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OPTIMUM MONENSIN LEVELS IN FEEDER CALF RECEIVING DIETS

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Summary

Monensin was fed in the receiving diets of recently weaned calves at a rate of 0, 10, 20, or 30 g per ton (air dry basis) or 100 or 200 mg per head daily to determine effects on feed intake and coccidia control. The 240 steer calves used originated from western rangelands and had no previous exposure to milled feeds or confinement. During the first week in the feedlot, monensin fed at 30 g per ton depressed feed intake by 5% and the depression response was linear ($P<.001$) over the range of dosages tested. This reduction in feed intake did not affect average daily gain or calf health. Over 90% of these calves were shedding coccidia oocysts on the first day in the feedlot. Monensin began to suppress ($P<.01$) oocyst shedding after 10 days on feed and this effect persisted throughout the 84-day experiment. The percentage of calves within a treatment that were not shedding oocysts improved as monensin dosage was increased. These data indicate that intake sensitivity to monensin is primarily related to daily intake of the drug rather than drug concentration in the diet. Furthermore, monensin can be included in receiving calf diets at sufficiently high levels to reduce coccidia oocyst shedding without depressing performance.

Key Words: Calf, Receiving, Monensin, Coccidiosis

Introduction

Newly received feeder calves are susceptible to coccidiosis and preventative measures are indicated for most feedlots. The ionophores currently available for beef cattle diets are approved for the control and prevention of coccidiosis and could be used for these purposes as well as to increase daily gains of feeder cattle. In reference to the ionophore monensin, there is considerable debate regarding when monensin can be included in the diet and at what rate it should be fed. The concerns evolve from the necessary adaptation of cattle to diets containing monensin to avoid significant reductions in feed intake.

An important aspect of this concern is whether adaptation is a function of the concentration of monensin in the feed or if adaptation is in response to the daily dosage consumed by the calf. In newly weaned calves that have not previously been confined or fed, feed intakes are so low (<1.5% body weight) that diets containing 30 g per ton monensin would only provide 125 mg of drug per day. This level of ionophore intake may be low enough to facilitate the adaptation process even though most cattle feeders would interpret the 30 g per ton feeding rate as excessively high for this purpose.

In a previous experiment conducted at this station, we found that feeding 10, 20, or 30 g per ton monensin had minimal effects on feed intake. These diets consistently reduced coccidia oocyst

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shedding within 18 days after weaning. Since intake responses and the severity of coccidiosis infections can be highly variable from year to year, this research was repeated and is described here.

Materials and Methods

Steer calves were obtained from two ranches in western South Dakota. The calves had not been confined or exposed to milled feeds prior to weaning and shipment (375 miles) to the SDSU research feedlot near Brookings, SD. On arrival at the feedlot, calves had access to long hay and fresh water. Within 24 hours of weaning calves were vaccinated, weighed, and individually identified. Allotment to pens and feeding of experimental diets occurred the following day (48 hours postweaning). Six diets based on corn silage (Table 1) were formulated to provide 0 (0), 11 (10), 22 (20), or 33 (30) g per ton monensin (DMB) or to provide 100 (100) or 200 (200) mg monensin per day. Steers were fed these diets to appetite once daily for 85 days. Five pens of eight steers were assigned to each treatment. This resulted in 30 pens containing a total of 240 steers. Initial feedlot weight of the steers was 548 $\pm$ 1 lb.

Table 1. Basal receiving diet formulation

Item	% dry matter basis
Hay	15.00
Corn silage	74.68
SBM[a]	9.33
$CaCo_3$[a]	.59
Trace mineral salt[a]	.30
Fat[a]	.10
	100.0

[a]Included as a supplement that provides micronutrients at levels that meet or exceed NRC requirements. Monensin was included in the pelleted supplement.

Fecal samples were obtained directly from each steer twice weekly during the initial 4 weeks on test and again on days 54 and 81. Samples were individually packaged and submitted to the SDSU Animal Disease Research and Diagnostic Laboratory for quantifying the oocyst contamination. Oocyst shedding was categorized as A = 0 per g feces, B = 1 to 99 oocyst per g, C = 100 to 499 oocyst per g and D = >499 oocysts per gram.

Feed ingredient samples were obtained and analyzed weekly for determining dry matter intakes and diet nutrient composition (Table 2). Calf health was monitored daily. Morbid calves were removed from the original pen, treated, and penned individually with access to the assigned test diet. Upon recovery calves were returned to their original pen and sick pen intakes were added back into the pen data. One steer each from treatments 0 and 10 died of respiratory illness while in sick pens and performance data from these two individuals were deleted. Steers were individually weighed in the morning before feeding after 27, 55, 84, and 85 days. The final two body weight determinations were averaged and used as the final weight.

Feedlot performance data were evaluated on a pen mean basis using AOV appropriate for a completely random design. Means separations were done by orthogonal contrast including the following treatment comparisons: 0 vs all others, 10 vs 20 and 30, 20 vs 30, 30 vs 200 mg/day, and 100 mg/d vs 200 mg/day. Oocyst shedding was evaluated as discrete data by Chi square analysis of individual observations within sampling day.

Dry matter offered was restricted to 4.9 lb for the initial 3 days as we usually do when starting naive calves on feed. From that point feed deliveries were gradually increased to allow ad libitum intakes.

Results and Discussion

It was originally intended that steers on treatment 200 would receive 100 mg monensin daily for 5 days before feeding the 200-mg dosage. Inadvertently, they were fed 200 mg per day during the initial 7 days at which time

Table 2. Diet nutrient analysis[a]

Item	Treatment[b]						SEM
	0	10	20	30	100	200	
Dry matter	46.32	46.32	46.32	46.33	46.30	46.33	.44
Crude protein	10.61	10.66	10.56	10.69	10.77	10.73	.21
Neutral detergent fiber	46.64	46.64	46.64	46.64	46.66	46.64	1.19
Acid detergent fiber	25.60	25.60	25.60	27.74	25.61	25.59	1.27
Ash	6.05	6.29	6.11	5.99	6.44	6.14	.13

[a]All values except dry matter on dry matter basis, n = 13.
[b]Monensin, grams per ton diet, air dry basis, or mg per head daily.

reduced intakes (Table 3) made the error obvious to us. Monensin dosage was then reduced to 100 mg/day for the next 7 days and then increased again to 200 mg/day. This corresponded to the resumption of a more normal intake pattern.

There were no significant (P>.10) differences in feedlot performance attributable to monensin dosage in any of the interim or cumulative data sets (Table 4). This is consistent with results obtained in the previous experiment. Since the 0, 10, 20, and 30 treatments were similar for each of the 2 years research, these data were pooled, blocked by year, and monensin concentration effects on feedlot performance were revaluated. This provided 10 pens or 80 steers per treatment.

In the pooled data (Table 5), intakes during the initial period declined linearly (P<.05) with increasing monensin concentration. Intakes on treatment 30 were 5.5% lower than those on treatment 0. Gains were unaffected and feed/gain improved (P<.10) in response to lowered intakes. During the second month postreceiving average daily gain tended to decrease (P=.070) with increasing dietary monensin concentration, although intakes were no longer depressed by treatments (P>.20). In the first experiment, performance during the third month in the feedlot was quite low due to a variety of factors including a deterioration in silage quality and poor weather. However, when data from only the second experiment are evaluated, there is still no cumulative response to dietary monensin concentrations over the 0 to 30 g/ton range of treatments.

As previously observed, 96% of the calves were shedding coccidia oocysts when they arrived at the feedlot. Monensin began to suppress oocyst shedding (P<.05) by day 10 in this experiment (Table 6). The percentage of calves not shedding oocysts appeared dosage dependent and increased from 16% for control to 72% for treatment 100. Differences due to treatment persisted throughout the 81-day fecal sampling. No clinical symptoms of coccidiosis were evident in the course of the feeding period.

We have consistently observed that calves raised on western rangelands and coming into the feedlot directly after weaning are infected with coccidia. Some prophylactic measure should be used even though calves are not showing any clinical signs of coccidiosis. In this experiment monensin effectively reduced coccidia oocyst shedding, indicating that it may be a suitable prophylactic treatment. Including monensin in the receiving diets did cause some (5%) reduction in feed intake. There was no evidence that monensin delayed calves from accepting feed, but rather it limited the total amount of feed consumed daily. In this situation, calf gains and health were not adversely affected by including monensin in the receiving diets, which is supportive of the interpretation that monensin effects on feed intake were not detrimental to the calf.

Table 3. Weekly dry matter intake summary[a]

Item	Treatment[b]						P<[c]				
	0	10	20	30	100	200	0 vs rest	10 vs 20,30	20 vs 30	30 vs 200	100 vs 200
1 to 7 days	7.12	7.10	6.86	6.79	6.50	6.14	.0003	.0242	NS	.0001	.0136
8 to 14 days	9.92	10.10	9.38	8.87	8.88	8.73	.0591	.0288	NS	NS	NS
15 to 21 days	12.38	11.22	11.64	11.76	11.90	11.56	.1457	NS	NS	NS	NS
22 to 28 days	15.73	15.73	15.41	14.85	15.41	14.62	.1343	.1260	NS	NS	NS
29 to 35 days	15.61	15.87	15.85	15.10	16.06	15.56	NS	NS	.1150	NS	NS
36 to 42 days	15.80	15.01	15.97	15.20	16.21	15.19	NS	NS	NS	NS	.0689

[a]Pounds per head per day.

[b]Monensin concentration, g/ton air dry basis or mg/head.

[c]NS = P>.15.

Table 4. 84-day feedlot performance summary

Item	Treatment[a] 0	10	20	30	100	200	SEM
Initial wt, lb	546	549	549	548	547	549	1.4
Days 1 to 27							
Body weight, day 27	625	621	621	621	622	624	4.9
Avg daily gain, lb	2.93	2.67	2.81	2.70	2.80	2.76	.168
Dry matter intake, lb	10.65	10.32	10.18	10.04	9.98	9.72	.255
Feed/gain, lb	3.70	3.98	3.63	3.75	3.60	3.54	.202
Gain/feed, lb/cwt	27.03	25.10	27.53	26.70	27.79	28.25	1.526
Days 28-55							
Body weight, day 55	682	675	677	671	683	682	4.6
Avg daily gain, lb	2.04	1.94	1.97	1.79	2.16	2.08	.106
Dry matter intake, lb	15.57	15.73	15.75	15.16	15.83	15.20	.292
Feed/gain, lb	7.64	8.28	8.03	8.61	7.38	7.43	.469
Gain/feed, lb/cwt	13.09	12.08	12.45	11.61	13.54	13.46	.655
Days 56 to 84							
Body weight, day 84	742	738	749	734	749	746	4.3
Avg daily gain, lb	2.05	2.16	2.38	2.19	2.29	2.23	.099
Dry matter intake, lb	17.03	16.95	17.33	16.60	16.82	16.65	.271
Feed/gain, lb	8.39	7.87	7.46	7.63	7.36	7.54	.390
Gain/feed, lb/cwt	11.91	12.71	13.41	13.10	13.59	13.27	.697
Days 1 to 84							
Avg daily gain, lb	2.33	2.25	2.38	2.22	2.41	2.35	.056
Dry matter intake, lb	14.49	14.41	14.51	14.01	14.29	13.94	.221
Feed/gain, lb	6.25	6.44	6.09	6.32	5.93	5.94	.172
Gain/feed, lb/cwt	16.00	15.53	16.41	15.82	16.86	16.85	.518

[a]Monensin level, g/ton air dry basis or mg/head.

Table 5. Pooled performance data when newly received feeder calf diets contain monensin

Item	Treatment[a]				SEM
	0	10	20	30	
Period 1[b]					
ADG	2.71	2.56	2.67	2.69	.101
DMI[e]	10.64	10.46	10.04	10.06	.149
F/G[f]	4.00	4.15	3.78	3.76	.131
Period 2[c]					
ADG[f]	2.53	2.54	2.41	2.35	.080
DMI	16.13	16.27	15.83	15.83	.265
F/G	6.61	6.82	6.84	7.15	.268
Period 3[d]					
ADG	1.47	1.46	1.67	1.56	.094
DMI	16.87	16.62	16.25	16.66	.329
F/G	14.22	16.11	14.74	12.88	1.967
Cumulative					
ADG	2.26	2.21	2.27	2.22	.046
DMI	14.52	14.43	14.03	14.15	.203
F/G	6.48	6.55	6.19	6.37	.132

[a]Monensin concentration, g/ton air dry basis or mg/head.
[b]Experiment 1 = 29 days, experiment 2 = 27 days.
[c]Experiment 1 = 28 days, experiment 2 = 28 days.
[d]Experiment 1 = 25 days, experiment 2 = 29 days.
[e]Linear ($P<.05$).
[f]Linear ($P<.10$).

Table 6. Frequency of calves shedding oocysts[a]

Sample day[b]	Oocyst[c] counts	Treatment[d] 0	10	20	30	100	200
		Percentage of calves					
0	0	5.41	5.26	5.41	0.0	0.0	7.89
	1-99	35.14	39.47	43.24	55.00	48.72	50.00
	100-499	59.46	55.26	51.35	45.00	51.28	42.11
	500 +	0.0	0.0	0.0	0.0	0.0	0.0
3	0	2.63	7.69	7.50	10.26	7.89	2.56
	1-99	65.79	71.79	62.50	56.41	68.42	71.79
	100-499	18.42	7.69	17.50	23.08	13.16	17.95
	500 +	13.16	12.82	12.50	10.26	10.53	7.69
6	0	13.51	18.92	12.82	23.08	23.68	21.62
	1-99	72.97	67.57	79.49	71.79	71.05	72.97
	100-499	13.51	13.51	7.69	5.13	5.26	5.41
	500 +	0.0	0.0	0.0	0.0	0.0	0.0
10[e]	0	16.22	35.90	45.00	32.50	72.97	62.16
	1-99	78.38	61.54	47.50	67.50	24.32	37.84
	100-499	5.41	0.0	5.00	0.0	0.0	0.0
	500 +	0.0	2.56	2.50	0.0	2.70	0.0
13[e]	0	23.08	50.00	58.97	57.50	70.00	72.50
	1-99	74.36	50.00	38.46	42.50	30.00	27.50
	100-499	2.56	0.0	2.56	0.0	0.0	0.0
	500 +	0.0	0.0	0.0	0.0	0.0	0.0
17	0	74.36	87.50	92.50	90.00	92.50	95.00
	1-99	23.08	12.50	7.50	7.50	7.50	5.00
	100-499	2.56	0.0	0.0	0.0	0.0	0.0
	500 +	0.0	0.0	0.0	2.50	0.0	0.0
20[e]	0	44.44	72.50	85.00	76.92	75.00	81.58
	1-99	55.56	27.50	15.00	23.08	25.00	18.42
	100-499	0.0	0.0	0.0	0.0	0.0	0.0
	500 +	0.0	0.0	0.0	0.0	0.0	0.0
24[f]	0	70.27	77.78	82.05	95.00	90.00	85.00
	1-99	29.73	22.22	17.95	5.00	10.00	15.00
	100-499	0.0	0.0	0.0	0.0	0.0	0.0
	500 +	0.0	0.0	0.0	0.0	0.0	0.0
26[e]	0	50.00	70.00	90.00	92.50	82.05	79.49
	1-99	50.00	30.00	7.50	7.50	17.95	20.51
	100-499	0.0	0.0	2.50	0.0	0.0	0.0
	500 +	0.0	0.0	0.0	0.0	0.0	0.0
54[e]	0	47.37	77.78	91.89	94.74	92.31	92.50
	1-99	52.63	19.44	8.11	5.26	7.69	5.00
	100-499	0.0	2.78	0.0	0.0	0.0	2.50
	500 +	0.0	0.0	0.0	0.0	0.0	0.0
81[e]	0	74.36	90.0	100.0	97.44	92.11	100.00
	1-99	25.64	10.00	0.0	2.56	5.26	0.0
	100-499	0.0	0.0	0.0	0.0	2.63	0.0
	500 +	0.0	0.0	0.0	0.0	0.0	0.0

[a]Percentage of calves within a treatment that were shedding oocysts at the rate listed.
[b]Days in the feedlot prior to sampling.
[c]Oocyst counts per gram feces.
[d]Monensin level as g/T or mg/head.
[e]Percentages differ between monensin treatments (P<.001).
[f]Percentages differ between monensin treatments (P=.055).