International Journal of Agriculture, Environment and Biotechnology
Citation: *IJAEB*: **17**(01): 45-52, March 2024
DOI: 10.30954/0974-1712.01.2024.7

ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

RESEARCH PAPER

Effect of Dietary Supplementation of *Andrographis paniculata* and *Curcuma longa* Powder on Growth Performance, Immunity and Carcass Characteristics of Commercial Broiler Chicken

Chitra, P.

Department of Veterinary and Animal Sciences, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Corresponding author: chitra.p@tnau.ac.in (**ORCID ID:** 0000-0001-6148-721X)

Paper No. 1109 **Received:** 16-11-2023 **Revised:** 12-02-2024 **Accepted:** 28-02-2024

ABSTRACT

The research was conducted to assess the effect of *Andrographis paniculata* (Nilavembu) and *Curcuma longa* (Turmeric) powder supplementation on growth performance and immune response, serum biochemistry and carcass characteristics of commercial broiler chicken. Five hundred and sixty-day-old (Ven Cobb 400) broiler chicks were randomly allotted into seven treatment groups with four replicates of twenty chicks each. The control group T_1 was fed a basal diet formulated as per BIS (2007) while in treatment groups T_2, T_3, T_4, T_5, T_6, T_7 fed basal diet with A. *paniculata* powder1.0g/kg (T_2), basal diet with C. *longa* powder 1.0 g/kg (T_3), basal diet with A. *paniculata* 2.0 g/kg (T_4), basal diet with C. *longa* 2.0 g/kg (T_5), basal diet with combination of A. *paniculata* powder 1.0g/kg and C. *longa* powder 1.0 g/kg (T_6) and basal diet with combination of A. *paniculata* powder 2.0g/kg and C. *longa* powder 2.0 g/kg (T_7) for 42 days period. A. *paniculata* and C. *longa* supplementary feed compared to the control feed significantly ($P<0.05$) increased the average weight gain and average feed intake of broilers. A numerical difference was observed in carcass characteristics. Serum biochemical parameters (serum total protein, serum albumin) did not differ significantly among the treatment groups. The serum cholesterol significantly reduced in treatment groups compared to control. The immune response (HI titre) to Newcastle disease non-significant in treatment groups. But numerical improvement observed in all treatment groups compared to control. The results of this study show that the application of A. *paniculata* and C. *longa* powder at the level of 2g/kg in broilers showed better growth rate and feed conversion ratio compared to other treatment groups and their combination can to be used effectively as a growth promoter in broilers.

HIGHLIGHTS

- *Andrographis paniculata* (Nilavembu) and *Curcuma longa* (Turmeric) powder used in broiler diet as a natural feed additives and act as an alternative to Antibiotic Growth Promoters in broilers.
- *Andrographis paniculata* (Nilavembu) and *Curcuma longa* (Turmeric) powder supplementation in broilers improved the body weight, feed conversion, immunity and carcass characteristics and reduce the serum cholesterol.

Keywords: *Andrographis paniculata,* Broiler, Body weight, *Curcuma longa,* Immunity

Poultry occupies a unique position in the livestock economy of India. With a vibrant indigenous industry compared to other developing countries, it is the world's fastest growing poultry industry and one of the fast-growing agri-business activities

How to cite this article: Chitra, P. (2024). Effect of Dietary Supplementation of *Andrographis paniculata* and *Curcuma longa* Powder on Growth Performance, Immunity and Carcass Characteristics of Commercial Broiler Chicken. *Int. J. Ag. Env. Biotech.*, **17**(01): 45-52.

Source of Support: None; **Conflict of Interest:** None

in India. Broiler production has become a profitable and fast developing enterprise in India. Tamil Nadu state is leading in broiler integration in the country which has Coimbatore as a major broiler pocket. Antibiotics have been used widely to artificially increase broiler health and subsequently improve broiler production. However, this practice has led to the growth of multiple drug resistant bacteria. To prevent the risk of developing such pathogens and also to satisfy consumer demand for a food chain free of drugs, use of in-feed antibiotics was totally banned nowadays.

Antibiotic Growth Promoters (AGPs) are commonly used in poultry feed. Due to antibiotic resistance, the use of AGPs has decreased in many countries. Instead of antibiotics, feed additives to poultry feed to improve chicken's performance. Commercial feed additives of plant origin like herbs, spices and various plant extracts are considered to be a natural product in which consumers would have received an increased attention as possible antibiotic growth promoter replacement and improved broiler performance (Hernandez *et al*. 2004).

Andrographis paniculata, commonly known as creat or green chiretta, is an annual herbaceous plant in the family *Acanthaceae*, native to India and Sri Lanka. It is a well-known traditional medicinal plant used in Ayurveda and had been used for centuries in Asia and called as "King of bitters" and has wide range of medicinal pharmacological application which has been used either single or in combination with other drugs in various Indian traditional systems of medicine. Andrographolides are active compounds of *A. paniculata* is believed to play important roles in antioxidant, antimicrobial, and ant parasite activity (Dai *et al.* 2019). This herb and its isolates are reported to possess anti-viral, anti-inflammatory, hepatoprotective, astringent and anti-pyretic properties.

Curcuma longa (Turmeric) is a tropical plant native to southern and south eastern tropical Asia. Turmeric is an herbal plant in the *Zingiberaceae* family. The main yellow bioactive substances isolated from the rhizomes of curcuma are curcumin, dimethoxy curcumin and bisdemethoxycurcumin which is present to the extent of 2 - 5 % of the total spice in turmeric powder (Wuthi-Udomler *et al.* 2000). Curcumin is the main important bioactive ingredient found in turmeric, can also decrease mitochondrial malondialdehyde levels increase mitochondrial glutathione levels and increase glutathione peroxidase (GSH-Px), glutathione S-transferase (GSST) and superoxide dismutase (SOD) activities (Zia *et al.* 2021). An increase in total antioxidant capacity in broilers leads to a reduced oxidative stress and increased digestibility and leads to growth performance. Turmeric has a wide spectrum of biological actions including anti oxidative, anti-carcinogenic, anti-hepatotoxic, anti-inflammatory and hypocholesterolemia. Turmeric powder can be safely and economically used as a natural supplement in broiler feed due to the presence of bioactive substances responsible for the beneficial effects on the health of the chickens and on the quality of meat. Hence, this study was undertaken to study the effect of *A. paniculata* and *C. longa* on growth performance and carcass traits of broilers.

MATERIALS AND METHODS

Experimental design and birds

A total of five hundred and sixty commercial, straight run day-old broiler chicks (Ven Cobb 400) belonging to a single hatch were purchased from a local hatchery, wing banded, weighed and randomly allotted into seven treatment groups with four replicates of twenty chicks each. The birds were reared in deep litter system under standard management practices up to six weeks of age. This biological study was statistically designed by completely randomized design. The study was carried out in Department of Veterinary and Animal Sciences, Tamil Nadu Agricultural University Coimbatore.

Experimental diet

The experimental diet was formulated according to the standards prescribed in Bureau of Indian Standards (BIS, 2007) standard with similar nutrient composition for all the treatments. The proximate composition of the basal diet for pre starter, starter and finisher phase was analyzed by Association of Official Analytical Chemists (AOAC, 2016) and is presented in Table 1. All the experimental diets were iso-caloric and iso-nitrogenous.

The basal experimental diet was formulated according to the standards prescribed in Bureau of

Table 1: Ingredient (%) and Nutrition composition (% DM basis) of Pre starter, Starter and Finisher feed for broilers

Feed ingredients (per cent)	**Pre starter feed 2 weeks)**	**Starter feed (3-4 weeks)**	**Finisher feed (5-6 weeks)**
Maize	51.0	53.0	55.0
Cumbu/Bajra	7.0	9.0	10.0
Soyabean meal	39.6	35.7	32.7
Salt	0.4	0.3	0.3
Mineral Mixture [1]	2.0	2.0	2.0
	100	100	100
Feed Additives (g/100kg)			
Vitamin Supplements [2] AB_2D_3K (gm)	20	20	20
B- Complex vitamins [3]	25	25	25
Trace Minerals [4]	50	50	50
Aminoacids	100	100	100
Lysine	50	50	50
DL- methionine-80 g	80	80	80
Nutrient Composition (% DM basis)			
Metabolizable Energy (Kcal/kg)	3015	3142	3256
Dry matter %	91.20	91.50	90.20
Crude protein %	22.25	21.25	19.50
Crude fibre %	3.75	3.50	3.40
Ether Extract %	5.27	6.89	7.57
Calcium %	0.99	0.96	0.92
Available Phosphours %	0.45	0.45	0.43
Lysine %	1.33	1.27	1.21
Methionine %	0.64	0.62	0.61

[1]Mineral mixture supplied per kg of feed: Calcium 6.4g, Phosphorus 1-2 g, Manganese- 55mg, Iodine 2mg, Zinc52 mg, Copper 2mg and Iron 20mg; [2]One gram of Vitamin AB2D3K supplement contained 82500 IU of vitamin A, 50 mg of vitamin B2, 12,000 IU of vitamin D3 and 10 mg of vitamin K; [3]One gram of B-Complex supplement contained 8 mg of vitamin B1, 16 mg of vitamin B6, 80 mg of vitamin B12, 80 mg of vitamin E, 120 mg of niacin, 8 mg of folic acid, 80 mg of calcium pantothenate, 120 mg of calcium and 300 mg of phosphate; [4]One gram of trace minerals contained 54 mg of manganese, 52 mg of zinc, 20 mg of iron, 2 mg of iodine and 1 mg of cobalt.

Indian Standards (B.I.S. 2007). Broiler birds were given broiler pre-starter feed from 0 to 2nd week and broiler starter feed from 2nd to 4th week and broiler finisher feed from 4th to 6th week of age. Feed and water were provided *ad libitum* throughout the experimental period. The broiler chicks were reared under deep litter. The chicks were provided with uniform floor, feeder and waterer space and were reared under standard management conditions throughout the experimental period. The experimental birds were vaccinated Newcastle disease vaccine on 7th and 21st day and Infectious Bursal disease vaccine on 14th 28th day of age.

Andrographis paniculata and *Curcuma longa* were included in the basal diet to form different treatment groups as shown in Table 2**.**

Growth performance

Body weight gain and feed consumption were recorded every week and mortality was recorded at regularly until six weeks of age. From the above data, feed conversion ratio and livability were calculated.

Antibody titer against Newcastle disease

Blood samples were collected randomly two birds per replicate 14th and 28th day old birds. Samples were allowed to clot and centrifuged at 1500 rpm per 20 min to separate the sera. The separated sera samples were utilized for Hemagglutination Inhibition (HI) test (Alexander, 1998) to detect the level of immune developed against the Newcastle disease.

Table 2: Treatment groups with respective experimental diets

Treatments	Experimental diets
T_1	Control (Basal diet)
T_2	Basal diet + *Andrographis paniculata* powder (1.0g /kg)
T_3	Basal diet + Curcuma *longa* powder (1.0g/kg)
T_4	Basal diet + *Andrographis paniculata* powder 2.0 g/kg
T_5	Basal diet + *Curcuma longa* powder (2.0 g/kg)
T_6	Basal diet + *Andrographis paniculata* powder (1.0g /kg) + *Curcuma longa* powder (1.0g/kg)
T_7	Basal diet + *Andrographis paniculata* powder (2.0g /kg) + *Curcuma longa* powder (2.0 g/kg)

Carcass yield

At the end of the experimental period, one male and one female from each replicate were randomly selected and weighed to record the live body weight. The birds were received 12 hours prior to slaughter, the feeding was stopped but sufficient drinking water given. Bird was then slaughtered, to study carcass characteristics and organ weight of the broiler birds. Dressing percentage was determined using carcass weight as a proportion of the slaughter weight.

Serum biochemistry

At the time of slaughter, blood was collected from all selected birds via the jugular vein into a heparinized tube. Samples were allowed to clot and centrifuged at 1500 rpm/20 min to separate sera. Serum samples were stored for analysis of total serum protein, serum albumin was measured by Grimsley and Pace, (2003) and serum cholesterol was a determined by using the protocols followed by Sultana *et al*., 2021. The body weight, feed conversion ratio, Heamagglutination - Inhibition (HI) titre (log_2) value, carcass characteristics, total serum protein, serum albumin, and serum cholesterol values were collected and statistically analyzed utilizing methods suggested by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Growth performance

The body weight gain of broilers from 1 to 6 weeks of age as influenced by dietary inclusion of *A. paniculata* and *C. longa* are furnished in Table 3. The body weight was higher in herbal supplemented groups than the control group indicating positive effect of *A. paniculata* and *C. longa* powder added in broiler diet. Based on statistical analysis at the end of the experimental period significantly (P<0.05) higher mean body weight was observed in combination of *A. paniculata* and *C. longa* powder @ 1g/kg each and 2g/kg each supplemented groups as compared to rest of the treatment groups and control group. The present study revealed the best improvement in the growth of broiler chickens when the birds were fed on a diet supplemented with 2 g/kg *A. paniculata* and *C. longa* powder. An 11% increase in live body weight was recorded in this group of chickens as compared with the control group. This study also found lesser, but still significant, increases in growth from the supplementation of *A. paniculata* and *C. longa* powder in diet at selected dosages.

According to Malahubban *et al.* (2013), Laing *et al*. (2013) and Jagia *et a*l., (2022) reported that supplementation of *A. paniculata* to broilers resulted in better body weight and weight gain. Supplementation of *A. paniculata* causes reduced pH and decreased the intestinal thickness. Durrani *et al*. (2006) observed significantly higher body weight in birds fed diet containing Turmeric at 0.5% of the diet as compared to control and other treatment groups. Yarru *et al.* (2009) recorded that addition of 0.5% Turmeric powder to the diet significantly (P<0.05) improved body weight gain of chicks. In Traditional Herbal Medicine, A. *Paniculata* is known for its anti-hepatotoxicity, anti-infection, anti-hepatic and immune stimulatory properties A. *Paniculata* can be used as an additive in feeding stuffs. It can enhance the nutritional content of the feed, increase body weight and reduce the mortality of birds. Sapcota *et al*. (2005) observed a better FCR in *A. paniculata* fed groups at sixth weeks of age.

Al-Kassie *et al.* (2019) fed five levels of a mixture cumin and Turmeric at the rate of 0.00, 0.25, 0.50,

Table 3: Effect of supplementation of *Andrographis paniculata* (Nilavembu) and *Curcuma longa* (Turmeric) on body weight gain (g) (Mean ± SE) of broilers from 1 to 6 weeks of age

Treatment Groups	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
T_1 – Basal diet *(Control)*	148 ± 3.58	401± 10.27	813 ± 16.61	1259 ± 47.99	1737 ± 54.49^a	2047 ± 12.21^a
T_2 – Basal diet + *Androgra paniculata* (1.0g /kg)	147 ± 5.75	402 ± 9.38	813 ± 18.12	1280 ± 40.33	1746 ± 64.21^b	2132 ± 17.32^b
T_3 – Basal diet + *Curcuma longa* (1.0g/kg)	148 ± 4.26	403± 9.54	815 ± 17.19	1290 ± 25.34	1832 ± 47.36^b	2156 ± 21.49^b
T_4 – Basal diet + *Andrographis paniculate* (2.0 g/kg)	146 ± 5.26	402± 9.64	815 ± 15.76	1296 ± 26.60	1875 ± 41.22^b	2148 ± 19.52^b
T_5 – Basal diet + *Curcuma longa* (2.0g/kg)	148 ± 4.18	403± 10.54	817 ± 16.46	1296 ± 40.33	1832 ± 47.36^b	2162 ± 15.56^b
T_6 – Basal diet + *Andrographis paniculata* (1.0g /kg) + *Curcuma longa* (1.0g/kg)	149 ± 3.76	403± 8.96	821 ± 14.19	1348 ± 25.34	1875 ± 41.22^c	2245 ± 10.31^c
T_7 – Basal diet + *Andrographis paniculata* (2.0g /kg) + *Curcuma longa* (2.0g/kg)	148 ± 3.86	403± 8.75	821 ± 13.76	1352 ± 26.60	1875 ± 41.22^c	2276 ± 12.24^c

The value given in each cell is the mean of eighty observations. Values are mentioned as Means ± SE; a-c Means within a column bearing one common letter superscript differ significantly (P<0.05); Means bearing same superscript do not differ significantly within the rows otherwise significant at 5% level of significance.

Table 4: Effect of supplementation of *Andrographis paniculata* (Nilavembu) and *Curcuma longa* (Turmeric) on Feed Conversion Ratio (Mean ± SE) of broilers from 1 to 6 weeks of age.

Treatment Groups	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
T_1 – Basal diet (Control)	0.14 ± 0.003	0.39± 0.008	0.85± 0.016	1.38± 0.026	1.88 ± 0.031^a	1.70 ± 8.24^a
T_2 – Basal diet + *Androgra paniculata* (1.0g /kg)	0.13 ± 0.001	0.38 ± 0.012	0.81 ± 0.015	1.39 ± 0.025	1.79 ± 0.020^b	1.66 ± 3.52^{ab}
T_3 – Basal diet + *Curcuma longa* (1.0g/kg)	0.14 ± 0.003	0.39 ± 0.006	0.83 ± 0.012	1.37 ± 0.013	1.78 ± 0.020^b	1.63 ± 4.22^{bc}
T_4 – Basal diet + *Andrographis paniculata* (2.0 g/kg)	0.14 ± 0.001	0.39 ± 0.013	0.83 ± 0.013	1.37 ± 0.018	1.79 ± 0.022^b	1.68 ± 7.35^{ab}
T_5 – Basal diet + *Curcuma longa* (2.0g/kg)	0.13 ± 0.001	0.38 ± 0.007	0.81 ± 0.015	1.39 ± 0.025	1.75 ± 0.020^{bc}	1.64 ± 9.42^{bc}
T_6 – Basal diet + *Andrographis paniculata* (1.0g /kg) + *Curcuma longa* (1.0g/kg)	0.14 ± 0.003	0.38 ± 0.010	0.83 ± 0.018	1.37 ± 0.013	1.73 ± 0.020^c	1.62 ± 4.21^c
T_7 – Basal diet + *Andrographispaniculata* (2.0g /kg) + *Curcuma longa* (2.0g/kg)	0.14 ± 0.001	0.39 ± 0.012	0.83 ± 0.016	1.37 ± 0.018	1.72 ± 0.022^c	1.60 ± 3.27^c

The value given in each cell is the mean of eighty observations. Values are mentioned as Means ± SE; a-c Means within a column bearing one common letter superscript differ significantly (P<0.05); Means bearing same superscript do not differ significantly within the rows otherwise significant at 5% level of significance.

0.75 and 1% and observed significant effects (P<0.05) on chicks for all treatments as compared to the control. The improvement in the broiler chickens' body weight could be attributed to a number of factors, including the appetizer effects of turmeric, which increase the gastric digestion liquor (William and Losa, 2001); increased villus length and width in the chickens' duodenum, jejunum, and caeca (Rajput *et al.* 2013); enhanced bile production, which improves the chickens' ability to digest fats (Al-Sultan and Gameel, 2004), increased pancreatic lipase activity, as well as increased levels of amylase, trypsin, and chymotrypsin (Chattopadhyay *et al.* 2004).

The results of the present study are in agreement with the Rajput *et al.* (2013), Mondal *et al.* (2015), Sethy *et al.* (2016) and Urusan and Bolukbasi (2017) that supplementation of *C. longa* powder (Turmeric) increase the body weight of broiler birds. The results of the present study did not agree with Nouzarian *et al.* (2011) Kassu *et al.* (2016) and Attia *et al.* (2017) recorded non-significant effect of turmeric supplementation on body weight and body weight gain in broilers.

Feed conversion ratio

The feed conversion ratio of broilers from 1 to 6 weeks of age as influenced by dietary inclusion of *A. paniculata* and *C. longa* are furnished in Table 4. The feed conversion ratio showed a significant

difference (P<0.05) between treatment groups at 5th and 6th weeks of age.

Antibody titre against Newcastle disease

Effect of supplementation of *A. paniculata* and *C. longa* on Hemagglutination Inhibition (HI) titre (log_2) against Newcastle disease of broilers is furnished in Table 5. The present study showed no effect (P> 0.05) on Hemagglutination Inhibition (HI) titre against Newcastle disease of broiler. Numerical improvement in antibody titre against NDV was found in all treated groups as compared to control.

Carcass Characteristics

Effect of supplementation of *A. paniculata* and *C. longa* on carcass characteristics of broilers are furnished in Table 6. The differences among all the treatment groups were found to be non-significant. Numerically higher dressing percentage was recorded in treatment T7 (73.15±0.48).

Serum Biochemistry

Effect of supplementation of *A. paniculata* and *C. longa* on serum biochemical parameters of broilers are furnished in Table 7. The present study showed no effect (P> 0.05) on Total serum protein and albumin except serum cholesterol level was significant (p<0.05). The result showed, reduced serum cholesterol in treatment groups compared to control.

The results of the present study regarding the immune response coincide with the findings of Nouzarian *et al.* (2011) no significant effect on the titer against New Castle disease when it was supplemented at the rates of 0.33, 0.66 and 1.0%. On the contrary of the present study findings, Arsian *et al.* (2017) reported that turmeric powder supplantation in broilers at the rates of 0, 0.5, 1 and 1.5% improved antibody titers against ND and IBD. Serum total cholesterol was reduced and HDL-cholesterol was increased, while LDL-

Table 5: Effect of supplementation of *Andrographis paniculata* (Nilavembu) and *Curcuma longa* (Turmeric) Heamagglutination - Inhibition (HI) titre (log2) against Newcastle disease of broiler

Treatment	14th Day	28th day
T_1 – Basal diet (Control)	4.25 ± 0.14	5.92± 0.21
T_2 – Basal diet + *Androgra paniculata* (1.0g /kg)	4.65± 0.12	6.65± 0.18
T_3 – Basal diet + *Curcuma longa* (1.0g/kg)	4.62± 0.16	6.52± 0.12
T_4 – Basal diet + *Andrographis paniculata* (2.0 g/kg)	4.86± 0.14	6.65± 0.14
T_5 – Basal diet + *Curcuma longa* (2.0g/kg)	4.88± 0.18	6.56± 0.15
T_6 – Basal diet + *Andrographis paniculata* (1.0g /kg) + *Curcuma longa* (1.0g/kg)	4.92± 0.11	6.68± 0.12
T_7 – Basal diet + *Andrographispaniculata* (2.0g /kg) + *Curcuma longa* (2.0g/kg)	4.94± 0.17	6.72± 0.13

The value given in each cell is the mean of fifty-six observations; Values are mentioned as Means ± SE.

Table 6: Effect of supplementation of *Andrographis paniculata* (Nilavembu) and *Curcuma longa* (Turmeric) on carcass characteristics of broilers.

Treatment	Live weight (g)	Carcass weight (g)	Giblet weight (g)	Dressing %
T_1 – Basal diet *(Control)*	2105 ± 54.49	1483 ± 48.21	0.10± 0.48	69.43± 0.65
T_2 – Basal diet + *Androgra paniculata* (1.0g /kg)	2178 ± 64.21	1567± 32.46	0.12± 0.48	70.93± 0.98
T_3 – Basal diet + *Curcuma longa* (1.0g/kg)	2212 ± 47.36	1602± 42.25	0.12± 0.48	71.45± 1.41
T_4 – Basal diet + *Andrographis paniculata* (2.0 g/kg)	2325 ± 41.22	1700± 47.36	0.14± 0.48	71.56± 0.48
T_5 – Basal diet + *Curcuma longa* (2.0g/kg)	2178 ± 64.21	1567± 32.46	0.12± 0.48	71.93± 0.98
T_6 – Basal diet + *Andrographis paniculata* (1.0g /kg) + *Curcuma longa* (1.0g/kg)	2212 ± 47.36	1602± 42.25	0.12± 0.48	72.82± 1.41
T_7 – Basal diet + *Andrographis paniculata* (2.0g /kg) + *Curcuma longa* (2.0g/kg)	2325 ± 41.22	1700± 47.36	0.14± 0.48	73.15± 0.48

The value given in each cell is the mean of fifty-six observations. Values are mentioned as Means ± SE.

Table 7: Effect of supplementation of *Andrographis paniculata* (Nilavembu) and *Curcuma longa* (Turmeric) on the Serum biochemical parameters of broiler

Treatment	Total serum protein (g/dl)	Serum Albumin (g/dl)	Serum Cholesterol (mg/dl)
T_1 – Basal diet *(Control)*	3.89 ± 1.45	1.96±0.25	145.34±1.82^{c}
T_2 – Basal diet + *Androgra paniculata* (1.0g /kg)	3.92 ± 1.29	1.93±0.19	130.25±1.23^{ab}
T_3 – Basal diet + *Curcuma longa* (1.0g/kg)	3.92 ± 1.34	1.94±0.23	133.14±1.62^{b}
T_4 – Basal diet + *Andrographis paniculata* (2.0 g/kg)	3.88 ± 1.62	1.93±0.27	129.84±1.86^{ab}
T_5 – Basal diet + *Curcuma longa* (2.0g/kg)	3.88 ± 1.62	1.94±0.27	132.26±1.86^{b}
T_6 – Basal diet + *Andrographis paniculata* (1.0g /kg) + *Curcuma longa* (1.0g/kg)	3.88 ± 1.62	1.92±0.27	125.26±1.86^{a}
T_7 – Basal diet + *Andrographis paniculata* (2.0g /kg) + *Curcuma longa* (2.0g/kg)	3.88 ± 1.62	1.92±0.27	126.26±1.86^{a}

The value given in each cell is the mean of fifty-six observations. Values are mentioned as Means ± SE; a-c Means within a column bearing one common letter superscript differ significantly (P<0.05).

cholesterol and triglycerides remained unaffected due to turmeric supplementation. *A. paniculata* to broilers and *C. longa* powder have been separately reported to improve performance of broilers when added in the feed. However, there were no studies of the use of both powders combined. The purpose of this study is to determine *A. paniculata* to broilers and *C. longa* powder either separately or combined in different levels as feed additive in broilers.

CONCLUSION

It can be concluded that combination of *A. paniculata* (Nilavembu) and *C. longa* (Turmeric) at 2 % level enhanced growth performance, feed conversion ratio and dressing percentage compared to control and can be used as a feed additive in broiler diet. It also persuades the immune response against Newcastle disease. Therefore, Combination of *A.* and *C. longa* powder at 2% level may be used as a natural feed additive to improve broiler chicken's overall performance. The effective rate of incorporation might be because of the hormesis.

REFERENCES

Alexander D.J. 1998. Newcastle disease diagnosis. In: Newcastle Disease.1st edn. Kluwar, Academic Pub, Boston 1998: 98-160.

Al-Kassie, G.A.M., Mohseen, A.M. and Abdajaleel, R.A. 2019. Modification of productive performance and physiological aspects of broilers on the addition of a mixture of cumin and turmeric to the diet. *Research Opinions in Animal and Veterinary Sciences*, **1**: 31-34.

Al-Sultan, S.I. 2003. The effect of *Curcuma longa* (turmeric) on overall performance of broiler chickens. *International Journal of Poultry Science*, **3**: 333-340.

Attia, Y.A., Al-Harthi, M.A. and Hassan, S.S. 2017. Turmeric (*Curcuma longa* Linn.) as a phytogenic growth promoter alternative for antibiotic and comparable to mannan oligosaccharides for broiler chicks. *Revista Mexicana de Física.*, **8**(1): 11-21.

Arsian, M., Ul Haq, A., Ashraf, M., Iqbal, J. and Mund, M.D. 2017. Effect of turmeric (*Curcuma longa*) supplementation on growth performance, Immune response, Carcass characteristics and Cholesterol Profile in broilers. *Veterinaria*, **66**(1): 16-20.

Association of Official Analytical Chemists. (AOAC). 2016. Official method of analysis. 20 th ed. Association of Official Analytical Chemists International. Arlington, VA.

Bureau of Indian Standards (BIS.). 2007. Requirements for chicken feeds. IS:1374; Manak Bhavan, 9, Bhadurshah Zafar Marg, New Delhi.

Chattopadhyay, I., Biswas, K., Bandyopadhyay, U. and Banerjee, R.K. 2004. Turmeric and curcumin: Biological actions and medicinal applications. *Current Science*, **87**(1): 44-53.

Dai, Y., Chen, S.R., Chai, L., Zhao, J., Wang, Y. and Wang, Y. 2019. Overview of pharmacological activities of *Andrographis paniculata* and its major compound andrographolide. *Critical Reviews in Food Science and Nutrition*, **59**(1): 17-29.

Durrani, F.R., Ismail, M., Sultan, A., Suhail, S.M., Chand, N. *et al*. 2006. Effect of different levels of feed added turmeric (*Curcuma longa*) on the performance of broiler chicks. *Journal of Agriculture and Biological Science*, **1**(2): 9-11.

Grimsley G.R. and Pace, C.N. 2003. Spectrophotometric determination of protein concentration. *Current Protocols Protein Science*, **33**: 3-11.

Hernández, F., Madrid, J., García, V., Orengo, J. and Megías, M.D. 2004. Influence of two plant extracts on broilers performance, digestibility, and digestive organ size. *Poultry Science*, **83**(2): 169-174.

Jagia, E., Yuliana, R., Simanjuntak, W.T., Fitriy, N., Rahmawati A. and Yulinah, E. 2022. Potency of *Origanum vulgare* and

Andrographis paniculata extracts on growth performance in poultry. *Veterinary Animal Science,* **19**: 137-142.

Laing, D., Wong tangtintharn, S., Tungjarernkul, B., Sirilaophaisan, S. and Khajarern, J. 2013. Effects of *Andrographis paniculata* and *Zingiber cassumunar* mixture on productive performance and carcass quality of broiler chickens. *International Conference on Agriculture and Biotechnology,* **60**(7).

Kassu,Y., Tamir, B. and Tesfaye, E. 2016. Effect of Supplementing Natural Feed Additives: Black Cumin, Fenugreek and Turmeric on the Growth Performance and Economic Efficiency of Broiler Chickens. *Advanced Biological Research*, **10**(5): 335-344.

Mondal, M.A., Yeasmin, T., Karim, R., Siddiqui, M.N., Raihanun-Nabi, S.M., Sayed, M.A. and Siddiky, M.N.A. 2015. Effect of dietary supplementation of turmeric (*Curcuma longa*) powder on the growth performance and carcass traits of broiler chicks. *SAARC Journal of Agriculture,* **13**(1): 188-199.

Malahubban, M., Alimon, A.R., Sazili, A.Q. and Fakurazi, S. 2013. Effects of *Andrographis paniculata* and *Orthosiphon stamineus* supplementation in diets on growth performance and carcass characteristics of broiler chickens. *International Journal of Agriculture and Biology,* **5**(6): 1814–1819.

Rajput, N., Muhammad, N., Yan, R., Zhong, X. and Wang, T. 2013. Effect of dietary supplementation of curcumin on growth performance, intestinal morphology and nutrients utilization of broilers. *Journal of Poultry Science*, **50**: 44-52.

Nouzarian, R., Tabeidian, S.A., Toghyani, M., Ghalamkari, G. and Toghyani, M. 2011. Effect of turmeric powder on performance, carcass traits, humoral immune responses and serum metabolites in broiler chicken. *Journal of Animal Feed Science*, **20**: 389-400.

Qasem, M.A.A., Alhajj, M.S., Ger El Nabi, A.R. and Al-Mufarrej, S.I. 2015. Effect of turmeric powder as a dietary supplement on performance indicators and immune responses in broiler chickens. *Journal of Animal and Veterinary Advances*, **14**(2): 30-3.

Snedecor, G.W. and Cochran, G.W. 1989. Statistical Methods. 8th Edn., The Iowa State University Press, Ames, Iowa.

Sapcota, D., Upadhyaya, T.N., Islam, R. and Choudhury, K.B. 2005. Effect of dietary *Emblica officinalis* in ameliorating aflatoxicosis in broiler chicken: gross and histopathological studies. *Indian Poult. Sci. Association,* **XXIII** Annual Conference.

Sethy, K., Swain, P., Behera, K., Nayak, S.M., Barik, S.R., Patro, P. and Meher, P. 2016. Effect of turmeric (*Curcuma longa*) supplementation on growth and blood chemistry of broilers. *Exploratory Animal and Medical Research,* **6**(1): 75-79.

Suliman, G.M., Alowaimer, A.N., Al-Mufarrej, S.I., Hussein, E.O., Fazea, E.H., Naiel, M.A., Alhotan, R.A. and Swelum, A.A. 2020. The effects of clove seed (*Syzygium aromaticum*) dietary administration on carcass characteristics, meat quality, and sensory attributes of broiler chickens. *Poultry Science,* **100**: Article 100904.

Urusan, H. and Bolukbasi, S.C. 2017. Effects of dietary supplementation levels of turmeric powder (*Curcuma longa*) on performance, carcass characteristics and gut microflora in broiler chickens. *Journal of Animal Plant Science*, **27**(3): 732-736.

William, P. and Losa, R. 2001. The use of essential oils and their compounds in poultry nutrition. *World Poultry,* **17**: 14-15.

Wuthi-Udomlert, M., Grisanapan, W., Luanratana, O. and Caichompoo, W. 2000. Antifungal activity of *Curcuma longa* grown in Thailand. *Southeast Asian Journal of Tropical Medicine Public Health,* **31**: 178-182.

Yarru, L.P., Settivari, R.S., Gowda, N.K.S., Antoniou, E., Ledoux, D.R. *et al.* 2009. Effects of turmeric (*Curcuma longa*) on the expression of hepatic genes associated with biotransformation, Antioxidant and immune systems in broiler chicks fed aflatoxin. *Poultry Science*, **88**(12): 2620-2627.

Zia, A., Farkhondeh, T. and Pourbagher-Shahri, A.M. 2021. The role of curcumin in aging and senescence: Molecular mechanisms. *Biomedicine and Pharmacotherapy,* **134**: 111-119.