EFFECT OF DAILY ROTATION OF IONOPHORES ON RUMINAL FERMENTATION IN CATTLE FED CONCENTRATE DIETS

J. Zorrilla-Rios[1], J.D. Garza-F[1] and F.N. Owens[2]

Story in Brief

Eleven mature ruminally cannulated cattle were fed an 80% concentrate diet to examine ruminal fermentation changes in response to several different ionophore programs. Animals received their basal diet for 2 weeks. Starting with the third week, 4 different treatments were imposed: 1) control (no ionophores), 2) monensin-tylosin (300 mg/day) fed continuously, 3) lasalocid (300 mg/day) fed continuously and 4) daily rotation of 2 and 3. Ionophores were fed for 5 consecutive weeks, followed by a 3-week ionophore withdrawal period. Compared to the other treatments, monensin plus tylosin tended to be more effective at depressing total gas and methane production. In vitro ammonia concentration and ruminal pH were not altered by dietary treatments. No synergistic effects on ruminal microbial fermentation activity were apparent from the daily rotational ionophore program as compared to the mean of monensin-tylosin or lasalocid fed individually. In vitro batch culture procedures can rapidly screen ionophore feeding programs.

(Key Words: Ionophores, Fermentation, Beef Cattle.)

Introduction

The use of ionophores to improve feed efficiency in cattle is a common practice in the feedlot industry. However, individual ionophores differ in their effect on performance. Continuous feeding of monensin depresses feed intake with little effect on gain; in contrast, lasalocid fed continuously has limited effect on feed intake but increases rate of gain. Knowledge of such individual ionophore characteristics could be employed to enhance ionophore usefulness during the feeding cycle. Branine et al. (1989) suggested that feeding of monensin and lasalocid on alternate days to beef cattle enhanced feed efficiency and gain more than continuous use of either ionophore alone.

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[1]Research Associate [2]Regents Professor

In addition, daily rotation versus weekly ionophore rotation gave more consistent responses in feed efficiency and rate of gain. Mechanisms of these responses are not clear, but it has been suggested that bacteria are less likely to adapt to an ionophore when ionophores are fed on alternate days. The objectives of this study were to determine the effect of 3 different ionophore programs on in vitro ruminal fermentation changes and to develop procedures for in vitro measurements of total gas, methane and ammonia.

Materials and Methods

Eleven mature beef cattle with large rumen cannulas, were allotted randomly to individual pens and fed a 80% concentrate basal diet. Animals were fed twice daily (8:30 am and 4:30 pm) and water was available at all times during the 10-week trial. The first two weeks of the study served as a control period; the basal diet was fed without ionophores. From week 3 to 7, three different ionophore treatments were imposed. Treatments included additions of 1) control (no ionophore), 2) monensin-tylosin (300 mg/day) fed continuously, 3) lasalocid (300 mg/day) fed continuously, and 4) daily rotation of 2 and 3. For the last 3 weeks of the study, ionophores were withdrawn from the diet. Ruminal liquid samples were taken weekly during the entire trial at 2 h after the morning feeding. Samples were strained through four layers of cheese cloth and pH was recorded immediately. Ruminal fluid was transferred to the laboratory in a pre-warmed thermos for in vitro batch culture studies.

Hungate culture tubes (15 ml) with a screw cap and rubber septum were used to incubate 2.5 ml of strained ruminal fluid with 250 mg of ground corn. All tubes received 2.5 ml of McDougall's artificial saliva plus 200 ul of a glutamic acid solution. Prior to incubation, all culture tubes were bubbled with CO_2. Tubes were run in triplicate and incubated in a water bath at $38^{o}C$ for approximately 22 h. Total gas production was measured directly with a graduated syringe equipped with a 23 gauge needle. Thereafter, cultured tubes were maintained on ice for gas chromatographic analysis (methane). Ammonia-N (NH_3-N) was determined colorimetrically (Broderick and Kang, 1980).

Data were subjected to analysis of variance for a completely random design with a model including ionophore treatments as the main plot and sampling (weeks) in the subplot. Means were adjusted by analysis of covariance to pre-treatment measurements. Orthogonal contrasts were used to compare treatment effects.

Results and Discussion

In vitro fermentation measurements during the period of ionophore administration (week 3 through 7) are presented in Table 1. Ionophore treatments reduced total gas ($P<.001$) and methane production ($P<.01$). Likewise differences were apparent between individual ionophores. Monensin-tylosin were more effective (4.0 vs 5.1 ml; $P<.001$) decreasing total methane production than lasalocid, but similar (5.1 vs 4.5 ml) to the daily ionophore rotation program. Past in vivo and in vitro studies (Thornton and Owens, 1981; Salim, 1989) indicated that addition of ionophores to the diet may reduce methane production from 13 to 27%. In Thornton's study, addition of 200 mg/day of monensin to low, medium and high roughage diets decreased methane production by 16% and 24%, compared to 15.1% in this study. In addition, methane reduction may be greatest during the first 12 to 15 days of ionophore administration (Rumper et al., 1986; Salim, 1989). Total methane production in this study tended to drop during the first 21 days of the trial; thereafter, methane concentrations increased to pre treatment levels (Figure 1). However values were always lower with the monensin-tylosin treatment except during week 3 when the rotation program gave the lowest values.

Continuous or daily rotation of ionophores did not alter ruminal fluid ammonia concentration or pH (Table 1). Similar results have been reported

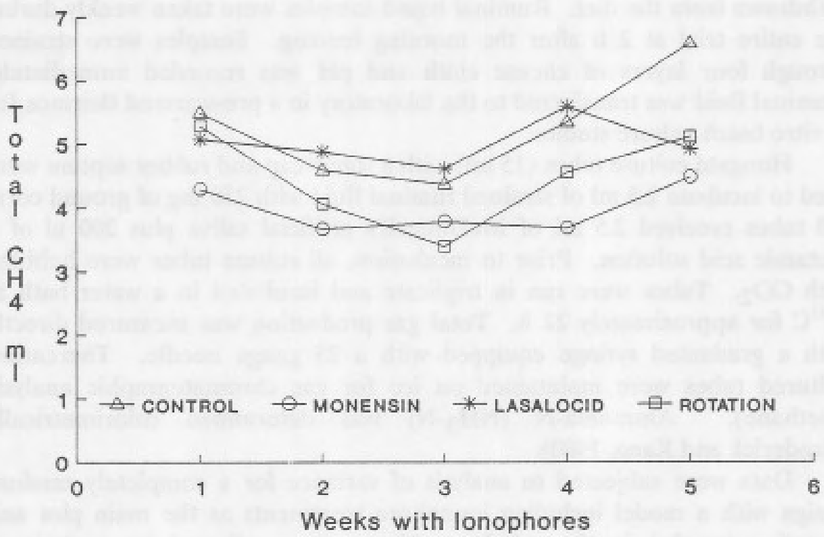

Figure 1. Weekly total methane production changes in beef cattle fed different ionophore programs.

Table 1. Effect of ionophore rotation program on ruminal fermentation.

	Treatments[a]					Orthogonal contrast[b]		
Variables	C	MT	L	DR	SE	C vs Others	MT vs L	DR vs MT,L
Gas, ml	27.3	22.0	22.8	22.6	0.73	.001	NS	NS
Total methane, ml	5.3	3.9	5.1	4.5	0.18	.01	.003	NS
Methane, % of total gas	19.3	18.1	20.8	19.8	0.67	NS	.02	NS
NH_3-N, mg/dl	9.0	8.5	8.1	9.1	0.89	NS	NS	NS
In vitro pH	5.1	5.2	5.2	5.1	0.03	NS	NS	NS

[a] C= Control; MT= Monensin-Tylosin; L= Lasalocid; DR= Daily rotation.
[b] Control vs others; Monensin-Tylosin vs Lasalocid; Daily rotation vs Monensin-Tylosin, Lasalocid.

(Salim, 1989) with steers receiving equivalent ionophore treatments and fed a 90% concentrate diet.

Analysis of values before and during administration of the 3 different ionophore treatments indicated that total gas production dropped (24.2 vs 22.5 ml; $P < .003$) during the treatment phase (Table 2).

Total methane production during the ionophore feeding fell by 15.1% compared to the control period although numerical values (5.3 vs 4.5 ml) showed no statistical differences. Ruminal ammonia concentrations were increased (6.8 vs 8.6 mg/dl) during ionophore inclusion (Table 2). In vivo depression in ruminal ammonia concentration are expected with monensin feeding (Schelling, 1984).

In conclusion, daily rotation of ionophores showed no advantage over a single continuous feeding of either monensin plus tylosin or lasalocid, on the measurements in this study. In addition, monensin-tylosin decreased methane production more than lasalocid. The daily ionophore rotation treatment gave intermediate methane production. Overall, the in vitro batch culture procedure may be a convenient method to evaluate ionophore feeding programs, and may be useful as a tool to test new ionophores.

Table 2. In vitro fermentation changes before and during administration of 3 different ionophore programs.

Variable	Before treatment	After treatment	P[a] Value
Gas, ml	24.2	22.5	.003
Total methane, ml	5.3	4.5	.20
Methane, % of total gas	23.0	19.6	.28
NH_3-N, mg/dl	6.3	8.6	.002
In vitro pH	5.1	5.2	.22

[a] Probability of adjusted means by covariance analysis.

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