IMPACT OF IMPLANTS AND MONENSIN ON WEIGHT OF STEERS FED AT MAINTENANCE

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Story in Brief

Steer calves (n=192; 646 lb) were limit-fed a 50% concentrate diet at their estimated maintenance requirements (7.2 lb feed DM daily) for 56 d to determine the effects of implants and ionophores on maintenance energy requirements. Steers were stratified by weight and assigned randomly to 32 pens (six/pen); eight pens were assigned to each of four implant regimes: none, 14 mg estradiol 17β , 140 mg trenbolone acetate (TBA), or 14 mg estradiol 17β plus 140 mg trenbolone acetate. Within each implant regimen, four pens of steers were fed diets with no added monensin while the other four pens received the same diet with 30 g of monensin added per ton of feed. Steers receiving TBA alone or in combination had greater weight gain by d 7; this difference was maintained throughout the trial. A favorable response in weight retention to estrogen first became evident on d 28. At d 56, control steers had gained 19.6 lb (for an ADG of .35 lb); TBA implants had increased weight beyond that of control steers at d 56 by 22.5 lb, whereas estrogen implants had increased weight at d 56 beyond that of control steers by 7.6 lb. No interaction between TBA and estrogenic implants was detected; effects were additive. An advantage in weight maintenance also was detected starting on d 21 for cattle fed diets containing monensin, so that by d 56 steers receiving monensin averaged 7.2 lb heavier than steers not receiving monensin. These results indicate that weight maintenance of steers fed very low amounts of energy can be enhanced by either estrogenic or TBA implants and by including monensin in the diet.

Key Words: Hormonal Implants, Ionophores, Energy, Maintenance, Beef

Introduction

In the United States, most calves are "grown" or "backgrounded" for a period of time before entering the feedlot. In Oklahoma, approximately 2.5 million calves are backgrounded; with a portion of these calves being "dry wintered" on dormant native or improved warm season grasses. During dormancy, these grasses are of low quality and therefore gains are at very slow rates. These calves are typically implanted with growth stimulants. Should they be? Although not substantiated by research, many producers and researchers believe that estrogenic implants are not beneficial for cattle gaining less than .2 lb/d (Kuhl, 1997). If calves are implanted, should they be given an estrogen implant, an androgen implant like testosterone or trenbolone, or a combination of these two? Limited research suggests that trenbolone acetate

(TBA; 300 mg) implants may decrease energy requirements for maintenance (Hunter and Magner, 1990), whereas, estrogenic implants may increase maintenance energy requirements (Rumsey et al., 1980).

Steers backgrounded on low quality forage typically are fed a protein supplement but not an ionophore. Are ionophores beneficial to steers consuming low quality forage if they are at or near maintenance? Although direct research evaluating the effects of ionophores on maintenance energy requirements is lacking, the NRC (1996) suggests that ionophores decrease maintenance energy requirements by 12%. This suggestion that ionophores can reduce maintenance energy requirements needs to be tested directly. This study was designed to determine the effects of implant type and monensin supplementation on weight maintenance of steers limit-fed to attain zero weight gain.

Materials and Methods

Large frame Angus crossbred steer calves (n=192; approximately 9 mo of age) weighing approximately 646 lb and originating in the upper midwest United States were transported to the Willard Sparks Beef Research Center, Stillwater, OK on November 23, 1998. After recovering from transport stress, all steers were stratified by weight and assigned randomly to 32 pens (six steers/pen). Eight pens of calves were assigned to each of four implant regimens: none, 14 mg estradiol 17β , 140 mg trenbolone acetate, or 14 mg estradiol 17β plus 140 mg trenbolone acetate. Within each implant regimen, four pens were fed diets with no added monensin whereas the other four pens received the same diet with 30 g/ton monensin added. During this 56-d trial, steers were fed an average of 7.2 lb dry matter daily of a diet that consisted of 50% concentrate and 50% roughage (Table 1). Pens of steers were weighed at 8:00 a.m. every 7 d prior to feeding throughout the trial, and the feeding rate was adjusted in an attempt to achieve zero body weight change (maintenance) for the nonimplanted cattle consuming feed without an ionophore. Hip height measurements were taken initially and at the conclusion of the 56-d maintenance period. Fat thickness at the $12^{th}/13^{th}$ rib interface was determined via ultrasound on d 56. Fecal samples were checked at day 56 for the presence of coccia.

Data were analyzed as a 4 x 2 factorial (four implants and two levels of monensin) using the GLM procedure of SAS (SAS, 1996) with initial weight serving as a blocking factor and pen serving as experimental unit. Because no interaction between implant and ionophore was detected, data reported will be that of simple effects. Treatment sums of squares for implant type were separated using nonorthogonal contrasts that compared 1) nonimplanted control vs all implanted steers, 2) steers implanted with estrogen alone or in combination vs steers not receiving an estrogenic implant, and 3) steers implanted with TBA alone or in combination vs steers not receiving a TBA implant.

Results and Discussion

All steers lost weight during the first 14 d of the limit-fed period. These losses would not be uncommon for cattle placed on a weight maintenance diet and could be attributed to a decrease in digestive tract contents. However, environmental conditions during this 2-wk period were not favorable (average temperature 10^{o}F, wind chill □10^{o}F) which would have increased maintenance energy requirements beyond that required for maintenance under thermoneutral conditions. As is often observed during energy restriction, these limit-fed cattle initially lost weight, but after a period of several weeks, tended to gain weight even though feed intake was held constant. This observation supports the concept that ruminants can adapt to a period of energy shortage by reducing the amount of dietary energy needed for weight maintenance (Armstrong and Blaxter, 1984. No interactions between implant type and monensin supplementation were detected. Because no interaction was detected, the benefits from implants and monensin appear to be additive and will be discussed separately. Analyses of hip height (skeletal growth) measurements were similar among all treatments, but all steers, regardless of treatment, had an increase in hip height of 1.3 in during this 56-d period. Thus, even though weight gain was minimal, skeletal growth continued. Although not measured initially, fat thickness measurements obtained on d 56 were similar among implant regimens, indicating that body composition did not differ markedly between implant or ionophore treatments. Fecal samples were negative for coccidial oocysts. To better illustrate effects of implant regimen and ionophore supplementation on weight maintenance, differences between treated and control cattle will be shown in all data plots (Figures 1 and 2).

Implant Type. By d 7, implant effects were detected (Table 2). Steers administered TBA either singularly or in combination with estradiol 17β had greater weight retention than nonimplanted steers or those steers that received an estradiol 17β implant only. The numeric difference in weight was maintained and tended to increase throughout the trial. Overall, steers implanted with TBA gained 22.5 lb more weight than control steers, indicating that TBA implants may be reducing maintenance energy requirements, probably through alteration of nutrient partitioning or decreased protein turnover as proposed previously (Hunter and Vercoe, 1987). Estradiol 17β resulted in similar weight changes to nonimplanted calves through d 21, but by d 28 these steers had greater weight gain than control steers. However, because response in weight gain to the estrogen implant was reasonably small, it is not surprising that several workers previously have detected no weight gain response to estrogen implants among cattle with low rates of gain, particularly with grazing cattle where feed intakes and weight can vary. At the end of the 56-d limit-fed period, steers that had received estrogen implants weighed 7.6 lb more than nonimplanted steers. The benefits of estradiol 17β appeared to be additive to those of TBA (Figure 1); steers implanted with estradiol 17β plus TBA tended to gain more weight than those steers implanted with TBA alone.

Monensin. Weights, daily gains, feed efficiency, hip height, and $12^{th}/13^{th}$ rib fat thickness data are shown in Table 3. Although all calves were fed 7.2 lb DM daily, those calves fed monensin gained 7.2 lb more live weight during the 56-d weight maintenance period than those not fed monensin. This 23% enhancement occurred as a result of greater daily weight gains first detected on d 21 and was retained until completion of the limit-fed period (Figure 1). Since each pen of calves within a weight block received the same amount of feed, differences in gain:feed paralleled those of daily gains. The weight gain advantage for calves supplemented with monensin indicates that monensin either decreases the maintenance energy requirements or increases the efficiency at which consumed nutrients are utilized. This efficiency enhancement may be due to alteration of volatile fatty acid composition, specifically increasing the propionate:acetate ratio. NRC (1996) suggests that feeding monensin decreases maintenance energy requirements by 12%. Weight changes observed in this trial match those expected if monensin decreased maintenance requirements by 3.85%. These results support the concept that feeding monensin improves efficiency at which dietary energy is used. However, one cannot differentiate between potential effects of monensin that are related to the diet (ruminal energetics, digestion, absorption) and those related to tissue metabolism (heat production, nutrient partitioning). Further maintenance studies with animals differing in metabolic size may help to differentiate between these two potential modes of action. Limit feeding alone often improves feed efficiency, but because feeding monensin improved feed efficiency even when feed intake was not reduced, benefits from feeding monensin cannot be explained simply by the reduction in feed intake often observed when monensin is fed.

Implications

Feeding monensin increased weight gain of cattle fed at a maintenance level of energy, suggesting that monensin decreases the amount of dietary energy required for weight maintenance. Implants had more immediate and dramatic effects on weight gain, with TBA implants presumably altering the partitioning of nutrients or metabolism (e.g., reducing protein turnover or enhancing lipid mobilization) and thereby reducing the quantity of feed needed for weight maintenance. Overall, these results indicate that even with very low daily gains (.35 lb), weight maintenance of limit-fed steers can be enhanced by either estrogenic or TBA implants and by including monensin in the diet.

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Table 1. Feedstuff and energy content (DM basis of diet) of diet fed to steers during 56-d weight-maintenance period.

	Ration	
Ingredient	No Monensin	Monensin
Alfalfa hay, %	49.91	49.91
Dry corn, %	44.92	44.92
Cottonseed meal, %	4.13	4.13
Wheat midds, %	.65	.63
Salt, %	.33	.33
Rumensin-80, %	.00	.02
Tylan-40, %	.03	.03
Vitamin A-30, %	.03	.03
NEm, Mcal/cwt	79.66	79.65
NEg, Mcal/cwt	49.24	49.23

Table 2. Least squares means for rate and efficiency of gain of nonimplanted and implanted steers during 56-d weight maintenance period.

	Implant regimen[a]					
Item	Control	E17β	TBA	E17β +TBA	SE	Effect[b]
Pens	8	8	8	8		
Weight, lb						
Initial	646	650	642	645	4.64	--
Final	667	677	683	696	4.04	TB, E, I
Daily gain, lb/d						
0 □ 7	-3.25	-2.86	-1.79	-1.78	.43	TB, I
0 □ 14	-3.58	-3.66	-3.06	-2.92	.35	tb
0 □ 21	-.23	-.10	.39	.52	.15	tb, I
0 □ 28	.17	.50	.81	.98	.11	TB, E, I
0 □ 35	.09	.35	.60	.79	.09	TB, E, I
0 □ 42	.14	.28	.50	.66	.08	TB, e, I
0 □ 49	.25	.32	.62	.77	.08	TB, I
0 □ 56	.37	.48	.73	.90	.06	TB, E, I
Hip height, in						
Day 1	46.20	46.18	46.25	46.22	.19	--
Day 56	47.52	47.37	47.54	47.46	.14	--
Fat thickness, mm	1.99	1.78	1.76	1.84	.15	--

[a]Implant regimen: Control = no implant; E17β = 14 mg estradiol 17β ; TBA = 140 mg trenbolone acetate; E17β +TBA = 14 mg estradiol 17β plus 140 mg trenbolone acetate.

[b]Effect:

I= Control vs E17β , TBA, and E17β +TBA (P<.05);

E= E17β and E17β +TBA vs Control and TBA (P<.05);

TB=TBA and E17β +TBA vs Control or E17β (P<.05);

e=E17β and E17β +TBA vs Control and TBA (P<.10);

tb=TBA and E17β +TBA vs Control or E17β (P<.10).

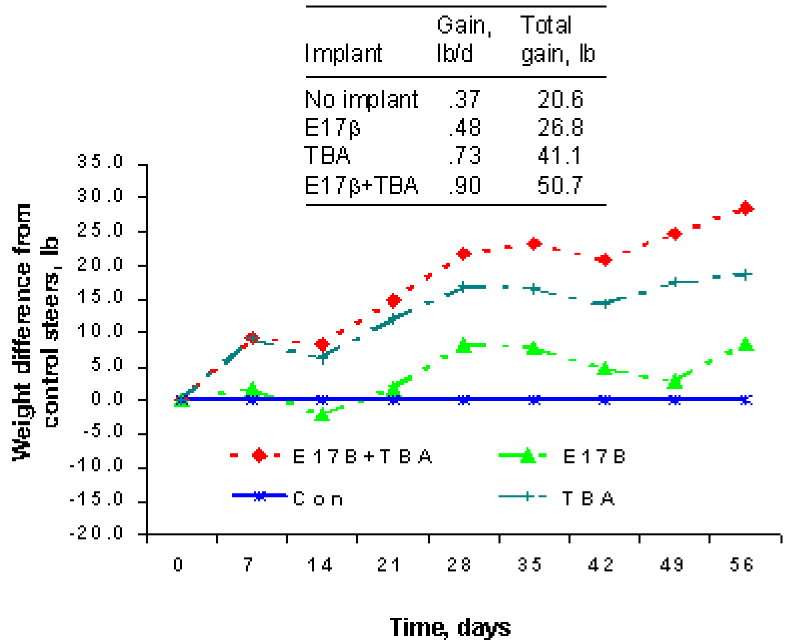
[c]Fat thickness was determined using ultrasound and was estimated at the 12^{th}/13^{th} rib juncture.

Table 3. Least squares means for rate and efficiency of gain of steers during 56-d weight maintenance period with or without monensin in the diet.

	Supplement[a]			
Trait	No Monensin	Monensin	SE	P =
Pens	16	16		
Weight, lb				
Initial	645.0	646.6	3.28	.74
Final	676.2	684.9	2.86	.04
Daily gain, lb/d				
0 □ 7	-2.40	-2.45	.30	.91
0 □ 14	-3.25	-3.36	.25	.76
0 □ 21	-.00	.29	.11	.07
0 □ 28	.49	.74	.08	.03
0 □ 35	.32	.59	.07	.01
0 □ 42	.30	.49	.06	.02
0 □ 49	.40	.58	.06	.03
0 □ 56	.56	.69	.04	.04
Hip height, in				
Day 1	46.2	46.2	.14	.98
Day 56	47.5	47.5	.10	.98
Fat thickness, mm[b]	1.26	1.25	.11	.64

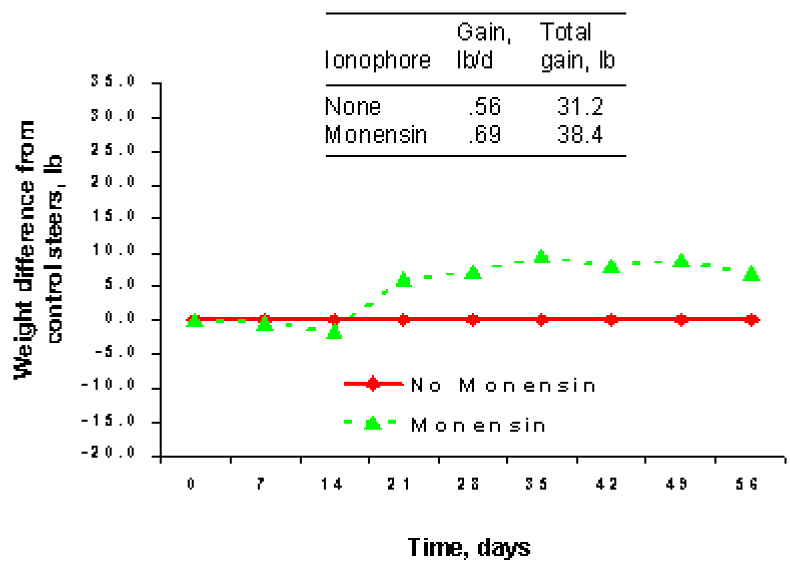
[a]Supplement was formulated to contain 30 g/ton monensin.

[b]Fat thickness was determined using ultrasound and was estimated at the 12th/13th rib juncture.



Implant	Gain, lb/d	Total gain, lb
No implant	.37	20.6
E17β	.48	26.8
TBA	.73	41.1
E17β+TBA	.90	50.7

Figure 1. Weight difference between implanted and nonimplanted steers during a 56-d weight maintenance period.



Ionophore	Gain, lb/d	Total gain, lb
None	.56	31.2
Monensin	.69	38.4

Figure 2. Weight difference between steers during a 56-d weight maintenance period fed diets with or without monensin.

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