COMPARISON OF BAMBERMYCINS, LASALOCID, AND MOMENSIN ON THE NUTRITIONAL PHYSIOLOGY OF BEEF CATTLE CONSUMING CONCENTRATE AND FORAGE BASE DIETS

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SUMMARY

Eight ruminally-cannulated steers were utilized to evaluate two traditional ionophores (rumensin, monensin sodium, bovatec, lasalocid-sodium) versus bambermycin, a new product from Hoechst-Roussel Vet Company. With concentrate diets, ionophores and bambermycins improved digestible DM intake by more than 13 percent. Bambermycins also displayed similar changes in digesta kinetics, rate of digestion, fermentation characteristics, and microbial profiles. However, the variation in concentrate diet intake and low ruminal pH with the bambermycin-fed steers relative to monensin-fed steers raises concerns regarding the possibility of acidosis and liver abscesses.

On forage base diets, bambermycins and ionophores displayed similar influences on intake, digestion and ruminal fermentation and microbial analysis. Although, the data from the forage diets do not shown dramatic indications that the ionophores and bambermycins would yield performance improvements, actual performance trials are needed to illustrate the benefits of bambermycins relative to ionophores with roughage base diets.

INTRODUCTION

Numerous studies have documented the benefits of rumensin and lasolocid ionophore administration in both growing and stocker, as well as the finishing phases of beef cattle production. These benefits come in the form of improved performance and/or cheaper costs of gain. In addition, ionophores have been shown to have indirect benefits such as reduction of methane, reduction of lactate, and reduced occurrence of actue bovine pulmonary emphysema. Although ionophores have proven their effectiveness in many types of beef-cattle diets, problems persist relative to reduced palatability of supplements or rations, and concern regarding accidental consumption by monogastric species (specifically horses).

Recently a new product, bambermycins (Gainpro; Hoechst-Roussel Agri-Vet Company), has been introduced that may offer unique advantages relative to monensin and lasalocid ionophores. Although bambermycins is not an ionophore, its mode of action is similar to ionophores in that Gram-positive pathogenic bacteria are selected against due to inhibited bacterial cell wall synthesis. Thus, bambermycin seems to produce similar positive effects on rumen fermentation characteristics without the negative effects of reduced palatability or toxicity problems exhibited by the ionophores. In addition, bambermycins has been shown to: 1) not be absorbed by the host animal; 2) be rapidly biodegrade in the feces and, as a result, be more compatible with human health issues.

The objective of this research, therefore, was to evaluate bambermycins with monensin and lasalocid on the nutritional physiology of beef cattle consuming forage or concentrate diets.

MATERIALS AND METHODS

Study Design and Data Collection Techniques

Eight ruminally cannulated Hereford x Simmental steers were randomly assigned to a dual latin-square design evaluating one of four treatments: 1) control, no additive; 2) monensin; 3) lasalocid; and 4) bambermycins dietary addition. Square one (average weight 311 kg) corresponded to a concentrate diet in which monensin, lasalocid, and bambermycins were fed twice daily in a complete ration at 275, 275, and 20 $mg \cdot hd^{-1} \cdot d^{-1}$, respectively. Square two (average weight 322 kg), corresponded to a forage diet consisting of primarily of alfalfa/grass hay. Monensin, lasalocid, and bambermycins were provided once daily at 175, 175, and 20 $mg \cdot hd^{-1} \cdot d^{-1}$, respectively, in .45 kg of ground corn. Levels of drug administration were derived by taking current levels recommended by the beef industry. All steers were fed twice daily at 700 and 1800 h, with ruminal additives provided in the rations for the concentrate fed steers. Each 28-d period of the latin-square design consisted of 14 d of adaptation, 6 d of intake collection data, and 6 d of fecal collections, respectively; with ruminal sampling on d 27 and ruminal evacuations on d 28. Between each of the four latin-square periods, all steers were allowed a 4-d rest period in which they were held on the control diets until being allotted to the next treatment.

Table 1. Chemical composition of concentrate (square 1) and forage base (square 2) diets.[a]

		Forage base ration[c]	
	Concentrate ration[b]	Alfalfa/grass hay	Corn supplement
CP, %	12.95	15.77	8.94
ADIN, % of total N	2.86	5.23	1.13
ADF, %	7.43	33.12	1.81
NDF, %	16.24	45.84	8.54
ADL , %	2.06	7.43	.69

[a] Chemical composition of diets expressed on a DM basis.

[b] Concentrate ration consisted of 78% corn grain, 10% chopped alfalfa, 3% canola oil and 9% of a 32% CP finishing cattle supplement.

c Alfalfa/grass hay was provided with ad libitum access. Corn, used as a carrier for the ionophores and bambermycins, was fed at .45 $kg \cdot hd^{-1} \cdot d^{-1}$.

Table 2. Comparison of bambermycins vs ionophores on the intake and digestibility of beef cattle consuming concentrate and forage base diets.

Item	Treatments					Contrasts		
	Control	Monensin	Lasalocid	Bambermycins	SE[a]	Control vs additives	Bambermycins vs Monensin	Bambermycins Vs Lasalocid
Concentrate Diets:								
DMI, kg/d	7.09	7.72	7.97	7.37	.33	.17	.48	.25
DMI, % BW	2.28	2.49	2.51	2.38	.11	.23	.50	.45
DMI CV, %[b]	24.0	11.7	14.8	26.6	4.75	.30	.07	.13
Fecal output, kg	1.79	1.63	1.95	1.34	.23	.59	.41	.11
DMD, %	76.3	79.7	79.2	82.0	1.84	.11	.41	.32
TDN, lbs	5.37	6.16	6.20	6.04	.16	.01	.61	.50
Forage Diets:								
DMI, kg/d	9.08	9.10	9.08	8.98	.18	.91	.63	.70
DMI, % BW	2.80	2.82	2.81	2.78	.05	.99	.70	.76
Fecal output, kg	3.34	3.13	3.26	3.02	.06	.03	.24	.03
DMD, %	63.0	63.8	63.7	63.3	.29	.11	.23	.28
NDF dig, %	54.2	54.8	53.9	52.6	.87	.69	.13	.36
TDN, lbs	5.72	5.81	5.79	5.68	.12	.77	.48	.54

[a]SE = Standard error of the means (n = 4).
[b] DMI CV = coefficient of variation for DMI calculated on the final 12 days of each period.

RESULTS and DISCUSSION

Intake and Digestibility (Table 2). Dry-matter intake (DMI) and total tract digestibility (DMD) differed among diets (squares) with 13.5 percent lower intakes ($P < .01$), and 25 percent greater DMD ($P < .01$) with steers fed concentrate rations. Because of the difference between concentrate and forage diets in DMI and DMD, all subsequent treatment effects are analyzed and presented within diets.

Dry-matter intake of concentrate rations was not influenced by ionophore or bambermycin additions ($P > .10$), averaging 2.42 percent BW. Variation in DMI over the 14-d intake monitoring segment of each period, however, did appear substantial with steers fed bambermycins having greater variation than steers fed diets containing monensin ($P < .10$) and tending to be greater than steers fed diets containing lasalocid ($P = .13$). Total tract DMD tended to be higher ($P = .11$) in steers fed rations with ruminal additives compared to steers on control diets. Likewise, digestible DMI was 12 percent greater in steers fed monensin, lasalocid, and bambermycin rations compared to steers fed the control ration. However, no differences ($P > .10$) existed between monensin, lasalocid, and bambermycin fed steers relative to intake and total tract digestibility.

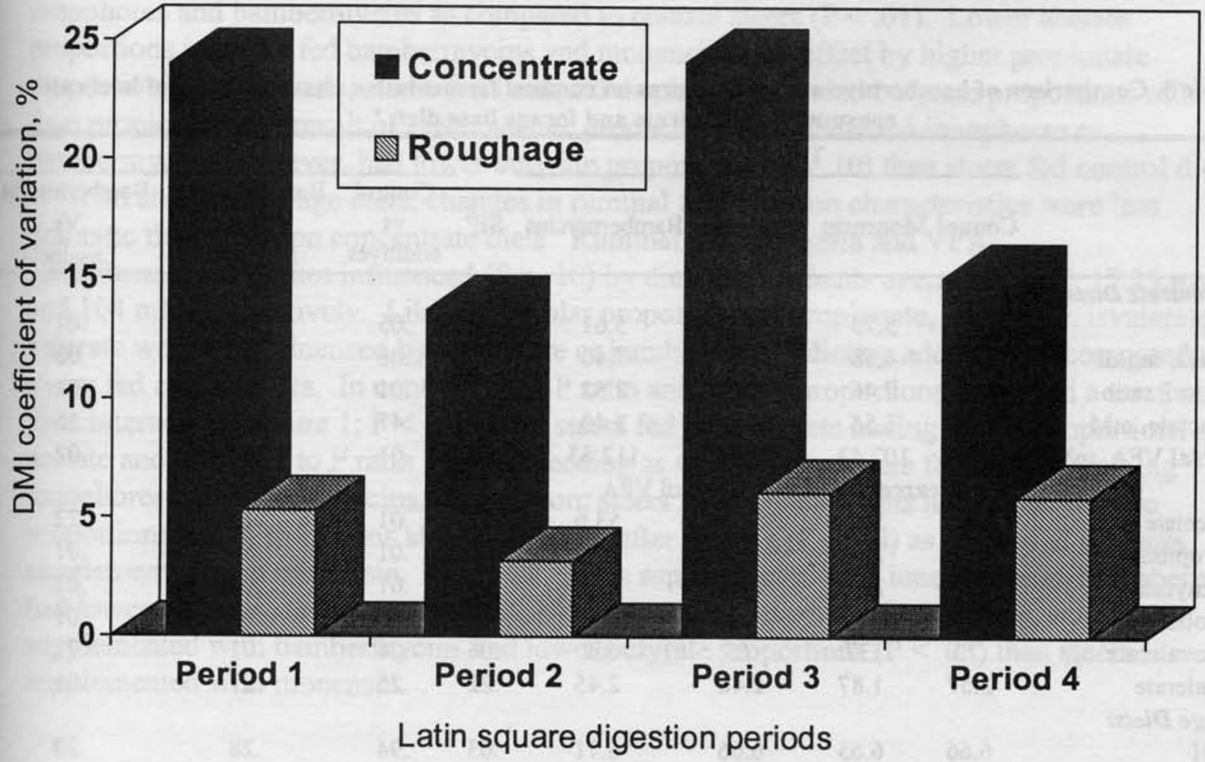

Figure 1. Coefficient of variation in DMI between concentrate and roughage diets across the four digestion periods of the Latin-Square Design. Steers fed concentrate diets displayed greater DMI variation across all 4-time periods compared to steers consuming roughage diets ($P < .05$). In addition, steers in period 2 displayed lower DMI variation than other periods for both concentrate and roughage diets ($P < .05$).

Dry-matter intake of forage diets was not influenced by ionophore or bambermycin additions, as well ($P > .10$), averaging 2.8 percent BW. Similar to concentrate rations, total tract DMD of forage diets tended ($P = .11$) to be improved with ionophore and bambermycin additions compared to steers consuming control rations. Total tract NDF digestibility, however, was not influenced by dietary treatments ($P > .10$) averaging 53.8 percent.

Although intake did not differ with ionophores or bambermycin supplemented steers, dramatic differences did exist relative to the variation in intake over time (Figure 1). Little variation existed on the forage-base diets with coefficients of variation averaging approximately 5 percent of the intake mean for all four-digestion periods. However, on concentrate diets the coefficients of variation ranged from 14 percent of the mean in period two, to 24 percent in periods one and three. Ionophores have been shown to reduce this variation in intake presumably by modifying fermentation rates and decreasing the possibility of acidotic condition. Our results support this contention particularly in regard to rations containing monensin. However, bambermycin did not appear to influence intake variation with coeficients in variation similar to control rations. These data can be interpreted to suggest that bambermycins on concentrate

Table 3. Comparison of bambermycins vs ionophores on ruminal fermentation characteristics of beef cattle consuming concentrate and forage base diets.[a]

Item	Treatments					Contrasts		
	Control	Monensin	Lasalocid	Bambermycins	SE[b]	Control vs additives	Bambermycins vs Monensin	Bambermycins Vs Lasalocid
Concentrate Diets:								
PH	5.86	5.79	5.83	5.61	.06	.05	.02	.01
NH3, mg/dl	3.66	4.68	5.05	7.40	.92	.06	.04	.08
A to P ratio	3.93	2.46	3.24	2.52	.17	.01	.79	.01
Lactate, mM	3.26	3.56	2.76	2.40	.41	.47	.05	.55
Total VFA, mM	95.30	107.43	102.73	112.63	2.88	.01	.21	.02
	..expressed as mol/100 mol VFA ..							
Acetate	60.0	51.8	51.9	53.6	.92	.01	.17	.22
Propionate	17.2	22.8	16.3	23.6	1.0	.01	.60	.01
Butyrate	18.5	22.3	27.5	19.0	.07	.01	.07	.01
Isobutyrate	1.1	.8	1.1	.8	.06	.01	.63	.01
Isovalerate	.70	.37	.65	.62	.06	.04	.01	.71
Valerate	2.57	1.87	2.48	2.45	.22	.25	.07	.91
Forage Diets:								
PH	6.66	6.65	6.66	6.71	.03	.94	.28	.29
NH3, mg/dl	13.96	13.13	13.73	12.19	.89	.30	.48	.19
Total VFA, mM	107.7	103.3	106.6	100.5	2.91	.54	.82	.74
	..expressed as mol/100 mol VFA ..							
Propionate	18.01	19.69	18.60	18.57	.40	.14	.32	.80
Butyrate	9.21	9.10	8.69	8.56	.12	.06	.04	.65
Isobutyrate	1.25	1.35	1.26	1.26	.04	.95	.45	.73
Isovalerate	.76	.86	.79	.75	.04	.78	.10	.65
Valerate	1.15	1.17	1.17	1.21	.04	.94	.70	.52

[a] Means presented in tabular form did not display treatment x time interaction (P < .10).
[b] SE = Standard error of the means (n = 4)

Ruminal Fermentation Characteristics (Table 3). With concentrate diets, steers fed ionophores and bambermycins had lower ruminal pH and higher VFA concentrations than steers fed control diets (P < .05). In addition, steers fed bambermycins had lower pH than steers fed monensin or lasalocid medicated diets (P < .05). Ruminal ammonia concentration was higher in steers fed ionophores and bambermycin compared to steers fed control diets (P < .10). Furthermore, steers fed bambermycins had higher ruminal ammonia than monensin or lasalocid supplemented steers (P < .10). Ruminal lactic acid concentrations were not different in steers fed ionophores or bambermycins as compared to steers on control diets (P >.10). The lack of difference may be reflective of the minimum 28-day adaptation to diets before assessing ruminal fermentation characteristics. Thus, fermentation characteristics during early stages of diet adaptation, when lactic acid concentrations are more likely to be high, were not monitored. Acetate to propionate ratio (A to P ratio) was lower in steers fed diets containing ionphores and bambermycins as compared to control steers (P < .01). Furthermore, steers fed bambermycin had lower A to P ratios than steers fed lasalocid diets ($P < .01$), but did not differ from steers fed monensin diets. The change in A to P ratio is due to lower acetate proportions in steers fed ionophores and bambermycins as compared to control steers ($P < .01$). Lower acetate proportions in steers fed bambermycins and monensin were offset by higher propionate proportions. In contrasts, steers fed lasalocid displayed increased butyrate proportions rather than propionate as a result of lower acetate production. All steers fed ionophores or bambermycins, however, had lower butyrate proportions ($P < .10$) than steers fed control diets.

With steers on forage diets, changes in ruminal fermentation characteristics were less dramatic than steers on concentrate diets. Ruminal pH, ammonia and VFA concentrations were not influenced ($P > .10$) by dietary treatments averaging 6.67, 13.25 mg/dl, and 104 mM, respectively. Likewise, molar proportions of propionate, isbutyrate, isvalerate and valerate were not influenced by ionophore or bambermycins dietary additions as compared to steers fed control diets. In contrast, A to P ratio and acetate proportions displayed a treatment x time interaction (Figure 1; $P < .10$), with steers fed control diets having higher proportions of acetate and higher A to P ratio 3 h after feeding as compared to steers fed diets containing ionophores and bambermycins. In addition, steers fed bambermycins had higher acetate proportions and A to P ratios at 0, 9, and 12 h after feeding ($P < .10$) as compared to steers supplemented with monensin. Likewise, steers supplemented with ionophores and bambermycin had lower proportions of butyrate ($P < .10$) compared to steers on control diets, and steers supplemented with bambermycins had lower butyrate proportions ($P < .05$) than steers supplemented with monensin.