EFFECT OF MONENSIN ON FEED EFFICIENCY FOR MAINTAINING GESTATING MATURE COWS WINTERED ON MEADOW HAY[1]

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SUMMARY

In each of two winters, 48 gravid-mature Hereford cows were stratified by weight and age to two treatments with three replications. Treatments consisted of the control group which received meadow hay free choice plus .45 kg of barley per day and the treated group which received 200 mg of monensin in addition to the control diet. Cows were individually fed the supplemental feed. Hay was weighed in daily with orts weighed back weekly.

In trial 1 (1974), monensin fed cows outgained the controls .43 to .23 kg ($P<.01$) on less hay intake 11.0 to 11.4 kg ($P<.06$). In trial 2 (1975), daily gains were .47 and .28 kg ($P<.05$) and hay intake 12.7 and 13.1 kg ($P>.05$), respectively, for monensin supplemented cows and the controls. Feed efficiency was substantially improved by monensin.

Rumen samples were taken from cows on each treatment 4 hr after supplemental feeding for volatile fatty acid (VFA) determination. Total VFA concentration (mM/liter) and relative proportions of acetate, propionate and butyrate (Molar %) for controls and monoensin fed cows were 68.2, 72.2; and 76.2, 72.4; 17.2 22.6; and 6.5, 5.0, respectively. Propionic acid percentage was increased ($P<.05$) with monensin feeding and acetic and butyric decreased ($P<.05$).

Vasectomized bulls with chin ball markers were used to determine frist post-partum estrus. Interval from calving to first estrus was shortened by 12 days ($P<.05$) with monensin in trial 1, but there were no differences between treatments in trial 2.

(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 growing cattle by increasing the production 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 reduced feed intake without a reduction in daily gain of feedlot cattle (Brown *et al.*, 1974; Raun *et al.*, 1974a) and increased gains of pasture fed cattle (Potter *et al.*, 1974; Oliver, 1975).

If similar results with monensin can be obtained with brood cows on a maintenance ration, the net result would be a savings in forage. This may provide a means to increase the size of an individual cow herd or a reduction of the total hay requirement. With low quality roughages that do not meet maintenance requirements, an increased energy utilization could reduce or eliminate the need for supplementation.

These studies were designed to test the effect of monensin on feed efficiency for maintaining pregnant cows on meadow hay, the effect on total and relative proportions of volatile fatty acids, and to determine if there is any subsequent effect on reproductive performance.

EXPERIMENTAL PROCEDURES

In the first trial (1974), 48 spring-calving Hereford cows 5 to 7 years old were stratified by age and weight and were randomly allotted to two treatments with three replications. Treatments included a control group receiving no monensin and a group receiving 200 mg of

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monensin per head per day. Barley was fed at the rate of .45 kg per head per day to facilitate intake of the monensin, the palatability of which is not well documented. Control animals also received .45 kg of barley.

Cows were brought into a barn, equipped with stalls and bunks, each morning and individually fed their supplement. The remainder of the day they were turned out into six adjacent lots where they had access to water, salt, a 50-50 mix of bonemeal and salt, and hay free choice. Hay intake was measured, on a replication basis, by weighing hay in daily with orts weighed back weekly. Hay was sampled for chemical analysis. Cows were weighed every 28 days after an overnight shrink from feed and water.

Monensin is widely used as a poultry anticoccidial and in order to not confound the experiments it was necessary to insure 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, via a vacuum pump and esophageal hose, to determine total and relative proportions of volatile fatty acids. Cows were on study 60 days prior to sampling. Three samples were taken from each replication, for a total of nine from each treatment. On the day rumen samples were taken, the supplements were fed to replicated groups at 1/2-hr intervals. This allowed for a constant sampling time of 4 hr after supplemental feeding. Hay was continually available. Feed samples were taken periodically for monensin analysis and results indicated the active monensin levels in the mixes were providing 200 mg per head per day at a constant level.

The second trial (1975) was conducted in the same manner as the first, except that the supplement was fed on a 6-day schedule rather than daily, and no rumen samples were taken. Also, over the last 64 days, barley was reduced from .45 kg to .23 kg with no adverse effects on supplemental intake.

The winter portion of the first trial ran from November 21, 1974 to February 27, 1975, a period of 98 days. These cows were then kept on their respective treatments, except that during calving they were group fed, throughout the summer. Calves were dropped during March and April. Following calving, two cows from each treatment were removed from the experiment and replaced with like cows from the main herd. One cow died just prior to calving, and the other three cows that were removed from the study lost calves at or near birth. Only pregnant cows were used in these trials, with pregnancy being determined by rectal palpation. On October 27, 1975 the cows were brought back into the barn area for a repeat of trial 1. Pens that contained control cows in trial 1 were assigned monensin fed cows in trial 2 and vice versa to equalize pen effects if any existed. The winter portion of trial 2 terminated on January 20, 1976, a period of 85 days, with cows continuing on their respective treatments through May 25, 1976. Calves were dropped during February, March and April.

Calving dates and birth weights were recorded so adjustments could be made for differences in weight change due to conceptus, if needed (Salisbury and VanDemark, 1961). Interval to first estrus was also determined using a combination of vasectomized bulls equipped with chin ball markers and visual appraisal. Cows were observed during early morning and late evening hours for marks and estrus activity. Breeding was by artificial insemination for the first 42 days and clean up bulls for the last 21 days, starting in late May each year.

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

RESULTS AND DISCUSSION

Gain data and hay intake results for trial 1 are presented in table 1. Initial weights were 461 and 465 kg for controls and monensin supplemented cows, respectively, with final weights being 484 and 507 kilograms. Cows receiving monensin gained .43 as compared to .23 kg per day for the controls ($P<.01$) and consumed less hay, 11.0 to 11.4 kg per day ($P<.06$).

Assuming equal gestation periods, calving records indicated a 6-day difference in stage of gestation between treatments with control cows being closest to parturition during the trial. Differences in gain due to conceptus and including the uterus changes between treatments were small and accounted for slightly more (.02 kg per day) of the control cows' gain than those receiving monensin. The actual gain difference between treatments would be slightly greater in favor of monensin supplemented

TABLE 1. GAIN DATA AND HAY INTAKE FOR TRIAL 1

Treatment Pen no.	Initial weight	Final weight	Hay intake	Average daily gain
	kg	kg	kg	kg
Control				
1	472	482	11.4	.10
3	451	483	11.3	.33
5	462	486	11.5	.25
Average	461	484	11.4	.23**
± SE			.04	.03
Monensin				
2	472	515	11.1	.44
4	469	514	11.1	.45
6	453	492	10.6	.40
Average	465	507	11.0	.43**
± SE			.17	.03

**Means significantly different at the P<.01 level between treatments.

cows if this adjustment were made, however, the effect is minimal. Birth weights were not significantly different between treatments. Calves from monensin supplemented cows averaged 36 kg and control cows' calves 34 kilograms.

Gain data and hay intake results for trial 2 are presented in table 2. Initial weights were 495 and 502 kg for controls and monensin supplemented cows, respectively, with final weights being 519 and 542 kilograms. Monensin supplemented cows gained more than the controls, .47 to .28 kg per day (P<.05), and tended to consume less hay 12.7 to 13.1 kg per day. The difference in hay intake was not significant (P>.05).

Differences in gain due to conceptus and uterine weight changes between treatments

TABLE 2. GAIN DATA AND HAY INTAKE FOR TRIAL 2

Treatment Pen no.	Initial weight	Final weight	Hay intake	Average daily gain
	kg	kg	kg	kg
Control				
2	509	536	13.4	.33
4	486	504	12.4	.21
6	493	519	13.4	.31
Average	495	519	13.1	.28*
± SE			.33	.04
Monensin				
1	513	544	12.7	.37
3	501	556	13.5	.64
5	492	525	12.1	.39
Average	502	542	12.7	.47*
± SE			.40	.04

*Means significantly different at the P<.05 level between treatments.

TABLE 3. VOLATILE FATTY ACID DATA FOR TRIAL 1[a]

Treatment Pen no.	Total mM/liter	Molar %		
		Acetate	Propionate	Butyrate
Control				
1	72.0	76.3	17.0	6.7
3	65.4	76.8	17.0	6.2
5	67.1	75.6	17.7	6.7
Average	68.2	76.2*	17.2*	6.5*
Monensin				
2	73.4	70.7	24.4	4.9
4	78.4	72.8	22.2	5.1
6	64.7	73.8	21.3	5.0
Average	72.2	72.4*	22.6*	5.0*

*Means significantly different at the P<.05 level between treatments.

[a]Rumen samples taken from three animals per replication.

were smaller in trial 2 than in trial 1, and no adjustments were made. Control cows averaged 4 days further along in gestation than monensin supplemented cows and as in trial 1, if this adjustment were made, it would widen the gain difference observed in favor of the monensin supplemented cows. Differences between birth weights due to treatment were minimal. Calves from control cows averaged 36 kg while those from monensin fed cows averaged 37 kilograms.

Results from these two trials were consistent and indicate that monensin substantially improves feed efficiency for maintaining gestating cows wintered on a relatively low quality roughage. Protein content of the meadow hay was 8.2% on a dry basis in trial 1 and 8.6% in trial 2. Daily gains were improved by feeding monensin which is similar to results with growing animals on pasture (Potter *et al.*, 1974; Oliver, 1975). Utley *et al.* (1976) also improved gains of growing animals fed hay in dry lot with monensin and showed a reduction of hay intake similar to that found in these trials with mature cows. Feeding a high roughage growing ration plus monensin, Raun *et al.* (1974b) found no effect on gain but reported a decrease in feed intake which improved feed efficiency. In feedlot cattle, monensin improved feed efficiency by reducing feed intake without a reduction in daily gain (Brown *et al.*, 1974; Raun *et al.*, 1974a).

Total volatile fatty acids in the rumen fluid and the portions of propionate, acetate and butyrate are presented in table 3. Feeding monensin significantly (P<.05) increased propionate by about 31% and decreased acetate and butyrate by 5 and 30%, respectively. Total volatile fatty acids in the two treatments were not significantly different, and these results are in agreement with Raun *et al.* (1974b), Dinius *et al.* (1976), Utley *et al.* (1976) and Perry *et al.* (1976) working with animals on growing rations and feedlot cattle.

Cows from the monensin treatment in trial 1 were in first estrus post-partum an average of 12 days earlier than the controls (P<.05) (table 4). Monensin fed cows were observed in heat an average of 30 days after calving while the control cows averaged 42 days. In trial 2 the interval from calving to first estrus was essentially the same between treatments, being 49 days for the monensin groups and 48 for the controls. These results suggest that monensin may reduce time from calving to first estrus in some instances. Prior to trial 1, these cattle were in a thrifty condition, but not carrying excess flesh. After having received good feed plus .45 kg of barley for the next full year, these cattle were carrying more fat than is desirable. This may have tended to mask a response from monensin to shorten the interval from calving to first estrus in trial 2.

Results of these studies indicate that monensin improves feed conversion for maintaining brood cows on roughage and could mean substantial savings in feed requirements for wintering cow herds. This may be accomplished by feeding less high quality roughage or by feeding lower quality roughages with reduced levels of supplementation.

TABLE 4. INTERVAL TO FIRST ESTRUS AFTER CALVING

Treatment	Trial 1		Trial 2	
	Number	First estrus	Number	First estrus
		days ± SE		days ± SE
Control	24	42* ± 3.61	20[b]	48 ± 2.94
Monensin	23[a]	30* ± 2.91	22[c]	49 ± 4.42

*Means significantly different at the P<.05 level between treatments.

[a]One cow got down on her back and died prior to calving.

[b]Two cows were sold (cancer eye and vaginal prolapse) and two died (acute mastitus and one of an unknown cause) prior to calving or shortly after.

[c]One cow got down on her back and died prior to calving and one cow did not show estrus and was found to have an infection in the reproductive tract.

LITERATURE CITED

Brown, H., L. H. Carroll, N. G. Elliston, H. F. Grueter, J. W. McAskill, R. D. Olson and R. P. Rathmacher. 1974. Field evaluation of monensin for improving feed efficiency in feedlot cattle. Proc. Western Section, Amer. Soc. Anim. Sci. 25:300.

Dinius, D. A., M. E. Simpson and P. B. Marsh. 1976. Effect of monensin fed with forage on digestion and the ruminal ecosystem of steers. J. Anim. Sci. 42:229.

Haney, M. R. Jr. and M. Hoehn. 1967. Monensin, a new biologically active compound. I. Discovery and isolation. Antimicrobial Agents and Chemotherapy. p. 349.

Oliver, W. N. 1975. Effect of monensin on gains of steers grazed on Coastal Bermudagrass. J. Anim. Sci. 41:999.

Perry, T. W., W. M. Beeson and M. T. Mohler. 1976. Effect of monensin on beef cattle performance. J. Anim. Sci. 42:761.

Potter, E. L., C. O. Cooley, A. P. Raun, L. F. Richardson and R. P. Rathmacher. 1974. Effect of monensin on daily gain of cattle on pasture. Proc. Western Section, Amer. Soc. Anim. Sci. 25:343.

Raun, A. P., C. O. Cooley, E. L. Potter, L. F. Richardson, R. P. Rathmacher and R. W. Kennedy. 1974a. Effect of monensin on feed efficiency of cattle. J. Anim. Sci. 39:250. (Abstr.).

Raun, A. P., C. O. Cooley, R. P. Rathmacher, L. R. Richardson and E. L. Potter. 1974b. Effect of different levels of monensin on feed efficiency, ruminal and carcass characteristics of cattle. Proc. Western Section, Amer. Soc. Anim. Sci. 25:346.

Salisbury, G. W. and N. L. VanDemark. 1961. Physiology of Reproduction and Artificial Insemination of Cattle. W. M. Freeman and Co., San Francisco and London.

Steel, R. G. D. and J. H. Torrie. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Co., Inc., New York.

Utley, P. R., G. L. Newton, R. J. Ritter, III and W. C. McCormick. 1976. Effects of feeding monensin in combination with zeranol and testosterone-estradiol implants for growing and finishing heifers. J. Anim. Sci. 42:754.