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Pasture intake, milk production and grazing behaviour of dairy cows grazing low-mass pastures at three daily allowances in winter

L.A. Pérez-Prieto, J.L. Peyraud, R. Delagarde *

[a] INRA, UMR1080, Production du lait, F-35590 Saint-Gilles, France
[b] Agrocampus Ouest, UMR1080, Production du lait, F-35000 Rennes, France

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ABSTRACT

Grazing low-mass pastures is almost inevitable when extending the grazing season into late winter to reduce feed costs, cows' performance being potentially affected. An experiment was carried out to estimate the performance, pasture intake (PI) and behavioural adaptation of dairy cows when grazing low-mass pastures at LOW, MEDIUM and HIGH pasture allowances (PA), corresponding to 19, 32 and 46 kg OM/cow per day above ground level, respectively. The study took place in the late winter of 2008 on good quality perennial ryegrass/white clover pastures with a mean pasture mass and a pre-grazing platemeter height of 2.3 t OM/ha above ground level and 5.8 cm, respectively. Each cow was supplemented with 4.4 kg OM of maize silage and 2.0 kg OM of cereal concentrate. Daily time at pasture was restricted to 9 h between the am and pm milkings. Eighteen midlactation Holstein cows (twelve multiparous and six primiparous) were used in a 3×3 orthogonal Latin square design with three consecutive periods of 13 days. On average, the cows produced 25.3 kg of milk and total OM intake was 14.4 kg/d. Pasture OM intake averaged 7.9 kg/d and linearly increased from LOW to HIGH (+0.04 kg/kg PA). Similarly, milk production per cow (+0.09 kg/kg PA) and milk protein concentration (+0.04 g/kg per kg increase in PA) linearly increased with increasing PA. Milk fat concentration, on the other hand, decreased by 0.10 g/kg per kg increase in PA. The daily grazing time (430 min) and the proportion of time spent grazing (79%) were not affected by PA. On average, pasture intake rate was low (19 g OM/min) and linearly increased from 16.9 g OM/min in LOW to 20.7 g OM/min in HIGH. In the present study, the PI was limited even at high PA because of the cumulative effect of the low-mass pasture (low intake rate) and the restricted access time (short grazing time). Consequently, the effect of PA on PI was low. However, the milk production response to variations in PI was high because of the low energy balance recorded in all treatments.

1. Introduction

Efficiently grazed pasture is widely recognized as the cheapest source of nutrients for dairy cows. The higher the proportion of grazed pasture in the annual diet of dairy cows, the greater the economic efficiency potentially achieved in dairy systems (Dillon et al., 2005). Extending the grazing season to late winter is therefore an interesting practice to reduce feed costs. Winter grazing, however, implies grazing cows during periods of rain, low temperature and short day length, the pasture availability being normally reduced due to low pasture growth rate. Grazing low-mass pastures is therefore highly probable during winter.

Studies on dairy cows grazing low-mass pastures (low pasture height) have mainly been conducted under continuously-stocked management, pasture intake and milk production being reduced with decreasing pasture mass (Rook et al., 1994). On low-mass pastures, cows are forced

* Corresponding author. INRA, UMR1080, Production du lait, F-35590 Saint-Gilles, France.
E-mail address: remy.delagarde@rennes.inra.fr (R. Delagarde).

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to graze very low strata, strongly increasing the difficulty to catch the sward. Pasture instantaneous intake rate is strongly decreased because of the important reduction of bite mass (Gibb et al., 1997; Pulido and Leaver, 2001). On the daily scale, dairy cows try to maintain PI by increasing grazing time, but in the presence of very short swards cows are unable to fully compensate the reduction of intake rate and the total daily intake is reduced (Hodgson et al., 1994).

In rotational grazing systems dry matter intake is primarily controlled by PA, described as the product between pasture mass and daily offered area (Dalley et al., 1999; Wales et al., 1999; Curran et al., 2010). The relationship is curvilinear, with PI increasing at a declining rate with increasing PA (Poppi et al., 1987). Studies carried out with medium- or high-mass pastures reported that PI increases by 0.10–0.20 kg/kg PA (Delagarde et al., 2001). On low-mass pastures, however, the effect of PA on PI has been scarcely studied. Pasture intake increased by 0.10 and by 0.16 kg/kg PA above ground level in the experiments carried out with a low-mass pasture i.e. 2.2 t DM/ha by King and Stockdale (1984) and Suksombat et al. (1994), respectively. This was comparable to the 0.18 kg/kg PA above ground level measured by Wales et al. (1999) in a spring experiment on ryegrass–white clover pastures (3.1 t DM/ha and a pre-grazing platemeter pasture height of 5.6 cm). The effect of PA on PI recorded in these experiments was therefore similar to that reported with higher pasture mass.

During winter, however, time at pasture is normally restricted to reduce pasture damage due to pugging, and supplementation is required to compensate the low pasture availability at the farm level. To our knowledge, grazing of low-mass pastures has never been studied under such conditions, two of the works presented above being experiments carried out in seasons other than winter i.e. with different sward structural characteristics (autumn: King and Stockdale, 1984; spring: Wales et al., 1999). On the other hand, although the experiment of Suksombat et al. (1994) studied the effect of PA on PI in late autumn, it was with unsupplemented cows and unrestricted access time at pasture. Therefore, if cows grazing low-mass pastures are given restricted access time to pasture, they will be not only limited by the low intake rate typical of low-mass pastures, but probably by an insufficient time to compensate this low intake rate. Under these conditions, pasture intake may be reduced even when pasture availability is not restrictive.

The objective of this study was to determine the effect of PA on PI, performance and grazing behaviour of dairy cows when strip-grazing low-mass pastures in winter. This will allow a better understanding of PI regulation under important restrictions of pasture mass when extending the grazing season.

2. Materials and methods

This experiment was carried out in late winter from February 8 to March 17, 2008, at the INRA experimental farm of Méjusseaume (1.71°W, 48.11°N, Brittany, France). Pastures comprised of 80% perennial ryegrass (*Lolium perenne* L., cv. 'Ohio'), 15% white clover (*Trifolium repens* L., cv. 'Alice') and 5% others, on a fresh basis. The pastures had been sown 5 years previously and were rotationally grazed by a dairy herd in the previous autumn to keep a low pasture mass in early December 2007 (post-grazing platemeter pasture height: 4.0 cm approx.).

2.1. Treatments and experimental design

Three PA levels, namely LOW, MEDIUM and HIGH (19, 32 and 46 kg OM/cow above ground level, respectively) were compared in a 3 × 3 orthogonal Latin square design balanced for carry-over effects (Jones and Kenward, 1989), during 3 successive 13-day periods. Each cow was offered a daily ration of 4.4 kg OM of maize silage, 2 kg OM of concentrate and 100 g of minerals (Table 1). The concentrate consisted of the following ingredients on a dry matter basis: sugar beet pulp, 20%; barley, 20%; corn meal, 20%; wheat, 20%; wheat bran, 15%, molasses 3%, sodium chloride 1%, and vegetable oils, 1%.

2.2. Cows

Twelve multiparous and six primiparous Holstein-Friesian dairy cows in mid lactation were selected and turned-out on January 21. The groups were balanced according to parity (1 primiparous per group; 3.0 ± 1.9 lactations), stage of lactation (125 ± 18 days in milk), milk production at peak (36.9 ± 8.1 kg), milk production (28.1 ± 4.5 kg), milk fat concentration (41.1 ± 5.1 g/kg), milk protein concentration (30.7 ± 2.4 g/kg), body weight (613 ± 80 kg) and body condition score (2.5 ± 0.3, scale 0–5), measured in a pre-experimental period from January 21 to February 5. During this period, the cows grazed nonexperimental pasture during the day (between am and pm milking) and were housed at night when they received maize silage and concentrate. These supplements were mixed and offered to the cows after the pm milking. Maize silage and concentrate were gradually decreased during this 15-day period from 15 to 5 kg DM/d and from 6 to 2 kg DM/d, respectively. Cows were milked twice daily at 06:30 h and 18:00 h.

2.3. Grazing and feeding management

Three paddocks were grazed during the experiment. Within each paddock, the three treatments groups grazed as separated herds, working in a strip-grazing system. All

Table 1
Chemical composition and nutritive value of supplements (maize silage and concentrate).

Supplements	Maize silage	Concentrate
DM (g/kg)	373	907
OM (g/kg DM)	956	948
OM composition (g/kg)		
CP	64	130
NDF	411	247
ADF	224	101
ADL	21	19
Starch	389	484
Nutritive value		
OM digestibility [a]	0.704	0.842
NE_L (MJ/kg OM)	6.66	8.20

ADL = acid detergent lignin.
[a] Calculated from pepsin-cellulase digestibility (Aufrère and Michalet-Doreau, 1988).