The effect of flavophospholipol (Flavomycin®) on milk production and milk urea nitrogen concentrations of grazing dairy cows

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Abstract

Milk production and milk composition responses to supplementation of Holstein-Friesian cows grazing kikuyu pasture in summer and a combination of annual ryegrass and maize silage in winter with 64 mg/d flavophospholipol were determined. There was no difference in the average milk yield over the first 100 days of lactation between the control group (19.8 kg/day) and the Flavomycin supplemented group (20.5 kg/day). Milk production over the full lactation of 300 days was also not influenced by Flavomycin addition (control: 5 525 kg; treatment: 5 627 kg). There was no difference between the control and treatment group in average butterfat percentage (3.55% *vs.* 3.62%), butterfat yield over 300 days (195.3 kg *vs.* 201.2 kg), average protein percentage (3.12% *vs.* 3.14%) or protein yield over 300 days (170.2 kg *vs.* 178.5 kg). Flavomycin addition only reduced the milk urea nitrogen (MUN) concentrations during the third week of April (treatment: 16.0 ± 0.8 mg MUN/dl; control: 18.6 ± 0.4 mg MUN/dl) and the second week of September (treatment: 16.0 ± 1.2 mg MUN/dl; control: 19.6 ± 0.9 mg MUN/dl). Cows grazing nitrogen-fertilized pastures displayed great variation in weekly and monthly milk urea nitrogen concentrations which frequently exceed 18 mg MUN/dl.

Keywords: Flavomycin, milk, urea, runimant, nuitrition, dairy
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Introduction

Monensin, an ionophore, has been shown to reduce urea nitrogen concentrations of milk from mid-lactation dairy cows grazing kikuyu pasture (Van der Merwe *et al.*, 2001). However, no information is available on the effect of the non-ionohore antibiotics used in ruminant diets on milk urea nitrogen concentrations in lactating dairy cows. The non-ionophore antibiotics represent a diverse group differing in chemistry, primary antibacterial spectrum, mode of action of bacterial inhibition, molecular weight and ability to be absorbed from the gut. Avoparicin, flavomycin, tylosin and virginiamycin promote growth primarily via modification of rumen fermentation characteristics (Nagaraja, 1997). Flavomycin has a marked antibacterial effect on numerous gram-positive micro-organisms that are found in the digestive tract, and enhances the breakdown of starch and cellulose in the rumen resulting in increased propionic and acetic acid production (Cafantaris, 1981). Flavomycin has been shown to increase milk fat and protein production (Hamman, 1983; Kraszewski *et al.*, 1991; Behrens *et al.*, 1993), the mode of action being an increased protein flow from the rumen and improved amino acid absorption in the small intestine (Behrens *et al.*, 1993). The first hypothesis of this study was therefore that the addition of Flavomycin to the diet of cows calving during early summer onto kikuyu (*Pennisetum clandestinum*) pasture would facilitate fibre digestion leading to improved milk production and composition. A reduction in the ammonia content of the rumen has also been reported to result from Flavomycin supplementation (Murray *et al.*, 1990) and this is an indication of increased microbial protein synthesis (Van den Bergh, 1995). Pastures that have been fertilized with high levels of N are characterized by a high crude protein content and a high rate and extent of crude protein degradation in the rumen (van Vuuren, *et al.*, 1990; van der Merwe, 1993). This results in high concentrations of ammonia-N in the rumen (van Vuuren, *et al.*, 1986) and substantial N losses via urinary excretion. It has been suggested that excess rumen ammonia production decreases milk yield and fertility in dairy cows (Westwood, *et al.*, 1998). Since the urea content of milk is correlated with rumen ammonia concentration (Roseler, *et al.*, 1993), milk urea nitrogen (MUN) concentration may be a useful indicator of the productive and reproductive performance of a herd (Hutjens & Barmore, 1995; Westwood, *et al.*, 1998). The second hypothesis was therefore that Flavomycin addition would decrease milk urea nitrogen concentrations as a result of decreased rumen ammonia concentrations.

Materials and methods

Fourteen cows and fourteen heifers were assigned to either the control or treatment group prior to calving. This procedure allowed cows and heifers in the treatment group a two-week adaptation period to Flavomycin prior to their estimated calving date. Groups were balanced for body weight (mean: 576 ± 54.0 kg for multi-parous and 530 ± 54.2 kg for primi-parous cows post partum), lactation number and previous lactation yield. Each group consisted of 14 Holstein-Friesian cows, half of which were first-calf heifers. Cows calved in late spring (November) and had access to kikuyu grazing for 24 h in summer (November to March) and limited irrigated annual ryegrass (*Lolium multiflorum*) grazing plus maize silage in winter (April to October). A step-rate system of concentrate allocation was followed whereby all cows received a concentrate mixture at a level of 10 kg/d (approximately 2% of post partum body weight) for the first 120 days of lactation, and at a level of 5 kg/d for the rest of the lactation. The concentrate mixture allocation (85% maize meal; 120 g CP/kg; 11.5 MJ ME/kg) was split into two equal portions and fed after the morning and afternoon milkings in a post-parlour individual feeding system. The treatment group cows received eight grams of Flavomycin® premix (64 mg Flavophospholipol) per day, which was top-dressed and mixed into the concentrates fed after the afternoon milking. The milk yield of each cow was recorded twice daily and a combined morning and afternoon milk sample was taken weekly and analysed for protein and butterfat (System 4000, Foss Electronic, Denmark). A composite morning and afternoon milk sample was taken from each cow on a weekly basis from mid December 1995 to the end of October 1996 and assayed for milk urea nitrogen (System 4000, Foss Electronic, Denmark). Cows were weighed and body condition scored on a scale of 0 to 5 (Mulvany, 1977) at monthly intervals after the morning milking.

Analysis of covariance was performed on the milk yield, milk composition and milk component yield data. Data over the first two weeks of lactation were used as a covariate. Analysis of variance was used to test for differences in MUN between the two groups on a weekly basis.

Results and discussion

The effect of Flavomycin on milk production and composition is presented in Table 1. There was no difference (P > 0.05) in average milk yield over the first 100 days of lactation between the control group and the Flavomycin-supplemented group. Milk production over the full lactation of 300 days was also not influenced by Flavomycin addition (P > 0.05). There was no difference (P > 0.05) between the control and treatment group in average butterfat percentage, butterfat yield over 300 days, average protein percentage or protein yield over 300 days. Reports on the effects of Flavophospholipol on milk production and milk composition are conflicting. Reports either indicate no significant change or a tendency (not significant) towards improved milk yield and composition (Ruffo & Valerani, 1977; Gunther, 1986; Arana, *et al*., 1992) or significant improvements in milk yield and composition (Hamann & Heeschen, 1983; Bahrecke, *et al.*, 1984). The greatest responses have been observed during early lactation.

Table 1 The effect of Flavophospholipol on milk production and milk composition

	Control	Flavophospholipol	s.e.	P	LSD (0.05)
Milk yield (kg; total over 300 d)	5 525	5 627	131.9	0.600	390.9
4 % FCM yield (kg; total over 300 d)	5 124	5 284	141.4	0.448	420.0
Milk yield (kg; avg. over 1st 100 d)	19.8	20.5	0.68	0.482	2.01
4% FCM yield (kg; avg. over 1st 100 d)	18.1	18.6	0.65	0.654	1.94
Butterfat (%; avg. over 300 d)	3.55	3.62	0.07	0.469	0.20
Butterfat (kg; total over 300 d)	195.3	201.2	6.54	0.542	19.3
*Protein (%; avg. over 300 d)	3.12	3.14	0.03	0.707	0.11
Protein (kg; total over 300 d)	170.2	178.5	4.65	0.227	13.9

* Covariate not used because of non-significance (P = 0.28)

The variation in MUN concentration from mid December to the end of October is shown in Figure 1. Over the eleven-month monitoring period, there were only two weeks when a significant difference was recorded between the milk urea concentrations of the two groups. Flavomycin addition reduced ($P < 0.05$) MUN concentrations during the third week of April (treatment: 16.0 ± 0.8 mg MUN/dl; control: 18.6 ± 0.4 mg MUN/dl) and the second week of September (treatment: 16.0 ± 1.2 mg MUN/dl; control: 19.6 ± 0.9 mg MUN/dl). The lack of a clear MUN response is consistent with the results of Murray *et al.* (1991) who reported that Flavomycin did not lower rumen ammonia concentrations in sheep. Similarly, in cattle fed a concentrate diet supplemented with straw *ad lib*., flavomycin had no effect on rumen VFA and ammonia concentrations, or on *in situ* cellulose fermentation (Rowe *et al*., 1982).

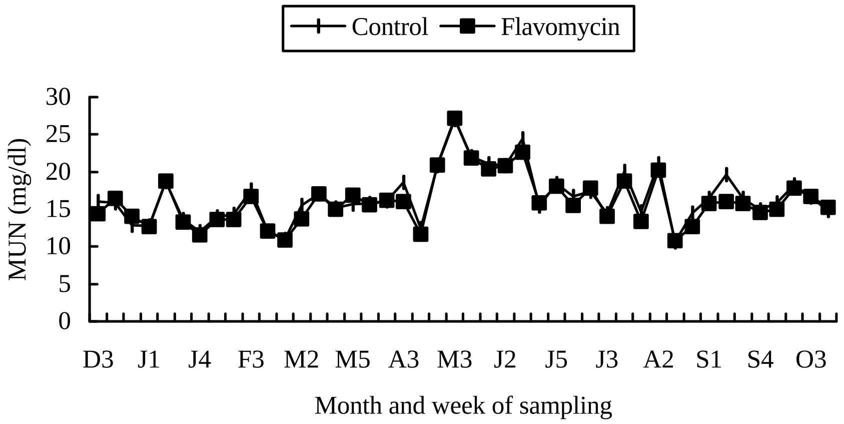

Figure 1 Weekly milk urea nitrogen (MUN) concentrations from January to October

According to Hutjens & Barmore (1995), a MUN concentration of 12-18 mg MUN/dl (257-385 mg urea/l) is desirable. MUN concentrations from cows grazing kikuyu pasture during the months of October to March were within this range, except for the second week in January when the concentrations for both groups exceeded 18 mg MUN/dl. When the cows grazed fertilized annual Italian ryegrass (April to October) MUN concentrations frequently exceed 18 mg MUN/dl. Fertilized annual Italian ryegrass has a high crude protein content (in excess of 200 g CP/kg DM) and a high rumen nitrogen degradability (75%; Van der Merwe, 1993). The cows would also have been fed the lesser of the two concentrate allocations (i.e. 5 kg/d) from April onwards, and this could possibly have contributed to the high MUN concentrations because of lower energy availability in the rumen and higher herbage intake. These factors could have contributed to excessive rumen ammonia production and consequently to high milk urea concentrations. Italian ryegrass displays fast growth rates during autumn (April/May) and spring (September/October), and the rumen protein degradability of ryegrass is also high (80%) during autumn and spring (Van der Merwe, 1993). The seasonal MUN trend depicted in Figure 2, where the weekly MUN values within each month were averaged to obtain a monthly average, is consistent with these observations.

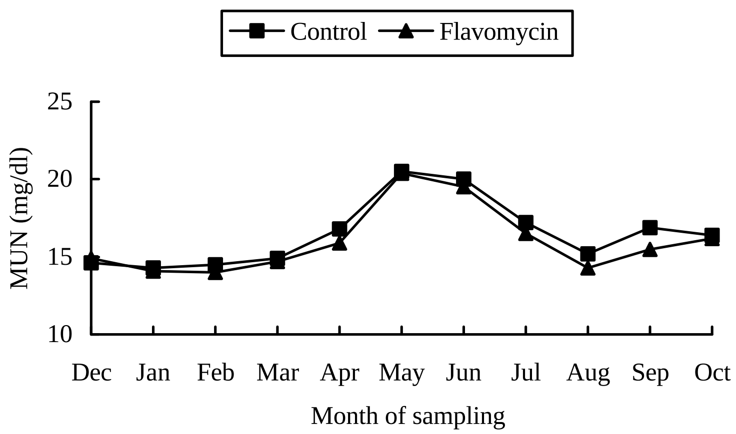

Figure 2 Monthly milk urea nitrogen (MUN) concentrations

Conclusion

The current study indicates that the addition of flavophosfolipol to grazing dairy cow diets does not significantly affect milk yield, milk composition or milk component yield. Flavomycin addition only significantly reduced MUN concentrations during two weeks over the full lactation period.

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