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Effect of Curcuma Longa on Growth and Lipid Profile of Broiler Chickens across Seasons

Sehrish -
Department of Biology, Lahore Garrison University, Sector C, Phase VI, DHA, Lahore,
maryammalik7244@gmail.com

Roheela Yasmeen
Department of Biology, Lahore Garrison University, Sector C, Phase VI, DHA, Lahore,
raheelasattar44@gmail.com

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EFFECT OF *CURCUMA LONGA* ON GROWTH AND LIPID PROFILE OF BROILER CHICKENS ACROSS SEASONS

SEHRISH[1], AND ROHEELA YASMEEN*[1]

[1]*Department of Biology, Lahore Garrison University, Sector C, Phase VI, DHA, Lahore*

Corresponding Author's email: roheelayasmeen@lgu.edu.pk

ABSTRACT

The poultry sector plays a critical role in driving economic growth and meeting the protein needs of the population. Recently, natural additives like turmeric (*Curcuma longa*) have attracted attention for their antimicrobial properties and their potential to reduce the reliance on antibiotics in poultry feed. This study evaluated the effects of turmeric supplementation at varying concentrations on broiler chickens during winter and summer seasons. Over a 42-day period, 40 broilers were divided into four groups: Control, Experimental Group 1 (1% turmeric), Experimental Group 2 (1.5% turmeric), and Experimental Group 3 (2% turmeric). Vaccination against Newcastle Disease (ND) and Infectious Bursal Disease (IBD) was performed. Feed intake was recorded daily, and blood samples were collected on day 35 for lipid profile analysis and antibody titer measurement. At the end of the study (day 42), body weights were measured to determine the feed conversion ratio (FCR), and chickens were slaughtered for carcass evaluation. Results indicated that 2% turmeric supplementation significantly ($p<0.05$) improved body weight gain, reduced FCR, and enhanced carcass quality, particularly in the breast, thigh, and liver. Lipid profile analysis revealed reductions in cholesterol, LDL, and triglycerides, along with an increase in HDL levels. ND and IBD titers were also improved. The study concluded that 2% turmeric supplementation was the most beneficial for broiler chickens, demonstrating positive effects across both seasons compared to lower concentrations.

Keywords: Broiler chicken, turmeric, seasons, carcass characteristics.

INTRODUCTION

Poultry production is one of the most popular sectors of Pakistan that contributes to 1.3 % in Gross Domestic Production of the country (Hussain et al., 2015). According to a recent report of FAO, poultry meat is beneficial for humans' health due to its high-quality protein, low fat, and favorable fatty acid profile, potentially reducing the incidence of metabolic illnesses linked to nutrient deficiencies (Ravindran, 2013). Turmeric (*Curcuma longa*) is a perennial plant from the Zingiberaceae family, with its rhizome being the medicinal part. Curcumin, the primary bioactive component of turmeric, is responsible for its therapeutic effects (Nouzarian et al., 2011; Sotiboldieva and Mahkamov, 2020). Although turmeric has been used medicinally for thousands of years, several recent research has clarified its mechanisms and biological activity (Gupta et al., 2013; Amalraj et al., 2017; Ahmad et al., 2020). Curcumin, a key polyphenol in turmeric, exhibits antioxidant, anti-inflammatory, antimutagenic, antibacterial, and anticancer properties (Aggarwal et al., 2003; Aggarwal et al., 2009; Lestari and Indrayanto, 2014; Rathore et al., 2020). These qualities make turmeric a promising alternative to antibiotics and a useful natural growth promoter (Kochhar, 2008; Prasad et al., 2014; Aderemi and Alabi, 2023).

The addition of antibiotics to poultry diets fosters bird growth (Ali et al.,

2008). However, antibiotic resistance and alterations in gut flora pose significant concerns (Schwarz et al., 2001; Lee et al., 2004; Al-Mashhadani, 2015). Synthetic medications and growth promoters, while effective, are associated with high costs, adverse health effects, and prolonged residual properties (Abd Al-Jaleel, 2012).

Natural feed additives, including herbs and spices with medicinal properties, offer an alternative. These additives can enhance digestion, boost immunity, and improve poultry productivity while acting as antibacterials and immunostimulants (Sapra and Mehta, 1990; Guo, 2003; Krauze, 2021; Olotu et al., 2023). Spices such as ginger, black cumin, garlic, coriander, and turmeric all are used in poultry feed for their benefits (Murugesan et al., 2015).

Turmeric's biochemical composition includes 69.4 % carbohydrates, 6.3 % proteins, 5.1 % fats, 3.5 % minerals, and 13.1 % water, with about 5 % curcumin and essential oils (Dono, 2014; Tajodini et al., 2015; Sharma, 2019). Although curcumin is soluble in organic solvents, it is not soluble in water or ether (Ahmad et al., 2020).

The turmeric rhizome powder decreased the morbidity and mortality of chickens when added to the feed of birds (AL-Kassie et al., 2011). It is also used against influenza viruses, this demonstrates its anti-influenza properties (Dao et al., 2012; Jennings and Parks, 2020). It inhibits viral invasion by altering metabolic activity and reducing inflammation, enhancing the immune response (Li et al., 2020; Emadi et al., 2007; Mehala and Moorthy, 2008). Turmeric supplementation also boosts immunity against pathogens like *Pasteurella multocida* (Raheem et al., 2021). Although turmeric powder is a potential replacement for antibiotics in poultry feed, this study is novel in its design as it assesses the seasonal use of turmeric (*Curcuma longa*) as a growth promoter. It provides new insights into its effects on broiler chicken growth performance, carcass evaluation, glucose levels, immune response, and lipid profile during winter and summer seasons.

MATERIALS AND METHODS

The experiment was performed on broilers chicken. Birds were fed with turmeric powder in varying doses in summer and winter seasons.

Selection and Purchasing of Experimental Birds

Five days old 40 broiler chicks were selected and purchased from a commercial hatchery

Preparation of Turmeric Powder

A commonly used specie turmeric, (*Curcuma longa*) was selected for this experiment. The dried turmeric rhizomes were purchased from the grocery store after proper recognition and crushed into the fine and soft texture powder (Figure 1). The obtained powder was added into the chicks feed according to the requirement.

Grouping of Experimental Birds

The chicks were allocated into four different groups. Each group consisted of 10 chicks for the purpose of experiment. All the chicks were randomly divided to 4 different cages and labelled as Control group (Poultry Feed + 0 % turmeric powder), Experimental group 1 (Poultry Feed + 1 % turmeric powder), Experimental group 2 (Poultry Feed + 1.5 % turmeric powder), and Experimental group 3 (Poultry Feed + 2 % turmeric powder).

Housing Management

The housing management included pre-heating equipment, changeable temperature controls, and a relative

humidity of 50–70 %. The birds were provided with proper light and ventilation. The electricity was also facilitated with UPS to maintain proper environmental conditions without interruption during the whole experiment. The chicks had remained in the floor of isolated cages

Figure 1: Dried turmeric rhizomes and its powdered form prepared for the experimentation of broiler chicken

Feed Conversion Ratio (FCR)

To calculate feed conversion ratio (FCR) the bird's body weight gain, and feed intake was recorded on weekly basis. The FCR was calculated by dividing the feed intake by weight gain (Oke, 2018).

Carcass Evaluation

At the 42 days, three birds were randomly selected from each group and slaughtered. The birds were defeathered, organs were separated and relative wet weight of organs such as breast, thigh, liver, gizzard, and spleen, recorded by following the procedures of Qasem et al., (2016) and Oke, (2018).

Blood Sample Collection

At the end of experiment (42 days), three birds from each group were punctured in the brachial vein to obtain 3 ml of blood samples. The blood samples were centrifuged at 2000 g for 10 minutes, serum was separated and stored at -20℃ until they were used for further analysis by following the methods of Ayodele et al., (2021) and Mustafa et al., (2021).

Glucose Levels and Lipid Profile

Using an automatic biochemical analyzer and the accompanying reagent kit, specific serum samples were examined for total cholesterol, HDL, LDL and tri. glyceride levels. Commercial kits were used to measure total cholesterol, triglycerides, HDL, and glucose.

Antibody Titers

The birds were vaccinated against ND and IBD and assessed for antibody titer production using ELISA kits.

Statistical Analysis

Data will be analyzed for independent sample t test and ANOVA by using SPSS version 22.0.

RESULTS

The experiment was performed on broiler chickens during the winter and summer season for 42 days. During the experiment different parameters such as temperature, growth performance, carcass evaluation, glucose levels, lipid profile and antibody titer production were noticed

Temperature Recorded in Winter and Summer Season

The temperature variation during the experimentation period was noticed. An overall lower temperature between 21.86+0.83 and 28.29±1.03 was noticed in winter while, in summer season the temperature was between 31.57±1.84 to 37.43±1.92 during the 42 days study period. However, temperature was kept maintained (30-32℃) in winter and summer seasons by keeping electrical heaters and fans respectively.

Feed Conversion Ratio in Control and Experimental broiler chicken in Winter and Summer Seasons

To calculate feed conversion ratio data of feed intake and body weight gain was recorded on weekly basis. The lowest FCR was observed in experimental group 3 that was fed with 2 % turmeric in diet followed by 1.5 %, 1 % and 0 % at every week during the experimentation for both seasons. It was proved that bird feed efficiency of body to convert food into energy was improved by giving higher amount of turmeric in their diet.

Carcass Evaluation in Control and Experimental Groups in Winter and Summer Season

The carcass evaluation showed breast and thigh weight increased with the increase in turmeric supplementation in the diet of chicken. Breast (217.81±9.33) and thigh (71.13±1.92) weight had seemed highest in Experimental group 3 in the summer season. The other carcass traits that included gizzard and spleen seemed not to be affected by turmeric and did not show any variation among all groups as shown in table 1. The liver weight of broiler was also increased with the increased percentage of turmeric in the diet of experimental birds. Data was statistically analyzed by one way ANOVA and significant differences were found in breast and thigh weights among the groups at p value 0.021. Overall, the highest weight was recorded for the summer season compared to winter season. Data was also analyzed statistically for independent sample t test and significant differences were noticed at p value <0.05 in both seasons.

Lipid Profile in Control and Experimental Groups in Winter and Summer Season

The turmeric feed diet decreased the total cholesterol, LDL and Tri. glycerides. The chicken group with highest amount of turmeric (2 %) showed the least cholesterol value (120.00±10.20) and the highest value (165.00±4.97) was observed in the control group. Broiler chicks in Experimental group 3 also seen with lowest Tri. glycerides and LDL value as 46.00±8.29 and 57.33±6.28, respectively among all the groups as shown in table 2. The HDL level was increased (37.76±5.63) in the Experimental group 3 of birds that given 2 % of turmeric in their diet particularly in winter season. After statistical analysis, significant variations ($p<0.05$) were seen when all parameters of lipid profile were compared with summer season. It demonstrated that the Cholesterol level was significantly decreased and HDL, LDL and tri. Glycerides level was significantly increased as compared to summer season.

Levels of Glucose in Control and Experimental Broilers Chicken in Winter and Summer Season

The levels of glucose found lowest in experimental groups as compared to control and highest glucose levels were recorded for summer season as compared to winter season (Figure 2).

Table 1: Effect of turmeric feed on carcass characteristics of broiler chicken in winter and summer seasons

Organs	Control group (0 %)		Exp group 1 (1 %)		Exp group 2 (1.5 %)		Exp group 3 (2 %)	
	Winter	summer	winter	summer	winter	summer	Winter	summer
Breast	167.09±7.26	168.52±4.98	178.95±4.85	185.78±4.21	184.78±3.08	193.46±5.15	193.46±5.14	217.81±9.33
Thigh	34.63±3.75	41.96±2.44	41.57±2.63	47.57±3.29	47.95±5.58	60.96±1.84	61.13±3.10	71.13±1.92
Liver	15.87±0.69	16.87±2.01	21.92±2.89	21.92±2.86	27.11±4.87	25.84±4.60	33.51±4.61	35.18±4.18
Gizzard	3.22±0.32	3.32± 0.46	3.28±0.55	3.31± 0.51	3.28±0.36	3.33± 0.43	3.20±0.28	3.20± 0.28
Spleen	0.66±0.42	0.72± 0.42	0.65±0.47	0.71± 0.57	0.66±0.38	0.72± 0.55	0.63±0.36	0.72± 0.45

Table 2: Effect of turmeric feed supplementation on Lipid profile (mg/dL) of broiler chicken in winter and summer season

Serum parameters	Control group (0 %)		Exp group 1 (1 %)		Exp group 2 (1.5 %)		Exp group 3 (2 %)	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
Cholesterol	165.00±4.97	172.44±5.71	161.00±8.58	166.33±2.05	132.00±4.32	137.33±4.71	120.00±10.20	127.67±8.22
Tri. Glycerides	87.67±6.94	80.67±6.60	78.67±4.50	70.00±2.62	59.00±4.97	53.33±3.86	46.00±8.29	40.97±7.36
LDL	87.33±3.68	83.67±2.16	76.33±7.04	72.67±4.11	68.00±6.48	61.33±2.36	57.33±6.28	52.67±4.03
HDL	20.67±4.99	18.67±4.99	24.33±2.62	20.33±2.62	27.33±1.70	23.67±1.70	37.76±5.63	31.67±5.73

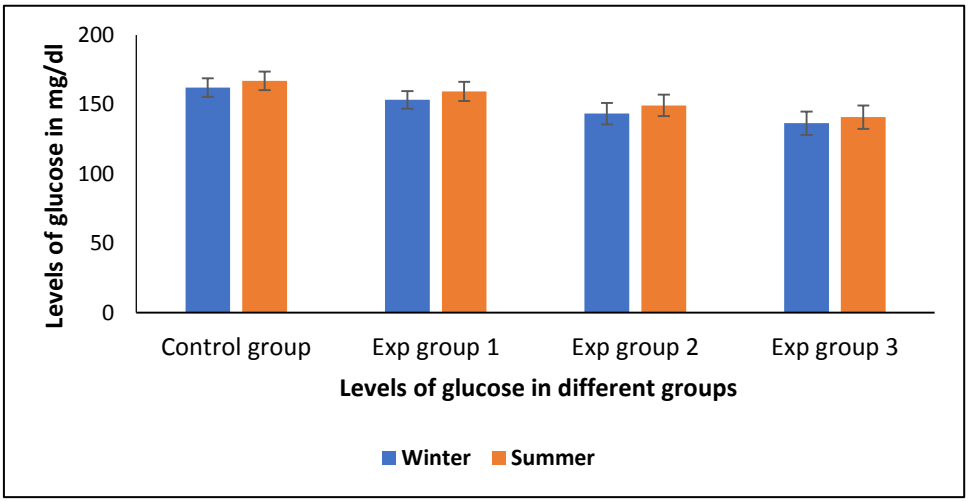

Figure 2: Levels of glucose in broiler chicken in different seasons

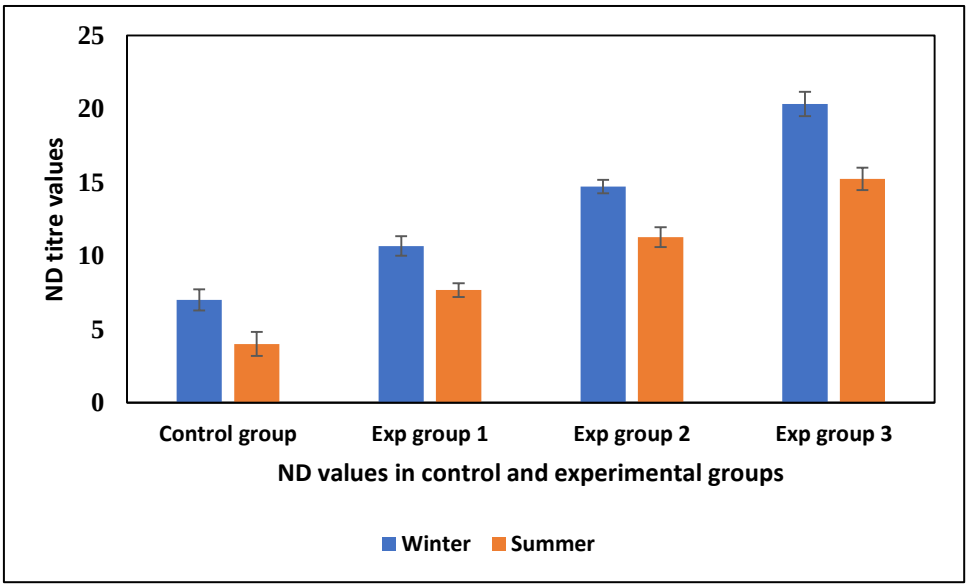

Figure 3: Levels of ND titers in broiler chicken in different seasons

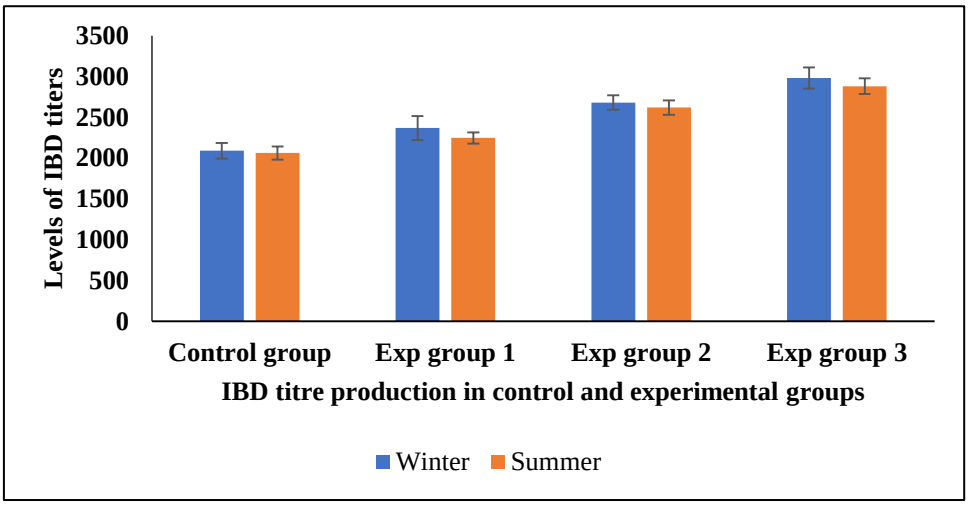

Figure 4: Levels of IBD titers in broiler chicken in different seasons

ND Antibody Titers Production in Control and Experimental Broilers Chicken in Winter and Summer Season

The turmeric feed diet induced observable changes in antibody production against ND in chicken across all experimental groups. The highest ND titers were observed in Experimental group 3 as compared to other groups, indicating that turmeric supplementation positively affected antibody production in the chicks. Notably, ND values were higher in the winter season compared to the summer season (Figure 3). Statistical analysis revealed significant variations ($p < 0.05$) in ND titers between seasons and among the different groups.

IBD Antibody Titers Production in Control and Experimental Broilers Chicken in Winter and Summer Season

The turmeric feed diet induced changes in antibody production against Infectious Bursal Disease (IBD) in the broiler chicken groups. Titers were increased in the experimental groups, particularly in those receiving 2% turmeric in their diet (Figure 4). The highest IBD titers were observed in Experimental Group 3, with values of 2880.00 ± 95.97 for the winter season and 2980.00 ± 129.67 for the summer season. Thus, turmeric supplementation positively influenced antibody titer production for IBD in the chicks. However, statistical analysis revealed non-significant variations ($p > 0.05$) in IBD titers between the two seasons.

DISCUSSION

Turmeric in chickens diet significantly improved their growth performance and feed conversion ratio among all chicken groups in both seasons (summer and winter). The chicks that were given 2 % of turmeric in their diet in summer gained more weight (1399.80kg) as compared to chicks that grown in winter (1200.33kg) with same percentage of turmeric. This might be due to the increase in metabolic rate and use of more nutrient for heat production in the body of chicks in winter season. The results showed beneficial effect of turmeric feed supplementation in both seasonal conditions.

The chicks gained the maximum weight that was fed with the highest percentage 2 % of turmeric followed by 1.5 %, 1 % and 0 %. It was related to the results of previous studies (Wuthi-Udomler et al., 2000; Al-Sultan et al., 2003; Durrani et al., 2006; Samarasinghe et al., 2003). It might be due to that turmeric stimulated the digestion system and increased the feed utilization due to which chicks gain weight. There may be substances in this herb plant that facilitate better nutritional absorption and digestion. Also, these conclusions contradicted the findings of Namagirilakshmi, (2005), according to which turmeric at different percentages like 0.25 %, 0.5 %, 0.75 % and 1 % did not improve the weight gain of broilers chickens.

Feed Conversion Ratio was best in Experimental group 3 with highest amount of turmeric in their diet in both seasons. The lowest FCR was observed in the group with 2 % turmeric in diet followed by 1.5 %, 1 % and 0 % indicating that chicken have best feed efficiency. Same results were mentioned in the studies of (Durrani et al., 2006; Abd Al-Jaleel, 2012; Al-Sultan et al., 2003; Wuthi-Udomler, 2000). According to their studies, the chick's group with 0.5 % turmeric powder in their diet more efficiently utilized their feed and have best FCR. But according to the (Yaghobfar et al., 2011), turmeric powder on the diet of broilers did not affect the FCR at different percentages 0.4 and 0.8 %.

Turmeric supplementation at 2 % in both seasons increased the breast and thigh weight experimental group 3, followed by experimental group 2 and

experimental group 1, and the control group. This aligns with findings by Osawa et al., (1995) and Durrani et al., (2006), who reported increased breast, thigh, and dressing percentage with turmeric supplementation. The weight gain might be due to enhanced protein synthesis from turmeric's antioxidant properties. However, Nouzarian et al., (2011) reported no significant effect of turmeric on breast and thigh weight.

Turmeric supplementation also positively affected liver weight, with the highest percentage leading to an increase. This aligns with findings by Emadi and Kermanshahi (2007), who noted turmeric's positive impact on liver enzymes, suggesting better chicken health, including increased lactase dehydrogenase (LDH) activity and decreased serum alkaline phosphatase (ALP). However, this contradicts Al-Sultan (2003), who found no positive effect of turmeric on liver weight.

However, the turmeric in the feed of broiler at different levels did not cause any observable variation in the weight of gizzard and spleen in all groups during experimentation in both seasons. Thus, the weight of gizzard and spleen remained the same among all groups. It was related to the findings of the (Lal et al., 1999; Al-Sultan et al., 2003), who concluded that turmeric did not affect the gizzard and spleen sizes.

Turmeric supplementation in chicken feed positively influenced lipid profiles in both summer and winter seasons, demonstrating hypolipidemic effects. It reduced total cholesterol, triglycerides, and LDL while increasing HDL levels, with 2 % turmeric showing the most significant impact. These findings align with studies by Kermanshahi and Riasi (2006) and Abbas et al., (2010), who reported similar reductions in cholesterol and triglycerides. Emadi et al., (2007) also observed decreased LDL and increased HDL with turmeric. When comparing seasons, cholesterol levels were higher in summer, while triglycerides, LDL, and HDL were lower. These results suggest turmeric's role in lipid metabolism and elimination in chickens.

Turmeric supplementation in the diet of broiler chicks positively influenced titer production against ND and IBD, with the highest titers observed in the group receiving 2 % turmeric. This effect was consistent across both summer and winter seasons. These findings align with studies by Qasem et al., (2015), Arslan et al., (2017), and Mustafa et al., (2021) which reported increased titer production with turmeric supplementation. The results suggest that turmeric's antiviral, antimicrobial, and immunomodulatory properties contribute to enhanced immune response. However, titer production was statistically lower in summer compared to winter.

CONCLUSION

In conclusion, turmeric supplementation at a 2 % rate significantly improved broiler growth performance and body weight gain across both summer and winter seasons. It enhanced feed conversion efficiency, reduced cholesterol, triglycerides, LDL levels, and increased HDL levels in the blood. Additionally, turmeric positively influenced antibody titers against ND and IBD, and increased the weight of breast, thigh, and liver in broilers. These findings suggest that turmeric can be an effective and beneficial feed additive for improving the overall health and growth of broiler chickens. However, further research is recommended with larger bird population size.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS CONTRIBUTION

Sehrish, an M. Phil research student, conducted the experimental work and prepared the first draft of the manuscript. Roheela Yasmeen (RY), as the supervisor, conceived the research idea, finalized the manuscript, and handled the correspondence related to the article.

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