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MONENSIN AND ZERANOL ALONE AND IN COMBINATION FOR GROWING-FINISHING STEERS AND GROWING HEIFERS[1]

D. G. Wooten, H. A. Turner and R. J. Raleigh
Squaw Butte Experiment Station
Burns, Oregon 97720

Summary

Ninety-two spring-born and 76 fall-born steer and heifer calves (Hereford and Angus x Hereford) averaging 188 and 255 kg, respectively, were utilized in a 2x2 factorial to study the effects of zeranol and monensin, alone and in combination, on growth rate, feed efficiency and carcass characteristics. After weaning, calves were stratified by weight for random allotment to four treatments: 1) control (no zeranol, no monensin); 2) zeranol alone; 3) monensin alone; and 4) zeranol-monensin combination. Zeranol (36 mg) was implanted every 90 days and monensin (200 mg) was fed daily. The diet for both growing periods consisted of hay free choice and a barley-biuret supplement. The diet of both finishing periods (steers only) consisted of a full feed of barley with hay intake limited. Spring calves' results indicated treatments 3 and 4 increased ADG ($P<.05$) during the winter (196 days) while feed efficiency for steers and heifers was improved by 8, 5; 24, 21; and 27, 27% on treatments 2, 3 and 4, respectively, as compared to 1. Average daily gain for the summer grazing period (98 days) was increased ($P<.05$) by treatments 2 and 4. During the finishing period (97 days) treatment 4 increased ADG ($P<.05$) while monensin improved feed efficiency by 12%. Overall ADG (391 days), for steers, was increased 3, 7 and 16% on treatments 2, 3 and 4, respectively, as compared to 1. During the growing period (111 days), fall-born steers and heifers gained .68, .61; .86, .70; .82, .71 and .88, .86; respectively, on treatments 1, 2, 3 and 4. All treatments increased gains ($P<.05$) over 1 with treatment 4 providing increased gains ($P<.05$) over 2 and 3 on the heifers. During the 153-day finishing period for treatments 1, 2, 3 and 4, gains were .89, .95, .92 and 1.01 kg, respectively, with treatment 4 different ($P<.05$) from 1 and 3. Monensin improved feed efficiency by 12%. Overall ADG (264 days), for steers, was increased 13, 9 and 18% on treatments 2, 3 and 4, respectively, over 1. Carcass data, for all steers, indicated a one-third older maturity score ($P<.05$) for steers receiving zeranol. No other carcass data were significant. The combination of monensin and zeranol retained the response of each alone and provided an additive response.

Introduction

Feed additives and subcutaneous implants have been used in the cattle industry for over two decades to promote average daily gains (ADG) and improve feed utilization. Rapid weight gains and efficient feed utilization are two important factors in maximizing the efficiency of red meat production. Zeranol, a subcutaneously implanted anabolic agent, promotes weight gains in the pasture and in the feedlot (Perry et al., 1970; Ward et al., 1978). Monensin, a biologically active feed additive, has improved the feed to gain ratio in grazing animals (Boling et al., 1977; Turner et al., 1980) and in the feedlot (Davis and Erhart, 1976; Raun et al., 1976). A study by Hoffman et al. (1977), using monensin and zeranol in combination, suggested their effects may be additive due to the lack of a significant interaction.

This study was designed to evaluate the effects of monensin and zeranol, alone and in combination, on ADG and feed efficiency of growing-finishing steers and growing heifers. The heifers will become part of a five-year study to evaluate the effects of these treatments on developing replacement heifers.

Experimental Procedure

Spring calves (Hereford and Angus x Hereford), born in March and April, were weaned on September 11 and started on a barley (IFN-4-07-939) and biuret supplement along with rake-bunched meadow hay (IFN-1-03-181). On October 24, 56 steers and 36 heifers were weighed and stratified by weight and randomly assigned to four treatments; control (no zeranol, no monensin), zeranol alone, monensin alone and a zeranol-monensin combination. All weights for these trials were taken after an overnight (14-hour) shrink without feed or water. The steers formed two replications of the four treatments with 14 head per treatment while the heifers formed a separate replication consisting of nine head per treatment. Zeranol implants were 36 mg while daily intake of monensin was 200 mg.

From October 24 to May 7, a period of 196 days, all animals were kept in identical side by side pens and received a full feed of meadow hay plus a daily supplement. The supplement consisted of .06 kg of biuret mixed with .23 kg of finely ground barley subsequently combined with 1.13 kg of ground barley. Monensin was mixed with the finely ground barley to act as a carrier for those animals receiving monensin. Both the hay and supplement were hand fed daily with the hay fed in covered bunks and the supplement in open feeders located in the center of the pens. All animals had free access to self-waterers, salt and a 50-50 mixture of salt and bonemeal. Hay intake was measured, on a replication basis, by weighing hay in daily with orts weighed back weekly. Calves on zeranol treatments were reimplanted on January 23, 91 days after the first implant. Upon termination of the winter phase, all animals were weighed with the steers continuing on the summer pasture phase.

During the summer grazing period steers were combined into two groups, animals receiving monensin formed one group and those not receiving monensin another. The two groups were kept in similar fields consisting of early vegetative crested wheatgrass, (IFN-2-05-420) with free access to water, salt and a 50-50 mixture of salt and bonemeal. Both groups received a daily hand fed supplement, fed in open bunks, beginning at .5 kg of barley and no biuret,

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increasing to 1.4 kg of barley and .06 kg of biuret by August 13, the termination date for the summer grazing period. Monensin was added to the supplement as previously described. This increasing supplementation program was necessary to compensate for the decline in the nutritive quality of the range as the plants matured. Forage consumption data were not collected. On August 13, all steers were weighed with those on zeranol treatments being reimplanted.

In the finishing period, steers remained in the combined groups and were put on an accelerated supplement program by increasing the barley by .5 kg every other day until they reached full feed. Steers reached full feed in two weeks when they no longer consumed the entire amount of barley fed. Steers remained on range receiving barley ad libitum, .06 kg of biuret and .06 kg of limestone hand fed daily in open feed bunks with free access to water, salt and 50-50 salt-bonemeal mixture. Monensin was fed as previously described. Hay was fed on the ground daily and was held at 1.4 kg per head. On November 18, the finishing period was terminated with final weights taken. Steers were slaughtered at a commercial packing plant and carcass data collected by a USDA grader. Carcass data included maturity; marbling; quality grade; warm carcass weight; adjusted fat thickness; ribeye area; kidney, heart and pelvic fat and yield grade.

Fall calves (Hereford and Angus x Hereford), born in October and November, were weaned on July 25 and started on a barley-biuret supplement along with meadow hay aftermath and/or rake-bunched hay ad libitum. On August 22, 36 steers and 40 heifers were weighed and assigned to treatments as previously described, except these steers were not replicated. At the initiation of the growing trial, steers and heifers remaining on pasture, were mixed and combined by treatments as previously described. Initially, all animals were hand fed 1.6 kg of supplement and were increased to 3 kg by the termination date of December 11. The supplement consisted of increasing levels of rolled barley with biuret remaining at .06 kg mixed in .23 kg of finely ground barley. Monensin was fed as described earlier. These supplement levels were used to background the steers for the feedlot. Normally, the recommended supplement would not exceed 1.4 kg, particularly for growing heifers.

Calves were weighed on December 11, with steers on zeranol treatments being reimplanted and moved into the feedlot. Hay and barley were fed in open bunks daily with orts weighed back monthly. The steers were put on the accelerated supplement program as described for the spring-born steers on range. The finishing ration was the same as before, except for an additional .23 kg of beet pulp pellets (IFN-4-00-669). On May 13, final weights were taken, steers were slaughtered and carcass data collected as previously described. Statistical analysis of all gain data was conducted by the least-squares mean procedure of Harvey (1975).

Results and Discussion

Performance of the spring-born steers over the winter are summarized in table 1. Average daily gains for the control, zeranol alone, monensin alone and the combination were .56, .51, .61 and .62 kg, respectively. Monensin alone and the combination increased ADG ($P<.05$) over the controls. Zeranol alone did not imrpove gains. Results of previous studies have also shown occasional failure of zeranol to stimulate gains. The reasons for this are not clear. Ralston (1978) noted hybrid vigor of crossbreeding along with implanation of zeranol may cause added stress when milk was limiting. In this study the pens were muddy, crossbred calves were used and hay consumption of the zeranol alone animals was down by 15% as compared to the control. Feed required per kg of gain was reduced by 9, 24 and 27% over the controls.

Spring-born heifer performance, summarized in table 2, shows relatively the same trend as the steers with heifers receiving monensin having increased gains ($P<.05$) as opposed to those not receiving monensin. Zeranol did not improve gains. The trend for the combination to have the best overall feed per kg of gain was the same as for the steers, with it reduced by 27% compared to 5 and 21% for zeranol alone and monensin alone, respectively, over the controls.

During the summer grazing period (table 3), zeranol alone and the combination treatment increased gains ($P<.05$) over the controls or monensin alone treatments. Steers in the zeranol alone treatment may have compensated for reduced gains during the preceding period. Steers on the monensin treatments responded early, but gains tailed off toward the end of the grazing period. This reduced response to monensin may have been due to poor forage quality (Turner and Raleigh, 1975). This was a high precipitation year with quantity of grass substantially increased over average years, but quality was exceptionally low.

The performance data for the finishing period are presented in table 3. The combination treatment increased ADG ($P<.05$) over all other treatments. Gains for this period were 1.21, 1.26, 1.28 and 1.46 kg for the control, zeranol alone, monensin alone and the combination, respectively. Here again, zeranol alone did not improve gains. Monensin reduced the feed to gain ratio by 12%.

The overall ADG for the entire 391 days (table 3) was .74, .76, .79 and .86 for the control, zeranol alone, monensin alone and the combination, respectively. The combination treatment significantly increased ADG ($P<.05$) over all other treatments. Throughout this entire trial, the combination treatment has consistently shown significant results while some inconsistency was seen with either alone. Final weights of steers on the combination treatment were 47 kg heavier than the controls, with the steers on zeranol and monensin alone being 10 and 20 kg heavier, respectively, than the controls.

Gain performance of fall-born heifers is presented in table 4. Zeranol alone and monensin alone increased ADG ($P<.05$) over the controls while the combination increased ADG ($P<.05$) over all other treatments.

Performance for the fall-born steers during the growing and finishing trials are presented in table 5. All three treatments increased ADG ($P<.05$) over the controls during the growing trial. The combination group ADG was not significantly greater than the zeranol alone or monensin alone as shown in the fall-born heifer data. Sharp and Dyer (1971) suggested that the response to exogenous sex hormones depends on the relative rate of production of somatatrophin, thyroxine and sex hormones at the time of administration. Since zeranol seems to act as an estrogen agonist and heifers mature at a lighter weight as opposed to steers, this may have contributed to this difference.

During the finishing trial, the combination groups increased ADG (P<.05) over the control and monensin alone treatment. Monensin improved the feed to gain ratio by 12%

Overall ADG for the 264-day period was .81, .91, .88 and .95 for the control, zeranol alone, monensin alone, and the combination, respectively. As in the finishing period, the combination increased the overall ADG (P<.05) over the control and monensin alone treatments. Zeranol was more consistent in its response in the fall-born calves. These calves were heavier than the spring calves at the initiation of their respective trials. The maturity of the animals may improve zeranol performance (Sharp and Dyer, 1971).

Carcass data (not presented in tables), for spring and fall-born steers, indicated a one-third older maturity score for steers receiving zeranol. No other carcass data were significant. Zeranol has decreased the lean to fat ratio in animals fed to similar weights (Sharp and Dyer, 1971).

In summary, either monensin or zeranol alone will provide an acceptable increased in gains, but the additive effect exhibited by their combination provides additional gains throughout the growing and finishing periods and a substantial decrease in feed required per unit of gain. Monensin alone improved feed efficiency in all cases.

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Table 1. Gain, feed intake and feed efficiency of spring-born steers over the winter (196 days)

Treatment[1/]	Initial weight	ADG	Daily feed intake[2/]	Feed per kg of gain	Improvement in feed efficiency over the controls
		kg			%
Control	190	.56[a]	7.2	5.9	-
Zeranol	190	.51[a]	6.1	5.4	8
Monensin	190	.61[b]	6.0	4.5	24
Zeranol-monensin	190	.62[b]	5.9	4.3	27

1/ Each treatment consisted of 14 steers.
2/ Includes 1.5 kg of supplement with the remainder being meadow hay.
a,b Means within the same column without a common superscript differ (P<.05)

Table 2. Gain, feed intake and feed efficiency of spring-born heifers over the winter (196 days)

Treatment[1/]	Initial weight	ADG	Daily feed intake[2/]	Feed per kg of gain	Improvement in feed efficiency over the controls
		kg			%
Control	185	.45[a]	5.8	5.9	-
Zeranol	186	.46[a]	5.6	5.5	5
Monensin	186	.53[b]	5.5	4.6	21
Zeranol-monensin	186	.59[b]	5.1	4.3	27

1/ Each treatment group consisted of 9 heifers.
2/ Includes 1.5 kg of supplement with the remainder being meadow hay.
a,b Means within the same column without a common superscript differ (P<.05)

Table 3. Gains for summer period (98 days) and gain, feed intake and feed efficiency data for the finishing period (97 days) and overall gains (391 days) for spring-born steers

Treatment	Summer ADG	Finishing ADG	Daily feed intake1/	Feed per kg of gain1/	Improvement in feed efficiency	Overall ADG	Final weight	Improvement over controls
	kg				%	kg	kg	%
Control	.63[a]	1.21[a]				.74[a]	478	-
Zeranol	.78[b]	1.26[a]	10.1	3.7	-	.76[a]	488	3
Monensin	.67[a]	1.28[a]				.79[a]	498	7
Zeranol-			9.7	3.2	12			
monensin	.73[b]	1.46[b]				.86[b]	525	16

1/ Steers were fed by monensin groups so data on zeranol are not available.
a,b Means within the same column without a common superscript differ ($P<.05$).

Table 4. Gain performance of fall-born heifers during the growing period (111 days)

Treatment1/	Initial weight	ADG	Increase in gain over controls
	kg	kg	%
Control	231	.61[a]	-
Zeranol	231	.70[b]	14
Monensin	234	.71[b]	16
Zeranol-monensin	229	.86[c]	41

1/ Each treatment group consisted of 10 heifers
a,b,c Means within the same column without a common superscript differ ($P<.05$)

Table 5. Gains for the growing period (111 days) and gain, feed intake and feed efficiency for the feedlot period (153 days) and overall gains (264 days) for fall-born steers

Treatment1/	Initial weight	Growing ADG	Feedlot ADG	Daily feed intake2/	Feed per kg of gain2/	Improvement in feed efficiency over controls	Overall ADG	Final weight	Improvement over controls
		kg				%	kg	kg	%
Control	243	.68[a]	.89[a]			-	.81[a]	455	
Zeranol	247	.86[b]	.95[ab]	12.5	6.2		.91[bc]	487	13
Monensin	249	.82[b]	.92[a]				.88[b]	481	9
Zeranol-				11.6	5.5	12			
monesin	248	.88[b]	1.01[b]				.95[c]	499	18

1/ Each treatment consisted of 9 steers.
2/ Steers were fed by monensin group so data on zeranol are not available.
a,b,c Means within the same column without a common superscript differ ($P<.05$).