



Original Research

Dietary Supplementation of Chromium Picolinate on Productive Performance and Cost Economics of Coloured Broiler Chicken during Hot-Humid Summer

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Rec. Date:	Dec 30, 2017 05:34
Accept Date:	May 06, 2018 13:58
DOI	10.5455/ijlr.20171230053426

Abstract

The efficacy of chromium picolinate (0, 20 or 40 mg/kg diet) in coloured broilers (n=120) was evaluated (0-42 d) during hot-humid summer. The chicks were randomly divided into three treatment groups having five replicate of eight birds each. The parameters viz. feed intake, body weight gain, feed conversion ratio, energy and protein efficiency, carcass traits, immune-competence and cost economics were studied. The 0-42 d body weight gain and feed intake was comparable with improved FCR. There was no significant difference in the yield of breast, back, drumstick, thigh, neck and wing. The supplementation of Cr picolinate did not bring any significant changes in the shrinkage, blood and feather loss, but eviscerated and ready to cook yield improved significantly with fat pad reduction. The cost/kg live weight and cost/kg meat yield were reduced. Dietary addition of 20 mg chromium picolinate per kg diet helps to improve the production performance.

Key words: Carcass Traits, Chromium, Hot-Humid, Productive Performance

How to cite: Kulkarni, R., Mandal, A., Bhanja, S., Goel, A., & Mehara, M. (2018). Dietary Supplementation of Chromium Picolinate on Productive Performance and Cost Economics of Coloured Broiler Chicken during Hot-Humid Summer. International Journal of Livestock Research, 8(10), 132-139. doi: 10.5455/ijlr.20171230053426

Introduction

In combating tropical heat stress, producers use cooling systems in the poultry house that is effective but expensive. Therefore, cost-effective solutions to the problem should be thought. The manipulation of the diet including supplementation of anti-stress minerals or vitamins is often recommended (Attia *et al.*, 2015). Chromium (Cr⁺³) is an indispensable trace mineral required for optimum health and productivity of livestock, which play key role in metabolism of carbohydrates, fats and proteins (Davis and Vincent, 1997), activation of certain enzymes, stabilizes proteins and nucleic acids (Anderson, 1994). Its dietary supplementation is recommended by NRC (1997) for animals. Although chromium is not currently considered as an essential trace mineral for poultry, preceding report suggests a nutritional and



physiological role of chromium as a micronutrient (Sands and Smith, 1999). Dietary Cr⁺³ supplementation have been shown to positively affect growth rate and feed efficiency in broiler chicken (Jackson *et al.*, 2008; Samanta *et al.*, 2008). The recommendations regarding the inclusion level of Cr⁺³ in poultry diet are yet to be established (NRC, 1994) particularly during hot-humid summer.

Accordingly, the current experiment was conducted in coloured broiler chickens receiving either no dietary supplementation of Cr⁺³ or different levels of Cr⁺³ in the form of Cr picolinate. The objective of this study was to assess the effects of dietary Cr⁺³ supplementation on productive performance, carcass traits and cost economics of coloured broilers.

Materials and Methods

Experimental Birds

The performance of coloured broiler chickens (n=120, day-old) fed diets with or without addition of Cr picolinate was assessed during hot-humid summer.

Table 1: Ingredient and nutrient composition of experimental diets

Ingredients (kg/100kg)	Starting (0-21 days) (%)	Finishing (22-42 days) (%)
Yellow maize	53.3	58.4
Soybean meal	40.3	35.5
Rapeseed meal	3	3
Limestone powder	0.9	0.9
Dicalcium phosphate	1.7	1.45
Common salt	0.3	0.3
DL-Methionine	0.11	0.07
Constant*	0.41	0.41
Total	100.02	100.03
Nutrient composition (As fed basis)		
ME, kcal/kg***	2840.87	2894.6
Crude Protein, %**	21.48	19.94
Lysine, %***	1.27	1.15
Methionine, %***	0.52	0.46
Calcium, %**	1.08	0.96
Total Phosphorus, %**	0.77	0.7
Available Phosphorus, %***	0.45	0.4
Zinc, mg/kg**	46	44
Potassium, %***	0.41	0.39
Chloride, %***	0.28	0.3
Cost, Rs.***	15.68	15.12
Ether extract, %**	2.82	2.02
Crude fiber, %**	4.52	4.58
Total ash, %**	5.22	5.34

*Constant includes trace mineral premix 0.1, vitamin premixes 0.215, toxin binder 0.05 and coccidiostat 0.05%. Trace mineral premix supplied Mg- 300, Mn- 55, I- 0.4, Fe- 56, Zn-30 and Cu- 4 mg/kg diet. The vitamin premixes supplied vitamin A 8250 IU, vitamin D₃ 1200 ICU; vitamin K 1mg; vitamin E 40 IU, vitamin B₁ 2mg, vitamin B₂ 4mg, vitamin B₁₂ 10mcg; niacin 60mg; pantothenic acid 10mg and choline chloride 500mg/kg diet.

** Analyzed values as fed basis

***calculated values as fed basis

Three dietary treatments were prepared by adding different levels of Cr picolinate (0, 20 and 40 mg/kg diet) in broiler starter (0-21d) and finisher (22-42d) diets (Table 1). Each diet was offered to 5 replicated groups of 8 birds each. The experimental birds were reared under uniform management following approved welfare practices.

Feed Conversion Ratio (FCR), Energy and Protein Efficiency

Based on the data pertaining to the feed consumption and body weight gain (BWG), the phase wise cumulative feed conversion ratio. The energy and protein efficiency was calculated by using standard method.

Carcass Traits

After 42nd day of age, eight birds from each dietary treatment were selected as per body weight closer to mean. The birds were kept off feed for eight hours prior to slaughter but drinking water was offered to them. The carcass parameters viz. Shrinkage loss, blood loss, feather loss, eviscerated as well as ready to cook yield, cut-up part yields (breast, thigh, drumsticks, back, neck and wing) and yield of various organs (liver, heart gizzard, pancreas, fat pad etc.) were recorded and expressed as % of live weight.

Cost Economics

The cost of diets consumed in each treatment group was calculated by adding cost of starter and finisher feed consumed. Thereafter, the cost of feed per kg live weight gain and meat yield was calculated.

Statistical Analysis

Data emanated from different treatments were analyzed for statistical significance using completely randomized design (CRD) by following standard methods (Snedecor and Cochran, 1989). All the data were statistically analyzed using SPSS software package version 16.0. variables having unequal observations were analyzed following least square design method and the Duncan's multiple range test (Duncan, 1955).

Result and Discussion

The results pertaining to the productive traits viz. body weight gain, feed intake, feed conversion ratio, energy and protein efficiency have been presented in Table 2. The body weight gain (BWG) was found to be higher in Cr Picolinate supplemented birds as compared to that of control (un-supplemented). However, it did not reach up to the significant level during starting, finishing and overall growth phases. There was also no mortality either in control or Cr picolinate supplemented group throughout the experiment. The present findings are corroborates with earlier finding of (Uyanik *et al.*, 2002; Anandhi *et al.*, 2006). The supplementation of Cr as Cr yeast (an organic form), at higher level i.e. 1 g/kg diet (Hossain *et al.*, 1998)

and at the different levels of 0, 400 and 600 mg/kg diet (Wang *et al.*, 2003) did not affect body weight of the broilers.

Table 2: Effect of supplemental chromium picolinate on production performance in different growth phases

Parameter	Phase (wk)	Control	CrP 20mg/kg	CrP 40mg/kg	SEm	Prob.
Live wt gain (g)	0-3	497.2	504.2	510.5	5.488	NS
	6-Mar	982.6	1041.8	1041.9	11.67	NS
	0-6	1479.8	1546.1	1552.4	15.561	NS
Feed intake (g)	0-3	803.9	808.1	812.3	5.75	NS
	6-Mar	2013.7	2072.8	2048	23.169	NS
	0-6	2817.7	2880.9	2860.3	26.656	NS
Feed conversion ratio	0-3	1.62	1.6	1.59	0.005	NS
	6-Mar	2.05 ^c	1.99 ^b	1.96 ^a	0.012	P<0.001
	0-6	1.90 ^c	1.86 ^b	1.85 ^a	0.007	P<0.001
Energy efficiency (kcal ME/g gain)	0-3	4.59	4.55	4.52	0.015	NS
	6-Mar	5.93 ^c	5.76 ^b	5.69 ^a	0.033	P<0.001
	0-6	5.48 ^c	5.37 ^b	5.30 ^a	0.023	P<0.001
Protein efficiency (g/g gain)	0-3	0.35	0.34	0.34	0.001	NS
	6-Mar	0.41 ^c	0.40 ^b	0.39 ^a	0.002	P<0.001
	0-6	0.39 ^c	0.379 ^b	0.3754 ^a	0.002	P<0.001

CrP- Cr Picolinate; Values bearing different superscript differed significantly ($P<0.05$); NS= Non-significant

On the contrary, Jackson *et al.* (2008); Samanta *et al.* (2008) also observed that dietary Cr supplementation has positive effect on growth rate. The supplementation of inorganic salt of Cr in the diet of broilers as Cr chloride at 20 and 40 mg/kg diet (Mohamed and Afifi, 2001) and Cr chloride or Cr sulfate (Bhuvnesh *et al.*, 2004) also significantly improved BWG in broilers.

Current study further revealed that the feed intake of chicks was not significantly affected by chromium supplementation. Similarly, Cr picolinate supplementation did not significantly improve the FCR during starting phase but the chicks that received either 20 or 40 mg Cr picolinate/kg diet exhibited better ($P<0.001$) FCR during finishing and overall growth phases than the control group. The chicks fed with 40 mg Cr picolinate/kg diet showed better capacity to convert feed into body weight than the chicks receiving either 0 or 20 mg Cr picolinate/kg of diet. The efficiency of utilizing energy and protein was greater ($P<0.001$) in Cr picolinate fed birds than control during the finishing and overall growth phases, but it remained comparable during the starting phase. Nonetheless, efficiency was better in birds fed with 40 mg/kg Cr picolinate as compared to other dietary treatments.

This findings is in accordance with the reports of Jackson *et al.*, 2008; Samanta *et al.*, 2008; Naghieh *et al.*, 2010). Mohamed and Afifi (2001) used Cr chloride instead of Cr picolinate and reported similar findings. However, efficiency of energy, protein utilization and BWG was apparently higher in the chicks fed with Cr supplemented diet. The gain in body weight may be attributed to property of Cr to improve amino acid uptake by tissues and muscle cell as well as to augment protein retention (Naghieh *et al.*, 2010). Cr is generally accepted as the active component in the glucose tolerance factor (GTF) which increases the

sensitivity of tissue receptors to insulin, resulting in increased glucose uptake by cells and increased oxidation of glucose (Jeejebhoy *et al.*, 1977). It may be hypothesized that increased in glucose uptake leads to higher BWG. The data on carcass traits, relative weight of visceral organs and cut-up parts yield of the broiler as expressed as percentage of live weight is given in Table 3.

Table 3: Effect of supplemental chromium picolinate on carcass traits

Parameter	Control	CrP 20mg/kg	CrP 40mg/kg	Mean	SEm	Prob.
Shrinkage	5.74	4.74	4.61	5.03	0.276	NS
Blood loss	2.66	2.76	2.75	2.72	0.121	NS
Feather loss	5.43	5.41	5.15	5.33	0.228	NS
Eviscerated yield	69.06 ^a	69.51 ^{ab}	70.03 ^b	69.53	0.147	P<0.017
Ready to cook yield	74.14 ^a	74.69 ^{ab}	75.28 ^b	74.7	0.148	P<0.003
Breast	16.41	16.85	16.58	16.61	0.256	NS
Back	16.3	16.35	16.06	16.24	0.155	NS
Drumstick	10.63	11.56	11.2	11.13	0.195	NS
Thigh	10.09	10.37	10.08	10.18	0.174	NS
Neck	3.97	3.51	3.52	3.67	0.111	NS
Wing	9.71	10.14	9.63	9.83	0.094	NS
Heart	0.52	0.53	0.51	0.52	0.01	NS
Liver	2.43	2.5	2.51	2.48	0.05	NS
Gizzard	2.14	2.15	2.24	2.18	0.063	NS
Giblet	5.09	5.19	5.25	5.17	0.077	NS
Pancreas	0.21	0.25	0.25	0.23	0.009	NS
Fadpad	0.75 ^b	0.39 ^a	0.60 ^{ab}	0.58	0.055	P<0.020

Values bearing different superscript differed significantly ($P<0.05$); NS= Non significant

There was no significant difference on the yield of breast, back, drumstick, thigh, neck and wing. Further, the supplementation of Cr picolinate did not bring any significant changes in the shrinkage, blood and feather loss, but eviscerated and ready to cook yield improved significantly due to dietary supplementation of chromium. On the contrary, no significant difference was observed in the yield of giblet (heart, liver and gizzard) and pancreas, although there was significant ($P<0.02$) reduction in abdominal fad pad thickness in birds fed with Cr picolinate. Similar findings were reported in earlier studies (Toghyani *et al.*, 2006; Samanta *et al.*, 2008; Naghieh *et al.*, 2010). On the contrary Sahin *et al.* (2003) reported that dietary addition of Cr was beneficial to augment the relative yields of liver, heart, spleen and gizzard. Further, Guo *et al.* (1999) revealed that supplemental Cr as Cr-yeast and Cr-chloride (2.0 and 10.0 mg/kg diet respectively) had positive effect on meat yield. Similarly, Chen *et al.* (2001) accounted that Cr supplementation significantly increases the breast and thigh muscle yield. A similar trend was observed in pullets (Holoubek *et al.*, 2000). The pre-slaughter, eviscerated, ready-to-cook yield and giblets weight did not differ significantly due to dietary inclusion of organic chromium (Anandhi *et al.*, 2006). Nevertheless, Jackson *et al.* (2008) concluded that there was no significant effect of Cr on carcass traits.

The reduction in abdominal fat content recorded in this study. It may be due to stimulation of insulin action and role in lipid metabolism leading to lessening of abdominal fat. In low levels of insulin, glucose converts to lipid and store in adipose tissues (Mertz, 1993). In addition, Cr plays role in protein and nucleic acid metabolism (Ohba *et al.*, 1986; Anderson, 1987). It has been shown that Cr supplementation causes significant changes in the chemical composition of animal carcasses (Lukaski, 1999). Feed cost of broiler chicken in terms of weight gain was significantly ($P < 0.001$) reduced in Cr picolinate fed birds as compared to control with the lowest feed cost recorded in birds fed Cr at the rate of 40 mg/kg diet (Fig. 1).

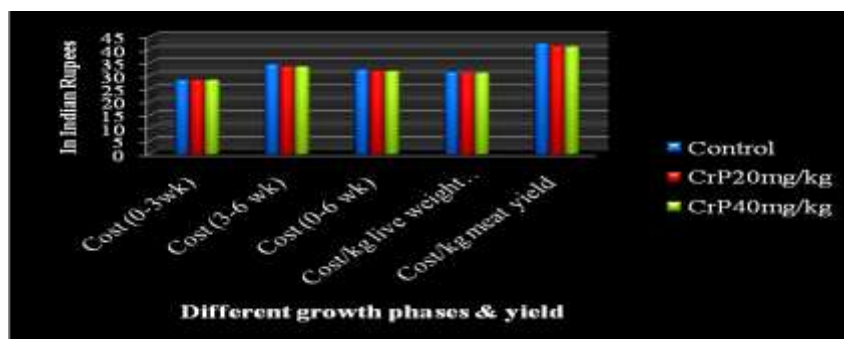


Fig. 1: Cost economics on chromium picolinate supplementation

The cost/kg live weight and cost/kg meat yield also reduced significantly ($P < 0.001$) with Cr picolinate supplementation. Nonetheless, the present study indicates that dietary Cr supplementation is important from economics point of view since the cost/kg live weight gain and cost/kg meat yield was reduced due to its supplementation, which may be ascribed to better utilization of energy and protein by the chicks.

Conclusion

Thus it may be concluded that the dietary supplementation of Cr picolinate at the level of 20 mg/kg diet improved feed conversion ratio, energy and protein efficiency, eviscerated and ready to cook yield in broiler chicken. Chromium supplementation further seems to decrease mortality rate and helps to reduce the cost of production of broiler chickens.

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