Milk production from grazed pasture in mountainous regions of Austria - impact of calving season

Steinwidder A., Starz W., Podstatzky L., Gasteiner J., Pfister R., Rohrer H. and Gallnböck M.
Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein, 8952 Irdning, Austria
Corresponding author: andreas.steinwidder@raumberg-gumpenstein.at

Abstract

The influence of calving season on milk yield, lactation length, composition of the diet, reproduction and nutrient supply for pasture-based systems in a mountainous region of Austria was examined with thirty-three dairy cows on an organic farm. Three groups of cows with a mean calving date of 17 November (group 1), 25 December (group 2) and 20 February (group 3) were compared. During winter periods the cows were housed and fed with grass silage, hay and a restrictive amount of concentrate. Cows were on pasture for 202 days in 2008 and 203 days in 2009 (177 day and night grazing days). The pasture area was continuously grazed at an average sward height of 4.7 cm. Calving in February (group 3) significantly depressed lactation length and milk-fat yield and tended to decrease energy-corrected-milk yield. From group 1 to 3 the amount of concentrate fed per cow decreased from 669 to 373 kg DM y^{-1} and the grazed pasture proportion increased from 43 to 50% of total feeding ration per year. Calving date had no effects on reproductive performance and frequency of veterinary treatments. However, at the beginning of the grazing season live weight loss and contents of βHBA, FFA and AST were highest in blood samples of group 3.

Keywords: grazing, dairy cows, seasonal milk production

Introduction

Seasonal dairy production of pastoral systems aims at implementing a site-adapted low-cost strategy. Both the season and calving distribution have major effects on milk yield, composition of diet and nutrient supply for pastoral milk production systems (Dillon *et al.*, 1995; Garcia *et al.*, 1998; Auldist *et al.*, 1997 and 1998; Garcia und Holmes, 1999; Häusler *et al.*, 2009). In typical pasture-based seasonal milk production regions, the majority of dairy cows calve in late winter-early spring. In mountainous regions the grazing period is quite short (5-8 months) and housing costs are high. The cows are bred for high daily milk yields and are larger and heavier on average than in pasture-based seasonal milk production regions. Under mountainous conditions a shift of the calving season to the beginning of the winter time may have positive effects on nutrient supply, milk yield and physiological parameters.

Animals, materials and methods

The experiment was performed at the organic dairy farm of the AREC Raumberg-Gumpenstein (680 m altitude, 7°C average temperature, 1014 mm precipitation $year^{-1}$; latitude: 47° 31/ 03/ / N; longitude: 14° 04‘26‘‘E). A total of 33 dairy cows (13 Brown Swiss, 20 Holstein Friesian; lactation number 2.7) were assigned to three calving date groups in 2008 and 2009. The mean calving dates were 17 November (group 1), 25 December (group 2) and 20 February (group 3). During winter period all cows were housed and fed *ad libitum* with forage (grass silage, hay). Concentrate was distributed according to lactation period and milk yield, varying from 0 to 7 kg DM cow^{-1} day^{-1}. At the beginning of the grazing period grass silage and concentrate amount were continuously reduced. Grass silage feeding was completed at the beginning of

the day and night grazing period (30 April). Hay was offered restrictedly (1.5 kg DM cow^{-1} day^{-1}) and concentrate was only fed to cows exceeding 28 kg daily milk yields (28-30 kg daily milk yield: 1 kg concentrate; > 30 kg daily milk yield: 2 kg concentrate cow^{-1} day^{-1}). At the end of lactation and during the dry period, cows in the cowshed got 4 kg hay and grass silage *ad libitum*. All cows were on the same pasture for 202 or 203 days (12 April-1 Nov. 2008; 15 April-3 Nov. 2009) with 177 day and night grazing days. The permanent grassland area was continuously grazed at a sward height between 4-6 cm (Ø 4.7 cm - Filip`s Folding Plate Pasture Meter). During the stable period, forage intake was recorded by 5-day recording periods each week using Calan gates. During the grazing season, at the end of lactation and in the dry period, feed intake was calculated according to the energy requirements (GfE, 2001). Nutrient and energy content of grass silage, hay and concentrate were analysed from samples pooled over six weeks (Dlg, 1997). Grazed pasture nutrient content was measured on simulated grazing plots which were cut when sward reached an average height of 8.5 cm (Starz *et al.*, 2011) and the energy content was calculated according to GfE (1998). Individual milk production was recorded twice daily and the milk ingredients were analysed three times a week. Cows were weighed weekly and the body condition was scored every second week. At the beginning of the grazing season blood samples were taken after morning milking every two weeks. Data were analysed using the MIXED procedure of the statistical program package SAS 9.2 with the fixed effects ‚calving group', ‚breed', ‚lactation number', ‚year', ‚lactation week' and ‚pregnancy group' and the continuous covariate ‚ECM-milk yield at the beginning of the lactation' (ddfm = kr; repeated statement cow within year; type compound symmetry). Statistical differences were considered to be significant when $P < 0.05$ and tended to be significant when $0.05 < P < 0.10$.

Results and discussion

According to the results of Steinwidder *et al.* (2010) and Pötsch *et al.* (2010) grazed pasture samples showed a high net energy (6.4 ± 0.33 MJ NEL kg^{-1} DM) and CP content (22 % ± 3 kg^{-1} DM). The energy contents of hay and grass silage (5.4 and 5.8 MJ NEL kg^{-1} DM resp.) and the CP contents (15% and 12% resp.) were markedly lower than that of pasture herbage. Calving at the beginning of the vegetation period significantly depressed lactation length and milk fat yield and tended in a decreased energy-corrected-milk (ECM) yield (Table 1). Contrary to group 3, the lactation curves in groups 1 and 2 showed a second peak at the beginning of the grazing season. Similar results on the lactation curves have been reported in New Zealand for autumn- and spring-calved cows by Auldist *et al.* (1997) and Garcia *et al.* (1998). From group 1 to 3 the amount of concentrate fed per cow decreased from 669 to 373 kg DM and the grazed pasture proportion increased from 43 to 50% of total feeding ration per year. The calving date had no effects on frequency of veterinary treatments and reproductive performance. The average pregnancy rate and calving interval was 85% and 365 days respectively. Nevertheless 14% of the pregnant cows had a calving interval > 415 days which indicates repeated fertility problems of these cows. At the beginning of the grazing season live weight and body condition losses, as well as the blood contents of beta-hydroxy-butyric acid, free fatty acids and aspartate transaminase were highest in group 3. In terms of management, it has to be taken into account that in group 1 all cows were bred in the winter feeding period and in group 3 during the grazing season. In group 2 the end of the grazing season fitted best with the cows' drying-off period. The milk sales revenues (milk yield and contents, premiums for winter milk) and the pasture area requirements decreased and the feeding costs increased from group 1 to 3.

Table 1. Effects of calving date on milk yield and composition of the diet

	Group				
	1	2	3	s_e	*P*-value
Lactation length (days)	299 [a]	297 [a]	284 [b]	9	0.019
ECM (kg cow^{-1})	6.300	5.974	5.449	305	0.068
Milk (kg cow^{-1})	6.360	6.135	5.727	703	0.258
Fat (kg cow^{-1})	261 [a]	245 [ab]	217 [b]	28	0.026
Protein (kg cow^{-1})	200	189	178	19	0.149
Fat (g kg^{-1} milk)	410	400	379	29	0.091
Protein (g kg^{-1} milk)	315	308	311	17	0.612
Live weight (kg)	595	550	571	39	0.069
Hay (kg DM cow^{-1} year^{-1})	1.075 [a]	981 [b]	957 [b]	32	<0.001
Grass silage (kg DM cow^{-1} year^{-1})	1.830	1.780	1.668	209	0.359
Grazed pasture (kg DM cow^{-1} year^{-1})	2.670 [b]	2.856 [ab]	3.046 [a]	249	0.032
Concentrate (kg DM cow^{-1} year^{-1})	669 [a]	541 [ab]	373 [b]	146	0.004

Conclusions

The season of the calving period markedly influenced the results of the pasture-based seasonal milk production in mountainous region. Delaying calving date from middle of November to the end of February (group 1-3) significantly depressed lactation length and milk fat yield and tended to decrease energy-corrected-milk yield cow^{-1} y^{-1}. The amount of concentrate fed cow^{-1} y^{-1} decreased and the grazed pasture proportion of total feeding ration increased from group 1 to 3. At the beginning of the grazing season live weight loss and the contents of βHBA, FFA and AST in blood samples were highest for cows in group 3.

References

Auldist M.J., Walsch B.J. and Thomson N.A. (1997) Effects of time-of-calving on dairy production. Proc. of the New Zealand, *Soc. of Animal Production* 57, 204.

Auldist M.J., Walsch B.J. and Thomson N.A. (1998) Seasonal and lactational influence on bovine milk composition in New Zealand. *Journal of Dairy Research* 65, 401-411.

Dlg-Deutsche-Landwirtschafts-Gesellschaft (1997) Futterwerttabellen Wiederkäuer. 7. erweiterte u. überarbeitete Auflage, DLG-Verlag Frankfurt, 212 p.

Dillon P., Crosse C., Stakelum G.and Flynn F. (1995) The effect of calving date and stocking rate on the performance of spring-calving dairy cows. *Grass and Forage Science* 50, 286-299.

Garcia S.C., Cayzer F.J., Holmes C.W. and MacDonald A. (1998) The effect of calving season on milk production. A System Study. Proc. of the New Zealand, *Society of Animal Production* 58, 61-63.

Garcia S.C. and Holmes C.W. (1999) Effects of time of calving on the productivity of pasture-based dairy systems: A review. New Zealand, *Journal of Agricultural Research* 42, 347-362.

GfE - Gesellschaft für Ernährungsphysiologie (1998) Formeln zur Schätzung des Gehaltes an Umsetzbarer Energie in Futtermitteln aus Aufwüchsen des Dauergrünlandes und Mais-Ganzpflanzen. Proc. Soc. Nutr. Physiol., 7, 141-150.

GfE-Gesellschaft für Ernährungsphysiologie-Ausschuss für Bedarfsnormen (2001) Empfehlungen zur Energie- und Nährstoffversorgung der Milchkühe und Aufzuchtrinder. DLG-Verlag Frankfurt, 136 p.

Häusler J., Resch R., Gruber L., Steinwidder A., Pötsch E. and Guggenberger T. (2009) Einfluss der Ergänzungsfütterung auf Futteraufnahme und Milchleistung bei Weidehaltung von Milchkühen. Bericht zur 36. Viehwirtschaftliche Fachtagung 2009, 99-128.

Starz W., Steinwidder A., Pfister R. and Rohrer H (2011) Forage feeding value of continuous grazed sward on organic permanent grassland. EGF 2011, Raumberg-Gumpenstein, Grassland Science in Europe 16, 356-358.

Pötsch E.M., Resch R., Haeusler J. and Steinwidder A. (2010) Productivity and floristic diversity of a continuous grazing system on short swards in mountainous regions of Austria. EGF 2010, Kiel Germany, *Grassland Science in Europe* 15, 988-990.

Steinwidder A., Starz W., Podstatzky L., Kirner L., Pötsch E.M., Pfister R. and M. Gallnböck (2010) Changing towards a seasonal low-input pastoral dairy production system in mountainous regions of Austria - results from pilot farms during reorganization. EGF 2010, Kiel Germany, *Grassland Science in Europe* 15, 1012-1014.