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Effect of Garlic and Chromium Picolinate Supplementation on Production Performance, Carcass Characteristics and Immunological Parameters of Guinea Fowls

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ABSTRACT

A study was conducted on 120 guinea fowls to see the effect of garlic powder and chromium picolinate supplementation on growth performance, carcass characteristics and immunological parameters of guinea fowls. The birds were randomly divided into four treatment groups, having three replications consisting of ten birds each. The birds in the control group (T_1) were not given any supplement, whereas, in treatments, birds were supplemented with garlic powder @ 1 % of basal diet (T_2), chromium picolinate @ 1500 ppb in drinking water (T_3) and chromium picolinate @ 1000 ppb in drinking water plus garlic powder @ 0.5 % of basal diet (T_4) respectively. Results of trial indicated that both garlic and chromium picolinate supplementation improved body weight gain and feed conversion ratio ($P<0.05$) of Guinea fowls. Feed intake of birds was also found reduced ($P<0.05$) in all treatment groups in comparison to control. At the end of twelve week of age, the carcass traits-eviscerated weight with and without giblet and organ weights did not differ significantly between treatment groups. The abdominal fat expressed as percentage of live weight was significantly lower ($P<0.05$) in all treatment groups as compared to control group. Immune response as revealed by delayed type of hypersensitivity (measurement of skin thickness) and serum immunoglobulin were improved in all the three supplemented groups. Thus it can be concluded that both chromium and garlic supplementation can improve growth performance and immunity and thus can be used as growth promoters in poultry.

Keywords: Guinea fowl, garlic, chromium, carcass traits, immunity

Feed additives are gaining significance in poultry production and health due to their multidimensional beneficial aspects to be used as growth promoters and immunomodulators in poultry (Dhama *et al.* 2014**)**. The positive effects of herbal supplements on poultry performance, carcass quality and immune modulation have been demonstrated (Tariq *et al.* 2014, 2015). Garlic (*Allium sativum*) is well known spice and herbal medicine which can be used for prevention and treatment of variety of diseases. Antibiotic, anticancer, antioxidant, immunomodulatory, anti-inflammatory, hypoglycemic and cardiovascular protecting effects of garlic have been reported (Reuter *et al.* 1996). The major active ingredients of garlic are allicin, ajoene and S-allyl cysteine. It has tendency to lower serum and liver cholesterol and can improve productive performance of broilers (Elagib *et al.* 2013). In addition garlic has been shown to increase feed palatability and thus feed intake (Choi *et al.* 2010).

Recently, there has been considerable research interest in the utilization of trivalent chromium (Cr) as feed additive in livestock and poultry feeds. It has been found to produce maximum beneficial effects during environmental, dietary and hormonal stresses. Dietary chromium supplementation improved the egg production and performance in laying hens (Korenekova *et al.* 2005) and broilers (Jackson *et al.* 2008). It has shown a positive effect on productive performance, carcass traits and oxidative stability of refrigerated meat in broilers reared under heat stress (Toghyani *et al.* 2012). It is a component of glucose tolerance factor, which participates in glucose metabolism by enhancing the effects of insulin (Mertz, 1993). It improves insulin effectiveness by enhancing it's

binding to receptors and thus increasing the sensitivity of the target cell (Anderson, 1997). It is involved in carbohydrate, lipid, protein, and nucleic acid metabolic pathways (McCarty 1991). Keeping in view the above background, the present study was planned to probe the influence of dietary supplementation of garlic powder, chromium picolinate and their combination on carcass traits and immunological parameters in Guinea fowls.

MATERIALS AND METHODS

Birds and experimental design

One hundred twenty guinea fowl chicks of same hatch were reared at Instructional Poultry Farm (IPF) of G.B. Pant University of Agriculture and Technology, Pantnagar-263145. All the chicks were individually weighed and randomly allocated into four different treatment groups with three replicates of ten guinea fowls in each pen. The birds used in experiment were housed in deep litter system. All the birds received similar housing and managemental conditions. Standard experimental commercial broilers feed were fed as per Bureau of Indian Standards (BIS, 1992). The ingredient and chemical composition of diet have been presented in Table. 1. The birds in control group (T_1) were given no supplement, whereas in treatments T_2, T_3 and T_4, chicks were supplemented with garlic powder @ 1% of basal diet, chromium picolinate @ 1500 ppb in drinking water, chromium picolinate @ 1000 ppb in drinking water plus garlic powder @ 0.5% of basal diet respectively. Chromium was supplemented in the form of chromium picolinate (procured from Hi Media Laboratories Pvt. Ltd.). Garlic (*Allium sativum*) was procured from local market in the form of bulbs, which were peeled-off and sun-dried.

Growth performance and carcass characteristics

The data on production attributes of Guinea fowls during the experimental period as affected by supplementation of chromium picolinate and Garlic powder were collected and feed intake, body weight gain and feed conversion ratio were analyzed. After prior permission from 'Institutional Animal Ethics Committee (I.A.E.C.)' and at the end of the experimental feeding trial (twelve weeks), two birds from each replicate within each treatment (six birds/treatment) were randomly selected and slaughtered for carcass characteristics on percent live weight basis. The data on eviscerated weight with and without giblet, abdominal fat and organs weight (heart, liver and gizzard) were recorded and analyzed.

Immunological parameters

On 42nd day of experiment, six birds from each group were selected for cell mediated immune response study using delayed type of hypersensitivity reaction to 2, 4, dinitro-chloro-benzene as per method adopted by Tiwary and Goel (1985) with slight modifications. Blood samples were collected from two birds from each replicate at the end of experimental feeding trial. Blood was collected aseptically from the wing vein in sterilized disposable syringes (24 gauge needle) and serum was separated to study total serum immunoglobulin which was estimated by using zinc sulphate turbidity test (Mondesire 2003).

Statistical Analysis

The data were analysed using completely randomized design (Snedecor and Cochran, 1994). Significant differences among different treatments were identified using Duncan's Multiple Range Test at 5% level of significance.

RESULTS AND DISCUSSION

The data pertaining to effect of dietary supplementation of garlic powder, chromium picolinate and their combination on growth performance of Guinea fowls have been presented in Table 2. The result showed that overall feed intake was lower ($P<0.05$) in T_2, T_3 and T_4 in comparison to T_1 group with lowest feed intake in T_4 which differed significantly with T_2 and T_3 groups. These are in agreement with the findings of Uyanik *et al.* (2002), who found that addition of chromium @ 20 ppm significantly reduced the feed consumption. Canogullari *et al.* (2010) reported that supplementation of diet with 1 % of garlic caused significant reduction in feed consumption in laying quails. However, in contrast to our results, Naghieh *et al.* (2010) reported supplementation of chromium picolinate @ 600 µg/kg of the feed significantly increased the feed intake in broiler chicks. The decreased feed intake in guinea fowl could be due strong aroma of garlic which can decrease

feed palatability as well as better efficiency of utilization in all treatment groups as indicated by better growth found in them which in turn reduce their nutrient requirement.

Table 1: Ingredients and nutrients composition (on dry matter basis) of basal ration used during experiment

Ingredients (%)	Starter diet (4-8 week)	Finisher diet (8-12 week)
Maize	45.83	54.08
Wheat	9.71	8.87
Soybean meal	32.50	26.00
Ground nut cake	4.40	3.60
Fish meal	4.64	4.50
Dicalcium phosphate	1.20	1.20
Lime stone	0.40	0.40
Sodium chloride	0.30	0.40
DL-Methionine	0.17	0.10
Vitamin premix*	0.35	0.35
Trace mineral mix**	0.50	0.50
Nutrients (%)		
Dry matter	90.15	90.30
Crude protein	23.13	21.13
Crude fibre	5.01	5.62
Ether extract	3.68	3.69
Total ash	7.11	7.92
Acid insoluble ash	2.52	2.61
Calcium	1.29	1.37
Phosphorus	0.88	0.90

Overall mean body weight gain and feed conversion ratio of guinea fowl were significantly ($P<0.05$) improved in all treatment groups in comparison to control group with best results found in T_4 group. It is in agreement with the findings of Kroliczewska *et al.* (2005) who found increased body weight gain, body weight and feed conversion ratio (FCR) due to supplementation of chromium enriched yeast @ 500 µg/kg diet in broilers. Bhuvnesh *et al*. (2004) also reported that supplementation of chromium chloride and sulfate, significantly increased body weight gain and FCR in broilers reared in hills than control. Similarly, Lewis *et al.* (2003) found improved body weight gain in broilers supplemented with garlic. However, Sarica *et al.* (2005) did not find any significant difference in FCR of broilers supplemented with garlic. The improved FCR and body weight gain in Guinea fowls can be due to better efficiency of nutrient utilization in them which could be due to improved microbial health resulting better digestibility (Peinado *et al.* 2005).

Carcass characteristics

The effect of garlic powder, chromium picolinate and their combination on various carcass traits (eviscerated weight without giblet, eviscerated weight with giblet, liver, gizzard, heart and abdominal fat) have been presented in Table 3. The carcass traits are expressed as percent of pre-slaughter live weight. All the carcass trait viz. eviscerated weight without giblet, eviscerated weight with giblet, liver, gizzard and heart did not differ significantly ($P>0.05$) between different treatment groups. It is in agreement with the findings of Anandhi *et al.* (2006) who reported that chromium supplementation did not have any effect on the carcass yield of broilers. Similarly, Javandel *et al.* (2008) reported that garlic supplementation at different graded levels of did not have any significant effect on carcass characteristics.

In contrast to our study, Ademola *et al*. (2009) reported that dietary supplementation with garlic and ginger at 1.5 and 2% respectively, affected ($P<0.01$) the carcass parts and organ development of broiler chickens. The abdominal fat was found lower ($P<0.05$) in T_2, T_3 and T_4 as compared to the control group. The lowest value was recorded in guinea fowl of group T_2, fed garlic powder @ 1% of basal diet. Toghyani *et al*. (2006) reported that chromium supplementation did not have any significant effect on the weight of the liver, gall bladder, heart and pancreas but resulted in decreased abdominal fat content in broilers. Cr plays an important role as integral component of the glucose tolerance factor (GTF), which potentiate the action of insulin, and regulate fat metabolism. At low insulin level glucose is converted into fat and stored in fat cells (Mertz 1993).

The ability of insulin to regulate glucose levels in blood and lipid metabolism is dependent upon the binding of this pancreatic hormone to specific receptors found in many peripheral tissues like adipocytes, muscle and liver which could be the reason behind this decrease in abdominal fat content due to chromium supplementation in guinea fowls. Similarly, Onibi *et al*. (2009) reported that the carcass and organ characteristics of the chicken were not significantly affected ($P>0.05$) by dietary garlic supplementation

Table 2: Effect of Garlic and Chromium picolinate supplementation on growth performance and immunological parameters of Guinea fowls

Attributes Treatments	Feed Intake (g); 4-12 wk	Weight gain (g); 4-12 wk	FCR (4-12 wks)	Skin Thickness (mm)	Serum Immunoglobulins (mg / dl)
T_1	$2790.76^{a} \pm 16.56$	$728.73^{c} \pm 4.93$	$3.83^{a} \pm 0.02$	$2.87^{b} \pm 0.02$	$3.28^{b} \pm 0.03$
T_2	$2735.18^{b} \pm 16.74$	$751.95^{bc} \pm 9.00$	$3.64^{b} \pm 0.069$	$3.06^{a} \pm 0.02$	$3.30^{b} \pm 0.05$
T_3	$2625.18^{c} \pm 2.89$	$763.16^{ac} \pm 2.81$	$3.45^{c} \pm 0.02$	$2.91^{b} \pm 0.03$	$3.45^{a} \pm 0.04$
T_4	$2566.25^{d} \pm 6.53$	$770.65^{a} \pm 3.69$	$3.33^{d} \pm 0.02$	$3.02^{a} \pm 0.01$	$3.44^{a} \pm 0.02$

Values bearing different superscripts in a column differ significantly (P<0.05).

Table 3: Effect of garlic and chromium picolinate supplemented diet on organ weights (% live weight)

Treatments	T1	T2	T3	T4
Eviscerated wt. (% live wt.) without giblet	67.64± 0.39	68.20± 0.43	67.91± 0.80	67.52± 1.02
Eviscerated wt. (%live wt) with giblet	72.12± 1.15	72.71± 0.60	72.50± 0.31	71.97± 1.27
Liver weight (%)	1.58± 0.03	1.85± 0.07	1.74± 0.05	1.64± 0.12
Gizzard weight (%)	2.34± 0.03	2.22± 0.04	2.34± 0.03	2.34± 0.16
Heart weight (%)	0.45± 0.01	0.46± 0.01	0.46± 0.01	0.47± 0.01
Abdominal fat* (%)	$1.32^{a} \pm 0.01$	$1.04^{b} \pm 0.04$	$1.10^{b} \pm 0.03$	$1.08^{b} \pm 0.02$

Values bearing different superscripts in a row differ significantly (P<0.05).

but the abdominal fat content was numerically lowered. Garlic supplementation has also found to decrease serum cholesterol level in broilers (Elagib *et al.* 2013). In addition garlic has been used as antioxidative, hypolipidaemic and hypocholestrolemic (Reuter *et al.* 1996).

Immunological Parameters

Average mean skin thickness and total serum immunoglobulin of guinea fowl on the 55th day of experiment in different treatment groups have been presented in Table 2. Results showed significantly (P<0.05) higher mean skin thickness in T_2 group as compared to T_1 and T_3 group, while there was no significant difference between T_2 and T_4. Supplementation of chromium picolinate in T_3 group caused significant increase in values of serum immunoglobulin as compared to control and T_2 groups. However, there was no significant difference between T_3 and T_4 groups. These findings confirm the immunomodulatory role of *Allium sativum* in guinea fowls. These results are in accordance with Ghazanfari *et al.* (2002), who reported a significant increase of delayed hypersensitivity response in garlic extract injected mice, but there was no antibody response in sheep RBC in comparison to control group. Kheiri and Toghyani (2009), reported that dietary supplementation of chromium in the form of chromium chloride significantly improved the humoral immune response of the broilers which was indicated by the rise in the antibody titre against Newcastle disease and Avian influenza vaccines. Lee *et al.* (2003) also reported that antibody titre against infectious bronchitis was improved in broiler fed 400 µg/kg chromium picolinate.

CONCLUSION

It can be concluded that supplementing garlic and chromium picolinate in the diet of Guinea fowl can improve growth performance and immunity without affecting their carcass characteristics, indicating their potential to be used as growth promoters in them.

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