Comparison of a feeding variant of the current and future grassland-based milk production programme

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Abstract

The aim of the Grassland-Based Milk and Meat (GMM) programme, part of the direct payment ordinance in Switzerland, is to maintain ruminant production based on herbage and the reduced use of concentrates. Variants of the current and future GMM programme were compared in our study. During the winter, the forage of 64 dairy cows consisted of hay. From the end of March onwards, a continuous switch to full grazing was made. During the first 90 days in milk, cows in the 'current GMM' treatment (ACT) received 2 kg of energy and 1 kg of protein concentrate (as fed). In the 'future GMM' treatment (FUT), the cows received 3 kg of energy concentrate exclusively. The results of the first six official milk recordings are presented here. Cows in the FUT treatment produced less energy-corrected milk (ECM) compared to those in the ACT group, and their milk urea content was lower. The lactose content was minimally higher in the FUT treatment group than in the ACT group. The milk fat and protein contents, as well as the somatic cell counts, were not influenced by the treatment type. With a herbage-based ration, the protein-reduced concentrate supplementation of the cows leads to a lower milk yield with a reduced milk urea content.

Keywords: grassland, feeding systems, dairy cow, herbage, protein

Introduction

Feed-food competition and the massive import of protein rich feeds like soya bean meal, of which at least 1/3 is used as ruminant feed, are largely disapproved of by society and authorities, especially as the medium-term environmental goals of Swiss agriculture with regard to nitrogen losses and emissions will probably not be achieved.

On the 1st January 2014 the GMM programme was introduced in Switzerland as a part of the direct payment ordinance. The aim of the GMM programme is to maintain ruminant production geared to local conditions that are based on fresh and preserved herbage and a reduced use of concentrates. Participation in the GMM programme is voluntary and farmers receive contributions upon their participation in the programme. In this context, the reorientation of the future GMM and administrative simplifications of the programme were discussed among stakeholders and the Federal Office of Agriculture. Subsequently, the suitability of the future variants proposed by the Federal Office of Agriculture was assessed (Schori, 2020). One proposed variant of the future GMM programme would only allow the purchase of concentrates for ruminants with a maximum crude protein (CP) content of 12% per kg dry matter (DM). Consequently, the main part of the protein that is needed to cover the protein requirements of ruminants should come from the feed produced on the farm. In this study, variants of the current and future GMM were compared in a herbage-based feeding system throughout the standard lactation period of 305 d of dairy cows.

Animals, materials and methods

The experiment was carried out on the organic farm, Ferme-Ecole de Sorens, located in Sorens, Switzerland. During the winter, the forage of the Holstein and Swiss Fleckvieh cows consisted of hay *ad libitum* (5.3±0.10 (standard deviation [sd]) MJ net energy for lactation [NEL] and 118±4.8 (standard deviation, SD) g CP per kg DM, n=4). From the end of March onwards, a continuous switch to full grazing was made (fresh herbage: 6.1±0.39 (SD) MJ NEL and 158±31.7 (SD) g CP per kg DM, n=6). The average calving date of the experimental dairy cows was 25 February 2021 (±35 d (SD)). During the first 90 days in milk, the cows in the ACT treatment received 2 kg of an energy (7.7±0.17 (SD) MJ NEL and 136±2.7 (SD) g CP per kg DM, n=3) and 1 kg of a protein concentrate (8.2±0.02 (SD) MJ NEL and 412±2.9 (SD) g CP per kg DM, n=3). In the FUT treatment, the cows received 3 kg of the same energy concentrate exclusively. In total, 64 cows, of which 40% were primiparous, were paired in relation to their breed, lactation number, and calving date. Every 14-days, during the official milk recording, the individual milk yield was recorded. At the same time, milk samples from two consecutive milkings were taken from each cow. The fat, protein, lactose, and urea contents as well as the somatic cell counts of these milk samples were analysed. The energy-corrected milk (ECM) was calculated based on the fat, protein, and lactose content of the milk according to Münger *et al.* (2021). A mixed linear model (R Core Team, 2021) was used for the evaluation, with the treatment type and number of recordings as well as their interaction forming the fixed factors. The cow pairs were set as a random factor.

Results and discussion

The preliminary results of the first six official milk recordings are presented in Table 1. The Holstein and Swiss Fleckvieh dairy cows in the FUT treatment produced less milk and ECM compared to those in the ACT group. With a CP-to-NEL ratio of 22.3 and 25.7 g MJ^{-1} the hay and the fresh herbage, respectively, should contain sufficient CP. Nevertheless, with the effect of an additional 257 g CP on the milk yield, the finding of approximately 1.7 kg more milk per cow and day during the first 12 weeks of lactation, is rather surprising. Law *et al.* (2009) found with an increase of the CP content of the ration from 114 to 144 g kg^{-1} DM and 144 to 173 g kg^{-1} DM an increase in milk yield during the first 150 days of lactation of 6.4 and 3.6 kg per cow and day, respectively. In our experiment, the difference between the ACT vs FUT treatments was approximately 15 g CP kg^{-1} DM feed. Consequently, our results seem to be consistent with the milk yield difference obtained by Law *et al.* (2009) at a feed protein level between 144 to 173 g CP kg^{-1} DM. Interestingly, the difference in the milk protein yield between the two feeding treatments in our experiment agrees quite well with the estimated value according to Huthanen and Hristov (2009) for a northern European data set (47 vs 42 g d^{-1}). In contrast to our results, Zang *et al.* (2021) obtained a significant effect of the protein content of the ration, on the milk yield of dairy cows in the first three weeks in milk, but not during the first 13 weeks. Moreover, the lactose content was minimally higher in the FUT treatment group than in the ACT treatment group. In general, lactose content is relatively constant and related to energy balance (Reist *et al.*, 2002), udder health, and metabolic disorders (Costa *et al.*, 2019). Milk fat and protein content were not influenced in our study by the treatments (FUT vs ACT). With the increase of 144 to 173 g CP kg^{-1} DM, Law *et al.* (2009) also detected no differences in the content of the milk from dairy cows at the beginning of lactation. As an indication of udder health, the somatic cell count was used in our study. No differences were observed according the somatic cell counts between the FUT vs ACT treatments. Not surprisingly, the milk urea content was lower in the FUT treatment group compared to the ACT treatment group. An advantage of the future GMM variant would be that less protein-rich feedstuffs, such as soya bean meal, rapeseed meal, or grain legumes, are used in the feeding of dairy cows. Lower urea levels in the milk of the dairy cows may indicate lower N emissions and/or losses from the milk production system (Powell *et al.*, 2011), which would be another benefit for society. A disadvantage for milk producers would be the reduced milk yield and, consequently, reduced revenue. At the magnitude of our experiment, such revenue losses cannot be compensated by savings in concentrate costs.

Table 1. Results (least squares means) of the first six official milk recordings.[1]

	Actual treatment (ACT)	Future treatment (FUT)	Standard error	*P*-values
Milk yield (kg d^{-1})	29.6	27.9	0.76	<0.001
ECM yield (kg d^{-1})	29.1	27.4	0.78	<0.001
Milk fat (g kg^{-1})	40.7	40.3	0.55	0.51
Milk protein (g kg^{-1})	30.6	30.8	0.29	0.54
Lactose (g kg^{-1})	48.1	48.4	0.20	0.005
Milk urea (mg dl^{-1})	19.7	15.9	0.58	<0.001
SCC (log 10 ml^{-1})	4.58	4.59	0.050	0.94

[1] ECM = energy-corrected milk; SCC = somatic cell counts.

Conclusions

Even with herbage rations of an average quality regarding nutritive values, the use of a cereal mixture as the sole concentrate supplementation for dairy cows leads to lower milk yields with similar milk contents and reduced milk urea contents compared to a partial protein concentrate supplementation. The future GMM variant has benefits for society as well as disadvantages for milk producers. Overall, more in-depth investigations are needed to study the interaction between forage CP content and reduced protein concentrate supplementation on milk production, nitrogen losses, animal-welfare and fertility.

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