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Part-time grazing – a suitable grazing model for barns with automatic milking?

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Summary

Part-time grazing with access to pasture during 10-12 hours daytime was studied in two experiments with automatic milking systems. In the experiments, production pasture was compared with offering the cow access to a smaller field mainly for exercise. Cows with production pasture were given new pasture area at an allowance of 15-20 kg dry matter per cow and day, while access to supplementary silage was limited in time (experiment 1) or time and amount (experiment 2). Cows with exercise pasture were put in the same field each day throughout the experiment and were offered silage ad libitum during 24 hours (experiment 1) or 16 hours (experiment 2) daily. In experiment 1, cows with production pasture had access to silage ad libitum during the late afternoon and night. In this experiment cows with production pasture had a significantly higher milk yield (+1.6 kg Energy Corrected Milk/day) compared with the cows with exercise pasture. This increase in production was, however, fairly costly as the cows in the production pasture group consumed approximately 10 kg dry matter (DM) silage daily, even though they were given a new pasture area daily. Therefore in experiment 2, the amount of silage for cows in the production pasture group was restricted to 6 kg DM at night time. Even though the grazing conditions, due to dry weather, were not optimal in experiment 2, cows in the production pasture group with restricted silage allowance at night time, had the same milk production as the cows in the exercise group who had free access to silage during 16 hours per day. The two experiments showed that the system of part-time exercise pasture combined with full indoor feeding used by many farmers can be challenged by production pasture. Compared with cows on exercise pasture, it was possible for cows on production pasture to achieve a higher milk yield or a lower intake of silage, but both advantages were not achieved at the same time in the experiments that a evaluated a system with part-time grazing during the daytime.

Introduction

In countries like Sweden, where it is stipulated in the law that cows must go out to pasture a few hours daily in the summer, many farmers with AM have chosen to offer the cows only

exercise pasture with full indoor feeding. However, grazing during only part of the 24 hour period can offer several advantages for milk producers with automatic milking (AM) systems. In a system with part-time production pasture, cows are offered a new pasture area daily during 8-12 hours daily at a high pasture allowance. In this system, it is envisaged that pasture utilization will high but the area needed for pasture is smaller compared with full-time grazing. Thus, the distance to the pasture area can be shorter. The distance to pasture, has been shown to be an obstacle in AM barns (Spörndly & Wredle, 2004) and therefore shorter distances can be important and have a significant impact on cow traffic, especially in larger herds. The objective of the part-time production pasture system is to utilize pasture as a cheap feed during part of the day while during the remaining hours, cows are indoors with supplements which secure the nutrient supply to the animals throughout the season, especially during periods with sub-optimal pasture conditions. With this model, pasture is utilized in the ration while the negative effects of the large variations in pasture supply and in pasture quality can be avoided. By keeping the cows indoors during part of the 24 h period, it is also possible to achieve a more even milking interval. The objective of the experiments was to study production pasture compared with exercise pasture in a barn with AM, in a system with part time grazing. The hypothesis was that the system with production pasture combined with silage feeding in a part time grazing system would stimulate the cows to a high total intake and this would give 1) a lower consumption of conserved feed (silage) and 2) a higher milk yield compared with exercise pasture with full silage feeding indoors.

Material and Methods

Two experiments and one smaller behaviour study with part-time grazing were performed in an AM barn where exercise pasture with full indoor silage feeding was compared with production pasture and silage supplied during non-grazing hours. Experiment 1 was performed with 53 cows of the Swedish Red Breed during 12 weeks in 2011 and experiment 2 took place during 5 weeks in 2013 using 42 cows of both the Swedish Holstein and the Swedish Red breed. In both experiments and in the smaller behaviour study, primiparous cows constituted approximately one third of the experimental cows. In the two experiments milk yield, milking frequency and feed intake indoors was registered automatically. In experiment 2 the time the cows were on pasture was also automatically registered. Milk samples were collected for analysis before experimental start and thereafter every second week during the experiment.

Manual observations of cow behaviours on pasture were performed every 15 minutes during three days in all experiments. Furthermore, in a smaller behaviour study performed in 2012, the behaviour of 43 cows of the Swedish Holstein and the Swedish Red breed with exercise and production pasture were also studied in the same way.

Pasture height and pasture allowance were measured daily and samples of pasture and supplementary feed were collected daily for chemical analysis to determine nutrient composition of pasture and feeds. Cows had access to the outdoor pasture/exercise are during

9.5-12 hours daytime. The animals could move freely from the barn to the pasture during this time. During the remaining time, they were kept in the barn with access to feed and water and without possibility to go out.

All animals in both groups were given concentrates according to calculated requirements based on the milk production level before experimental start with a standardized calculated decrease in production level of 0.4 kg energy corrected milk (ECM) per week after lactation week 10 and assuming an intake of roughage (pasture+silage) of 12 kg DM per day. Drinking water was available only in the barn. The animals were divided into comparable blocks, and from these blocks, cows were randomly assigned to the two treatment groups "Production" or "Exercise". Both groups were kept in the same barn but were assigned to different pasture areas (production or exercise) when passing a selection gate on the passage out to the pasture. In all experiments cows in both treatment groups had access to the outdoor area (production or exercise pasture) during the same hours, 06-15.30 in experiment 1, 06-18 in experiment 2 and 06-16 in the behaviour study, giving the animals 9.5, 12 and 10 h outdoor access time in the three studies respectively.

Exercise pasture treatment: cows in this group had access to the same field of 1 ha throughout the experiment with a possibility to utilize an adjacent small paddock (1 ha) for shorter periods if the field was at a risk of becoming damaged by overgrazing. During experiment 1, the cows in the group on the exercise pasture had free access to silage in the barn during 24 hours/day. During experiment 2 cows had access to the exercise pasture during 16 h per day (14h – 06 h the next morning). The distance to the exercise pasture was approximately 200 m in all the studies.

Production pasture treatment: Cows in this group were given a new grazing area daily at a pasture allowance 20 kg DM per cow & day in experiment 1, and 15 kg DM/cow and day in experiment 2. To stimulate the cows to a high pasture intake, no silage was given during grazing hours. In experiment 1 free access to silage was offered starting 1.5 hours before the end of the grazing session to attract the animals to come back to the barn voluntarily, and thereafter throughout the late afternoon and night when they were confined in the barn. In experiment 2, cows in the production pasture group had access to 6 kg DM silage only during the hours when they were confined in the barn. The distance to the pasture area varied between 20 and 200 m in experiment 1 and between 200 and 400 m in experiment 2 and in the behaviour study. In experiment 1 the total area utilized for the production pasture group was 3.6 ha and in experiment 2 the area utilized in the rotation was 5 ha.

The results from the experiments were analysed in a general linear model using the SAS program (ver. 9.2; SAS Institute Inc.). The final model for the statistical analysis of the production parameter (milk yield and milk components) in experiment 1 contained the variables treatment group (production/exercise) and the milk yield before experimental start as a covariate. For milk yield, the variable lactation stage was also significant and therefore included in the model. The model for experiment 2 also contained the variables breed, age (primiparous/multiparous) but not lactation stage due to lack of significance. Other variables and interactions were tested but were excluded from the model as they were not significant.

In the analysis of the first experiments behaviour results the model contained only the variable treatment, while for the second experiment and the behaviour study, the variables breed and age were also included as they were statistically significant.

Results and discussion

Both experimental years were characterized by dry weather and the second experiment was also shorter than originally planned due pasture shortage. Feed and pasture composition are presented in Table 1 and Table 2.

Table 1. Nutrient content per kg dry matter (DM) in silage, production pasture and exercise pasture in experiment 1 and 2, and sward height (cm), experimental mean.

	Experiment 1			Experiment 2		
	Silage[1]	Prod	Exercise	Silage[2]	Prod	Exercise
Crude protein, g/kg DM	146	196	183	148	132	169
NDF, g/kg DM	472	427	414	453	426	358
Metabolizable energy, MJ/kg DM	10,8	11,0	11,0	11,2	9,7	9,4
Sward height, cm		9,3	2,5		22,5	5,1

[1]Experimental year 1:DM in silage 40 %; [2]Experimental year 2: DM in silage 32 %

During experiment 1 the cows with production pasture had 1.6 kg ECM higher milk yield compared with cows in the exercise group (Table 2). No significant difference was obtained in milking frequency which was 2.83 and 2.72 in the production and exercise pasture groups, respectively. In experiment 1, cows with production pasture had free access to silage 16 h per day and had access to the pasture area 9.5 hours per day. The behaviour studies on pasture (Table 3) showed that in experiment 1, the cows on the production pasture spent approximately 3 h daily on the pasture and only spent 2 hours grazing even though they were offered new pasture daily. Besides eating pasture, cows in the production pasture group had an average intake of 9.8 kg DM silage per day in the barn. This can be compared with the average silage intake in the exercise group that was 12.2 kg DM per day for these cows who had access to only exercise pasture. Thus, even if the milk yield for the cows in the production pasture group was higher, the cost for the increase in production was high as the cows were offered new high quality pasture daily, yet consumed large amounts of conserved feed.

Based on the results from experiment, 1, the amount of silage offered to the cows in the production pasture group was restricted to 6 kg DM/cow and day in experiment 2. The objective was to see if it was possible to achieve a high milk yield when silage intake was restricted. To stimulate the cows to a higher pasture intake, the access to the pasture was

extended to 12 h daily and the supplementary silage was offered at night, when the cows could not go out to pasture. The objective was that cows in this group would consume at least half their roughage intake as pasture in the daytime and 6 kg DM silage at night. Cows in the exercise group were offered free access to silage during 16 hours daily, between 14 and 06 hours.

Table 2. Milk yield and milk composition in experiment 1 and 2, least square means.

	Experiment 1			Experiment 2		
	Production	Exercise	Sign[1]	Production	Exercise	Sign[1]
Milk, kg	35,6	33,3	**	32,2	32,6	NS
ECM, kg	35,8	34,2	*	32,5	32,1	NS
Milk fat, %	4,03	4,25	*	4,04	3,91	NS
Milk protein, %	3,36	3,37	ES	3,37	3,32	NS

[1]NS = not significant difference; ** *P<0,01; * P<0,05*

In experiment 2 the average intake of was 11.5 and 6.2 kg DM in the exercise and production group, respectively. As seen in Table 2, there was no difference between the groups in milk yield or milk composition in experiment 2. For milking frequency, there was a significant (*p<0.05*) interaction between treatment and parity in the exercise pasture group 2.75 and 2.51 milkings/day for primiparous and multiparous cows, respectively. No other significant differences between parity and treatment groups were found. In a similar manner, there was a significant interaction in milking frequency between breed and parity with a significantly lower milking frequency for multiparous cows of the Swedish Red Breed (2.45 milkings/day) compared with primiparous cows of the Swedish Red Breed ((2.75 milkings/day; *p<0,01*) and multiparous cows of the Swedish Hostein breed (2.72 milkings/day; *p<0,05*).

The weather was very dry and the pasture rapidly became less digestible with a considerably lower content of metabolizable energy compared with the nutritive content of the silage that year and also lower compared with the pasture in experiment 1. The results showed that even when pasture conditions are less favorable, cows on production pasture daytime and restricted supplementary silage at night can achieve similar production results as cows on an exercise pasture daytime and with free access to high quality silage 16 h daily.

Table 3. Behaviour of cows with production pasture (Prod), or with exercise pasture (Ex) in a barn with automatic milking and part-time grazing (daytime). Hours (h) spent outside the barn and hours spent grazing. Access to pasture was 9.5, 12 and 10 h in experiment 1, 2 and in the behaviour study, respectively. Least square means and significance levels.

	Experiment 1	Experiment 2	Behaviour study[3]

	Prod	Ex	Sign.[1]	Prod	Ex	Sign.[1]	Prod	Ex	Sign[1]
Outdoor time, h	3,0	1,9	***	4,5[2]	3,5[2]	***	4,1	4,1	NS
Grazing time, h	2,0	1,1	***	2,3	1,1	***	2.4	2,1	NS

[1]NS= not significant; ***= *P<0,001;* [2] Data from 18 days automatic registrations [3]Guzhva, 2013

In both experiments 1 and 2 there was a significant difference in the time that the cows on the different treatments spent outdoors and spent grazing (Table 3). The cows on production pasture only utilized the possibility to be outdoors around 30-40% of the outdoor access time in the three studies and they spent only 20-25% of this time grazing.

No significant difference in behavior between the treatment groups was observed in the small behavior study. This can be explained by the fact that during this study, there were problems with the indoor feeding equipment which resulted in similar indoor feeding for the two treatment groups that year. This indicates that the behavior of the cows in the two groups was only marginally affected by the pasture conditions which differed considerably. Instead they were mainly influenced by the level of supplementary silage offered in the barn.

The results of the two experiments showed that it is possible to achieve either a higher milk yield (experiment 1) or a considerably lower intake of supplementary silage (experiment 2) on production pasture compared with exercise pasture, but both these advantages were not obtained at the same time.

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