Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

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Effect of curcumin on hemato-biochemical alterations after induced *E. coli* infection in broilers

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Abstract
Ninety birds were divided into six groups randomly and equally. Group I was normal control, Group II was *E. coli* control, Group III and IV received curcumin prophylactically and therapeutically @ 200 mg/kg and 400 mg/kg feed, respectively. Group V received cephalexin and Group VI served as curcumin control. From the results of hemato-biochemical profile, significant (P< 0.05) alterations were observed in MCV, MCH, TEC and TLC in *E. coli* challenged groups compared to controls. Total serum protein levels of curcumin treated groups increased significantly (P< 0.05) compared to *E. coli* control group. The significant (P< 0.05) alterations in serum AST, ALT, ALP and uric acid levels were observed in *E. coli* control group. However, these alterations were found to be ameliorated by curcumin treated groups. The average of sodium and potassium values were found to be non-significant whereas serum chloride of *E. coil* challenged groups increased significantly (P< 0.05) when compared to controls. From the results, it is concluded that curcumin found to have ameliorative effect on altered heamto-biochemical profile in *E. coli* induced broilers.

Keywords: Broilers, curcumin, *E. coli*, hemato-biochemical

Introduction
Bacterial diseases of poultry represent a major threat to poultry industry all over the world and microbial infections are the world's leading killing diseases among the poultry. Colibacillosis is a broad term that refers to any infection or disease caused by the bacteria *E. coli* which continues to be one of the most economically important respiratory and systemic diseases leading to high morbidity, mortality, loss of body weight, bad feed conversion ratio (FCR), and decrease in egg and meat production and condemning or low grading of carcasses. Colibacillosis is associated with many different kinds of diseases ranging from respiratory tract infection, swollen head syndrome in poultry to urinary tract infections [1].

Control of *E. coli* is very important in poultry sector which depend mainly on the use of antimicrobials. Recently, the use of antibiotic growth promoters (AGPs) in poultry industry has been seriously criticized by government policy makers and consumers because of the development of microbial resistance and the potential harmful effects on human health [2]. It is conceivble that herbal agents could serve as safer alternatives to AGPs due to their suitability and preference, lesser toxicity risks and minimum health hazards.

Turmeric (the common name for *Curcuma longa*) is an Indian spice derived from the rhizomes of the plant and has a long history of use in Ayurvedic medicine. *C. longa* is a perennial member of the Zingiberaceae family and is cultivated in India and other parts of Southeast Asia. Turmeric has been traditionally used in prevention and treatment of several conditions and diseases. Studies indicated that active constituents of turmeric i.e. curcumin is responsible for most of pharmacological properties of turmeric. It exerts hepato and nephro-protective, thrombosis suppressing, myocardial infarction-protective, antioxidant, antimicrobial, wound healing, anticarcinogenic and anti-inflammatory [3, 4]. As per unpublished data, curcumin has got potential to control *E. coli* infection in piglets [5]. Therefore, the present study was carried out to evaluate the effect of curcumin on biochemical and hematological parameters in *E. coli* induced infection in broilers.

Materials and Methods
Ninety broiler chicks were procured from Amruta Hatcheries, Amravati. Chicks were divided into six equal groups of fifteen birds each. The experiment conducted for five weeks. Group I served as control group fed with basal diet. Group II, III, IV, V challenged with E. *coli*

infection in which group II was non-treated, Group III was given prophylactic treatment of curcumin @ 200 mg/kg feed for total experimental period of five weeks, Group IV was therapeutically treated with curcumin @ 400 mg/kg feed for five days from the day of manifestation of clinical symptoms post *E. coli* challenge. Group V was treated therapeutically with cephalexine @ 1g/lit of drinking water for five days post *E. coli* challenge. Group VI received curcumin diet @ 200 mg/kg of feed for five weeks. For evaluation of biochemical and hematological parameters, blood was collected from birds on 35th day. Before the start of the research work, the experimental protocol was approved from Institutional Animal Ethics Committee (IAEC, Reg. no. 312/CPCSEA) of PGIVAS, Akola.

Hemoglobin (Hb), Total erythrocyte count (TEC), Mean corpuscular volume (MCV), Mean corpuscular hemoglobin

(MCH) and Mean corpuscular hemoglobin concentration (MCHC) were estimated by Sahil's hemometer [6]. Packed cell volume (PCV) was estimated using micro-hematocrit method [7]. Serum total protein (TP) and Albumin (Alb) level in each group was estimated by Biuret method [8]. Serum Creatinine level was estimated by modified Jaffe`s method [9]. Serum Aspartate amino transferase (AST), Serum alanine amino transferase (ALT) level and Serum Alkaline phosphatase (ALP) level were estimated as per UV Kinetic method-liquid [10]. Serum sodium and serum potassium levels in different groups were estimated using flame emission spectrophotometer [11]. Serum chloride level was estimated using thiocynate end point assay method using autospan diagnostic kit on serum auto analyzer [12].

Table 1: Effect of curcumin on hematological values in different treatment group of *E. coli* infection induced broilers (n=6).

Group	Hb (g/dl)	PCV (%)	TEC (10^6/ cu mm)	MCV (fl)	MCH (pg)	MCHC (g/dl)	TLC (10^3/ cu mm)
I	10.67 ±0.21	25.83 ±0.47	2.64c ±0.12	98.66a ±4.47	40.87a ±2.05	41.29 ±0.39	13c ±0.44
II	10.83 ±0.33	27.50 ±0.76	3.24a ±0.08	84.76b ± 1.98	31.87b ±1.08	37.77 ±1.82	18.70b ±1.12
III	10.5 ± 0.42	25.66 ±0.67	3.73a ±0.14	69.10c ± 2.28	28.45b ±1.90	41.06 ±1.96	20.39ab ±1.42
IV	11.13 ±0.40	25.00 ±0.73	3.45ab ±0.13	72.84c ±2.93	31.52b ±1.50	43.25 ±0.80	22.37a ±0.62
V	11.17 ±0.40	26.5.0 ±0.67	3.68a ±0.13	72.60c ±4.07	30.66b ±2.14	42.10 ±2.75	21.13ab ±1.29
VI	10.67± 0.33	25.83 ±0.60	2.73c ±0.14	94.55ab ±5.49	39.48a ±2.53	41.26b ±0.49	13.83c ±0.82

Values are expressed as mean ± SE, means bearing common superscripts in column do not differ significantly (P < 0.05).

Table 2: Effect of curcumin on biochemical parameters in different treatment group of *E. coli* infection induced broilers (n=6).

Group	Total Protein	Albumin	Globulin	AST	ALT	ALP
I	1.77bc ±0.08	1.08bc ±0.06	0.62±0.05	157.33b ±1.8	14.05cd ±0.8	109.93a ±4.4
II	1.63c ±0.18	0.93c ±0.06	0.74±0.16	188.33a ±2.34	31.07b ±2.0	105.16a ±7.3
III	1.78bc ±0.10	1.08bc ±0.07	0.69±0.04	153b ±4.14	8.57d ±0.35	28.16d ±0.70
IV	2.00ab ±0.12	1.24ab ±0.07	0.77±0.05	126c ±6.77	17.46c ±0.77	43.72c ±0.68
V	2.31a ±0.10	1.40a ±0.07	0.90±0.04	127c ±.71	38.84a ±4.5	90.21b ±1.42
VI	2.14a ±0.05	1.33a ±0.02	0.81±0.04	69.33d ±5.73	13.77cd ±1.16	37.87cd ±2.17

Values are expressed as mean ± SE, means bearing common superscripts in column do not differ significantly (P < 0.05)

Table 3: Effect of curcumin on serum creatinine, uric acid, Na, K and Cl in different treatment group of E. coli infection induced broilers (n=6).

Group	Creatinine	Uric acid	Na	K	Cl
I	0.16± 0.01	7.45cd ±.30	130.75±4.40	4.45±0.07	48.48c ±2.2
II	0.17±0.04	16.25a ±0.33	135.89±4.43	4.42±0.09	74.99a ±1.0
III	0.20±0.03	7.94bc ±0.34	134.54±3.74	4.15±0.36	62.76b ±1.2
IV	0.24±0.08	7.11a ± 0.26	135.62±3.6	4.28±0.14	70.74a ±1.7
V	0.22±0.03	8.49b ±0.26	139.96±5.8	4.4±0.09	60.19b ±2.9
VI	0.15±0.02	7.16cd ±0.13	136.26±4.01	4.38±0.06	71.09a ±1.75

Values are expressed as mean ± SE, means bearing common superscripts in column do not differ significantly (P < 0.05)

Results and Discussion

The observed hemoglobin (Hb) and packed cell volume (PCV) values in the different treatment groups of broilers found to differ non-significantly. In earlier reports of similar study, turmeric powder showed no significant effect on Hb and PCV levels [13]. The MCV and MCH significantly (P< 0.05) decreased in all *E. coli* challenged groups (II, III, IV and V) as compared to control group. The MCV and MCH values in this study are in agreement with earlier findings in which significant decrease in MCV and MCH observed in *E. coli* challenged broilers birds [14]. The estimated MCHC evaluated in different treatment groups found to be non-significant.

The total leucocytes count (TLC) in *E. coli* challenged groups (II, III, IV and V) increased significantly (P< 0.05) compared to controls. Increased in TLC in group II and different *E. coli* challenged treatment groups might be due to induced *E. coli*

infection in birds which is a natural indicator of bacterial infection. Similar observations of TLC count in *E. coli* infected broilers noticed by other researchers, which may be due to necrosis and hemorrhages in visceral organ [15]. Total serum protein levels of curcumin administered groups (III and IV) and from group V and VI increased significantly (P< 0.05) from *E. coli* control group. Thus, curcumin might be masking fall in serum protein levels. There was slight decrease in the level of albumin in group II as compared to controls. However, curcumin at prophylactic and therapeutic doses (groups III and IV) have shown improvement and restoration in albumin levels. There were no significant differences found in serum globulin values of different treatment group and controls.

Serum AST levels found to be increased significantly (P< 0.05) in *E. coli* control group as compared to normal control.

Serum AST levels decreased significantly (P< 0.05) in curcumin prophylactic and curcumin therapeutic groups and cephalexin treated groups compared to *E. coli* control group. The serum ALT values increased significantly (P< 0.05) in *E. coli* control group when compared to normal control. However, curcumin at prophylactic and therapeutic doses showed marked and significant decrease in serum ALT levels when compared to group II. The normalize levels of AST and ALT might be due to liver protective effect of curcumin and curcumin might be restoring these enzymes levels in *E. coli* challenged birds. However, reference drug Cephalexin group showed high ALT values which indicate that liver function might not be normalized. The present finding corroborated with other findings in which similar increase in AST and ALT values observed in *E. coli* infective group than normal control in poultry [16]. Serum ALP values of curcumin prophylactic, curcumin therapeutic and curcumin control (VI) group found to be differed significantly (P< 0.05) compared to *E. coli* control. As the experiment was conducted in summer season, ALP values from group I and II might be appeared at higher levels however, significantly lower ALP values of curcumin groups (III, IV and VI) indicates that curcumin has got protective effect against *E. coil* infection and stressful conditions. The creatinine values in different treatment group are found to be non-significant. Serum uric acid levels from *E. coli* control group found to be increased significantly (P< 0.05) when compared to control group. However, uric acid levels decreased significantly (P< 0.05) in group III & IV as compared to *E. coli* control group and found to be in the normal range. In related studies significant increase in the uric acid levels was observed in all *E. coli* challenged birds [14]. Thus, curcumin might be exerting protective effect on controlling the uric acid levels in colibacillosis.

The average of sodium and potassium values in different treatment group was found to be non-significant in different treatment groups. Serum chloride levels of *E. coil* control and *E. coli* challenged treatment groups altered (increased) significantly (P< 0.05) when compared to normal control.

From the present study, it is concluded that curcumin at prophylactic and therapeutic doses ameliorated alterations in the hemato-biochemical profile in *E. coil* induced infection in broilers and curcumin has potential to control *E. coli* in broilers.

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