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Abstract
Twenty crossbred steers were used to evaluate bovine somatotropin (bST) and an anabolic steroid implant, Revalor-S® (REV), to improve growth and increase carcass leanness. During the first 70 days on feed, bST-treated steers tended to improve live weight gains, consume more feed, and numerically improve feed utilization for growth. The implanted steers grew faster and utilized feed better than steers not implanted with REV. The improvement in gain and feed utilization for growth was maintained throughout the feeding period for REV-implanted steers. At slaughter, REV steers had heavier carcasses which resulted in more pounds of muscle, bone, and fat. When adjusted for hot carcass weight, bST increased leanness of the carcass as evident by the increased weight of the semitendinosus muscle, more pounds of dissected lean, and fewer pounds of dissected fat. Thus, REV and bST can be used to improve growth performance and increase carcass leanness.

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Summary

Twenty crossbred steers were used to evaluate bovine somatotropin (bST) and an anabolic steroid implant, Revalor-S® (REV), to improve growth and increase carcass leanness. During the first 70 days on feed, bST-treated steers tended to improve live weight gains, consume more feed, and numerically improve feed utilization for growth. The implanted steers grew faster and utilized feed better than steers not implanted with REV. The improvement in gain and feed utilization for growth was maintained throughout the feeding period for REV-implanted steers. At slaughter, REV steers had heavier carcasses which resulted in more pounds of muscle, bone, and fat. When adjusted for hot carcass weight, bST increased leanness of the carcass as evident by the increased weight of the semitendinosus muscle, more pounds of dissected lean, and fewer pounds of dissected fat. Thus, REV and bST can be used to improve growth performance and increase carcass leanness.

Introduction

The regulation of tissue growth and metabolism is influenced by genetic determinants, nutrient availability, and environment, but is more directly controlled by hormones and growth factors. Anabolic hormone implants have been used for more than 40 years to promote growth, improve efficiency, and enhance carcass protein deposition. Commonly used anabolic implants have included estrogens, testosterone, trenbolone acetate (a synthetic androgen), and combinations of estrogens and trenbolone acetate. The combination improves growth performance and carcass composition more effectively than hormones administered alone. Bovine somatotropin (bST) is another hormone used to manipulate growth and carcass leanness. bST has been shown to improve efficiency and growth, increase carcass protein, and decrease carcass fat. The overall objective of this project was to better understand the metabolism and key regulating mechanisms responsible for increasing carcass leanness and decreasing the unnecessary fat on beef carcasses. In this study, we used a combination steroidal anabolic implant (Revalor-S®) and recombinant bovine somatotropin (Posilac®) to manipulate the composition of beef carcasses. The objectives of this experiment were to examine the growth and carcass characteristics of steers implanted with Revalor-S® and injected with bST.

Materials and Methods

Twenty steers (mean initial body weight = 792 pounds) were blocked by body weight and allotted in a 2 X 2 factorial arrangement of treatments: control, Revalor-S® implant (REV), recombinant bovine somatotropin (bST) (Posilac®), and REV + bST. Steers were implanted on day one and reimplanted on day 97. Bovine somatotropin was injected on a weekly basis (160 milligrams/week). The cattle were predominantly Simmental and Charolais crossbred steers. The steers were housed in an open-fronted building and fed individually using a Calan® gate feeding system. They had free access to water and were fed a high-energy corn-based diet containing 16% crude protein on a dry basis: 70.84% cracked corn, 13% soybean meal (SoyPlus®), 12% dehydrated pelleted alfalfa, 2% cane molasses, .715% urea, .95% limestone, .3% sodium chloride, .024% elemental sulfur, .024% trace mineral premix, .08% vitamin A premix (to provide 1,400 IU per pound of dry matter), .05% Tylan® premix (to provide 5 mg of Tylosin per pound of dry matter), and .018% Rumensin® premix (to provide 14.4 mg of Sodium monensin per pound of dry matter). The steers were individually weighed in the morning before feeding on two consecutive days at the start and end of the feeding trial and at 14-day intervals throughout the experiment. All steers were fed twice daily.

The steers were slaughtered at the Iowa State University Meat Laboratory in order to collect hot carcass weights, 24-hour cold carcass weights, kidney-pelvic-heart fat percentage (KPH), loineye area, backfat depth, and quality grade. The USDA yield grade was determined from individual carcasses by using the yield grade equation. The right side of the carcass was used for physical separation into lean (muscle), fat, and bone. The three components were weighed, and the lean and fat were ground and sampled for proximate analysis. Before the right side was separated, the *Semitendinosus* (muscle from the round) and the *Longissimus dorsi* muscle were removed and weighed. Six steaks were removed from the New York strip loin of the left side of the carcass; the

steaks were aged for 14 days and then frozen for later analysis of physical and quality attributes.

Data were analyzed as a randomized complete block design with a 2 X 2 factorial arrangement of treatments within each block by analysis of variance. Hot carcass weight was used has a covariant to evaluate carcass characteristics and tissue components. The main effects are presented with the standard error of the mean. Where appropiate, preplanned t-tests were conducted.

Results and Discussion

The overall objective of this beef growth project was to better understand the metabolism and key regulating mechanisms responsible for increasing carcass leanness and decreasing the unnecessary fat on beef carcasses. Additional observations were made to investigate muscle protein turnover, adipose tissue lipogenesis and cellularity, key enzyme activities and relative mRNA regulating fatty acid metabolism, hormone and hormone binding protein concentrations and blood metabolite concentrations, but these will not be presented in this report. The steers were started on trial in the first of March 1995 and were slaughtered during the second, third and fourth weeks of August. There were periods of extreme heat during June, July, and August which affected growth performance. In addition, techniques described above were more invasive and required catheterization and minor surgery; these techniques were performed on five occasions and also may have affected growth performance. Therefore, the growth performance data presented in Table 1 described the first 70 days (before heat stress occurred) and for the first 140 days.

Growth performance is illustrated in Figure 1 and numerically presented in Table 1. Figure 1 depicts rapid growth for all treatments for the first 14 days. Implanted steers and steers injected with bST are gained faster than control animals after 14 days and reached significance by day 70. However, the rates of body weight gain decreased for all treatments between days 90 and 140 because of heat stress, and weight gains were more depressed for steers receiving bST. Two animals that were receiving bST treatment had to be removed from the study because they refused to consume their diets; removal from the study was not dependent on bST. At 70 days, steers implanted with REV had heavier live weights (6.2%, p =.004) , grew faster (18.2% increase in ADG, p =.02) and had better feed-to-gain ratio (13.4% improvement, p =.03) than steers not implanted. These improvements were expected and have been reported previously in the literature and in previous Beef Research Reports (A.S. Leaflets R1049, R1140). Similarly, at 70 days, steers receiving bST injections weekly as compared to steers not receiving bST had heavier live weights (3.9%, p =.04), tended to grow faster (11% increase, p =.11), tended to consume more feed (5.4% increase, p =.11) but no significant improvement in feed efficiency (numerical 6.9% improvement, p > .20). These data are similar to data previously published; ADG range from 0 to 5% increase, mixed results have been reported for DMI and feed-to-gain ratio. There were trends for interaction between REV and bST for ADG and the feed to gain ratio (p < .20).

Revalor-S® implanted steers did not appear to be as negatively affected by the heat and invasive protocols as did the control and bST-treated steers. After 140 days on test, steers implanted with REV had heavier live weights (16.1 % heavier, p =.002), grew faster (44% increase in ADG, p =.004) and had better feed-to-gain ratio (26.7% improvement, P=.002) than steers not implanted. After 140 days on test, there were no improvement in live weight, gain, or feed-to-gain for steers receiving bST injections. However, two steers receiving bST had to be removed from the study, resulting in fewer steers to compare the comparisons at the end of the study.

Carcass characteristics and composition are presented in Table 2 for bST- and REV- treated steers. Implanted steers had heavier hot carcass weights (20.9% heavier, p =.001) and larger loin-eye area's but when adjusted for the heavier carcasses, loin-eye area's were not different. Bovine somatotropin did not affect the hot carcass weights nor loineye area's, but tended to decrease backfat thickness (19% decrease, p <.20). In this study, two economically important muscles were excised and weighed. Implantation with REV resulted in heavier *L. dorsi* (p =.002) and *semitendinital* (p =.003) muscles, but when adjusted for hot carcass, weights were not different (p >.2). Conversely, only the *semitendinital* muscle tended to be heavier with bST (p =.11) and was significantly heavier (10.7% heavier, p =.05) when adjusted for hot carcass weight. In addition, there was a significant treatment interaction for the weight of the *semitendinosus*. These data describing leanness or the degree of muscling often can be misleading. If the loineye area or the weight of the *L. dorsi* were the only quantitative responses made to evaluate leanness, misinterpretation of the data could occur. It is therefore important to evaluate other muscle groups (round) or total muscle mass. In this study, the right side of the carcass was physically separated into lean (muscle), fat, and bone. Because REV resulted in heavier live weights and heavier carcasses, the implanted steer carcass had more pounds of muscle, fat, and bone (p<.05)(Table 2). But when adjusted for carcass weight, muscle, fat, and bone were not different than non-implanted steers. Contrary to REV-implanted steers, hot carcasses from bST steers were similar to steers not receiving bST. When the dissectable muscle, fat and bone of bST-treated animals were adjusted for hot carcass weight, bST-treated steers produced more pounds of muscle (4.3% increase, p =.05) and bone (8.2% increase, p =.05) and less fat (11% decrease, p =.07) than steers not recieving bST. The use of bST, therefore, has an advantage of altering the composition of beef carcasses. On a carcass basis, bST treated steers have more edible lean tissue (muscle) and less fat. These characteristics are desired by health-conscious consumers.

Implications

Bovine somatotropin can be used in combination with commercially available anabolic steroid implants to increase live weight gains and feed utilization for growth. In addition, somatotropin will result in carcasses with more lean tissue and less fat.

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Figure 1. Cumulative body weight gains in steers treated with Revalor-S® and recombinant bovine somatotropin.

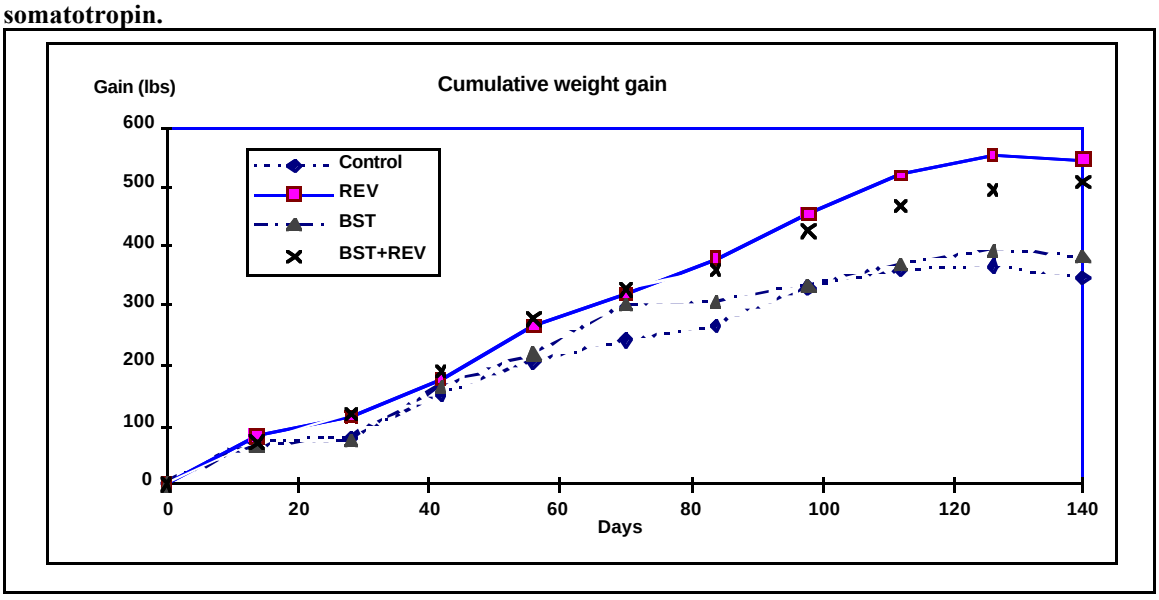

Table 1. Growth performance of steers implanted with Revalor-S® and injected with bovine somatotropin.

Item	Treatments				SEM	Main effects (P-value)		
	Control	REV[a]	bST[b]	REV +bST		REV	bST	REV +bST
Live wt, lbs								
Initial	782.7	791.8	786.9	809.1	14.93	0.31	0.49	0.67
70 days	1027.4	1113.8	1089.7	1135.1	18.28	0.004	0.04	0.28
140 days	1128.6	1339.0	1155.1	1313.6	44.25	0.002	0.99	0.58
ADG, lbs/d								
70 days	3.49	4.59	4.32	4.65	0.26	0.02	0.11	0.16
140 days	2.47	3.90	2.73	3.60	0.30	0.004	0.95	0.39
Dry matter intake, lbs/d								
70 days	16.4	17.6	17.8	18.0	0.54	0.21	0.11	0.21
140 days	17.1	19.3	18.5	18.9	0.77	0.13	0.52	0.28
Feed/gain								
70 days	4.81	3.85	4.15	3.92	0.24	0.03	0.24	0.16
140 days	7.07	5.00	6.98	5.28	0.43	0.002	0.83	0.68

[a]REV = Revalor-S® implants; a combination of 120 mg of trenbolone acetate and 24 mg estradiol-17β.

[b]bST= recombinant bovine somatotropin; injected weekly 160 mg/week.

Table 2. Carcass characteristics and composition of steers implanted with Revalor-S® and injected with bovine somatotropin.

Item	Treatments				SEM	Main effects (P-value)		
	Control	REV[a]	bST[b]	REV +bST		REV	bST	REV +bST
Hot carcass wt, lbs	701.5	855.6	705.7	844.8	30.6	0.001	0.92	0.82
Dressing percentage	63.0	61.9	62.1	62.8	0.84	0.84	0.99	0.36
Backfat thickness, in.	0.24	0.28	0.20	0.23	0.035	0.33	0.17	0.93
Kidney-pelvic-heart fat, %	2.1	1.8	1.9	1.5	0.35	0.38	0.47	0.94
Loin-eye area, in. sq.	11.7	14.2	11.8	13.6	0.71	0.01	0.72	0.64
Adjusted[c]	11.9	14.0	12.0	13.5	0.74	0.37	0.35	0.94
Yeild grade	2.6	2.4	2.4	2.4	0.20	0.53	0.69	0.76
Wt of Selected Muscles, lbs								
Longissimus dorsi	12.5	15.1	13.1	15.4	0.56	0.002	0.45	0.79
Adjusted[c]	13.3	14.4	13.9	14.8	0.50	0.3	0.37	0.87
Semitendinosus	4.7	6.6	5.9	6.5	0.31	0.003	0.1	0.06
Adjusted[c]	5.2	6.2	6.4	6.1	0.26	0.47	0.05	0.04
Carcass physical separation, lbs								
Muscle	397.2	500.3	422.7	510.0	19.1	0.001	0.39	0.69
Adjusted[c]	444.2	459.6	467.3	475.4	8.4	0.45	0.05	0.68
Fat	175.7	206.8	150.6	185.9	13.5	0.04	0.13	0.88
Adjusted[c]	200.4	185.3	174.0	167.7	10.5	0.59	0.07	0.69
Bone	113.5	129.2	124.8	137.1	4.3	0.01	0.05	0.71
Adjusted[c]	119.1	124.4	130.1	133.0	4.0	0.59	0.05	0.78

[a] REV = Revalor-S® implants; a combination of 120 mg of trenbolone acetate and 24 mg estradiol-17B.

[b] bST= recombinant bovine somatotropin; injected weekly 160 mg/week.

[c] Adjusted for hot carcass weight.