

Growth Performance and Serum Prolactin Concentrations of Stocker Steers Implanted with Trenbolone Acetate While Grazing Endophyte-Infected Fescue in the Spring

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Story in Brief

A 64-d grazing study was conducted to evaluate the impact of implant treatment on growth performance, hair score, and serum prolactin level of steers grazing high- (HE) or low- (LE) endophyte-infected tall fescue pastures. Mixed-breed steers ($n = 130$; 542 ± 7.7 lb) were allocated randomly to one of three 10-acre HE or one of four 10-acre LE pastures beginning April 13. Within each replication, half of the steers were implanted with trenbolone acetate (40 mg) and estradiol (8 mg), and half were not implanted. No implant treatment by endophyte level interactions were detected ($P > 0.10$). Overall BW gains were greater ($P < 0.05$) in the implanted groups than in the nonimplanted groups, but serum prolactin concentrations and hair scores did not differ ($P > 0.10$) between groups on either day 36 or 64. Steers grazing HE pastures had lower ($P < 0.01$) total BW gain, inferior ($P < 0.05$) hair scores, and lower ($P < 0.01$) serum prolactin concentrations on day 64 than those grazing LE pastures. Across forage and implant treatments, overall animal BW gains were negatively correlated with hair scores measured on day 64 ($r = -0.28$; $P < 0.01$), and positively correlated with serum prolactin levels measured on days 36 and 64 ($r = 0.33$ and 0.43 , respectively; $P < 0.01$). Therefore, fescue toxicity symptoms were manifested in HE steers, and implanting with trenbolone acetate and estradiol improved grazing BW gain, but implanting steers with trenbolone acetate and estradiol did not offset the toxic effects of grazing infected fescue.

Introduction

Reductions in animal BW gain due to the presence of infection of tall fescue with *Neotyphodium coenophialum* are well documented (Coffey et al., 1990; Hoveland et al., 1980; 1983; Fribourg et al., 1991; McMurphy et al., 1990). Many products or compounds have been tried in an attempt to reduce the impact of tall fescue toxicity, but most have been unsuccessful or impractical. However, in a fall-grazing study, steers implanted with zeranol (Ralgro, 36 mg) gained 36% faster than nonimplanted steers when grazing high-endophyte (HE) tall fescue, but they gained only 12% faster than nonimplanted steers when grazing low-endophyte (LE) tall fescue (Brazle and Coffey, 1991). Therefore, zeranol actually offset some of the toxic effects of infected fescue in grazing steers. Other estrogenic implants have not shown similar benefits when steers grazed HE fescue (Coffey et al., 1992; Davenport et al., 1993; Beconi et al., 1995). The benefits of implanting steers grazing HE fescue with a combination of an androgenic (trenbolone acetate) and an

estrogenic (estradiol) implant have not been determined. The objective of this study was to compare the effects of an androgenic-estrogenic implant combination on growth performance of steers grazing LE- or HE-infected fescue in the spring.

Experimental Procedures

A total of 130 mixed-breed steers (542 ± 7.7 lb) were weighed without prior removal from pasture and water on April 13 and allocated randomly into one of seven groups that were then allocated randomly to either one of four LE-infected or one of three HE-infected fescue pastures. Pastures varied slightly in their acreage and were stocked at two steers per acre. Within each pasture group, half of the cattle were implanted with a combination of 40 mg trenbolone acetate and 8 mg estradiol (Revalor G; Hoescht-Roussel Agri-Vet., Co., Overland Park, KS) and half were not implanted. Calves had ad libitum access to a commercial mineral supplement and were fed no other supplemental feed.

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Calves were weighed on May 19 (day 36) and June 16 (day 64) without prior removal from pasture or water to determine an intermediate and final weight. Groups of calves were comingled prior to weighing and were weighed in random order. A hair score based on a five-point scale (Table 1) was assigned to the calves on day 36 and day 64. Blood samples were collected via jugular venipuncture on those days, and serum prolactin levels were determined.

Pastures were fertilized with 50 lb nitrogen/acre on February 19, and phosphorus and potassium fertilization was applied in the fall. Hand-plucked pasture samples were gathered from multiple random locations within each pasture for ergovaline analysis on day 36. These samples were immediately stored on ice in plastic bags, transported to an ultra-low freezer (-75°C), and then freeze-dried. Available forage was appraised visually at the beginning of the experiment and on days 36 and 64. Height of leaf canopy and a visual appraisal of forage density were used to estimate available forage on June 16.

Data were analyzed using SAS (SAS Inst., Inc., Cary, NC) procedures for a 2×2 factorial arrangement of a split-plot design experiment using initial weight as a covariate. The model included effects of endophyte level, replicate (endophyte level), implant, and the implant \times endophyte level interaction. Animal was considered the experimental unit for the implant treatment, and group of animals was considered the experimental unit for endophyte level.

Results and Discussion

The implant treatment \times endophyte level interaction was not significant ($P > 0.10$) for any of the measurements evaluated in this experiment. Overall gain by steers grazing LE-infected pastures averaged 34.5 lb (0.54 lb/d) greater ($P < 0.01$) than that by calves grazing HE-infected pastures (Table 2). The majority (64%) of this weight differential occurred between days 36 and 64. During the period from day 0 until day 36, steers grazing LE-infected pastures gained 0.35 lb/d more than those grazing HE-infected pastures, whereas from day 36 until day 64, steers grazing LE-infected pastures gained 0.79 lb/d more than those grazing HE-infected pastures. Others (Crawford et al, 1989; Chestnut et al., 1991; Thompson et al., 1993) have reported seasonal differences in response to the endophytic toxins.

Hair scores did not differ between steers grazing LE- and HE-infected pastures on day 36. However, by day 64, calves grazing LE pastures had lower ($P < 0.05$) hair scores than those grazing HE pastures. Although hair-score data were not analyzed across dates, the apparent difference in scores came from a decrease in those from calves grazing LE pastures. Those calves had almost one full hair score change during the 28-d period between May 19 and June 16,

whereas calves grazing HE pastures did not demonstrate a change in hair score during that same period.

Implanted calves gained 0.2 lb/d more ($P < 0.05$) during the 64-d study than nonimplanted calves. Much of this gain differential was accounted for during the first 36-d period; implanted calves gained 0.25 lb/d more ($P < 0.01$) than nonimplanted calves during this period, but gained only 0.13 lb/d more ($P = 0.29$) than nonimplanted calves during the last 28 d. Hair scores did not differ ($P > 0.10$) between implant treatments.

Implant treatment had no effect on serum prolactin concentration. Calves grazing HE-infected pastures had lower serum prolactin levels than those grazing LE-infected pastures.

Implications

Many products have been tried in an attempt to offset the effects of consuming tall fescue toxins; most have met with limited success. Other implants have shown promise in directly reducing some of these toxic effects in the fall, but the combination of trenbolone acetate and estradiol apparently does not offset these toxic effects in the spring. However, in order to improve performance by calves consuming infected fescue, a combination of growth-promoting products will probably have to be used, even though these products do not directly affect the toxic effects of tall fescue. Therefore, in a grazing program with stocker cattle, implanting calves with trenbolone acetate and estradiol could be used to improve weight gains.

Acknowledgments

Appreciation is expressed to Hoescht-Roussel Agri-Vet. Co. for donation of implants.

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Table 1. Hair score scale.

1	Smooth, short (<1/4 in) hair over entire body.
2	Rough hair over 25% of body.
3	Rough hair over 50% of body.
4	Rough hair over 75% of body.
5	Rough hair over entire body.

Table 2. Gain, hair score, and serum prolactin levels of steers grazing high- and low-endophyte tall fescue and implanted with a combination of trenbolone acetate and estradiol.

	Implant effects				Endophyte effects			
	I	NI	SE	P value	HE	LE	SE	P value
Weight day 36, lb	605	596	3.1	0.01	594	607	3.9	0.04
Weight day 64, lb	642	629	4.4	0.01	618	652	6.3	0.01
Gain day 0–36, lb	63	54	3.1	0.01	52	65	3.9	0.04
Gain day 37–64, lb	36	33	3.1	0.29	24	46	6.6	0.04
ADG day 0–36, lb	1.75	1.50	0.085	0.01	1.45	1.80	0.109	0.04
ADG day 37–64, lb	1.30	1.17	0.112	0.30	0.84	1.63	0.234	0.04
Total gain, lb	99	87	4.4	0.01	76	110	6.3	0.01
Daily gain, lb	1.55	1.35	0.068	0.01	1.18	1.72	0.098	0.01
Hair score day 36	3.6	3.4	0.16	0.25	3.3	3.7	0.26	0.24
Hair score day 64	3.2	3.0	0.15	0.36	3.4	2.8	0.16	0.02
Hair change	0.4	0.3	0.14	0.74	-0.1	0.9	0.16	0.01
Prolactin day 36, ng/ml	76	70	13.2	0.70	14	132	13.8	0.01
Prolactin day 64, ng/ml	205	208	36.2	0.95	9	404	37.0	0.01

Means presented are least-squares means.

See Table 1 for description of hair score.

HE = high-endophyte-infected pastures; I = implanted with trenbolone acetate (40 mg) and estradiol (8 mg); LE = low-endophyte-infected pastures; NI = not implanted.

Effect of Dietary Chromium-L-Methionine on Glucose Metabolism of Beef Calves

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Story in Brief

Thirty-six crossbred steers (635 ± 8.2 lb initial BW) were used to determine the effect of chromium (Cr), as chromium-L-methionine, on glucose tolerance and insulin sensitivity in beef calves. Calves were fed a control diet (55% corn, 38% cottonseed hulls, 5% soybean meal) or the control diet supplemented with 400 or 800 ppb Cr as chromium-L-methionine. On days 21, 22, and 23, four calves per dietary treatment were fitted with an indwelling jugular catheter. Approximately 24 h after catheterization, an intravenous glucose tolerance test (500 mg glucose/kg BW) followed 5 h later by an intravenous insulin challenge test (0.1 IU insulin/kg BW) was conducted. There was no effect ($P > 0.10$) of dietary treatment on ADG or feed intake. During the glucose tolerance test, serum insulin concentrations were increased by supplemental chromium-L-methionine (linear effect of Cr, $P < 0.05$). Supplemental chromium-L-methionine increased the glucose clearance rate from 0 to 10 min after the insulin challenge test (linear effect of Cr, $P < 0.05$). Glucose half-life from 0 to 15 min after the insulin infusion was also decreased by supplemental chromium-L-methionine (linear effect of Cr, $P < 0.03$). These data indicate that supplemental Cr as chromium-L-methionine increased the glucose clearance rate after an insulin infusion and increased the insulin response to an intravenous glucose challenge in growing calves.

Introduction

Chromium (Cr) was first shown to be an essential nutrient for normal glucose metabolism in 1959 in the rat. Chromium is a component of a glucose tolerance factor that potentiates the action of insulin. The bioavailability of Cr sources has been determined on the basis of their ability to alter glucose metabolism. Limited research has investigated the effect of supplemental Cr in cattle diets on glucose metabolism. Supplemental Cr, as chromium picolinate, increased glucose clearance rate and decreased glucose half-life and area under the curve in calves fed corn-cottonseed hull-based diets. In calves fed milk replacer, supplemental Cr, as a chromium-nicotinic acid complex, slowed the return to the basal glucose concentration after an insulin infusion (NRC, 1997). The objective of this experiment was to assess the effect of 400 or 800 ppb supplemental Cr, as chromium-L-methionine, on glucose tolerance and insulin sensitivity of beef calves.

Materials and Methods

Thirty-six crossbred steers initially weighing 635 ± 8 lb were blocked by weight (two blocks) and randomly assigned to pens (three pens per block, six steers per pen). Pens within

a block were randomly assigned to a treatment. Steers were kept in drylots and had ad libitum access to water. Twice daily, at 0730 and 1430, calves were moved to a feeding barn containing 36 locking feeding gates, where they were individually offered feed.

Three dietary treatments included either a control diet or the control diet supplemented with 400 or 800 ppb Cr as chromium-L-methionine (Zinpro Corp., Eden Prairie, MN). The diets were formulated to meet or exceed, NRC (1996) recommendations (Table 1). Calves were offered an amount of feed greater than most had consumed on the previous day.

Calves were fed their respective diets for 22, 23, or 24 d. On days 21, 22, and 23, four calves per dietary treatment were fitted with an indwelling jugular catheter. Calves were weighed before the morning feeding on day 21, 22, or 23. The next day, 2 h after being offered the morning feeding, steers were infused intravenously with 0.5 g glucose/kg BW (IVGTT). Five hours later, steers were infused intravenously with 0.1 IU insulin/kg BW (IVICT). Blood samples were obtained immediately before (-10 and 0) and 5, 10, 15, 30, 45, 60, 90, 120, and 150 min after each infusion.

The plasma glucose and serum insulin concentrations after each infusion were analyzed using the MIXED procedures of SAS (SAS Inst. Inc., Cary, NC). A spatial structure was used as the covariance structure. The model

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included dietary treatment, block, time, and the time by dietary treatment interaction. The glucose and insulin kinetic data and the growth performance data were analyzed using the GLM procedure of SAS. The model included block and dietary treatment. Individual animal was used as the experimental unit. Least-squares means were reported.

Results and Discussion

There was no effect ($P > 0.10$) of Cr supplementation on ADG, DM intake, or feed-to-gain ratio during the 21- to 23-d feeding period (Table 2). Supplemental Cr has increased ADG of calves in some studies; however, in other experiments, it has not affected ADG (NRC, 1997). These variable results may reflect differences in Cr status of the calves, the amount of stress to which the calves had been exposed, the amount and bioavailability of Cr in the basal diet, or the bioavailability of the supplemental Cr source.

Intravenous Glucose Tolerance Test. There was a significant time by dietary treatment interaction ($P < 0.05$) on plasma glucose concentrations after the glucose infusion (Figure 1). Plasma glucose concentrations of calves fed 800 ppb supplemental Cr were greater than controls immediately after the glucose infusion, but by 30 min after infusion, those calves had plasma glucose concentrations that were lower than calves fed the control diet. Glucose clearance rates and glucose half-lives after the intravenous glucose tolerance test (Table 2) were not affected ($P > 0.10$) by dietary treatment.

There was a linear effect ($P < 0.05$) of supplemental chromium-L-methionine on serum insulin concentrations after the glucose infusion (Figure 2). Calves fed increasing concentrations of chromium-L-methionine had greater insulin responses than control calves after the glucose infusion. Area under the insulin curve between 0 and 60 min after IVGTT was greater ($P < 0.05$; linear effect of Cr supplementation) for calves supplemented with chromium-L-methionine (Table 2).

Intravenous Insulin Challenge Test. There was a linear effect of supplemental dietary chromium-L-methionine on glucose clearance rates (Table 2) when measured between 0 to 10 min ($P < 0.05$), 5 to 10 min ($P < 0.02$), and 0 to 15 min ($P < 0.07$) after infusion. Steers fed 800 ppb Cr had the greatest glucose clearance rates, whereas steers fed 400 ppb Cr had intermediate rates of glucose clearance. Glucose half-lives were decreased in a linear manner by supplemental Cr from 0 to 10 min ($P < 0.03$), 5 to 10 min ($P < 0.08$), 0 to 15 min

($P < 0.04$), and 0 to 30 min ($P < 0.06$) after infusion.

There was not a time \times treatment interaction ($P > 0.10$) on plasma glucose concentrations after the IVICT. There was, however, a linear effect of supplemental chromium-L-methionine ($P < 0.05$) on plasma glucose concentrations after the insulin challenge test (Figure 3). Calves fed increasing concentrations of chromium-L-methionine had reduced concentrations of plasma glucose after the insulin infusion.

There was a time \times dietary treatment interaction ($P < 0.01$) on serum insulin concentrations after the insulin infusion (Figure 4). There were also overall linear ($P < 0.04$) and quadratic ($P < 0.04$) effects of supplemental chromium-L-methionine on insulin concentrations after the insulin infusion. Steers fed 800 ppb Cr as chromium-L-methionine had the greatest serum insulin concentrations after the insulin infusion.

Implications

Currently, chromium is not approved for addition to cattle diets. Chromium-L-methionine was a bioavailable source of chromium, altering glucose and insulin metabolism in growing beef calves. More research must be done to determine the impact of this supplemental chromium source on immune function, body composition, and growth performance.

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Table 1. Composition of basal diet (as fed basis).^a

Ingredient	%
Cottonseed hulls	38.3
Corn, cracked	54.8
Soybean meal	5.2
Limestone	0.92
Salt, white	0.17
Urea	0.81
Vitamin premix ^b	+
Trace mineral premix ^c	+

^a Diet analyzed 88.9% DM, and 11.8% CP, 45.9% neutral detergent fiber, 31.1% acid detergent fiber, 3% ash, and 0.2 ppm chromium (DM basis).

^b Vitamin premix supplied 1,136 IU of vitamin A, 227 IU of vitamin D, and 0.14 IU of vitamin E/lb of diet.

^c Trace mineral premix supplied 5 ppm copper as copper sulfate, 20 ppm zinc as zinc sulfate, 0.1 ppm cobalt as cobalt carbonate, 0.5 ppm iodine as calcium iodate, and 0.1 ppm selenium as sodium selenite.

Table 2. Effects of dietary chromium-L-methionine on growth performance, and glucose and insulin kinetics.

	Supplemental chromium, ppb			SE
	0	400	800	
<i>Growth performance</i>				
Initial wt, lb	635	635	635	8.2
Final wt, lb	688	688	686	10.8
ADG, lb	2.38	2.38	2.31	0.324
DM intake, lb/d	14.02	14.22	13.85	0.300
<i>After the intravenous glucose tolerance test</i>				
Glucose clearance rate, %/min				
15 to 30 min	1.53	1.57	1.70	0.125
Area under the insulin curve, μIU of serum insulin/(mL • min)				
0 to 60 min ^a	3571	5205	6604	1000
<i>After the intravenous insulin infusion</i>				
Glucose clearance rate, %/min				
0 to 10 min ^a	1.31	1.64	1.66	0.120
5 to 10 min ^a	2.18	2.73	2.82	0.181
0 to 15 min ^b	1.64	1.99	1.96	0.120
Glucose half-life, min				
0 to 10 min ^a	64.4	43.8	45.1	5.95
5 to 10 min ^b	36.8	26.2	27.0	3.89
0 to 15 min ^a	50.0	35.5	36.9	4.22
0 to 30 min ^b	42.4	33.5	33.0	3.41

^a Linear effect of Cr supplementation ($P < 0.05$).

^b Linear effect of Cr supplementation ($P < 0.10$).

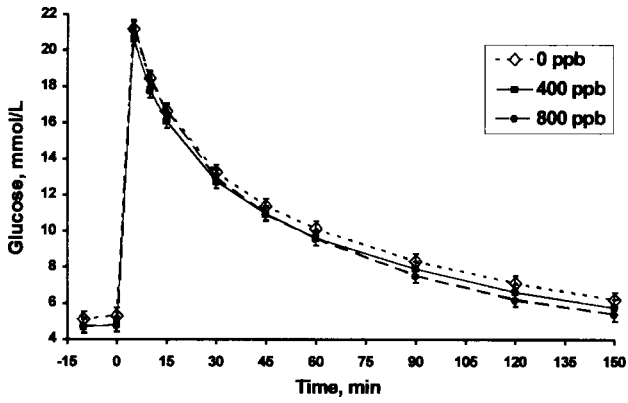


Figure 1. Effect of chromium-L-methionine on plasma glucose concentrations after an intravenous glucose tolerance test. Significant time x dietary treatment interaction ($P < 0.05$).

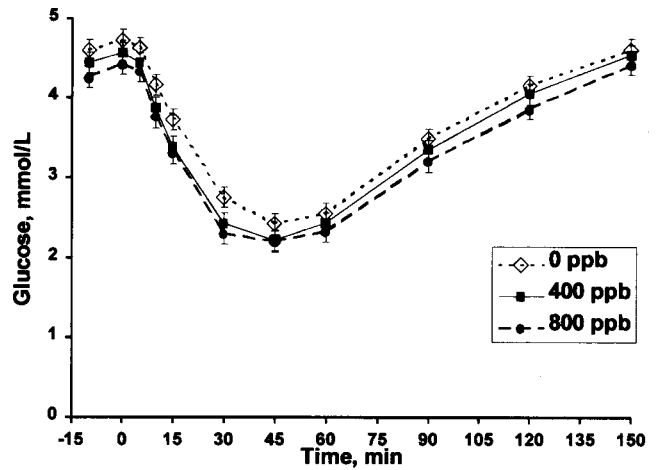


Figure 3. Effect of chromium-L-methionine on plasma glucose concentrations after an intravenous insulin infusion. Linear effect ($P < 0.05$) of supplemental chromium-L-methionine.

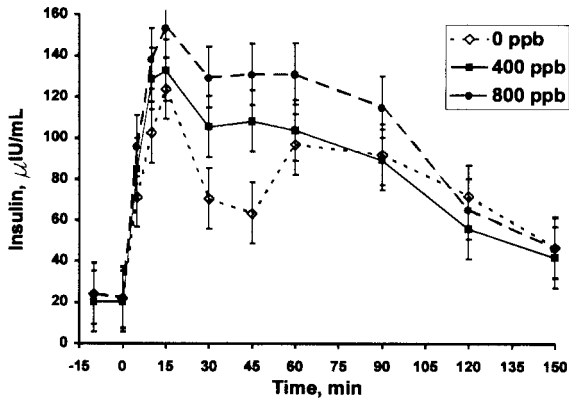


Figure 2. Effect of chromium-L-methionine on serum insulin concentrations after an intravenous glucose tolerance test. Linear effect ($P < 0.05$) of supplemental chromium-L-methionine.

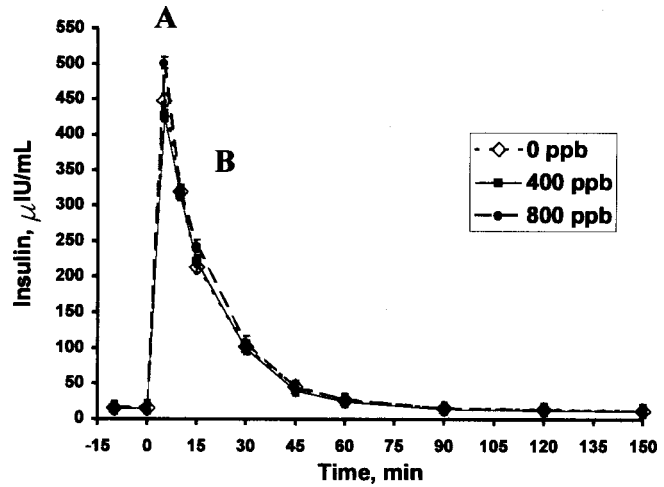


Figure 4. Effect of chromium-L-methionine on serum insulin concentrations after an intravenous infusion. Significant time x dietary treatment interaction ($P < 0.01$). A = 800 ppb greater ($P < 0.01$) than 0 and 400 ppb. B = 800 ppb greater ($P < 0.05$) than 0 ppb.