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Effects of Rumensin or Lasalocid on rumen fermentation in vitro (1979)

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Effects of Rumensin[1] or Lasalocid[2] on Rumen Fermentation in Vitro

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Summary

A series of artificial-rumen studies tested effects of Rumensin and lasalocid on rumen fermentation. At concentrations of 22, 44, and 66 ppm both depressed microbial protein synthesis. Both severely inhibited protein synthesis at 176 ppm. Both increased propionic acid and decreased acetic acid concentrations. However, only Rumensin increased lactic acid. Both inhibited total gas production and decreased the percentage of methane. We concluded that lasalocid and Rumensin have similar effects on rumen fermentation.

Introduction

Rumensin (monensin sodium) and lasalocid sodium are both polyether antibiotics that have been used as anticoccidials in poultry rations. Because Rumensin has improved feed efficiency in beef cattle, we compared it with lasalocid, although lasalocid is not approved for ruminant animals.

Procedure

Rumen fluid was taken from a rumen-fistulated Angus X Holstein steer before the morning feeding. The steer was fed twice daily 12 lb. of alfalfa hay and 10 lb. of a concentrate mixture containing 80.3% sorghum grain, 9.0% soybean meal, 8.0% Starea-70, 2.0% dicalcium phosphate, 0.5% trace mineralized salt, and .2% vitamin A and D supplement. The rumen fluid was strained immediately through two layers of cheesecloth and the pH determined. To 1.0 g substrate (67% ground corn, 25% brome hay, 8% Starea-70), previously weighed into 50-ml, plastic centrifuge tubes, was added 10 ml rumen fluid and 20 ml mineral buffer. The tubes were flushed with CO_2, capped with Bunsen valves, and incubated for 6 hr at 39 C. The quantity of microbial protein synthesized during fermentation was determined by the method of Barr et al. (J. Dairy Sci. 58:1308). The dried microbial fraction was analyzed for amino acids.

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[1] A product of Elanco Products Co., Indianapolis, IN.

[2] A product of Hoffman-LaRoche Inc., Nutley, NJ. Presently lasalocid is approved for poultry but not for ruminants.

Five grams of substrate, 100 ml buffer, and 50 ml rumen fluid were incubated in a water bath (39 C) for 6 hours. Gas production was measured, and samples of headspace gas were analyzed for hydrogen, carbon dioxide, and methane by gas chromotography. At the same time pH of the fermentation mixture was determined and samples were saved for determination of lactic and volatile fatty acids.

Both Rumensin and lasalocid were added at 0, 22, 44, 88, and 176 ppm of substrate. The experiment was repeated four times with each antibiotic. Each dose was tested in duplicate.

Results

Both antibiotics decreased microbial protein synthesis (Table 23.1). The decrease in synthesis at 44 ppm or more was proportional to the increase in antibiotic concentration.

Gas production was increased by both Rumensin and lasalocid, particularly at the lower concentrations (Table 23.1). When those two antibiotics were used, the organisms apparently fermented the substrate without synthesizing protein efficiently.

Rumensin and lasalocid decreased the proportion of methane and increased the proportion of carbon dioxide (CO_2) in rumen gas (Table 23.1). Lasalocid decreased methane (CH_4) more than did Rumensin.

Both Rumensin and lasalocid increased rumen propionic and decreased acetic acid (Table 23.2). Neither Rumensin nor lasalocid increased volatile fatty acid production. Rumensin significantly increased lactic acid production.

Discussion

As previously observed, Rumensin decreased rumen acetic production, increased propionic acid production, and depressed methane production. The effects of lasalocid were similar to those of Rumensin, except that lasalocid did not enhance lactic acid production.

Both Rumensin and lasalocid inhibited microbial protein production. Van Nevel and Demeyer reported a similar effect of monensin on microbial protein synthesis (Appl. and Environmental Microbiol. 34:251).

It appears that Rumensin decreases degredation of protein to ammonia. Because most rumen microorganisms prefer ammonia as a nitrogen source to peptides or amino acids, microbial protein synthesis is reduced.

We concluded that lasalocid and Rumensin affect the rumen fermentation similarly. Studies by Davis (70th Ann. Meet. American Soc. Anim. Sci. p. 414) and preliminary studies conducted here showed that, like Rumensin, lasalocid decreases feed intake and improves feed efficiency. If cleared by the Food and Drug Administration for use with ruminants, lasalocid could be substituted for Rumensin.

Table 23.1. Effects of Rumensin and lasalocid on gas production, carbon dioxide to methane ratio, and microbial protein synthesis.

Drug content of substrate	Monensin			Lasalocid		
	Gas production	CO_2/CH_4 ratio	Protein synthesis[a]	Gas production	CO_2/CH_4 ratio	Protein synthesis
ppm	(ml)		(mg)	(ml)		(mg)
0	158±35[b]	1.40±.19	16.3±1.2	106±13	1.34±.19	22.4±2.4
22	210±22	1.46±.11	10.5±1.8	143±6	1.56±.16	8.1± 3.1
44	195±20	1.76±.15	11.9±1.6	147±10	1.70±.11	12.5±1.0
88	193±14	1.62±.18	6.5± .4	133±8	1.96±.06	11.6± .6
176	189±13	1.73±.16	.7±.1	113±7	2.14±.18	5.2±1.4

[a]Milligrams microbial protein synthesized per gram of substrate.

[b]Mean ± standard error.

Table 23.2. Effects of Rumensin and lasalocid on lactic and volatile fatty acid production in rumen fluid.

Compound	Conc ppm	Acetic/ propionic ratio	VFA concentration in molar %				Total VFA µM/ml	Total lactate mg/ml
			Acetic	Propionic	Butyric	Valeric		
Rumensin	0	2.78 ± .17[a]	52.6 ± .6	18.8 ± .9	20.6 ± .5	8.0 ± .7	116.8 ± 5.2	1.0 ± .4
Rumensin	22	2.27 ± .08	49.0 ± .6	21.4 ± 1.1	21.9 ± 1.1	7.4 ± .4	119.9 ± 4.7	3.5 ± 2.7
Rumensin	44	2.11 ± .19	47.4 ± .5	23.5 ± 2.0	21.7 ± 1.6	8.0 ± .4	114.3 ± 4.3	9.3 ± .2
Rumensin	88	2.02 ± .11	48.4 ± .7	24.1 ± 1.1	20.0 ± 1.0	7.5 ± .1	115.3 ± 2.2	8.6 ± .4
Rumensin	176	1.80 ± .13	45.7 ± 1.6	25.6 ± 1.4	20.8 ± 1.5	7.9 ± .5	114.8 ± 2.8	8.7 ± .4
Lasalocid	0	2.35 ± .32	51.6 ± 2.3	22.7 ± 2.4	18.3 ± 1.1	7.4 ± 1.1	05.2 ± 9.0	3.4 ± 2.8
Lasalocid	22	2.24 ± .27	50.6 ± 2.6	22.9 ± 1.5	18.0 ± .8	8.5 ± .4	96.7 ± 10.9	3.8 ± 2.6
Lasalocid	44	1.65 ± .24	46.5 ± 2.8	28.5 ± 2.9	16.9 ± .9	8.2 ± .2	103.9 ± 4.0	4.6 ± 1.4
Lasalocid	88	1.65 ± .19	47.5 ± 2.3	29.2 ± 1.8	16.4 ± .5	6.9 ± .5	96.2 ± 9.8	1.8 ± 1.3
Lasalocid	176	2.37 ± .25	52.1 ± 1.8	22.4 ± 1.8	17.2 ± .9	8.1 ± .6	100.0 ± 1.9	3.3 ± 2.6

[a]Mean ± standard error.