EFFECTS OF SALINOMYCIN ON SITE AND EXTENT OF DIGESTION, RUMEN MICROBIAL PROTEIN SYNTHESIS AND LONG-CHAIN FATTY ACIDS COMPOSITION IN DIGESTA IN SHEEP

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Introduction

Salinomycin (SL) as well as other ionophores improves feed conversion of fattening cattle by shifting ruminal fermentation pattern toward more propionate. Other favorable effects, e.g. a protein sparing action in the rumen, have been found in monensin-fed cattle canulated postruminally (Muntifering et al., 1981), while in this regards no evidence has been obtained in SL-fed animals.

According to the preliminary results (Wakita et al., unpublished), it seems likely that SL depresses hydrogenation of unsaturated fatty acids in the rumen. However, changes in fatty acid composition of ruminal outflow remain undetermined.

This experiment was conducted to determine effects of SL on digesta flow and its constituents.

Materials and Methods

Four crossbred sheep equipped with ruminal and duodenal canulae were individually housed in a metabolism cage. They were randomly assigned to 2 groups of 2 sheep and supplied the following feeds; an Italian ryegrass hay (300 g/d) and a formula feed for beef cattle (500 g/d) blended with 0 (control) or 32 ppm SL (treatment). Half portions of them were offered twice a day to each animal. Water was freely available. The diets were reversed at 14-d intervals over a period of 56 d. Each treatment period consisted of 5 days' adaptation period followed by 9 days' collection period. In the collection period the daily amount of feeds was equally devided into 8 parts and each was given every 3 h with Cr mordanted NDF extracted from the hay fed. PEG dissolved in water was continuously infused through the rumen canulae. All feces and urine were sampled from the 9th to the 12th day during each treatment and duodenal digesta was taken at 3-h intervals during the following 2 days. Ruminal digesta was collected on the last day and rumen bacteria fraction were obtained by centrifugation. Diaminopimelic acid (DAPA) and nucleic purine base (PB) contents of digesta were analyzed by ion exchange chromatography and spectrophotometry, respectively. Long-chain fatty acids of digesta were methylated with 5% HCl-methanol and the methyl esters were determined by gas chromatography. Procedures of other analyses were the same as described elsewhere (Kobayashi et al., 1988).

Results and Discussion

Sheep medicated with SL showed an increased propionate proportion ($p < 0.05$), decreased acetate ($p < 0.01$) and butyrate ($p < 0.05$) proportions without alteration of total VFA level, and a depressed ammonia N level ($p < 0.05$) in the rumen. These observations are consistent with the SL effects which have been reported in numerous experiments.

SL supplement to the diet tended to reduce ruminal digestion of DM, OM, crude protein and crude fiber within a range of 2-4%, whereas improve post ruminal digestion of these nutrients at the same range. On account of this compensatory digestion in the lower tract, digestibility in the total tract showed no significant difference between treatments. The compensation observed postruminally could be partly explained by a decreased turnover rate in lower tracts by SL (Kobayashi et al., 1986).

Concentrations of DAPA and PB in rumen bacteria were slightly decreased with SL feeding, suggesting an alteration of ruminal bacterial flora. Both microbial marker contents of duodenal digesta were also depressed by SL ($p < 0.05$) and the estimated microbial flow into the duodenum showed a slight reduction when SL was fed (table 1). Dietary SL depressed protein degradability in the rumen and enhanced feed N in the duodenal total N (table 1), which in turn resulted in a decreased urinary N and an improved N retention by

TABLE 1. CONSTITUENTS OF DUODENAL DIGESTA IN SHEEP FED SALINOMYCIN

	Control	Salinomycin
	(g/d)	
Duodenal total N	18.6	18.8
NAN	17.4	17.8
Ammonia N	1.2	1.0
Microbial N		
DAPAa	13.1	11.2
PB[b]	11.2	9.8
Feed N		
DAPA	3.3	5.7
PB	5.2	7.0*
Feed N degradability	(%)	
DAPA	74.5	56.7
PB	60.0	46.4*
Duodenal fatty acids	(% in weight)	
Palmitic (16:00)	23.9	25.6
Stearic (18:0)	62.3	44.6**
Oleic (18:1)	9.1	23.6**
Linoleic (18:2)	4.7	6.2

[a,b]Diaminopimelic acid and nucleic purine base were used as microbial markers, respectively.

*,**Significantly different from control at $p < 0.05$ and $p < 0.01$, respectively.

27%, though these effects were not significant. These results agree with those obtained in monensin fed cattle (Muntifering et al., 1981), suggesting that SL as well as monensin would supply more nutrients absorbable to lower tracts by depressing ruminal degradation.

Long-chain fatty acid composition in duodenal digesta was changed by SL toward more oleic ($p < 0.01$) and linoleic acid and less stearic acid ($p < 0.01$) (table 1), while total lipid flow to duodenum was not affected. Similar shifts were observed in ruminal digesta and bacterial samples. These results show that SL could increase unsaturated fatty acids escaping from ruminal hydrogenation. Mechanisms involved in these effects are still unknown, though the effects are probably due to the selection of ruminal microflora by SL, because both oligotrich protozoa and *Butyrivibrio fibrisolvens*, rumen microbes associated with the hydrogenation (Chalupa and Kutches, 1968; Kemp and Lander, 1983), are susceptible to SL.

In conclusion, dietary SL modifies the site and extent of digestion by affecting primarily microbial activity in the rumen and intestine. N utilization, in particular, could be improved when SL is fed, because the drug depresses ammonia release in the rumen and increases outflow of feed N available. Long-chain unsaturated fatty acids escape from ruminal hydrogenation by SL, presumably through the selection of rumen microflora.

(Key Words: Salinomycin, Microbial Protein, Duodenum)

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