*Original Research*

# Effect of Dietary Supplementation of Graded Levels of Chromium Picolinate on the Production Performance, Immune Competence Traits, Development of Digestive Organs and Carcass Quality Traits of Coloured Chicken

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**Abstract**

*One hundred and twenty straight run, day old coloured chicken (Chabro) were distributed into four treatments: T1-basal diet, T2- T1+400ppb chromium picolinate (cp), T3- T1+800ppb cp, T4- T1+1600 ppb cp. There was no significant difference on average weekly body weight gain of coloured chicken among treatment groups except in 7$^{th}$ week during which T1, T2 and T3 were significantly higher ($p<0.05$) than that of T4. FCR was significantly better ($P<0.05$) in T1, T3 and T4 than T2 at 3$^{rd}$ week. Response to 1% SRBC ($log_2$ titre) and cell mediated immune response to PHA-P were comparatively better in T3 than other groups. There was no significant difference among treatment groups in the carcass quality traits and cut up parts. Thus, it may be inferred that supplementation of 800 ppb chromium picolinate revealed no adverse effect on body weight gain and resulted in higher humoral and cell mediated immune responses in coloured chicken.*

**Key words:** Body Weight Gain, Chromium Picolinate, Coloured Chicken, Immunity

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## Introduction

Trace mineral supplementation is now widely considered not only essential but also beneficial in poultry. They are involved in numerous biochemical functions, making them essential for optimal growth and health. Supplementation of Cr has promising effects on the immune system due to relative increase in

lymphoid organ weight, decreased heterophil-lymphocyte ratio, enhanced antibody response against infectious diseases and increased cell-mediated immune response (Khan *et al.*, 2014). Having such beneficial effects in broilers, studies on supplementation of organic chromium in broiler ration are necessary as most diets are primarily composed of ingredients from plant origin which are usually low in chromium. Hence, a study was conducted to assess effect of dietary supplementation of graded levels of chromium picolinate on production performance, immune competence traits, development of digestive organs and carcass quality traits of coloured chicken.

## Materials and Methods

### Birds and Feed

One hundred and twenty straight run, day old coloured chicken (Chabro) were distributed into four treatments: T1-basal diet or Control diet (C.P-22%, M.E- 2900 kcal/kg), T2- T1+400ppb chromium picolinate (cp), T3- T1+800ppb cp, T4- T1+1600ppb cp.

### Body Weight and Feed Conversion Ratio

Weekly body weight gain and group feed consumption was recorded. Thereafter, weekly feed conversion ratio was calculated at the end of the experiment.

### Immunocompetence Traits

The general innate immune-competence status of chabro birds was assayed by measuring two important immunocompetence traits as antibody response to SRBC and cell mediated immune response to PHA-P at 8 week of age.

### Antibody Response to Sheep Red Blood Cells (SRBC)

HA antibody titres against 1% SRBC in chabro birds was determined as described by Siegel and Gross (1980) and Vander Zijpp (1983). IgG and IgM antibodies were determined by means of a mercaptoethanol (ME) HA test as per the method described by Martin *et al.* (1989).

### *In vivo* Cell Mediated Immune Response

The cellular immune response was assessed by cutaneous basophilic hypersensitivity test *in vivo* by using PHA-P (Phytohaemagglutinin, lectin from *Phaseolus vulgaris*) (Corrier and De Loach, 1990).

### Development of Digestive Organs and Carcass Quality Traits

At 8 weeks of age, six representative birds from each treatment group was randomly selected and sacrificed to study the gastrointestinal tract development (proventriculus, gizzard, small intestine, large intestine and caeca) and various carcass traits.





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**Statistical Analysis**

Data were subjected to one-way analysis of variance in a completely randomized design (Snedecor and Cochran, 1994) using Statistical Package for the Social Sciences (SPSS, 2011). Homogenous subsets were separated using multiple range test described by Duncan (1955). Differences among treatments were considered to be significant when P≤0.05.

**Results and Discussion**

**Body Weight Gain and Feed Conversion Ratio**

There was no significant difference on average weekly body weight gain of coloured chicken among treatment groups except in 7th week during which T1, T2 and T3 were significantly higher (p<0.05) than that of T4 (Table 1).

**Table 1:** Effect of dietary supplementation of graded levels of chromium picolinate on average weekly body weight gain (g) and feed conversion ratio (FCR) of coloured chicken

| Average weekly body weight gain | | | | | | | | Weekly feed conversion ratio | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st wk | 2nd wk | 3rd wk | 4th wk | 5th wk | 6th wk | 7th wk | 8th wk | 1st wk | 2nd wk | 3rd wk | 4th wk | 5th wk | 6th wk | 7th wk | 8th wk |
| 62.46 | 112.87 | 160.8 | 187.13 | 210.93 | 190.6 | 218.46$^{b}$ | 191.86 | 2.39 | 2.29 | 2.17$^{a}$ | 2.48 | 2.46 | 2.51 | 2.52 | 2.5 |
| 64.67 | 112.26 | 150.6 | 196.6 | 215.13 | 189.07 | 218.13$^{b}$ | 191.73 | 2.24 | 2.34 | 2.47$^{b}$ | 2.2 | 2.36 | 2.55 | 2.53 | 2.53 |
| 64.73 | 112.6 | 176.07 | 176.87 | 213.4 | 196.46 | 204.80$^{b}$ | 181.8 | 2.33 | 2.3 | 2.30$^{ab}$ | 2.27 | 2.42 | 2.56 | 2.54 | 2.55 |
| 64.06 | 110.73 | 149.33 | 184.56 | 189.77 | 179.27 | 170.07$^{a}$ | 171.67 | 2.34 | 2.32 | 2.30$^{ab}$ | 2.27 | 2.43 | 2.52 | 2.53 | 2.55 |
| 1.28 | 2.01 | 5.81 | 4.85 | 5.43 | 6.18 | 6.67 | 6.83 | 0.06 | 0.05 | 0.04 | 0.07 | 0.03 | 0.07 | 0.03 | 0.04 |
| NS | NS | NS | NS | NS | NS | P<0.01 | NS | NS | NS | P<0.05 | NS | NS | NS | NS | NS |

*Means bearing different superscripts within a column differ significantly (P<0.01); NS: Non significant (P>0.05) SEM: Standard error of means*

There was no significant difference in the weekly FCR of the chicks during the course of the experiment except 3rd week, where in FCR was found significantly better (P<0.05) in T1, T3 and T4 than T2 (Table 1). Similar observations were also reported by Wang *et al.* (2003). Uyanik *et al.* (2002) reported that chromium supplementation as chromium chloride at 20 ppm level caused significant reduction in feed intake and improved feed efficiency without affecting weight gain in broilers. Rao *et al.* (2012) also reported that the dietary supplementation of organic chromium in commercial broiler chickens has no effect on body mass gain. Rajalekshmi *et al.* (2014) also reported that there was no significant effect of supplementation of chromium propionate at different dosage levels in male broiler chickens (Cobb, 400) on weight gain during the whole study period of 42 days.

**Humoral Immune Response and Cell Mediated Immune Response**

There was no significant difference among the various treatment groups but the response to 1% SRBC ($log_2$ titre) was apparently better in T3 as compared to the other treatment groups. No significant difference was recorded in the response to PHA-P among the various treatment groups. However, cell





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mediated immune response to PHA-P was numerically better in T3 as compared to the other treatment groups (Table 2). Similar findings were observed by Uyanik *et al.* (2002), who observed increased IgM along with an increase in the Cell-Mediated Immunity (CMI) to phytohemagglutinin (PHA). An improved Hypersensitivity (CBH response test to PHA-P) was observed in broilers reared under heat stress, the organic form of chromium was found to be better in reducing heat stress-related immunodepression in broiler chicks (Ghazi *et al.*, 2012).

**Table 2:** Effect of dietary supplementation of graded levels of chromium picolinate on the humoral immune responses [antibody titer (log 2) values] to 1% SRBC and cell mediated immune response (response to PHA-P) (Foot web index) of coloured chicken at 6 weeks of age

| Treatment | HA | IgG | IgM | Foot web index |
|---|---|---|---|---|
| T1 | 6.50 | 1.50 | 5.00 | 0.46 |
| T2 | 7.00 | 1.43 | 5.57 | 0.41 |
| T3 | 7.86 | 1.86 | 6.00 | 0.54 |
| T4 | 7.13 | 1.63 | 5.50 | 0.51 |
| Pooled SEM | 0.23 | 0.11 | 0.20 | 0.04 |
| Sig Level | NS | NS | NS | NS |

*NS: Non significant (P<0.05) SEM: Standard error of means*

**Development of Digestive Organs and Carcass Quality Traits**

No significant differences were found in gastrointestinal tract development traits except lowest weight for large intestine was found for cp1600 ppb (Table 3).

**Table 3:** Effect of dietary supplementation of graded levels of chromium picolinate on the development of digestive organs of coloured chicken at 8 weeks of age

| Treatment | Proventriculus weight (g/ 100 g) | Small intestine length (cm/100g) | Small intestine weight (g/100 g) | Large intestine length (cm/100 g) | Large intestine weight (g/100 g) | Average caecal length (cm/100 g) | Caecal weight (g/100 g) |
|---|---|---|---|---|---|---|---|
| T1 | 0.45 | 8.26 | 2.90 | 0.50 | $0.21^{b}$ | 0.93 | 0.55 |
| T2 | 0.45 | 8.60 | 3.18 | 0.53 | $0.17^{b}$ | 0.89 | 0.54 |
| T3 | 0.43 | 8.70 | 2.97 | 0.47 | $0.17^{b}$ | 1.01 | 0.51 |
| T4 | 0.45 | 8.99 | 3.26 | 0.35 | $0.09^{a}$ | 0.99 | 0.56 |
| Pooled SEM | 0.02 | 0.31 | 0.11 | 0.03 | 0.02 | 0.03 | 0.03 |
| Sig Level | NS | NS | NS | NS | P<0.05 | NS | NS |

*Means bearing different superscripts within a column differ significantly (P<0.05); NS: Non significant (P>0.05) SEM: Standard error of means*

There was no significant difference among the treatment groups in the carcass quality traits *viz*. percent processing shrinkage, dressing percentage, per cent eviscerated weight, per cent heart weight, per cent liver weight and per cent gizzard weight (Table 4). There were no significant differences in the cut-up-parts such as thigh, drumstick, breast, back and neck among the treatment groups (Table 4). The findings of experiment corroborate well with the findings of Chaudhari *et al.* (2006), who tested the effects of







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chromium picolinate supplementation in broilers and found non-consistent effect on gizzard and heart weights.

**Table 4:** Effect of dietary supplementation of graded levels of chromium picolinate on carcass quality characteristics and cut up-parts of coloured chicken at 8 weeks of age

| Treatment | Shrinkage (%) | Dressing (%) | Eviscerated weight (%) | Heart weight (%) | Liver weight (%) | Gizzard weight (%) | Thighs (%) | Drumstick (%) | Breast (%) | Back (%) | Neck (%) | Wings (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T1 | 3.41 | 71.03 | 62.29 | 0.4 | 1.72 | 2.14 | 16.99 | 16.13 | 27.53 | 23.54 | 5.36 | $10.45^{a}$ |
| T2 | 3.7 | 78.32 | 63.05 | 0.49 | 1.95 | 1.81 | 16.73 | 16.23 | 28.07 | 23.93 | 4.44 | $10.60^{ab}$ |
| T3 | 3.7 | 83.38 | 61.07 | 0.57 | 1.81 | 2.01 | 16.56 | 16.77 | 27.49 | 24.22 | 3.18 | $11.80^{c}$ |
| T4 | 3.27 | 72.3 | 65.52 | 0.34 | 1.59 | 1.66 | 16.32 | 16.3 | 26.4 | 22.18 | 4.16 | $11.41^{bc}$ |
| Pooled SEM | 0.16 | 2.56 | 0.88 | 0.04 | 0.14 | 0.18 | 0.28 | 0.21 | 0.5 | 0.45 | 0.34 | 0.19 |
| Sig Level | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | P<0.01 |

*Means bearing different superscripts within a column differ significantly (P<0.01); NS: Non significant (P>0.05)*
*SEM: Standard error of means*

Rao *et al.* (2012) reported that the dietary supplementation of organic chromium in commercial broiler chickens had no effect on relative mass of liver, abdominal fat and ready to cook yields at 42 days of age.

## Conclusion

It may be concluded that supplementation of chromium picolinate at the level of 800 ppb revealed no adverse effect on body weight gain and resulted in higher humoral and cell mediated immune responses in coloured chicken.

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