Effect of Inophore on Rumen Characteristics, Gas Production, and Occurence of Bloat in Cattle Grazing Winter Wheat Pasture

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Story in Brief

Twelve ruminally cannulated steers (1164 ± 67 lb) were used to measure the effects of ionophores on ruminal parameters, gas production, and occurrence of bloat. Steers grazed a common wheat pasture near Stillwater, OK, from January 30 through April 7 and were alloted by weight to three treatments: Control (no ionophore), Rumensin® (monensin, 300 mg/d) or Bovatec® (lasalocid, 300 mg/d) via oral bolusing with gelatin capsules. No grain or mineral supplements were fed during the trial. Ruminal fluid was collected between 8:30 and 9:30 a.m. on three dates (March 13, 21, and 27) to measure *in vitro* gas production as well as ruminal fluid characteristics. Cattle were also observed for bloat and assigned a bloat score each morning from March 15 through March 28 (14 d). Ruminal fluid molar proportions of propionate were higher and acetate:propionate ratios were lower for steers receiving Rumensin®. Rumensin® decreased both the incidence and severity of bloat and was more efficacious for prevention of bloat than Bovatec®.

(Key Words: Bloat, Ionophore, Beef Cattle, Wheat Pasture.)

Introduction

Two ionophores, monensin and lasalocid, are available for wheat pasture stocker cattle. Both of them, if delivered in the proper dosage, increase weight gains of growing cattle on wheat pasture by about .18 to .24 lb/d over that of the carrier supplement (Horn et al., 1981; Andersen and Horn, 1987) and improve the economics of supplementation programs. In addition, both producer experience and research (Branine and Galyean, 1990) indicate that monensin decreases the incidence and severity of bloat from wheat pasture. The objective of this trial was to determine the effects of monensin and lasalocid on rumen characteristics, gas production, and bloat prevention in cattle grazing winter wheat.

Materials and Methods

Twelve ruminally cannulated steers (1164 ± 67 lb) were allotted by weight to three treatments, Control, Rumensin®, and Bovatec®, and grazed the same wheat pasture from January 30 to April 7, 1997. Steers were orally bolused according to treatment from February 27 and continuing until completion of the trial, with Rumensin® steers receiving 300 mg monensin and Bovatec® steers receiving 300 mg lasalocid daily. Control steers were not bolused.

Ruminal Fluid. Ruminal fluid was collected once each week from all 12 steers on three consecutive weeks. Three collections were used in an attempt to collect fluid at the time when wheat was actively growing, at or near its greatest bloat potential. Ruminal fluid was collected prior to bolusing between 8:30 and 9:30 a.m. on March 13, 21, and 27, when steers were actively grazing during their morning grazing bout (sunrise approximately 6:30 a.m.). Fluid was strained through four layers of cheesecloth and collected to measure *in vitro* gas production. A sub-sample of fluid from each animal was used to measure pH. Immediately after determining pH, the sub-sample was acidified with 20% H_2SO_4 and used to determine ammonia, VFA, and mineral concentrations.

Gas production was measured using an *in vitro* procedure in which 20 ml of ruminal fluid was incubated with .5 g of wheat forage in 25-ml volumetric flasks. Flask stoppers were equipped with rubber tubing connected to burets filled with colored water. Gases produced during fermentation traveled through the tubing into the water-filled burets. Gas production was monitored by measuring fluid displacement every hour for 8 h.

Bloat Scores. From March 15 through March 28, steers were monitored for bloat each morning at approximately 9:00 a.m.. Steers were evaluated in the pasture during their initial grazing bout and assigned a bloat score prior to bolusing. The scoring system was intended to characterize the incidence and severity of bloat across the three treatments. Bloat scores were as follows:

0 = Normal, no visible signs of bloat.

1 = Slight distention of left side of animal.

2 = Marked distention of left side of animal. Rumen distended upward toward top of back. Animal has asymmetrical (egg-shape) look when walking away from observer.

3 = Severe distention. Distension is above top of back and visible from right side of animal.

Mean bloat score was calculated for each steer by averaging daily bloat scores across the 14-d observation period. Incidence of bloat was calculated for each steer as the total number of days that bloat score was greater than zero.

Statistical Analysis. Ruminal fluid characteristics and *in vitro* gas production from all three periods were analyzed as a repeated measures design with treatment, steer, period, and treatment x period included in the model. Steer within treatment was used as the error term to test ionophore effects. Period measurements were separated using Fischer's protected LSD. Treatment sums of squares were separated using orthogonal contrasts that compared Control steers vs those receiving an ionophore (Control vs ionophore), and the relative effectiveness of the two ionophores (Rumensin® vs Bovatec®).

Data relative to the incidence and severity of bloat were analyzed as a completely randomized design with animal as the experimental unit. Control vs ionophore and Rumensin® vs Bovatec® contrasts were also used to separate treatment sums of squares.

Results and Discussion

No treatment x period interactions were detected (P>.20) for any ruminal fluid or *in vitro* gas production data. Consequently, results are presented by main effects of treatment and collection date.

Effect of Collection Date on Rumen Fluid Characteristics. . Ruminal pH was lower (P<.05; Table 1) on March 21 compared with March 13 and 27. There was a similar increase (P<.05) in ruminal ammonia and total VFA concentrations during the same week. Molar proportions of acetate were highest (P<.05) on March 13, resulting in a higher acetate:propionate ratio during the first collection period. Butyrate, potassium, calcium and magnesium concentrations were all lower (P<.05) on the March 13 collection date. *In vitro* gas production (total amount and rate) was also lower (P<.05) on March 21. The peak in VFA concentrations during March 21, as well as the increase in acetate, butyrate, and several minerals during March 21 and 27 may reflect differences in the size or degradability of the soluble fraction of wheat forage during the 3- wk period.

Effect of Ionophore on Rumen Fluid Characteristics. *Control vs ionophore.* Ruminal pH was not affected by presence of an ionophore (P=.33; Table 2). Ruminal ammonia, total VFA, acetate and propionate concentrations were also unaffected (P³ .20). Butyrate concentrations were decreased (P=.04) by the addition of an ionophore. Additionally, the acetate/propionate ratio was not altered (P=.32) by the addition of ionophore. While ionophore-treated and Control steers had similar acetate, propionate, and acetate/propionate ratio responses, the Control vs ionophore comparison may have masked differences in ruminal VFA concentrations between Bovatec® and Rumensin®, as discussed below. Steers receiving ionophores tended to have lower ruminal fluid Na concentrations (P=.08), and higher K and Mg concentrations (P£ .08) than control steers. Calcium concentrations were not affected (P=.42) by the addition of an ionophore. Russell (1987) reported that the addition of monensin to *Strep. bovis* cultures (a predominant species of ruminal bacteria) decreased intracellular K and increased intracellular Na. If this hypothesis is true, then the above mechanism would also create a related extracellular increase in K and decrease in Na concentrations. Because standard preparation of ruminal fluid for mineral analysis requires centrifugation to remove ruminal microbes, analyzed ruminal fluid is in essence, extracellular fluid, so our results support the mechanism proposed by Russell (1987).

In vitro gas production/g of forage was similar (P=.67) for ruminal fluid from Control steers and the average of both ionophore treatments, but differences existed between ionophores. Rate of gas production was similar (P=.61) between Control steers and those receiving ionophores.

Rumensin® vs Bovatec®. Within the steers receiving ionophores, ionophore type did not affect pH, ruminal ammonia or total VFA concentrations. Steers receiving Bovatec® tended (P=.09) to have higher acetate concentrations compared with steers receiving Rumensin®. Propionate concentrations were greater (P<.01) for steers receiving Rumensin®, whereas butyrate concentrations were higher (P<.01) for Bovatec® steers. Higher acetate and lower propionate concentrations resulted in higher (P<.01) acetate:propionate ratios in steers receiving Bovatec®. Ruminal fluid mineral concentrations (Na, K, Ca, and Mg) were similar (P³ .24) for steers receiving Bovatec® and Rumensin®.

In vitro gas production was greater (P<.01) in ruminal fluid from steers receiving Rumensin®, although there were no differences in rate of gas production (P=.16). Although *in vitro* gas production was greater for steers receiving Rumensin®, previous research (Branine and Galyean, 1990), as well as visual observations from this trial indicate that Rumensin® decreases the incidence and severity of bloat. Therefore, rate of gas production as determined by the *in vitro* procedure used in this study may not be a good indicator of actual *in vivo* ruminal gas production and(or) the incidence of bloat.

Incidence and severity of bloat. Control steers tended (P<.10; Table 3) to have more steer days of bloat and greater mean bloat scores compared with steers that received an ionophore. Rumensin® decreased (P<.05) both the incidence (mean days of bloat/steer) and the severity (mean bloat score/steer) of bloat as compared with Bovatec®. These results suggest that Rumensin® is more efficacious than Bovatec® in decreasing the incidence and severity of bloat in cattle grazing winter wheat.

Literature Cited

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Table 1. Effect of collection date on ruminal fluid parameters.

Item	March 13[a]	March 21	March 27	SE[b]
No. of cannulated cattle	12	12	12	
	- - - - - - - - - Ruminal fluid analysis - - - - - - - -			
PH	5.74[d]	5.56[c]	5.66[d]	.033
NH3, mg/100 ml	48.11[c]	57.66[d]	45.25[c]	1.543
Total VFA's, mmol/l	118.57[c]	157.32[d]	155.61[d]	1.881
Acetate, mol/100 mol	62.13[d]	59.39[c]	60.22[c]	.517
Propionate, mol/100 mol	19.50	20.02	20.17	.363
Butyrate, mol/100 mol	12.10[c]	13.75[d]	13.58[d]	.273
A/P ratio	3.24[d]	2.99[c]	3.02[c]	.073

Sodium, ppm	2029	1891	1948	42.4
Potassium, ppm	2180[c]	2541[d]	2579[d]	62.4
Calcium, ppm	97[c]	140[d]	131[d]	5.3
Magnesium, ppm	101[c]	127[d]	127[d]	3.5
	- - - - - - - - *In vitro* gas production - - - - - - - - -			
In vitro gas production, ml/g forage	52.04[d]	43.32[c]	55.18[d]	1.319
Linear slope of *in vitro* gas prod., ml gas/h	2.15[d]	1.48[c]	2.11[d]	.068

[a]Least squares means for each collection period.
[b]Standard error of least squares means.
[c,d]Means within a row with different superscripts differ (P<.05).

Table 2. Effect of ionophore on ruminal fluid parameters of steers grazing winter wheat[a].

Item	Control[a]	Rumensin®	Bovatec®	SE[b]	Control vs ionophore[c]	Rumensin® vs Bovatec®
No. of cannulated cattle	4	4	4			
	- Ruminal fluid analysis - - - - - - - - - - - - - - - - - -					
PH	5.62	5.70	5.64	.037	.33	.37
NH_3, mg/100 ml	47.90	51.88	51.24	2.317	.23	.85
Total VFA's, mmol/l	141.37	144.33	145.81	3.100	.36	.74
Acetate, mol/100 mol	60.69	59.56	61.50	.731	.87	.09
Propionate, mol/100 mol	19.21	22.05	18.43	.614	.20	<.01
Butyrate, mol/100 mol	14.06	11.51	13.86	.456	.04	<.01
A/P ratio	3.18	2.73	3.35	.114	.32	<.01
Sodium, ppm	2102	1897	1869	89.0	.08	.82
Potassium, ppm	2194	2527	2580	146.5	.08	.80
Calcium, ppm	117	134	118	9.0	.42	.24
Magnesium, ppm	111	122	123	4	.06	.94
	- - - - - - - - - - - - - - - - - - *In vitro* gas production - - - - - - -- - - - - - - - - -					
In vitro gas production, ml/g forage	50.91	54.42	45.22	2.013	.67	.01
Rate of gas production (linear), ml gas/hr	1.95	1.99	1.80	.088	.61	.16

[a]Least squares means for each collection period.
[b]Standard error of least squares means.
[c]P-value associated with orthogonal contrasts.

Table 3. Effect of treatment on incidence and severity of bloat.[a,b]

Item	Control[c]	Rumensin®	Bovatec®	SE[d]	Control vs ionophore[e]	Rumensin® vs Bovatec®

No. of steers	4	4	4			
No. of steers that bloated[f]	4	2	4			
Total steer d of bloat	40	4	33			
Mean d of bloat/steer	10.0	1.0	8.3	2.25	.083	.049
Mean bloat score/steer	.88	.05	.77	.206	.097	.036

[a]From March 15 to March 28, 14 d.
[b]Bloat scores consist of: 0 = no visible signs of bloat , 1 = slight distention of left side, 2 = marked distension of left side, 3 = left and right sides distended
[c]Least squares means for each collection period.
[d]Standard error of least squares means.
[e]P-value associated with orthogonal contrasts.
[f]Steers given a bloat score greater than zero on one or more days.

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