divided in two meals) of a cereal grain-based pelleted concentrate (Table 1).

2.3. Pasture measurements and dry matter intake from pasture

Table 1 shows the characteristics and chemical composition of the alfalfa pasture and the concentrate during the three experimental periods. Herbage mass (HM) was measured once a week at 5 cm above ground by cutting at least in 10 randomly sites. Sampling was done after noon, before and after grazing. Each sample was manually classified into alfalfa and weeds, weighing each fraction fresh and oven dried 48 h at 65 °C to determine DM content. The targeted daily HA was achieved by weekly adjusting the size of the strip-grazed area as a function of HM (kg DM/Ha).

Alfalfa DMI and grazing efficiency were estimated at each sampling date by the difference between initial and final herbage DM available biomass (Meijs, 1981).

Table 1
Characteristics and chemical composition of alfalfa pasture and concentrate; Mean ± SD.

Item	Experimental periods			Concentrate
	P I	P II	P III	
Date	6 Apr. – 3 May.	4-31 May.	1 Jun. – 5 Jul.	
Alfalfa HM[a] (t DM/ha)	2.0 ± 0.04	1.7 ± 0.02	1.1 ± 0.06	
Alfalfa[b] DM (proportion of HM)	0.72	0.55	0.58	
Canopy height (cm)	45 ± 5.0	45 ± 4.0	25 ± 3.5	
Crude protein (g/kg DM)	217 ± 1.36	217.8 ± 2.53	223.6 ± 2.49	163.7
NDF (g/kg DM)	415.3 ± 18	412.3 ± 31	434.7 ± 26	ND[c]
ADF (g/kg DM)	322.9 ± 11	327.9 ± 0.9	334.1 ± 12	95
ADL (g/kg DM)	82.8 ± 0.5	82.9 ± 0.8	87 ± 0.8	ND
IVDMD[d] (g/kg)	718 ± 17.9	717 ± 18.8	707 ± 17	826

[a] Herbage mass, ton of DM/ha.
[b] Alfalfa DM contribution to total HM as proportion.
[c] Not determined.
[d] In vitro dry matter digestibility.

2.4. Animal performance

Individual milk yields were recorded daily using Alfa-Laval™ milk jar recorders. An aliquot milk sample was taken twice a week from each animal in a pm:am basis and stored for compositional analysis. Cows were weighed every two weeks for three consecutive days at the same time after morning milking.

2.5. Chemical analysis

Concentrate was sampled every 15 days during the collection periods. Samples of alfalfa pasture and concentrate were dried at 65 °C ground through 1 mm screen in a Wiley-type mill, composite and stored for chemical analysis. From each sample, nitrogen content was determined by Kjeldhal method (AOAC, 1975). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) in alfalfa were determined according to Goering and van Soest (1970); and by the modified procedure of Robertson and van Soest (1981) in the concentrate. Alfalfa and concentrate *in vitro* DM digestibility was done according to Tilley and Terry (1963).

Milk samples were analyzed for total solids (TS); ash; fat; total nitrogen; protein N; Non protein N (NPN); Casein, and lactose. Milk fat, protein and non protein nitrogen contents were determined by standard methodologies according to the International Dairy Federation (FIL-IDF 1964, 1987, 1996). Protein was analyzed as (Nx6.38 – NPN). Lactose was estimated as the difference between non fat milk solids (NFS) minus (N + Ashes); 4% fat-corrected-milk (4%FCM) was estimated according to Gaines and Davidson (1923). The energy concentration of the milk was predicted from its fat and protein concentration using the formula of Tyrrell and Reid (1965).

2.6. Statistical analyses

Results (animal performance and herbage utilization) were analyzed by a repeated measurements procedure on the basis of a 3 × 3 Latin Square. Model includes terms for period within square, treatment and square (animal within square was used as random effect). Results were adjusted by covariance using the corresponding individual performances obtained during the pre-experimental period. The degrees of freedom for the F test were adjusted with the Kenward–Rogers option (SAS Proc Mixed, 1999). When significant ($P < 0.05$), mean separation was conducted by the Tukey's method.

3. Results

3.1. Dry matter intake

As shown in Table 1, chemical composition of the alfalfa pasture was similar along the experiment. However, HM and canopy height declined as the season progressed from autumn to winter (no statistical analysis was performed in this data). Since HA was reached as the combination of HM and surface available per cow, treatments differences were maintained according to the objective of this experiment (Table 2).

The DM disappearance (Table 2), which represents the pasture DMI, was lower at LHA although remained similar between MHA and HHA ($P < 0.05$). However, as HA increased, lower grazing efficiencies were registered ($P < 0.05$). With regards to total DMI, a similar pattern to pasture intake was observed (concentrate DMI