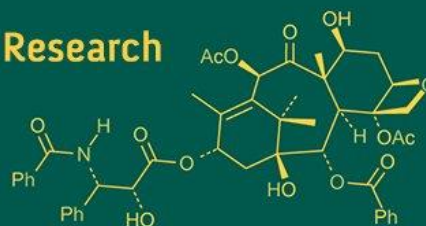


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## Effect of dietary supplementation of Giloy (*Tinospora cordifolia*) powder on growth performance, biochemical profile and antioxidant status in commercial broiler chickens

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### Abstract

**Background:** This study was conducted to evaluate the effect of *Tinospora cordifolia* (Giloy/Guduchi) powder as a dietary supplement on growth performance, biochemical profile and antioxidant status in commercial broiler chickens.

**Methods:** Total 240, day-old broiler chicks of "VenCobb 400" were randomly divided into 4 groups with 6 replicates having 10 birds each viz. (1) negative control (TNC), (2) positive control (TPC; basal diet + 50 mg/kg Bacitracin Methylene Disalicylate), (3) 0.5% (T<sub>0.5</sub>) and (4) 1.0% (T<sub>1.0</sub>) *Tinospora cordifolia* supplemented groups. The experiment lasted for 35 days. Growth parameters were recorded, while biochemical and oxidative stress indices were evaluated at the end of the trial.

**Results:** The findings of this study demonstrated significantly improved growth performance, with the 0.5% *Tinospora cordifolia* group (T<sub>0.5</sub>) achieving the maximum final body weight of 2497.70 g, significantly higher average daily weight gain and superior feed conversion ratio compared to other groups. Biochemical profile indicated significantly reduced serum total cholesterol in T<sub>0.5</sub> and decreased alanine amino transferase (ALT) levels in the supplemented groups. Antioxidant status also improved in the supplemented birds.

**Conclusion:** In conclusion, dietary inclusion of *Tinospora cordifolia*, particularly at 0.5%, enhanced growth performance, efficiency, reduced oxidative stress and exerted beneficial effects on ALT and lipid profile, making it a valuable dietary additive for sustainable poultry production.

**Keywords:** Antioxidant status, growth, broiler chickens, Giloy, *Tinospora*, FCR, growth, biochemical parameter

### Introduction

The poultry sector stands as a fundamental element of the global agricultural economy while serving as a major contributor to food security. Poultry farming practices often involve the use of antibiotics as growth promoters (AGPs) to enhance feed efficiency and growth rates while preventing diseases (Mehdi *et al.*, 2018) [7]. The reckless and excessive application of antibiotics in poultry production has led to numerous critical issues including antimicrobial resistance (AMR) development, poultry product contamination with antibiotic residues, and potential human health risks (Rafiq *et al.*, 2022) [10]. The industry faces an imperative to explore sustainable alternatives to synthetic chemicals because of challenges like disease outbreaks and antimicrobial resistance coupled with consumer demand for residue-free products (Rahman *et al.*, 2004 and Lewis *et al.*, 2003) [11, 6]. The application of natural feed additives emerges as a potential solution to boost animal performance and health while maintaining food safety standards.

The Ayurvedic herb *Tinospora cordifolia*, known by its common name Giloy exhibits a broad spectrum of medicinal uses. This herb is exceptionally rich in potent alkaloids such as berberine, choline and magnoflorine alongside complex glycosides like tinocordiside and various cordifoliosides (Mittal *et al.*, 2014) [8]. Furthermore, its robust pharmacological profile is heavily supported by diterpenoid lactones, including columbin and tinosporon, as well as essential active steroids (Saeed *et al.*, 2020) [14], which collectively facilitate the herb's antioxidant, antimicrobial, and hepatoprotective properties (Sinha *et al.*, 2004) [17].

*Tinospora cordifolia* has been shown to mitigate oxidative stress by neutralizing free radicals, thereby protecting cellular integrity (Mittal *et al.*, 2014) [8] and experimental evidence confirms its ability to enhance humoral immune responses, which are vital for combating infections and improving disease resistance in animals (Thatte *et al.*, 1994) [19]. Giloy showed encouraging results on the growth performance of birds in terms of body weight gain, improved FCR and nutrient metabolizability and it can effectively replace the synthetic growth promoter in broiler ration (Raut *et al.*, 2023) [13].

## Materials and Methods

This study was conducted in the Poultry unit of the Department of Animal Nutrition, College of Veterinary Sciences and A.H. Mhow, Indore (M.P.) following CPCSEA Guidelines for Poultry/Bird rearing. A total of 240, day-old broiler chicks of "VenCobb 400" were randomly distributed into four treatment groups: negative control ( $T_{NC}$ ), positive control ( $T_{PC}$ ), 0.5% Giloy ( $T_{0.5}$ ) and 1% Giloy ( $T_{1.0}$ ). The  $T_{NC}$  group received a corn-soya based basal diet, while  $T_{PC}$  received the basal diet along with antibiotic bacitracin methylene disalicylate (50 mg/kg) of feed. Birds in  $T_{0.5}$  and  $T_{1.0}$  were fed diets containing 0.5% and 1% Giloy powder above basal diet, respectively. Duration of trial was 35 days. The chicks were reared on deep litter system under strict hygienic conditions. The experimental diets were formulated as per BIS (2007) [3] specifications and supplemental ingredient i.e. Giloy powder was added. The experimental diets were analyzed for proximate principles before feeding and its composition given in table 01.

Growth performance parameters-body weight, weight gain, feed intake and feed conversion ratio (FCR) were recorded. Birds were weighed at day 0 and weekly for five weeks using a digital balance before feeding. Weekly weight gain was calculated as the difference between consecutive weeks, and average daily gain (ADG) was obtained by dividing weekly gain by seven. Feed intake per replicate was determined by subtracting leftover feed from feed offered, and per-bird intake was calculated accordingly. FCR was computed as the ratio of average daily feed intake to average daily weight gain. At the end of the trial, 3 mL of blood was collected from one bird per replicate to analyze biochemical parameters, including total protein, albumin, globulin, A:G ratio, cholesterol, triglycerides, blood glucose, AST (aspartate aminotransferase) and ALT (alanine amino transferase), using biochemistry auto analyzer (SB-501, SINDURI BIOTEC pvt. Ltd., Delhi, India) using Erba® kits, following the analytical guidelines as per the kits. Antioxidant parameters (reduced glutathione, superoxide dismutase, and catalase) were measured using Helios double beam spectrophotometer (Prins and Loos, 1969) [9]. Data collected were analyzed using ANOVA under completely randomized block design (Snedecor and Cochran, 1989) [18] and treatment means were compared using Duncan's multiple range test in SPSS (version 22).

## Results and Discussion

**Nutrient composition of experimental diet and Giloy:** Represented in Table 02.

### Growth performance

**Body weight (g):** Giloy powder had a significant effect on the live body weight of broilers, summarized in Table 03.

By the end of the first week, significant early weight improvements emerged in the higher inclusion supplemented groups compared to the unsupplemented control ( $p < 0.05$ ). Throughout the grow-out period (days 21, 28, and 35), the  $T_2$  (0.5% inclusion) group consistently recorded significantly higher body weights than both the negative and positive control birds, ultimately achieving a highly significant maximum final body weight of 2497.70 g at day 35 ( $p < 0.05$ ). Results were consistent with reports from Singh *et al.* (2018) [16] and Sharma *et al.* (2018) [15], who documented improved final body weights in commercial broilers and turkeys fed 0.5% Giloy diets, respectively. Similarly, Joshi *et al.* (2015) [5] observed significant weight increases at 1 g/kg and 2 g/kg inclusion rates. This growth enhancement is attributed to the plant's active bioactive compounds, such as alkaloids, which act as natural growth promoters by physically increasing gut villi height. This morphological improvement creates a much larger intestinal surface area, enhancing nutrient absorption and supporting overall growth (Saeed *et al.*, 2020) [14].

**Body weight gain:** During the weekly gain periods, birds receiving Giloy powder ( $T_{1.0}$ ) showed significantly higher daily body weight gain than the unsupplemented negative control in the early phase (0-7 days) ( $p < 0.05$ ). Later (15-21 days and 29-35 days), the  $T_{0.5}$  supplementation group recorded the highest daily gains, indicating enhanced growth performance ( $p < 0.05$ ). For cumulative average daily body weight gain, from the 0-21 day interval onward, the supplemented and positive control groups noted significant increases compared to the negative control ( $p < 0.05$ ), with the highest overall daily gain recorded over the complete 35-day period in the  $T_{0.5}$  group, as summarized in Table 04. Results align with Singh *et al.* (2018) [16], who demonstrated that adding a 0.5% dose of the herb to commercial broiler diets produces the highest daily body weight gains. Similarly, Sharma *et al.* (2018) [15] found that feeding turkey poults a 0.5% dose significantly increases their daily weight gain. Further, Joshi *et al.* (2015) [5] reported significant improvements in average daily weight gain when adding 1 g/kg and 2 g/kg of Giloy to broiler diets. The improved ADG in treated groups may be attributed to Giloy physically improving the lining of the intestines by making the gut villi taller, creating a larger surface area to absorb nutrients (Joshi *et al.*, 2015) [5]. Additionally, the plant creates a more stable gut environment, allowing the bird to digest its food better (Sharma *et al.*, 2018) [15]. The growth improvement is also due to the plant naturally supporting the bird's immune system, which lowers the amount of energy the bird wastes on fighting off mild infections, allowing it to use that energy directly to build muscle faster each day (Singh *et al.*, 2018) [16].

**Feed consumption (g):** During the initial phases, feed consumption showed no significant variation ( $p > 0.05$ ). However, during the final week (29-35 days), a highly significant difference in feed intake emerged ( $p < 0.05$ ). Feed consumption increased in the supplemented groups, with  $T_{0.5}$  and  $T_{1.0}$  exhibiting significantly higher intakes than the positive control and the negative control, summarized in Table 07. This increased intake during the last phase reflects the elevated nutrient demand driven by the significantly higher body weights achieved by the giloy fed broilers. For the cumulative average daily feed consumption, by the end of the experimental period (0-35 days), no significant differences were observed ( $p > 0.05$ ).

These results match previous studies showing that Giloy supplementation does not significantly alter overall cumulative feed consumption. Joshi *et al.* (2015) [5] reported that adding 1 g/kg and 2 g/kg of Giloy results in overall feed intake levels that remain statistically similar to unsupplemented diets ( $p > 0.05$ ), explaining that the plant's active compounds do not act as direct appetite stimulants but improve internal nutrient extraction. Similarly, Sharma *et al.* (2018) [15] observed no significant differences in overall feed consumption, reporting that the plant maintains high dietary palatability without suppressing the birds' natural appetite. Furthermore, Singh *et al.* (2018) [16] demonstrated that isolated increases in feed consumption during the final finishing phase are a natural biological response to the birds having already built heavier muscle mass, consuming more feed strictly in the last week to meet the higher maintenance energy requirements of their larger bodies.

**Feed conversion ratio:** During the weekly FCR, feed efficiency exhibited a statistically significant improvement with Giloy inclusion ( $T_{0.5}$ ) during the final finishing phase (29-35 days). For cumulative FCR, birds receiving Giloy at 0.5% and 1.0% inclusion levels exhibited significantly better feed efficiency from day 21 through the complete 35-day period compared to the negative control ( $p < 0.05$ ), reflecting maximized nutrient utilization throughout the grow-out period, presented in Table 08.

Results are highly consistent with Raut *et al.* (2023) [13], who identified that an inclusion level around 0.4% is consistently optimal for maximizing feed conversion efficiency. This mirrors the physiological framework established by Jain (2021) [4], who demonstrated that the botanical additive actively reduces competitive gut microbial load and thins the intestinal lining, directly enhancing overall nutrient metabolizability. In contrast, Joshi *et al.* (2015) [5] reported that lower dosages (1 g/kg and 2 g/kg) increased absolute body mass but did not significantly alter overall FCR. The present study resolves this discrepancy by demonstrating that a precise inclusion threshold at 0.5% (5 g/kg) is necessary to fully activate the digestive enzyme secretion and intestinal integrity required to convert standard feed intake into lean muscle mass with maximum efficiency.

**Serum biochemical parameters:** Total cholesterol and hepatic enzyme (SGOT and SGPT) activities were significantly lower in all supplemented groups compared to the negative control, suggesting potent hypolipidemic and hepatoprotective effects of Giloy, respectively ( $p < 0.05$ ). While, there were no significant differences among treatments in total protein, albumin, globulin, albumin:globulin ratio, triglycerides, or blood glucose ( $p > 0.05$ ), indicating that Giloy inclusion modulated lipid and liver markers without adversely affecting normal baseline protein metabolism or systemic homeostasis, represented in Table 10 and Figure 07.

Results corroborate previous work by Saeed *et al.* (2020) [14] and Sharma *et al.* (2018) [15], who similarly reported decreased levels of key liver enzymes (SGOT and SGPT) alongside significantly lower serum total cholesterol levels. Furthermore, the stability of the basal blood protein profile aligns perfectly with the observations of Bhardwaj *et al.* (2012) [2], who reported that Giloy extracts exert a neutral effect on baseline protein metabolism, resulting in

statistically insignificant differences in total protein, serum albumin, serum globulin, and the A:G ratio. Ultimately, the plant's active components actively protect underlying hepatic function, ensuring that the heavy metabolic burden placed on the liver during the birds' rapid growth phase is safely mitigated.

**Oxidative stress indices:** The oxidative stress indices of broilers, specifically Glutathione (GSH) levels and Catalase activity, showed a highly significant improvement in the supplemented birds, peaking in the  $T_{0.5}$  group compared to the unsupplemented control ( $p < 0.05$ ). Furthermore, Superoxide Dismutase (SOD) activity exhibited a statistically significant, progressive increase, reaching a maximum in the highest supplementation group ( $T_{1.0}$ ) ( $p < 0.05$ ). These beneficial shifts indicate that dietary inclusion of Giloy powder significantly enhanced the birds' systemic antioxidant defense mechanism, represented in Table 11.

These findings are similar to the observations of Ambwani *et al.* (2024) [1], who disclosed that the activity of crucial antioxidant enzymes, specifically SOD and Catalase, was significantly influenced by the dietary incorporation of Giloy, recording a progressive increase in these exact markers. Furthermore, Saeed *et al.* (2020) [14] reported that such botanical supplementation effectively boosts total antioxidant capacity, reducing oxidative damage in metabolic tissues. Ultimately, the active phytochemicals within the plant upregulate key protective enzymes to neutralize harmful free radicals and mitigate oxidative stress, protecting underlying cellular function and allowing the broilers to safely sustain their rapid growth and heavy metabolic activities without succumbing to oxidative tissue damage.

**Table 1:** Ingredient composition of experimental broiler diets

| Feed Ingredients                  | Pre-starter<br>(0 - 7 days) | Starter<br>(8 - 21 days) | Finisher<br>(22 - 35 days) |
|-----------------------------------|-----------------------------|--------------------------|----------------------------|
| Maize                             | 55.25                       | 57.30                    | 59.30                      |
| Soybean meal                      | 38.80                       | 35.15                    | 31.50                      |
| Calcite/LSP                       | 0.65                        | 0.67                     | 0.68                       |
| DCP                               | 1.63                        | 1.62                     | 1.65                       |
| Vegetable oil                     | 2.30                        | 3.88                     | 5.58                       |
| DL-Methionine                     | 0.21                        | 0.23                     | 0.22                       |
| L-Lysine                          | 0.27                        | 0.27                     | 0.22                       |
| Soda bicarb                       | 0.10                        | 0.10                     | 0.10                       |
| Salt                              | 0.24                        | 0.22                     | 0.20                       |
| Trace mineral premix <sup>1</sup> | 0.06                        | 0.05                     | 0.05                       |
| Vitamin premix <sup>2</sup>       | 0.06                        | 0.05                     | 0.05                       |
| Threonine                         | 0.07                        | 0.05                     | 0.05                       |
| Maduramicin                       | 0.00                        | 0.00                     | 0.02                       |
| Robimidine                        | 0.03                        | 0.03                     | 0.05                       |
| Choline chloride (60%)            | 0.10                        | 0.10                     | 0.15                       |
| Liver tonic                       | 0.05                        | 0.05                     | 0.05                       |
| Emulsifier                        | 0.05                        | 0.05                     | 0.05                       |
| Toxin binder                      | 0.10                        | 0.10                     | 0.10                       |
| Supplemental ingredient           | +                           | +                        | +                          |
| TOTAL                             | 99.99                       | 99.99                    | 99.99                      |

<sup>1</sup>Trace mineral provided per kg diet: Manganese-120 mg; Zinc, 80 mg; Iron, 25 mg; Copper, 10 mg; Iodine, 1 mg; and Selenium, 0.1 mg.

<sup>2</sup> Vitamin premix provided per kg diet: Vitamin A, 20000 IU; Vitamin D3, 3000 IU; Vitamin E, 10 mg; Vitamin K, 2 mg; Riboflavin, 25 mg; Vitamin B1, 1mg; Vitamin B6, 2 mg; Vitamin B12, 40 mcg; and Niacin, 15 mg.

+ Varying level of Eucalyptus supplement.

**Table 2:** Nutrient composition of experimental diet and Giloy powder (% DM basis)

| Nutrient composition (%) | Giloy | Pre-starter (0-7 days) | Starter (8-21 days) | Finisher (22-35 days) |
|--------------------------|-------|------------------------|---------------------|-----------------------|
| Moisture                 | 8.20  | 10.85                  | 10.64               | 9.41                  |
| Crude protein            | 7.86  | 22.97                  | 21.92               | 20.09                 |
| Crude fibre              | 19.9  | 3.62                   | 3.92                | 3.73                  |
| Ether extract            | 1.51  | 5.78                   | 6.29                | 6.10                  |
| Total ash                | 7.96  | 4.91                   | 5.88                | 5.12                  |
| Nitrogen free extract    | 26.97 | 62.72                  | 61.99               | 64.96                 |
| Dry matter               | 91.8  | 89.15                  | 89.36               | 90.59                 |
| Organic matter           | 92.05 | 95.09                  | 94.12               | 94.88                 |
| Calcium                  | .28   | 0.99                   | 0.98                | 1.04                  |
| Phosphorous              | .58   | 0.95                   | 0.90                | 1.02                  |

**Table 3:** Effect of dietary supplementation of *Tinospora cordifolia* powder on body weight (g) of broilers in different experimental groups

| Age (Days)       | T <sub>NC</sub>      | T <sub>PC</sub>       | T <sub>0.5</sub>      | T <sub>1.0</sub>     | SEM   | p-value |
|------------------|----------------------|-----------------------|-----------------------|----------------------|-------|---------|
| 0 <sup>th</sup>  | 52.42                | 53.28                 | 53.41                 | 52.77                | 1.14  | 0.920   |
| 7 <sup>th</sup>  | 183.80 <sup>a</sup>  | 197.35 <sup>ab</sup>  | 204.40 <sup>b</sup>   | 206.78 <sup>b</sup>  | 5.48  | 0.048   |
| 14 <sup>th</sup> | 478.14               | 507.93                | 505.02                | 523.63               | 13.32 | 0.166   |
| 21 <sup>st</sup> | 891.16 <sup>a</sup>  | 997.57 <sup>b</sup>   | 1011.36 <sup>b</sup>  | 1008.44 <sup>b</sup> | 23.23 | 0.009   |
| 28 <sup>th</sup> | 1452.68 <sup>a</sup> | 1552.25 <sup>ab</sup> | 1592.48 <sup>ab</sup> | 1576.22 <sup>b</sup> | 30.29 | 0.028   |
| 35 <sup>th</sup> | 2148.00 <sup>a</sup> | 2276.84 <sup>b</sup>  | 2497.70 <sup>c</sup>  | 2444.40 <sup>c</sup> | 27.02 | 0.001   |

<sup>abc</sup> Means bearing different superscripts within the rows significantly differ ( $p < 0.05$ ).

**Table 4:** Effect of dietary supplementation of *Tinospora cordifolia* powder on weekly average and cumulative average daily body weight gain (g) of broilers in different experimental groups

| Age (Days)                                | T <sub>NC</sub>    | T <sub>PC</sub>     | T <sub>0.5</sub>    | T <sub>1.0</sub>    | SEM  | p-value |
|-------------------------------------------|--------------------|---------------------|---------------------|---------------------|------|---------|
| Weekly average daily body weight gain     |                    |                     |                     |                     |      |         |
| 0-7 days                                  | 18.77 <sup>a</sup> | 20.58 <sup>ab</sup> | 21.57 <sup>ab</sup> | 22.00 <sup>b</sup>  | 0.71 | 0.031   |
| 8-14 days                                 | 42.05              | 44.37               | 42.95               | 45.27               | 1.48 | 0.452   |
| 15-21 days                                | 59.00 <sup>a</sup> | 69.95 <sup>b</sup>  | 72.33 <sup>b</sup>  | 69.26 <sup>b</sup>  | 2.40 | 0.009   |
| 22-28 days                                | 80.22              | 79.24               | 83.02               | 81.11               | 1.71 | 0.477   |
| 29-35 days                                | 99.33 <sup>a</sup> | 103.51 <sup>a</sup> | 129.32 <sup>b</sup> | 124.03 <sup>b</sup> | 2.79 | <0.001  |
| Cumulative average daily body weight gain |                    |                     |                     |                     |      |         |
| 0-14 days                                 | 30.41              | 32.48               | 32.26               | 33.63               | 0.93 | 0.159   |
| 0-21 days                                 | 39.94 <sup>a</sup> | 44.97 <sup>b</sup>  | 45.62 <sup>b</sup>  | 45.51 <sup>b</sup>  | 1.08 | 0.008   |
| 0-28 days                                 | 50.01 <sup>a</sup> | 53.53 <sup>ab</sup> | 54.96 <sup>b</sup>  | 54.41 <sup>ab</sup> | 1.06 | 0.026   |
| 0-35 days                                 | 59.88 <sup>a</sup> | 63.53 <sup>b</sup>  | 69.84 <sup>c</sup>  | 68.33 <sup>c</sup>  | 0.75 | <0.001  |

<sup>abc</sup> Means bearing different superscripts within the rows significantly differ ( $p < 0.05$ ).

**Table 5:** Effect of dietary supplementation of *Tinospora cordifolia* powder on average daily feed intake (g) of broilers in different experimental groups

| Age (Days)                                | T <sub>NC</sub>     | T <sub>PC</sub>     | T <sub>0.5</sub>    | T <sub>1.0</sub>    | SEM  | p-value |
|-------------------------------------------|---------------------|---------------------|---------------------|---------------------|------|---------|
| Weekly average daily feed consumption     |                     |                     |                     |                     |      |         |
| 0-7 days                                  | 22.27               | 22.25               | 22.08               | 22.54               | 0.58 | 0.953   |
| 8-14 days                                 | 62.72               | 60.59               | 60.13               | 60.04               | 1.67 | 0.647   |
| 15-21 days                                | 101.91              | 96.15               | 94.35               | 97.86               | 1.89 | 0.078   |
| 22-28 days                                | 124.3               | 122.88              | 124.92              | 120.67              | 2.89 | 0.739   |
| 29-35 days                                | 170.75 <sup>a</sup> | 180.95 <sup>a</sup> | 198.40 <sup>b</sup> | 197.67 <sup>b</sup> | 3.28 | <0.001  |
| Cumulative average daily feed consumption |                     |                     |                     |                     |      |         |
| 0-14 days                                 | 42.5                | 41.43               | 41.11               | 41.29               | 0.91 | 0.704   |
| 0-21 days                                 | 62.3                | 59.66               | 58.86               | 60.15               | 0.97 | 0.13    |
| 0-28 days                                 | 77.8                | 75.47               | 75.37               | 75.28               | 1.28 | 0.469   |
| 0-35 days                                 | 96.39               | 96.56               | 99.97               | 99.75               | 1.5  | 0.217   |

<sup>ab</sup> Means bearing different superscripts within the rows significantly differ ( $p < 0.05$ ).

**Table 6:** Effect of dietary supplementation of *Tinospora cordifolia* powder on Feed Conversion Ratio (FCR) of broilers in different experimental groups.

| Age (Days)     | T <sub>NC</sub>    | T <sub>PC</sub>    | T <sub>0.5</sub>  | T <sub>1.0</sub>   | SEM  | p-value |
|----------------|--------------------|--------------------|-------------------|--------------------|------|---------|
| Weekly FCR     |                    |                    |                   |                    |      |         |
| 0-7 days       | 1.20               | 1.07               | 1.04              | 1.02               | 0.05 | 0.133   |
| 15-21 days     | 1.54               | 1.38               | 1.31              | 1.42               | 0.06 | 0.105   |
| 22-28 days     | 1.55               | 1.55               | 1.5               | 1.49               | 0.04 | 0.606   |
| 29-35 days     | 1.72 <sup>ab</sup> | 1.76 <sup>b</sup>  | 1.54 <sup>a</sup> | 1.59 <sup>ab</sup> | 0.05 | 0.017   |
| Cumulative FCR |                    |                    |                   |                    |      |         |
| 0-14 days      | 1.40               | 1.28               | 1.28              | 1.24               | 0.05 | 0.133   |
| 0-21 days      | 1.47 <sup>b</sup>  | 1.33 <sup>a</sup>  | 1.29 <sup>a</sup> | 1.32 <sup>a</sup>  | 0.04 | 0.031   |
| 0-28 days      | 1.50               | 1.41               | 1.37              | 1.39               | 0.03 | 0.085   |
| 0-35 days      | 1.57 <sup>b</sup>  | 1.52 <sup>ab</sup> | 1.43 <sup>a</sup> | 1.46 <sup>a</sup>  | 0.03 | 0.011   |

<sup>ab</sup> Means bearing different superscripts within the rows significantly differ ( $p < 0.05$ ).

**Table 7:** Effect of dietary supplementation of *Tinospora cordifolia* powder on serum biochemical parameters and oxidative stress indices of broilers

| Parameter                                                | T <sub>NC</sub> (Control) | T <sub>PC</sub>     | T <sub>0.5</sub>     | T <sub>1.0</sub>    | SEM   | p-value |
|----------------------------------------------------------|---------------------------|---------------------|----------------------|---------------------|-------|---------|
| Protein (g/dL)                                           | 3.64                      | 3.74                | 3.98                 | 3.84                | 0.219 | 0.72    |
| Albumin (g/dL)                                           | 1.41                      | 1.56                | 1.54                 | 1.55                | 0.139 | 0.85    |
| Globulin (g/dL)                                          | 2.23                      | 2.17                | 2.44                 | 2.29                | 0.08  | 0.15    |
| AG Ratio                                                 | 0.63                      | 0.72                | 0.63                 | 0.68                | 0.038 | 0.32    |
| Cholesterol (mg/dL)                                      | 127.27 <sup>b</sup>       | 108.59 <sup>a</sup> | 109.71 <sup>a</sup>  | 111.48 <sup>a</sup> | 3.99  | 0.02*   |
| Triglycerides (mg/dL)                                    | 110.48                    | 85.72               | 87.87                | 88.39               | 10.21 | 0.32    |
| Glucose (mg/dL)                                          | 210.24                    | 208.6               | 195.88               | 197.5               | 6.5   | 0.32    |
| SGOT (U/L)                                               | 210.1 <sup>b</sup>        | 203.5 <sup>ab</sup> | 193.0 <sup>a</sup>   | 190.5 <sup>a</sup>  | 4.172 | 0.02*   |
| SGPT (U/L)                                               | 8.35 <sup>b</sup>         | 7.55 <sup>ab</sup>  | 6.80 <sup>a</sup>    | 6.15 <sup>a</sup>   | 0.463 | 0.03*   |
| GSH (mg/g Hb)                                            | 0.038 <sup>a</sup>        | 0.043 <sup>ab</sup> | 0.055 <sup>c</sup>   | 0.052 <sup>bc</sup> | 0.00  | 0.001   |
| SOD (Activity units/mg Hb)                               | 151.25 <sup>a</sup>       | 155.6 <sup>ab</sup> | 157.15 <sup>ab</sup> | 159.3 <sup>b</sup>  | 1.48  | 0.01    |
| Catalase (mmol H <sub>2</sub> O <sub>2</sub> /min/mg Hb) | 2.12 <sup>a</sup>         | 2.18 <sup>a</sup>   | 2.78 <sup>b</sup>    | 2.60 <sup>b</sup>   | 0.10  | 0.001   |

<sup>abc</sup> Means bearing different superscripts within the rows significantly differ ( $p < 0.05$ ).

## Conclusion

It was concluded that the inclusion of 0.5% *Tinospora cordifolia* (Giloy) powder in the broiler's diet significantly improved final body weight, average daily weight gain, feed conversion efficiency when compared with both the control and antibiotic-supplemented groups. Furthermore, *Tinospora cordifolia* powder had a positive effect on the reduction of oxidative stress, significantly improved serum total cholesterol and hepatic enzyme (AST and ALT) levels, and exerted a strong hepatoprotective role in the body.

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