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The effect of chromium propionate on performance responses and meat quality in male broilers

Abstract
A study was conducted evaluating the effect of feeding chromium propionate on performance parameters in male broilers reared to 60 days of age. Day old chicks (n = 720) were randomly assigned to one of 5 treatments (12 pens/treatment; 12 bird/pen): T1 - 0 ppb, T2 - 200 ppb, T3 – 200 ppb for 28 days/100 ppb through day 60, T4 – 100 ppb for 28 days/200 ppb through day 60, T5 – 100 ppb. Chromium significantly increased body weight (BW) on d 14 ($P \leq 0.001$) and tended to increase BW on d 28 and d 60. Feed conversion ratio (FCR) was significantly improved in chromium treatments compared to control on d 14 ($P = 0.05$). At d 60, T2 and T3 showed an improvement on FCR of 7 points compared to control, whereas T4 showed a numerical improvement on FCR of 9 points. T4 showed a numerical improvement on breast meat yield (BMY) of 0.7%, while T2 and T3 showed a numerical improvement on BMY of 0.3 and 0.8%, respectively. This data indicates chromium supplementation from chromium propionate may positively impact a number of performance parameters.

Introduction
Animals can be exposed to various stressors during production. When an animal encounters a stressor, the neurogenic system is activated[1]. Failed attempts to combat or flee from the stressor can trigger activation of the hypothalamic-pituitary-adrenal axis[1]. This initiates cascading effects that result in cortisol being released, which results in behavioral, metabolic, immunological, and intestinal changes[2]. Previous studies have shown that corticosteroids can have a negative impact on broiler growth[3]. Chromium has been shown to reduce the levels of corticosteroids in birds, thereby alleviating the negative impact of stress[4].

Numerous studies conducted outside the U.S. have shown that chromium supplemented diets can positively impact broiler body weight, body weight gain and carcass yield compared to birds not fed chromium[5,6,7]. Until 2016, few studies evaluated the effects of chromium propionate on performance in U.S. broiler operations. The food additive petition (FAP) approval for chromium propionate supplementation in broiler diets by the Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) more readily allows for broiler performance studies to be conducted in U.S. universities and commercial operations[8]. The present study was conducted to evaluate the effect of chromium propionate on body weight gain (BW), feed consumption, feed conversion ratio (FCR) and carcass characteristics of male broiler chickens.

Materials and Methods
One-day old male Cobb 500 broiler were randomly assigned to one of 5 treatments (12 pens/treatment; 12 birds/pen; Table 1), which included various levels of chromium from chromium propionate (KemTRACE® Chromium, Kemin Industries, Des Moines, IA) between 0 - 200 ppb. Broilers were raised until 60 days of age.

Table 1: Dietary chromium supplementation levels from chromium propionate for each experimental treatment and time period fed.

Treatment	Chromium 0d-28d (ppb)	Chromium 29d-60d (ppb)
1	0	0
2	200	200
3	200	100
4	100	200
5	100	100

The commercial type basal diets contained salinomycin sodium (60 g/t), BMD® (Zoetis, Madison, NJ) 50 g/t, and phytase. Diets were made for 4 growth phases: starter (0 - 14d), grower (15 - 28d), finisher 1 (29 - 42d) and finisher 2 (43 - 60d). The diets and water were provided *ad libitum*.

The building temperature was maintained at the recommended temperature for the age of the birds until 28d. From 29d to 60d, broilers were subjected to cyclic heat stress by exposing them to 28 ± 2 °C (82.4 ± 3.6 °F) from 0800 to 1800 and 22 ± 2 °C (71.6 ± 3.6 °F) from 1800 to 0800.

Bird weights, feed consumption and feed conversion were recorded on 0d, 14d, 28d, 42d and 60d. At day 60, carcass and breast meat weights were collected from 6 birds per pen (72 birds/treatment) and weighed.

Results and Discussion

Adding chromium to the diet significantly improved BW at 14d with all treatments compared to control ($P \leq 0.001$; Figure 1). Significant improvements were also observed for FCR at 14d. Treatment 4 was significantly different than the control at 14d showing 10 points of improvement ($P \leq 0.05$; Figure 1).

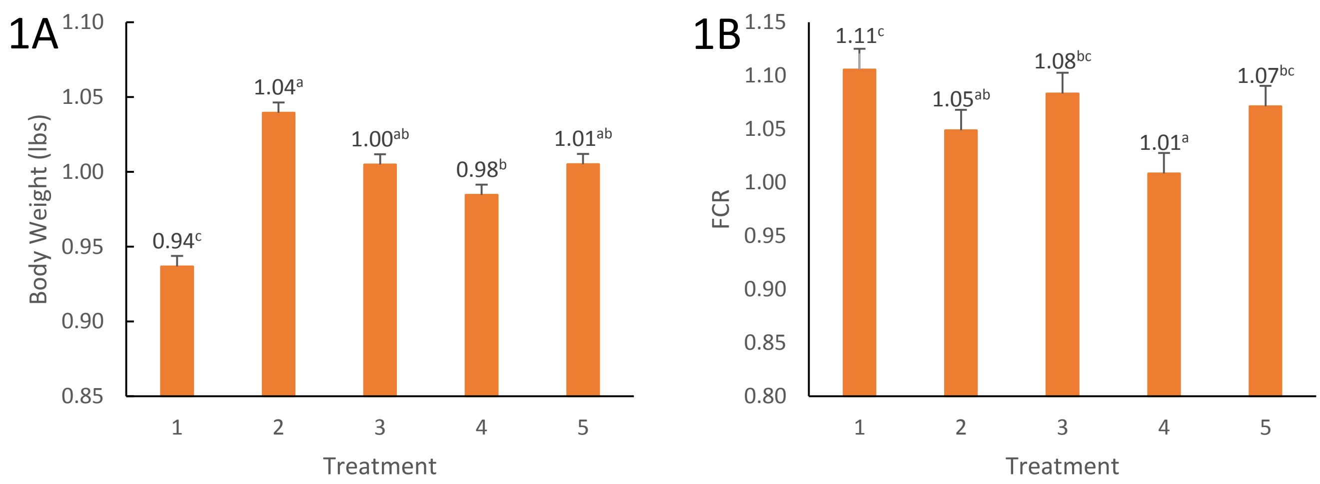

Figure 1. Effect of chromium supplementation from chromium propionate on body weight (1A) and FCR (1B) at 14d. Treatments: 1 = 0 ppb chromium, 2 = 200 ppb chromium, 3 = 200 ppb chromium for 28d then 100 ppb chromium until 60d, 4 = 100 ppb chromium for 28d then 200 ppb chromium until 60d, 5 = 100 ppb chromium. [a-c] Differing superscripts indicate significant difference $P \leq 0.05$. Error bar represents SEM.

Birds that were fed chromium tended to have a heavier BW at 28d than the control. (P = 0.091; Figure 2). Adding chromium to the diet significantly improved FCR at 28d ($P \leq 0.05$; Figure 2). Treatment 4 was significantly better than the control 28d showing an improvement in FCR of 5 points.

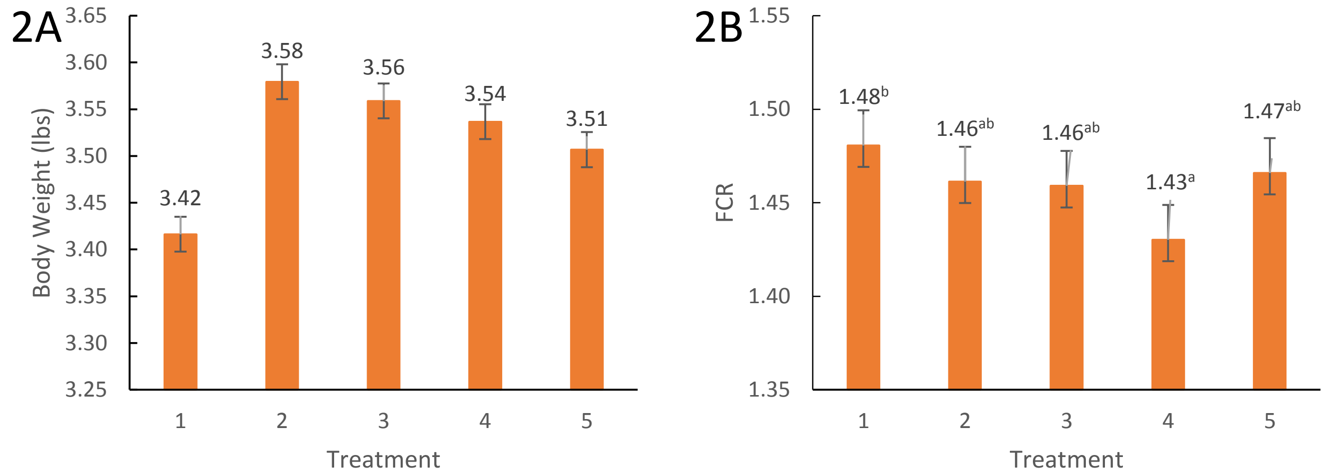

Figure 2. Effect of chromium supplementation from chromium propionate on body weight (2A) and FCR (2B) at 28d. Treatments: 1 = 0 ppb chromium, 2 = 200 ppb chromium, 3 = 200 ppb chromium for 28d then 100 ppb chromium until 60d, 4 = 100 ppb chromium for 28d then 200 ppb chromium until 60d, 5 = 100 ppb chromium. [ab] Differing superscripts indicate significant difference $P \leq 0.05$. Error bar represents SEM.

BW of 42d birds was numerically improved (P = 0.195) when chromium was added to the diet with the exception

of treatment 5 (Figure 3). At 42d, treatments 3 and 4 tended to improve FCR by 4 and 3 points, respectively (P

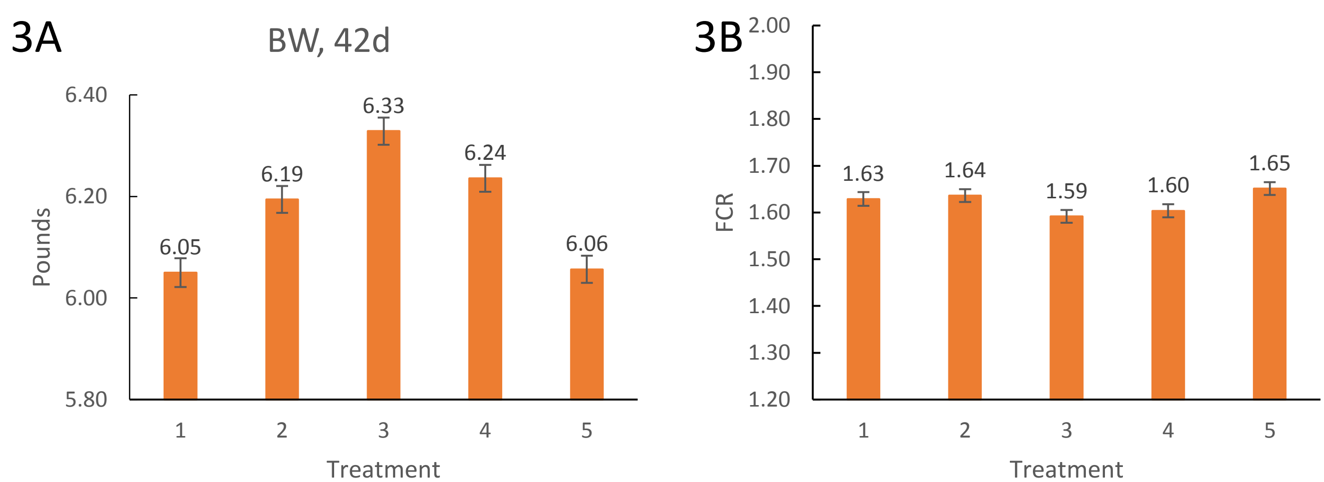

Figure 3. Effect of chromium supplementation from chromium propionate on body weight (3A) and FCR (3B) at 42d. Treatments: 1 = 0 ppb chromium, 2 = 200 ppb chromium, 3 = 200 ppb chromium for 28d then 100 ppb chromium until 60d, 4 = 100 ppb chromium for 28d then 200 ppb chromium until 60d, 5 = 100 ppb chromium. Error bar represents SEM.

The BW of 60d birds tended to be improved by chromium with the exception of treatment 5, which was similar to the control ($P = 0.085$; Figure 4). At 60d, treatments 2 and 3 showed a numerical improvement in FCR of 7 points compared to control. Treatment 4 showed a numerical improvement in FCR of 9 points (Figure 4).

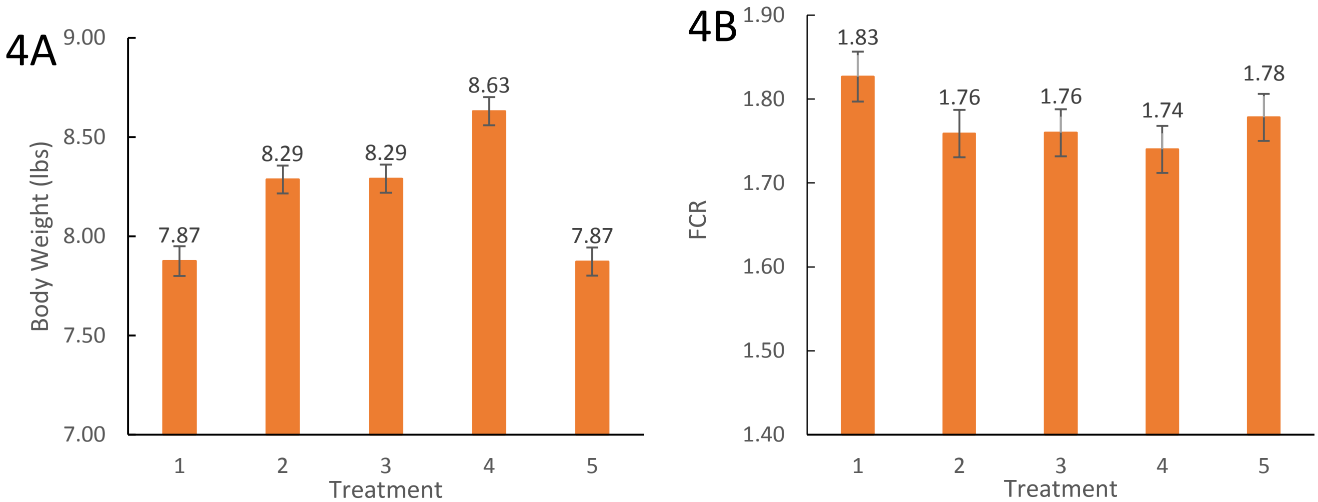

Figure 4. Effect of chromium from chromium propionate on body weight (4A) and FCR (4B) at 60d. Treatments: 1 = 0 ppb chromium, 2 = 200 ppb chromium, 3 = 200 ppb chromium for 28d then 100 ppb chromium until 60d, 4 = 100 ppb chromium for 28d then 200 ppb chromium until 60d, 5 = 100 ppb chromium. Error bar represents SEM.

These results are in agreement with Toghyani et al. who reported a positive effect of chromium on BW and

FCR[5,6].

Numerically improved results in breast meat yield (BMY) were observed in treatment groups supplemented with chromium (Figure 5). Treatment 4 showed a numerical improvement in BMY of 0.7%; whereas, treatments 2 and 3 showed a numerical improvement in BMY of 0.3 and 0.8%, respectively.

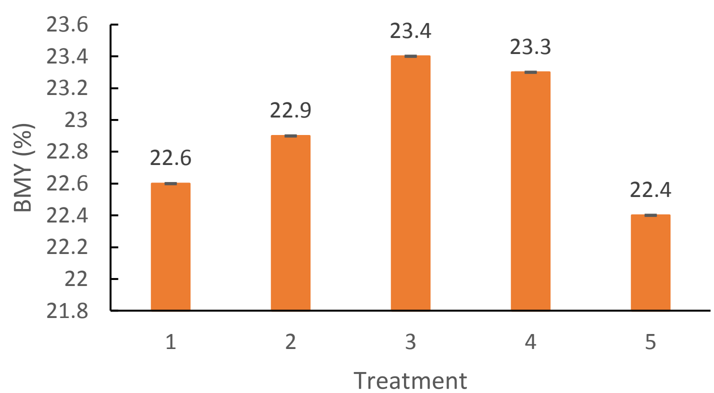

Figure 5. Effect of chromium propionate on breast meat yield (BMY). Treatments: 1 = 0 ppb chromium, 2 = 200 ppb chromium, 3 = 200 ppb chromium for 28d then 100 ppb chromium until 60d, 4 = 100 ppb chromium for 28d then 200 ppb chromium until 60d, 5 = 100 ppb chromium. Error bar represents SEM.

Supplementing chromium from chromium propionate in the diet showed a positive effect on FCR and BMY of birds subjected to cyclical heat stress. Chromium supplementation may alleviate the negative effects of stress on growth, performance and carcass traits.

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