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Technical Literature

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Effect of KemTRACE® Chromium on Feedlot Performance and Carcass Merit[1]

Introduction

Cattle feeders in today's market need to optimize performance to stay competitive and profitable. Nutritionists strive to balance nutrients to maximize growth potential and muscle accretion. Meeting nutrient demand with essential nutrients at the appropriate time, with the correct formulation is paramount for success. Essential nutrients are the key to driving performance optimization. Diet composition of most finishing rations today provide essential nutrients; however, nutrient demand of cattle with advanced genetics, use of growth implant and beta-agonist strategies challenge cattle feeders and nutritionists to refine programs to maximize growth potential. Optimizing trace mineral nutrition provides opportunities to improve performance[2].

Chromium has been studied for over fifty years and is considered an essential nutrient[3]. Chromium is important for efficient nutrient utilization playing key roles in carbohydrate, lipid and protein metabolism[3]. Chromium included in the diet as KemTRACE® Chromium (CrPro) has improved performance of cattle, expressed as body weight gain, improved feed efficiency, and lower morbidity[4,5,6]. Results from third party studies with feeder cattle demonstrate feeding KemTRACE Chromium has positive effects on immune response, cytokines, and acute phase response of cattle under stress[5]. The potential effects of improved glucose metabolism on carcass characteristics has shown trends in heavier, hot carcass weight and increased dressing percentage. The effect of chromium propionate on bovine muscle, intramuscular adipose and subcutaneous adipose tissue development has shown chromium enhances adipocyte differentiation greater in intramuscular adipocytes than in subcutaneous adipocytes[7]. Enhancement of adenosine monophosphate-activated protein kinase (AMPKα) and glucose transporter type 4 (GLUT4) mRNA by CrPro treatment may enhance glucose uptake in intramuscular adipocytes.

Understanding the mode of action of chromium helps explain animal growth response. Chromium acts to potentiate the action of insulin through optimizing the efficiency of the insulin receptor ultimately providing more glucose at the cellular level. Because the animal uses glucose in a hierarchical manner, glucose may be used for body maintenance or immune system function at the expense of providing glucose for protein accretion only. Animals fed supplemental chromium are benefiting from the additional incremental glucose availability. Other studies with chromium have shown carcass response, suggesting the additional glucose is providing the energy needed for muscle accretion[8,9].

Abstract

This study evaluated supplementing KemTRACE® Chromium at varying concentrations to beef cattle fed a high concentrate diet throughout the entire finishing period. Continental crossbred steers (n=32; (367 ± 2.5 kg) were utilized in a complete randomized block design to evaluate the following supplemental chromium treatments: 1) 0 ppb supplemental chromium, 2) 150 ppb supplemental chromium, 3) 300 ppb supplemental chromium, and 4) 450 ppb supplemental chromium, fed in a typical high concentrate feedlot finishing diet. Treatments were formulated using KemTRACE® Chromium (CrPro). Cattle receiving 450 ppb treatment were significantly heavier ($P < 0.05$) starting on d 56 and remained the heaviest treatment group throughout the experiment, showing also a significant linear effect ($P < 0.05$) for body weight on d 56 until d 147. There was no difference in ADG for the ractopamine period, d 119-147 ($P > 0.05$). The 450 ppb treatment had greater

DMI ($P < 0.05$) for the first 119 d of the experiment with no difference ($P = 0.32$) during the ractopamine period. Feed efficiency was different for the first 119 d with the 450 ppb treatment having the best F:G ($P < 0.05$). On a carcass basis, feeding 450 ppb resulted in the heaviest hot carcass weight ($P < 0.05$). There was a numeric linear increase in marbling scores; however, no significant relationship was identified ($P > 0.05$). There was no difference ($P > 0.05$) for any other carcass characteristic.

Materials & Methods

Continental crossbred steers (n = 32, 367 ± 2.5 kg) were obtained from a single source and processed after arrival utilizing standard feedlot processing protocols. Steers were vaccinated, treated for parasites, and given an individual ear tag for identification. Steers were transitioned to a final finishing ration (Table 1) formulated to meet or exceed dietary requirements described by the NRC (2000)[10]. The ration was manufactured daily, and steers were fed *ad libitum* once daily at 0800 h throughout the feeding trial. Steers were implanted on d 0 and d 88 using Synovex® Choice (Zoetis USA, Florham Park, NJ). On d 119, all steers began to receive 300 mg/hd/d of ractopamine HCl (Optaflexx™, Elanco Animal Health, Greenfield, IN) for 28 d. Animals were monitored daily for signs of illness or lameness.

A complete randomized block design was utilized. Steers were weighed 7 d and 3 d prior to initiation of the experiment. An average of the two body weights were used to stratify steers into 4 weight blocks with 4 pens in each block and 2 steers per pen. Within each block, pens were randomly assigned to treatment: 1) 0 ppb supplemental chromium, 2) 150 ppb supplemental chromium, 3) 300 ppb supplemental chromium, and 4) 450 ppb supplemental chromium. Treatments were formulated using chromium propionate from KemTRACE® Chromium (Kemin Industries, Des Moines, IA) and ground corn as a carrier. The 0 ppb supplemental chromium contained only the ground corn carrier. Treatments were administered to pens by topdressing the ration daily. Feed refusals were collected weekly and weighed to measure intake.

Table 1. Ingredient composition (%, DM basis) of the experimental diets*

Ingredients	%, DM Basis
Steam-flaked corn	75.96
Alfalfa hay, chopped	9.74
Cottonseed meal	4.58
Molasses	3.64
Texas Tech University mineral supplement	2.08
Fat	2.00
Urea	0.80
Calcium carbonate	0.75

*Diets were formulated to meet or exceed NRC (2000) requirements for growing – finishing beef cattle.

Results and Discussion

The 450 ppb treatment was significantly heavier (P < 0.05) starting on d 56 and remained the heaviest treatment group throughout the rest of the experiment (Table 2).

Table 2. Effects of chromium supplementation on BW, kg of feedlot steers*

	Treatment, ppb Cr				Statistics			
Day	0	150	300	450	SE[1]	*P*-value	Linear	Quadratic
d 0	366	365	368	368	2.4	0.6453	0.2748	0.9422
d 28	418	416	426	430	9.1	0.3141	0.0970	0.6382
d 56	464^{b}	464^{b}	481^{ab}	493^{a}	11.4	0.0261	0.0047	0.4164
d 91	535^{b}	521^{b}	541^{ab}	562^{a}	11.8	0.0075	0.0063	0.0408
d 119	574^{bc}	559^{c}	590^{ab}	615^{a}	15.2	0.0037	0.0021	0.0633
d 147	602^{b}	594^{a}	615^{ab}	638^{a}	15.1	0.0243	0.0082	0.1508

*[abc]Means within same row with different superscripts differ (P < 0.05)

[1]Pooled standard error of the mean

Table 3. Effects of chromium supplementation on ADG, kg of feedlot steers*

	Treatment, ppb Cr				Statistics			
Day	0	150	300	450	SE[1]	*P*-value	Linear	Quadratic
d 0-56	1.76^{b}	1.76^{b}	2.00^{ab}	2.24^{a}	0.192	0.0367	0.0068	0.3653
d 56-119	1.75	1.51	1.74	1.94	0.176	0.1034	0.1423	0.0829
d 0-119	1.76^{b}	1.63^{b}	1.87^{ab}	2.08^{a}	0.122	0.0040	0.0025	0.0518
d 119-147	0.98	1.27	0.94	0.81	0.288	0.3976	0.3269	0.2998
d 0-147	1.61^{b}	1.56^{b}	1.69^{ab}	1.84^{a}	0.098	0.0284	0.0093	0.1544

*[ab]Means within same row with different superscripts differ (P < 0.05)

[1]Pooled standard error of the mean

Table 4. Effects of chromium supplementation on DMI, kg of feedlot steers*

	Treatment, ppb Cr				Statistics			
Day	0	150	300	450	SE[1]	*P*-value	Linear	Quadratic
d 0-56	8.1^{ab}	7.9^{b}	8.4^{a}	8.3^{a}	0.17	0.0213	0.0237	0.8370
d 56-119	9.1^{b}	8.8^{b}	9.1^{b}	9.8^{a}	0.28	0.0114	0.0109	0.0286
d 0-119	8.6^{b}	8.4^{b}	8.8^{ab}	9.1^{a}	0.21	0.0168	0.0096	0.1058
d 119-147	8.6	8.5	8.6	9.3	0.47	0.3242	0.1550	0.2638
d 0-147	8.2	8.0	8.4	8.7	0.30	0.1751	0.0688	0.2621

*[ab]Means within same row with different superscripts differ (P < 0.05)

[1]Pooled standard error of the mean

Table 5. Effects of chromium supplementation on F:G of feedlot steers*

	Treatment, ppb Cr				Statistics			
Day	0	150	300	450	SE[1]	*P*-value	Linear	Quadratic
d 0-56	4.95	4.72	4.24	3.77	0.622	0.2079	0.039	0.788
d 56-119	5.44	6.31	5.23	5.08	0.741	0.3074	0.3265	0.3195
d 0-119	4.95^{a}	5.28^{a}	4.70^{ab}	4.41^{b}	0.284	0.0211	0.0144	0.1257
d 119-147	8.73	6.7	10.34	10.39	3.844	0.7706	0.9367	0.6898
d 0-147	5.16	5.21	4.95	4.79	0.263	0.3125	0.0923	0.5522

*[ab]Means within same row with different superscripts differ (P < 0.05)

[1]Pooled standard error of the mean

There was also a significant linear effect ($P < 0.05$) for body weight on d 56 until d 147. For the first 56 d of the experiment, there was a significant linear relationship ($P < 0.05$) for ADG with the 450 ppb treatment having the greatest ADG. This trend was also present for the first 119 d ($P < 0.05$) and the entirety of the trial ($P <$

0.05). However, there was no difference in ADG for the beta agonist feeding period of d 119-147 ($P > 0.05$). The 450 ppb treatment had greater DMI ($P < 0.05$) for the first 119 d of the experiment, and DMI was not different ($P > 0.05$) for the beta agonist feeding period. Feed efficiency was different for the first 119 d with the 450 ppb treatment having the lowest F:G ($P < 0.05$).

Table 6. Effects of chromium supplementation on carcass characteristics of feedlot steers*

	Treatment, ppb Cr				Statistics			
Item	0	150	300	450	SE[1]	*P*-value	Linear	Quadratic
Hot Carcass Weight, kg	394^{b}	395^{b}	404^{ab}	422^{a}	10.5	0.0232	0.0052	0.2232
Dressing Percentage	62.89	63.87	63.08	63.46	1.431	0.8889	0.8260	0.7589
Marbling score[2]	485	502	520	521	48.3	0.8340	0.3763	0.8011
12th rib fat thickness, cm	0.91	1.30	0.94	1.42	0.361	0.3764	0.3017	0.8443
Ribeye area, cm^2	87.7	92.3	91.0	92.9	4.58	0.7849	0.4374	0.8141
KPH, %	2.1	2.2	2.1	2.1	0.21	0.9360	0.7037	0.6429
Calculated yield grade	2.73	2.95	2.71	3.24	0.487	0.6416	0.3752	0.6452

*[ab]Means within same row with different superscripts differ ($P < 0.05$)

[1] Pooled standard error of the mean

As shown in Table 6 and Figure 1, the pattern present for live weight continued with the 450 ppb treatment having the heaviest hot carcass weight ($P < 0.05$). There was a numerically linear increase in marbling scores, however, no significant relationship was identified ($P > 0.05$). There was no difference ($P > 0.05$) for any other carcass characteristic.

Conclusions

This study evaluated supplementing KemTRACE® Chromium at varying concentrations to feeder cattle fed a high concentrate diet throughout the entire finishing period. Supplementing CrPro in feedlot diets resulted in increased weight gain and skeletal muscle growth in beef feeder cattle. Increasing the feeding concentration of chromium from 150 to 450 ppb improved growth performance in a linear fashion. Growth parameters, (body weight gain, average daily gain, and feed efficiency) were optimized at a feeding concentration of 450 ppb. The conversion of consumed nutrients to muscle accretion followed live performance with a significant difference in hot carcass weight at 450 ppb. The results of this study indicate feeding 450 ppb of chromium from chromium propionate throughout the entire finishing period maximizes feedlot performance and optimizes carcass muscle accretion.

References

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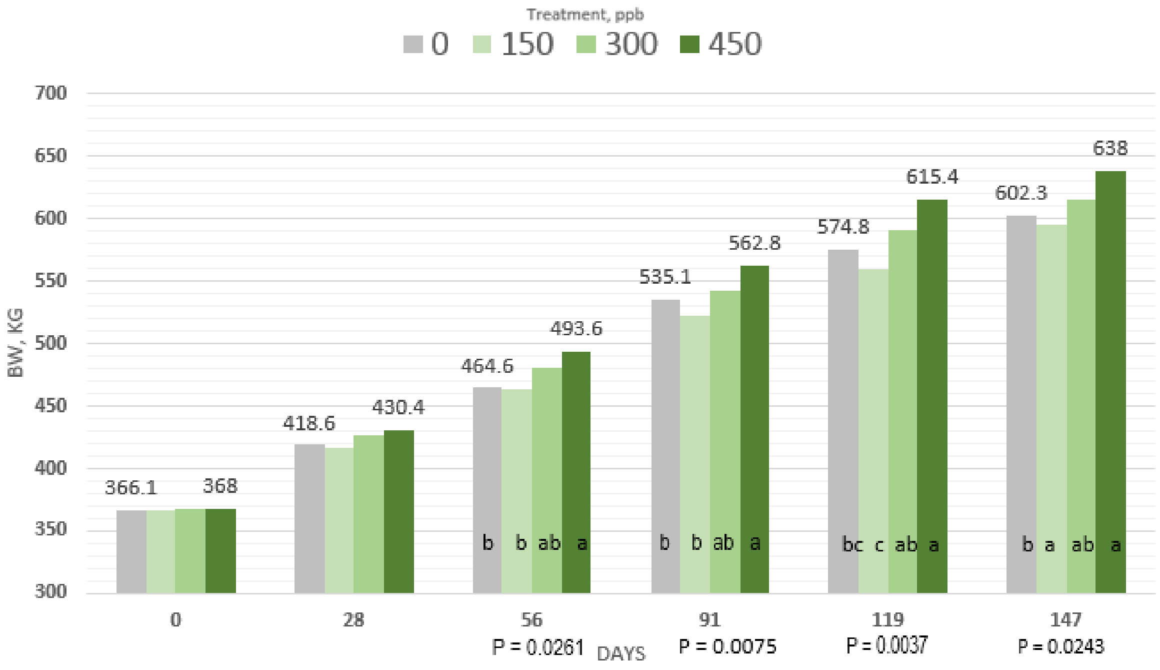
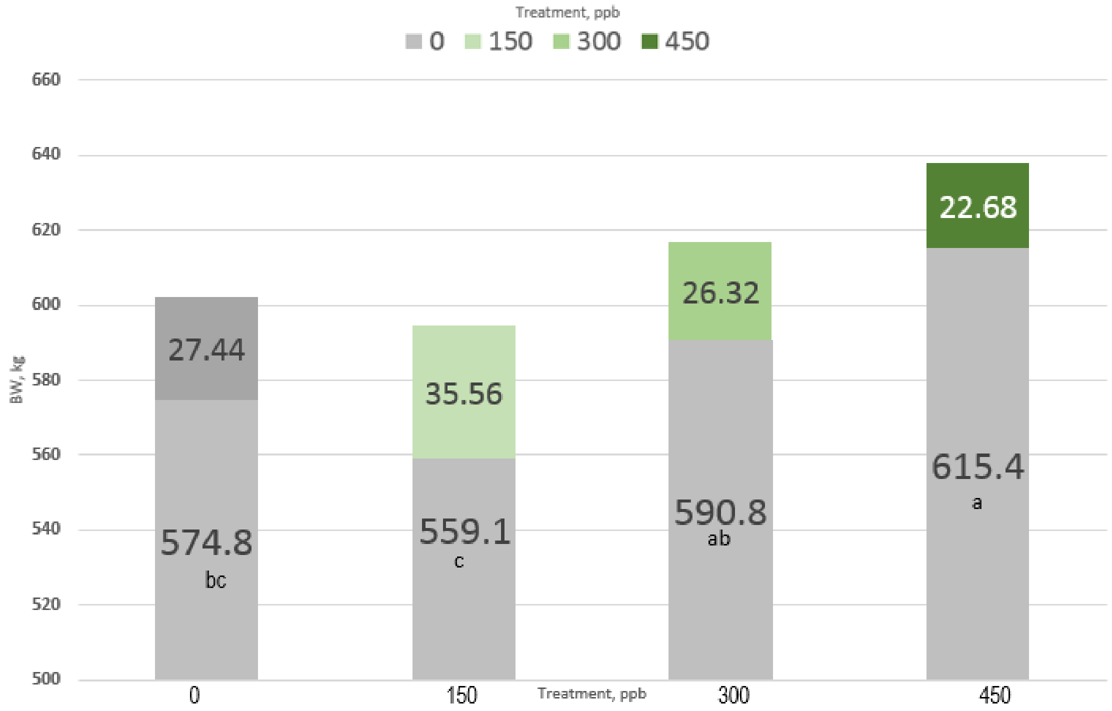
Appendix

Figure 1. The effect of incremental chromium supplementation on cumulative BW gain, kg



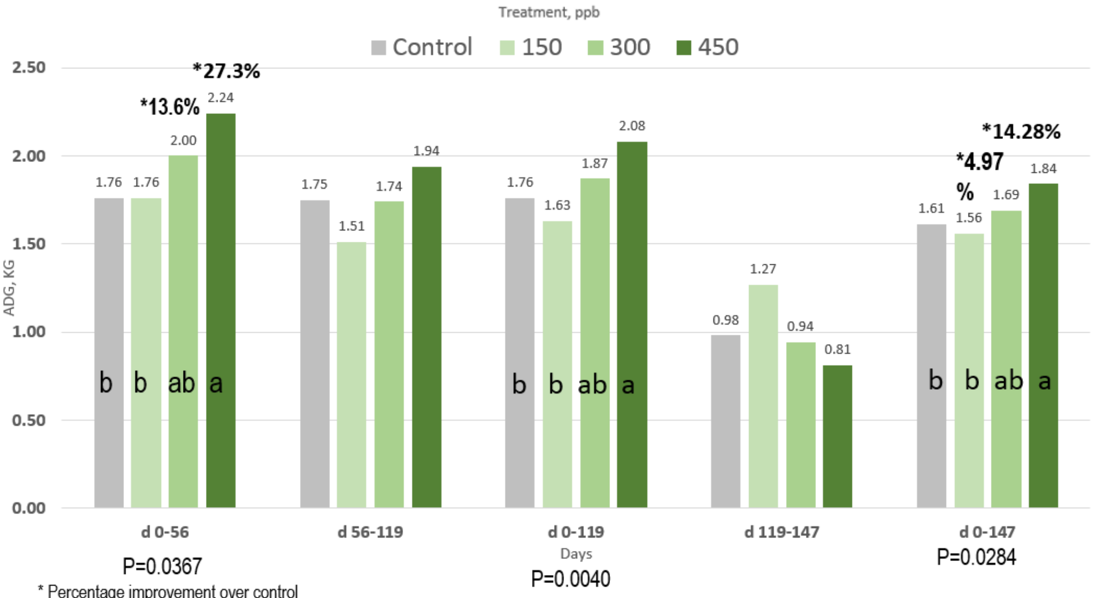
a,b,ab,c denotes significance

Figure 2. The effect of incremental chromium supplementation during the beta-agonist feeding



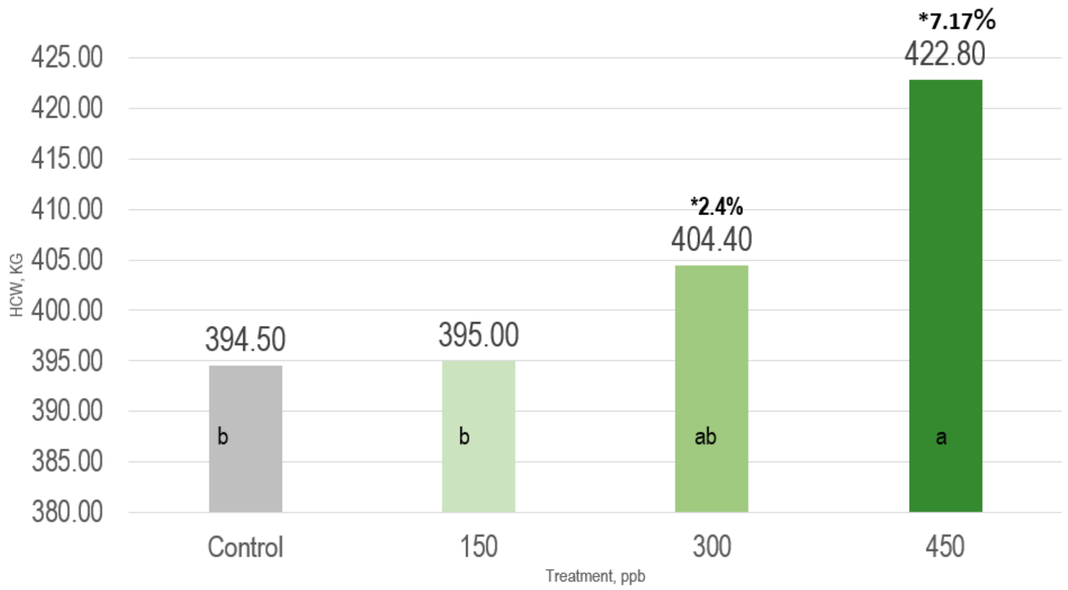
a,b,ab,c,bc denotes significance (P<0.0037)

Figure 3. The effect of incremental chromium supplementation on DMI, kg



* Percentage improvement over control
a,b,ab denotes significance

Figure 4. The effect of incremental chromium supplementation on hot carcass weight, kg



* Percentage improvement over control

a,b,ab denotes significance

P=0.0232