



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(5): 3279-3283
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www.thepharmajournal.com

Received: 10-03-2023

Accepted: 14-04-2023

Khwairakpam Ratika,
College of Veterinary Sciences &
AH, CAU Jalukie, Nagaland,
India

Neithono Kuotsu,
College of Veterinary Sciences &
AH, CAU Jalukie, Nagaland,
India

Rajkumar James Singh,
Indian Veterinary Research
Institute, Izatnagar, Bareilly,
Uttar Pradesh, India

Kshetrimayum Mahesh Singh,
College of Veterinary Sciences &
AH, CAU Jalukie, Nagaland,
India

Sheela Kharkwal
Sri Karan Narendra Agriculture
University, Jobner, Jaipur,
Rajasthan, India

Vimenuo S Kuotsu
Uttar Banga Krishi
Viswavidyalaya, Coochbehar,
West Bengal, India

Corresponding Author:
Neithono Kuotsu
College of Veterinary Sciences &
AH, CAU Jalukie, Nagaland,
India

Effect of dietary incorporation of garlic (*Allium sativum*) and turmeric (*Cucurma longa*) powder on growth performance and blood serum biochemical of starter and finisher growth phase of broilers

Khwairakpam Ratika, Neithono Kuotsu, Rajkumar James Singh, Kshetrimayum Mahesh Singh, Sheela Kharkwal and Vimenuo S Kuotsu

Abstract

To examine the effect of dietary supplementation of garlic (*Allium sativum*) and turmeric (*Cucurma longa*) powder on growth performance and blood serum biochemical constituents of starter and finisher growth phase of broilers, a feeding trial was carried out where 120 day-old broiler chicks were randomly distributed into four different treatment groups (T1, T2, T3 and T4) with three replicates of 10 chicks in each group i.e. 30 chicks in each group. The treatment groups were T1: basal diet no supplementation (control); T2: basal diet supplemented with 3% garlic powder; T3: basal diet supplemented with 0.5% turmeric powder and T4: basal diet supplemented with combinations of 1.5% garlic powder plus 0.25% turmeric powder. The feeding trial continued for 6 weeks viz., 0 to 3 weeks (starter phase) and 3 to 6 weeks (finisher phase). During starter phase, weight gain, FCR and PI were improved significantly in T2 and T4 groups. Similarly, during finisher phase, significant improvement in weight gain, feed intake, FCR, PI and PER of T2 group broilers were observed. Also, there was significant increase in feed intake, weight gain and performance index in T4 group of broilers. This study also showed that there was no significant effect on blood serum biochemical parameters on 21st day (starter phase) due to garlic and turmeric supplementation in the diet. But on 42nd day (finisher phase) there was significant reduction in level of serum cholesterol and triglycerides in group T2 and T4 as compared to T1 and T3.

Keywords: Garlic, turmeric, broiler, serum biochemical

Introduction

Over the years, antibiotics at sub therapeutic dose are used in poultry feeds to derive maximum growth of broiler chickens as it stimulates growth of favourable micro organisms in the gastrointestinal tract and suppress the growth of micro-organisms which compete for critical nutrients. Use of antibiotics in poultry production leads to residues in eggs and meat which can develop antibiotic resistance in human being consuming the poultry meat and eggs. Because of this reason, many countries have banned use of antibiotics growth promoters in livestock and poultry industry. Removing these kinds of growth promoters from poultry's diet result in low performance, and also less resistance against diseases. To prevail over the poor performance and the increased susceptibility to diseases, many attempts have been made to rule out other alternatives. Many researches have been carried out on herbal feed additives as alternatives to antibiotic growth promoters. Garlic (*Allium sativum*), and turmeric (*Curcuma longa*) are commonly available herbs known for their beneficial effects. Garlic is rich in organosulfur substances such as allin, allicin, ajoene, S-allyl cysteine, diallyl sulfide, and diallyl trisulfide. In poultry nutrition, garlic is known to result in improved growth, inhibition of growth of pathogens in the gut, enhanced pancreatic function, and improved meat and carcass quality. Garlic can be used as a feed additive in broiler diets as it improves weight gain and feed conversion ratio [1]. Garlic is widely consumed and have biological activities like hypolipidemic and hypocholesterolemic. Curcumin is the main yellow bioactive component of turmeric that has a wide spectrum of biological actions, including antioxidant, antibacterial, antifungal, antiprotozoal, antiviral, anti-inflammatory, antihypertensive, and hypocholesteremic activities [2]. Other bioactive compounds also exhibit beneficial effects, such as demethoxy curcumin (antioxidant), bisdemethoxy curcumin (antioxidant), and sodium curcumin (anti-inflammatory). These significant biological properties of turmeric powder make it a potential substitute for in-feed antibiotics in livestock diets.

Turmeric is well known to have a property as a safe, natural, and residue free phytobiotics [20]. Keeping the above facts in view, this feeding trial was done with an objective to prepare a better herbal feed additive with turmeric and garlic and supplementation in starter and finisher diet to learn its effect on growth performance and blood serum biochemical parameters of broiler chickens.

2. Materials and Methods

2.1. Experimental birds

The feeding trial was conducted to study the effect of dietary incorporation of garlic (*Allium sativum*) and turmeric (*Curcuma longa*) powder and its combination on growth performance and blood serum biochemical parameters of broilers at the end of starter and finisher phase. For this study, a total of 120 day- old broiler chicks were divided into four different groups (T1, T2, T3, and T4) each with three replicates having ten birds in each replicate.

2.2. Treatment Group

Garlic powder and turmeric powder and their combination were supplemented in the broilers basal diets (starter and finisher diet) for a period of 6 weeks as follows:

Treatment T1: Basal diet (no supplementation)

Treatment T2: Basal diet + 3% garlic powder

Treatment T3: Basal diet + 0.5% turmeric powder

Treatment T4: Basal diet + 1.5 % garlic powder + 0.25% turmeric powder

2.3. Basal Diet

Standard broiler diets for starter (0-3 weeks) and finisher (4-6 weeks) phases of growth were prepared by mixing the different ingredients as shown in Table.1 and provided to all the broiler chicks so as to meet the nutrient requirements as per BIS (1997). The chemical composition of starter and finisher diet are given in Table. 2. The starter diet was provided during 0-3 weeks while finisher diet was provided during 4-6 weeks of age in clean feeder. Garlic and turmeric powder were mixed with starter and finisher feed and fed to broilers.

2.4. Management

The broiler chicks were housed in a deep litter system, in well ventilated shed. Clean water was offered *ad libitum* and feed were measured and offered twice a day. Feed ingredients and nutrient composition of the basal diet are presented in Table 1 and Table2.

2.5. Growth Performance

For the study of growth performance, body weight of individual chick and feed consumption of each replicate group was recorded weekly upto 6th week of age. Then, feed conversion ratio (FCR), performance index (PI) and protein efficiency ratio (PER) were calculated by using the following formulae.

$$\text{Feed conversion ratio} = \frac{\text{Feed consumed (g)}}{\text{Weight gain (g)}}$$

$$\text{Performance index} = \text{Body weight gain (g)} \times \text{FER}$$

$$\text{Protein efficiency ratio} = \frac{\text{Weight gain (g)}}{\text{Protein consumed (g)}}$$

2.6. Blood Serum Biochemical Parameters

To study the blood parameters, blood samples were collected from six experimental birds of each group i.e. two broiler chicks from each replicate at the end of starter phase (21st day) and finisher phase (42nd day) of experimental feeding. Blood samples (about 1.5 ml) were collected aseptically from their wing vein, using sterilized syringes and needles. Collected blood samples were used for separation of serum. For separation of serum, blood sample was allowed to stand at room temperature in slanting position for clot formation for three to four hours. After clotting of blood, serum was separated and stored at -20 °C with date and sample number for further analysis.

2.7. Data Analysis

The experimental data obtained during the study were analysed statistically using completely randomised design with the simple Analysis of Variance (ANOVA) technique.

3. Results and Discussion

3.1 Growth performance during Starter and finisher Phase

During the starter phase (0-21 days) no significant differences were observed in feed consumption, FCR and protein efficiency ratio in broilers of various treatment groups. However, weight gain improved significantly ($P < 0.05$) in broilers of garlic powder supplemented group. Performance index was also improved in broilers of garlic and garlic plus turmeric powder supplemented group i.e. T4. (Table. 3). The results of present study corroborated with the findings of [6] who reported significant increase in weight gain and no effect on feed intake in broilers of garlic powder supplemented diets. Similarly, significant difference in feed intake in garlic supplemented group of broilers in comparison to control, whereas they recorded higher body weight gain in garlic supplemented group than control group of broilers [15]. Similar to our findings, addition of turmeric powder as feed additives in diet of broiler did not affect growth performance [17].

The data on Table.4 showed that during finisher stage (22-42 days), there was no significant improvement in growth performance of broilers of turmeric supplemented group T3, whereas growth performance in terms of weight gain, FCR and performance index of broilers of garlic powder supplemented group T2 improved significantly ($P < 0.05$) while feed intake and protein efficiency ratio were not influenced by supplementation of garlic powder in the diet. In case of garlic plus turmeric powder supplemented group T4, weight gain and performance index improved significantly, whereas feed intake, FCR and protein efficiency ratio were not affected. No significant difference was observed in ME efficiency in broilers of different treatment groups due to garlic and turmeric powder supplementation in the diet. The increase in growth performance in broilers due to feeding of garlic powder supplemented diet might be attributed to allicin, component of garlic which promotes the performance of intestinal flora, thereby improving digestion and utilization of nutrients by increasing villi length and width of intestine leading to improved growth performance [8]. The present findings are in line to the findings of [8, 5,19, 10] who reported that garlic supplementation in the diet increased body weight gain and also improved feed conversion rate in broilers [4]. Similar findings were also reported by [1] where weekly body weight gain, feed intake and FCR of broilers were not influenced by dietary incorporation of turmeric rhizome

powder. Dietary turmeric inclusion had no significant effect on body weight gain of broilers [11]. On the contrary, turmeric supplementation was effective in improving broiler performance [18].

3.2 Blood Serum Biochemical Parameters of Starter and Finisher Phase

All the blood serum biochemical parameters (Glucose, cholesterol, triglycerides, total protein, albumin, globulin ALP, SGOT and SGPT) showed no significant difference among the broilers of different treatment groups due to dietary incorporation of garlic and turmeric powder on 21st day (end of starter phase) of feeding trial (Table.5)

And all serum biochemical parameters at the end of finisher phase (42nd day) showed no significant difference among the different treatments except serum cholesterol and triglycerides level (Table.6). Significant ($P < 0.05$) reduction in serum cholesterol level in broiler chicks of treatment groups T₂ (131.27 mg/ dl) and T₄ (137.97 mg/ dl) fed diet supplemented with garlic powder and garlic plus turmeric powder, respectively, as compared to treatment groups T₃ (146.81 mg/ dl) and T₁ (149.79 mg/ dl) in which broiler chicks were fed diets supplemented with turmeric powder and without any supplementation, respectively (Fig.1). The triglyceride levels of broiler chicks fed diets supplemented with garlic powder (T₂) and garlic plus turmeric powder (T₄) were 78.80 and 79.09 mg/ dl and were significantly less than the broiler chicks of control group T₁ (87.10 mg/ dl). While serum triglyceride content was not significantly influenced in broiler chicks of treatment group T₃ (86.21 mg/ dl) due to supplementation of turmeric powder. Serum cholesterol concentration due to dietary garlic powder supplementation may probably be due to the possible mechanism of hypocholesterolaemic and hypolipidemic action of active principles present in garlic products which depresses the hepatic activities of lipogenic and cholesterogenic enzymes such as malic enzyme, fatty acid synthase, glucose-6-phosphatase dehydrogenase [3, 16] and 3-hydroxyl-3-methylglutaryl-CoA (HMG-CoA) reductase [13, 13, 6, 7, 13] reported that dietary garlic supplementation in broiler chicks reduced serum cholesterol. Also significant reduction in cholesterol

level in broilers when garlic and turmeric powder is incorporated in the diet as reported by [14]. Whereas [1] reported that addition of 0.5 g turmeric rhizome powder in diet of broilers did not affect serum cholesterol concentration. The serum triglycerides concentration (mg/dl) in broiler chicks of treatment groups T₂ and T₄ supplemented with garlic powder and garlic plus turmeric powder, respectively reduced significantly.

Table 1: Ingredient of the basal diets (starter and finisher feed)

Feed ingredients	Broiler starter diet (0-3 wks)	Broiler finisher diet (4-6 wks)
Maize	55.00	60.00
Deoiled soyabean meal	36.00	32.00
Rice polish	4.60	3.10
Soyabean oil	0.50	1.00
Marble stone	1.00	1.00
Dicalcium phosphate	2.00	2.00
DL- Methionine	0.10	0.10
Coccidiostat (Meduramycin)	0.05	0.05
Copper sulphate	0.01	0.01
Common salt	0.30	0.30
Merivite -100 (Vitamin B12)	0.02	0.02
Phosphoric acid	0.10	0.10
Lipocare (choline chloride)	0.05	0.05
Hepatocare	0.10	0.10
Vitamin mixture	0.03	0.03
Trace minerals	0.14	0.14

Table 2: Chemical composition of the basal diets (starter and finisher feed)

Chemical Composition		
Moisture	9.20	10.90
Crude protein	22.16	20.81
Crude fibre	4.00	4.00
Ether extract	4.50	4.25
Metabolizable energy (kcal/kg) calculated	2877.00	2946.00
Nitrogen- free extract	62.54	64.44
Total Ash	6.80	6.50
Acid insoluble ash	1.35	1.30
Calcium	1.24	1.21
Phosphorus	0.79	0.77

Table 3: Average cumulative growth performance of broiler chicks from 0-21 days fed diets supplemented with garlic and turmeric powder <

Parameters	Treatments/ Groups			
	T ₁	T ₂	T ₃	T ₄
	Control	Garlic (3%)	Turmeric (0.5%)	Garlic (1.5%) + Turmeric (0.25%)
Weight gain (g)*	492.29 ^b ±0.84	499.27 ^a ±0.80	492.47 ^b ±1.06	495.21 ^b ±1.49
Feed intake (g)	804.07±0.48	805.39±0.55	799.77±1.37	801.23±2.15
Feed conversion ratio	1.633±0.001	1.613±0.001	1.624±0.005	1.618±0.002
Performance index*	301.40 ^c ±0.87	309.50 ^a ±0.82	303.25 ^{bc} ±1.60	306.07 ^{ab} ±1.02
Protein efficiency ratio	3.058±0.003	3.076±0.003	3.076±0.010	3.083±0.001

^{a, b, c} values bearing different superscripts in a row differ significantly * $P < 0.05$

Table 4: Average cumulative growth performance of broiler chicks from 22-42 days fed diets supplemented with garlic and turmeric powder

Parameters	Treatments/ Groups			
	T ₁	T ₂	T ₃	T ₄
	Control	Garlic (3%)	Turmeric (0.5%)	Garlic (1.5%) + Turmeric (0.25%)
Weight gain (g)*	1160.62 ^c ±0.70	1183.91 ^a ±4.02	1163.87 ^c ±2.60	1173.71 ^b ±2.06
Feed intake (g)	2046.00±0.75	2058.13±4.13	2048.93±2.07	2052.63±1.97
Feed conversion ratio*	1.763 ^c ±0.002	1.738 ^a ±0.002	1.760 ^c ±0.002	1.749 ^b ±0.002
Performance index*	658.38 ^c ±0.62	681.03 ^a ±3.33	661.12 ^c ±2.31	671.13 ^b ±2.13
Protein efficiency ratio	3.096±0.001	3.083±0.006	3.097±0.006	3.091±0.004
Metabolizable energy efficiency	0.0203±0.00	0.0204±0.00	0.215±0.00	0.0209±0.00

^{a, b, c} values bearing different superscripts in a row differ significantly * $P < 0.05$

Table 5: Average values of serum biochemical constituents of broilers fed diets supplemented with garlic and turmeric powder (21st day)

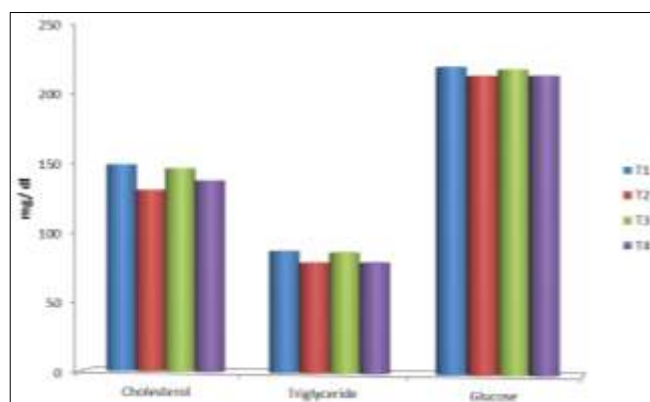
Parameters	Treatments/ Groups			
	T ₁	T ₂	T ₃	T ₄
	Control	Garlic (3%)	Turmeric (0.5%)	Garlic (1.5%) + turmeric (0.25%)
Cholesterol (mg/dl)	148.57±6.62	146.55±2.14	148.57±3.03	145.50±2.67
Triglyceride (mg/dl)	88.06±1.36	85.20±1.44	88.91±1.26	84.61±0.99
Glucose (mg/dl)	213.55±2.09	210.46±2.56	215.52±1.64	212.56±3.92
Total protein (g/dl)	4.10±0.04	4.19±0.05	4.19±0.04	4.22±0.03
Albumin (g/ dl)	1.38±0.02	1.42±0.02	1.41±0.03	1.44±0.03
Globulin (g/dl)	2.72±0.05	2.77±0.06	2.78±0.06	2.78±0.01
Albumin- globulin ratio	0.509±0.019	0.514±0.020	0.501±0.036	0.517±0.016
Serum alkaline phosphatase (U/l)	85.02±1.11	83.27±1.47	83.90±2.67	81.47±2.61
Serum glutamate pyruvate transaminase (U/l)	26.64±0.85	26.32±0.67	27.45±0.99	25.81±1.41
Serum glutamate oxaloacetate transaminase (U/l)	168.36±0.58	171.28±0.63	169.69±1.45	171.01±0.95

^{a, b, c} values bearing different superscripts in a row differ significantly * P<0.05

Table 6: Average values of serum biochemical constituents of broilers fed diets supplemented with garlic and turmeric powder (42nd day)

Parameters	Treatments/ Groups			
	T ₁	T ₂	T ₃	T ₄
	Control	Garlic (3%)	Turmeric (0.5%)	Garlic (1.5%) + Turmeric (0.25%)
Cholesterol (mg/dl)*	149.79 ^a ±3.27	131.27 ^b ±1.47	146.81 ^a ±2.56	137.97 ^b ±1.95
Triglyceride (mg/dl)*	87.10 ^a ±1.64	78.80 ^c ±2.54	86.21 ^{ba} ±2.50	79.09 ^{bc} ±3.07
Glucose (mg/dl)	217.86±2.31	211.30±1.91	215.57±2.35	210.99±1.10
Total protein (g/dl)	4.26±0.09	4.35±0.05	4.28±0.08	4.30±0.04
Albumin (g/dl)	1.41±0.06	1.46±0.05	1.40±0.01	1.49±0.06
Globulin (g/dl)	2.85±0.14	2.89±0.07	2.88±0.06	2.82±0.06
Albumin- globulin ratio	0.49±0.05	0.50±0.03	0.48±0.01	0.52±0.03
Serum alkaline phosphatase(U/l)	85.37±1.18	82.04±1.45	84.40±1.56	82.26±1.76
Serum glutamate pyruvate transaminase(U/l)	28.10±0.86	26.35±0.64	26.84±1.01	26.31±0.79
Serum glutamate oxaloacetate transaminase (U/l)	171.05±1.18	170.62±1.08	170.50±0.46	171.20±0.95

^{a, b, c} values bearing different superscripts in a column differ significantly * P<0.05

**Fig 1:** Average values of serum biochemical constituents of broilers fed diets supplemented with garlic and turmeric powder (42nd day)

4. Conclusions

From this study, it can be concluded that garlic and turmeric powder can be added in the diet of broilers without any harmful effect. In addition, 3% garlic powder had better impact on growth performance and blood serum biochemical of broilers as compared to broilers supplemented with 0.5 % turmeric powder and 1.5% garlic plus 0.25% turmeric powder.

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