EFFECT OF VARIOUS LEVELS OF MONENSIN ON EFFICIENCY AND PRODUCTION OF BEEF COWS[1,2]

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Summary

Ninety-six gravid cows were allotted to three replications of four treatments. Monensin treatments consisted of 0, 50, 200 and 300 mg per head per day. The basic feed was meadow hay with .45 kg of barley per head per day. Feed was adjusted periodically to maintain equal weight gain between treatments. Initial cow weights for the control, 50-, 200- and 300-mg treatments were 455, 447, 456 and 457 kg, respectively. Daily prepartum cow gains were .34, .38, .38 and .37 kg ($P>.05$) for the control, 50-, 200- and 300-mg levels, respectively. Treatments were terminated about 30 days after calving. Over the entire treatment period, including 30 days postpartum, daily losses for the cows were .12, .05, .10 and .17 kg ($P>.05$) for the control, 50-, 200- and 300-mg levels, respectively. Hay consumption was 92, 88 and 90% of the controls for the 50-, 200- and 300-mg groups. Adjusted weaning weights for the calves were 124, 134, 129 and 133 ($P>.05$) for the control, 50-, 200- and 300- mg groups, respectively, with calves being weaned at 139 days of age. Control cows came into estrus an average of 44 days postpartum as compared to 44, 41 and 45 days for the cows given 50-, 200- and 300-mg treatments, with no difference in conception rates. Concentration of rumen acetic and butyric acid production was reduced and propionic increased with the 200- and 300-mg levels. Monensin feeding improved efficiency and reduced hay requirements without reducing production or reproductive performance.

(Key Words: Beef Cattle, Monensin, Feed Efficiency, Forage, Winter Feed, Brood Cows.)

Introduction

Monensin is a biologically active compound produced by *Streptomyces cinnamonensis* (Haney and Hoehn, 1967). The compound improves feed efficiency in the ruminant by increasing the concentration of propionic acid and reducing acetic and butyric, with total volatile fatty acids remaining the same (Raun *et al.*, 1974b; Dinius *et al.*, 1976). Monensin reduces feed intake without a reduction in daily gain of feedlot cattle (Brown *et al.*, 1974; Raun *et al.*, 1974a), increases gains of pasture-fed cattle (Potter *et al.*, 1974; Oliver, 1975) and improves feed efficiency for wintering gravid cows (Turner *et al.*, 1977).

With the feeding of monensin and low quality roughages that do not meet the maintenance requirements of cows, the increased energy utilization could reduce or eliminate the need for supplementation. Where cow condition is adequate for maximum production and reproduction, and additional gain is not desired and the hay meets or exceeds the maintenance requirements of the cow, feeding monensin may reduce the amount of hay needed. This reduction in total hay required would allow hay to be stockpiled or sold or provide a means to increase the number of cows wintered on a given amount of hay.

The study was conducted to test various levels of monensin and to determine if the increased efficiency due to monensin (Turner *et al.*, 1977) would allow cows to be wintered on less hay. Cow reproduction and calf performance were also evaluated for the effects monensin treatments might have on them.

Experimental Procedures

Ninety-six gravid spring-calving Hereford cows 3 to 10 years old were stratified by age,

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[2] Monensin and financial assistance was provided by Eli Lilly and Co.

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[5] Jointly operated by Oregon Agr. Exp. Sta., Oregon State Univ., and Agricultural Research – SEA. USDA.

weight, condition score, breeding date and previous year's weaning weight and were randomly allotted to four treatments with three replications. Treatments included a control group receiving no monensin and groups receiving 50, 200 and 300 mg of monensin per head per day. Barley (IRN 4-07-939) was fed at the rate of .45 kg per head per day to cows on all treatments, including controls. The barley provided a vehicle for getting monensin into the diet. Cows were replicated by expected calving dates with replications being early, mid and late calvers.

In one replication, cows were brought into a barn each morning and individually fed their supplement. The barn was equipped with stalls and feed bunks. The remainder of the day they were turned out into adjacent lots. Cows in the other two replications were kept in outside lots with sheltered hay bunks and raised feed troughs. Supplements were fed daily on a group basis within each lot. All lots of cows were provided free access to water, salt, a 50-50 mix of bonemeal (IRN 6-00-400) and salt, and meadow hay (IRN 1-03-181).

Hay intake was measured, on a lot basis, by weighing hay daily; orts were weighed weekly. Cows were maintained in a condition to facilitate conception and milk production. Initially, the control cows were fed hay free choice, with the 50-mg group receiving 95% of this amount and the 200- and 300-mg groups getting 90%. Throughout the remainder of the study, hay was adjusted to maintain equal weight gain or loss among treatments. Composition of the native flood meadow hay used in this study was 80% rushes and sedges and 20% grasses. Crude protein content of the hay was 9.5%. The cows were weighed every 28 days prior to parturition; feed and water were withheld overnight before weighing. Cows and calves were then weighed within 24 hr postpartum, at treatment termination and at weaning. All calves were individually identified at birth, and bull calves were castrated.

The trial was initiated on November 16, 1976, and the confinement feeding portion terminated on May 9, 1977. This period was terminated about 3 weeks early because of a lead toxicity problem. Calves were chewing corral fences and ingesting enough lead from a lead base paint cover applied about 16 years earlier to kill them. Eleven calves were lost before the problem was diagnosed. Cows and calves were then turned out on the meadows and fed hay free choice or grazed through breeding and to weaning on August 29, 1977. Monensin was not fed during this period.

Monensin is widely used as a poultry anticoccidial, and in order to not confound the experiment, it was necessary to ensure that the cows used in these trials were free of coccidial organisms. Fecal samples were taken prior to initiation of the trial and found negative for coccidia.

Rumen samples were taken, with a vacuum pump and esophogeal hose, to determine total and relative proportions of volatile fatty acids. Four samples were taken from the cows from each replication, for a total of 12 from each treatment. Cows were sampled twice during the study, once before parturition and once postpartum. On the day rumen samples were taken, the supplements were fed to replicated groups at ½-hr intervals. This allowed for a constant sampling time of 3 to 4 hr after supplemental feeding. Hay was continually available. Feed samples were taken periodically for monensin analysis, and results indicated that the active monensin levels in the mixes were providing the desired intake.

First estrus postpartum was obtained by utilizing epididymectomized bulls equipped with chin ball markers along with visual observations made at least three times daily. Prior to and during the trial, cows were artificially inseminated with semen from a single Angus sire during a 42-day period beginning in early June. Hereford cleanup bulls were then used for 21 days. Pregnancy was determined in mid-October by rectal palpation. Calving dates were recorded the next spring and calving intervals determined.

At or near parturition, cows were removed from their pens and taken to a calving shed. During this time they were fed hay free choice, and those from monensin treatments, regardless of level, received 200 mg of monensin per head per day. Cows were returned to their pens as soon as possible, with no cows remaining off their treatments longer than 2 days. Cows that lost calves were eliminated from subsequent data.

Analyses of variance and least significant differences were applied to the data to test for differences among treatments (Steel and Torrie, 1960).

Results and Discussion

Cow gain data and hay intake results are

TABLE 1. PREPARTUM HAY INTAKE AND THE EFFECT OF MONENSIN TREATMENTS ON WINTER GAIN OF COWS (11/16 THROUGH 3/1)

Monensin treatment	No.	Initial weight	Prepartum weight	ADG[a]	Hay intake: Per day	Hay intake: Percentage of control
mg/head/day		(kg)				(%)
Control	24	455	490	.34	11.7	100
50	24	447	487	.38	10.9	93
200	24	456	496	.38	10.5	90
300	24	457	495	.37	10.7	92

[a]Means not significantly different between treatments (P>.05).

presented in tables 1, 2 and 3. Prepartum average daily gain (ADG) was not different (P>.05) among treatments. Monensin-supplemented cows consumed 7 to 10% less hay. Cows receiving 200 mg of monensin were the most efficient, with similar gain on 10% less hay than cows receiving the control diet (table 1). During the calving period (table 2), cows on all treatments had a negative ADG, with no differences among treatments (P>.05), due to parturition. Hay levels were increased to provide additional energy for rebreeding and lactation, but cows receiving monensin were given less hay than before relative to the control group's diet. The 200-mg level cows lost about the same weight as the controls on 13% less hay and the 50-mg group on 10% less hay. Cows receiving the 300-mg level consumed 11% less hay than the controls but lost more weight, indicating that they should have received more hay during this period. The entire confinement period is summarized in table 3. Both the 50-mg and 200-mg groups lost less weight than the controls (P>.05) and received 8% less hay on the 50-mg level and 11% less on the 200-mg level. If this portion of the trial had not been terminated early the cows on both the 50- and 200-mg level treatments would have had their hay further reduced in comparison to the controls to even out weight gains and losses. The 300-mg group would have received an increase from the 90% it was receiving.

These results show that monensin did improve feed efficiency throughout the treatment feeding portion of this trial. The 200-mg level appears to be the optimum having netted a savings of 11% in hay requirements. Over a 180-day wintering period this would save 262 kg of hay per cow. If this study had continued, hay intake on the 200-mg level apparently could have been further reduced. On a 500-head cow herd this savings would reduce

TABLE 2. HAY INTAKE AND THE EFFECT OF MONENSIN TREATMENTS ON COW GAIN JUST PRIOR TO CALVING THRU 30 DAYS OF LACTATION (3/1 THROUGH 5/9)

Monensin treatment	No.[a]	Prepartum weight	Treatment termination weight	ADG[b]	Hay intake: Per day	Hay intake: Percentage of control
mg/head/day		(kg)				(%)
Control	21	489	437	−.75	12.9	100
50	23	486	431	−.79	11.6	90
200	19	496	442	−.78	11.2	87
300	21	491	425	−.95	11.5	89

[a]Missing values are due to lead poisoning and losses from other causes.

[b]Means not significantly different between treatments (P>.05).

TABLE 3. HAY INTAKE AND THE EFFECT OF MONENSIN TREATMENTS ON COW GAIN FOR THE ENTIRE CONFINEMENT PERIOD (11/16 THROUGH 5/9)

Monensin treatment	No.[a]	Initial weight	Treatment termination weight	ADG[b]	Hay intake: Per day	Hay intake: Percentage of control
mg/head/day		(kg)				(%)
Control	21	458	437	−.12	12.2	100
50	23	440	431	−.05	11.2	92
200	19	459	442	−.10	10.8	89
300	21	455	425	−.17	11.0	90

[a]Missing values are due to lead poisoning and losses from other causes.

[b]Means not significantly different between treatments (P>.05).

hay needs by 131 metric tons, or make it possible to feed another 60 head on the same feed resource.

Cow data after the termination of the treatments and calf performance to weaning are presented in table 4. Cow weight gains were similar during the period (P>.05), with cows from the 50- and 200-mg treatments gaining slightly better than those from the 300-mg and control treatments. Control cows were 1 kg lighter at weaning than they were at the start of the trial in November; the 300-mg cows were 11 kg lighter; and the 50- and 200-mg cows were 12 and 8 kg heavier, respectively.

Birth weights of calves were not different among treatments, and similar results for ADG from calving to weaning were obtained (P>.05). Calves that were lost to lead poisoning from the control and 200-mg groups were from high production index cows, particularly those on the 200-mg level, as compared to those lost from the 50- and 300-mg groups. So in reality these gains among the four groups were even closer than shown. Adjusted weaning weights were not significantly different, although calves from the monensin-fed cows were somewhat heavier than those from controls.

Reproductive performance is presented in table 5. Days to first estrus were essentially the same among treatments. Pregnancy rates based on these small numbers have limited value but do show that all monensin-fed groups bred back at a higher rate than the controls. Calving interval results show that the control, 50-mg

TABLE 4. EFFECT OF MONENSIN TREATMENTS ON CALF GAIN (BIRTH TO 8/29) AND COW GAIN DURING LACTATION (5/9 THROUGH 8/29)

Item	Control	Monensin treatment: 50	200	300
Number[a]	19	23	19	19
Cow weight, 5/9 (kg)	437	428	445	426
Cow weight, 8/29 (kg)	456	452	467	444
ADG (kg)[b]	.17	.21	.20	.16
Birth weight (kg)[b]	34	35	35	34
ADG birth to 5/9 (kg)[b,c]	.82	.90	.81	.86
ADG 5/9 to 8.29 (kg)[b,c]	.61	.67	.64	.66
Adjusted weaning weights (kg)[b,d]	124	134	129	133

[a]Missing values are due to lead poisoning and losses from other causes.

[b]Means not significantly different between treatments (P>.05).

[c]Adjusted to a steer equivalence.

[d]Adjusted to a steer equivalence and a common age (139 days).

TABLE 5. EFFECT OF MONENSIN TREATMENTS ON REPRODUCTIVE PERFORMANCE

Monensin treatment	No.[a]	First estrus postpartum	Pregnancy rate		Calving interval
mg/head/day		Days	No.	%	Days
Control	19	44[b]	16	84	350[b]
50	23	44[b]	21	91	346[b]
200	19	41[b]	19	100	353[bc]
300	21	45[b]	18	86	361[c]

[a]Missing values are due to lead poisoning and losses from other causes.

[bc]Means with different superscripts differ at the P<.05 level within columns.

and 200-mg groups were not different from each other (P>.05); the 300-mg group have a larger interval (P<.05) than controls. The 300-mg group lost more weight through the calving period and gained less to weaning than the other groups. This observation may be reflected in these reproductive data.

Postpartum volatile fatty acid (VFA) concentration results (table 6) show that the 200- and 300-mg levels of monensin increased (P<.05) production of propionate in the rumen and decreased (P<.05) acetate and butyrate as compared to the control and 50-mg level. These results are in agreement with those reported by Raun *et al.* (1974b), Dinius *et al.* (1976), Utley *et al.* (1976), Perry *et al.* (1976), Richardson *et al.*, (1974) and Turner *et al.* (1977) working with animals on growing diets, feedlot cattle and cows. Total VFA concentrations were significantly altered in this study, but these findings are not in agreement with those obtained by the above cited authors, who reported little effect on total VFA production. These results are not consistent in that the 200-mg level of monensin increased VFA concentration and the 50- and 300-mg levels reduced it when compared to the controls. The VFA sample results taken prior to parturition are not shown because of highly variable results with large standard errors of the mean, which were due to a laboratory problem in analyses of these data. However, the results indicated an increase in propionic acid production and a decrease in acetic and butyric acids with all monensin treatments, with similar total VFA concentrations.

In summary, this study indicates positive results with monensin use for brood cows when cows are fed moderate quality hay. Feed efficiency is improved by feeding monensin. Increased gains on the same amount of feed (Turner *et al.*, 1977) or, as this study shows, a reduction in hay requirements to maintain body weight can be realized with monensin.

TABLE 6. EFFECT OF MONENSIN TREATMENTS ON VOLATILE FATTY ACID CONCENTRATIONS

Treatment	No.	Acetate	Propionate	Butyrate	Total concentration
mg/head/day		moles/100 g			mmoles/liter
0	12	75.8[a]	17.3[a]	6.8[a]	47.7[a]
50	12	75.7[a]	17.6[a]	6.7[a]	41.1[b]
200	12	72.5[b]	21.1[b]	6.4[ab]	48.7[c]
300	12	72.3[b]	21.9[b]	5.8[b]	36.1[d]

[abcd]Means with different superscripts differ at P<.05 level within columns.

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