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Effect of dietary inclusion of Giloy (*Tinospora cordifolia*) stem powder on growth performance and metabolizability in broilers

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Abstract
A total of 300, one day-old commercial broiler chicks were procured and randomly distributed into 30 subgroups means six dietary treatments with five replicates per treatment and each replicate had ten birds. Feeding trial was conducted for 42 days. The control group (T_1) was offered maize- soybean meal based diet which was formulated as per BIS (2007) to fulfill the metabolizable energy (ME) and crude protein requirements of broilers. The first group was kept as a control (T_1) and given the basal diet without antibiotic while in second group (T_2) basal diet with antibiotic, third (T_3), fourth (T_4), fifth (T_5) and sixth (T_6) groups were supplemented with giloy powder @ 0.25, 0.50, 0.75 and 1%, respectively in the diet. Feed intake (g/bird), body weight gain (g/b) and FCR showed significant (P<0.05) improvement as the level of giloy powder was increased. Dietary supplementation at the rate of 0.50 %, 0.75% and 1% giloy powder resulted in significantly (P<0.05) higher DM metabolizability, nitrogen metabolizability and gross energy metabolizability as compared to control group and antibiotic group.

Keywords: Broiler, Giloy powder, FCR, metabolizability

Introduction
Indian poultry industry has made a tremendous and remarkable progress from a small scale backyard to the status of commercial, full-fledged, self-sufficient agro based industry [21]. Feed additives are one of the important tools used for improving the feed conversion ratio (FCR), growth rate, disease resistant due to immunity. Feed additives are the non- nutrient substance which accelerates growth, efficiency of feed utilization, beneficial for health or metabolism of the animals [8]. The feed additives that hold great promise in the feeding of poultry comprises of antibiotics, anti-oxidants, coccidiostates, enzymes, hormones, probiotics, organic acid, mould inhibitor, herbals products etc. Antibiotics as antimicrobial growth promoters have been widely used in poultry feed industry. Longer use of antibiotics has resulted into negative effect such as residue in tissue, longer withdrawn period and development of resistance in micro-organism [6]. The use of various herbs as dietary additives may positively affect poultry health and productivity [2]. Herbal feed additives showing immunomodulatory activity have been used instead of drugs because of their low toxicity for the host system, adequate absorption and capability to reach the target organ without much degradation by host enzymes [3]. The possible mechanisms of action of herb in the animal for growth promotion include changes in the intestinal microbiota, increased digestibility and nutrient absorption; enhanced nitrogen absorption, improvement of the immune response, morphological and histological modifications of the gastrointestinal tract and antioxidant activity. Herbs can influence selectively the microorganisms by an anti-microbial activity or by a favourable stimulation of the eubiosis of the microflora. Furthermore, these herbal feed additives have no side effects on the health of birds and increase the performance of broiler by increasing live weight gain, feed conversion ratio [19] and immunity [15].

Tinospora cordifolia is an herbaceous shrub belongs to family Menispermaceae commonly known, as "Amrita" or "Guduchi" or "heart moon leaved" is an important drug and is well known for its medicinal properties in Indian medicinal system. Though every part of the plant has therapeutic value, the stem is the most frequently used part of the medicinal preparations [16]. The whole plant possesses diverse health benefits and has been used as traditional medicine against various human ailments since the distant past [4]. They belongs to different

classes such as alkaloids, diterpenoid lactones, glycosides, sesquiterpenoid, aliphatic compounds, phenolics, polysaccharides (1,4 α–D Glucan), steroids like tinosporine, tinosporide, tinosporaside, cordifolide, cordifol, heptacosanol, diterpenoid furanolactone tinosporidine, columbin and β-sitosterol. Leaves of the plant are rich in protein (11.2%) and are fairly rich in calcium and phosphorus. T. cordifolia contains high fibre (15.9%), sufficient protein (4.5%-11.2%), carbohydrate (61.66%), and low fat (3.1%). Its nutritive value is 292.54 calories per 100 g. It has high potassium (0.845%), high chromium (0.006%), sufficient iron (0.28%) and calcium (0.131%), important in various regulatory functions [17].

The aqueous extract of guduchi stem has shown the presence of arabinogalactan that showed immunomodulator activity [7].The immunomodulatory, antimicrobial, antioxidant, antineoplastic, hypoglycemic, antipyretic, hepatoprotective, diuretic, anti-stress, antihyperglycemic, antidiabetic and anti tuberculotic properties of this plant have also been reported [24].

Materials and Methods

The animal experiment was conducted in accordance with guidelines approved by the Institutional Animal Ethics Committee (IAEC), 235/CPCSEA dated 1-8-2000 in the Department of Animal Nutrition, LUVAS. Three hundred, one day old broiler chicks, were purchased from a local commercial hatchery. The chicks were individually weighed, wing banded and randomly distributed into 30 subgroups means six dietary treatments with five replicates per treatment and each replicate had ten birds. Basal ration was formulated as per BIS (2007) [5] to fulfill the metabolizable energy (ME) and crude protein requirements of birds. Ingredient compositions of experimental diets during different phases of growth are presented in Table 1. The first group was kept as a control (T_1) and given the basal diet without antibiotic while second (T_2) basal diet with antibiotic, third (T_3), fourth (T_4), fifth (T_5) and sixth (T_6) groups were supplemented with giloy stem powder @ 0.25, 0.5, 0.75 and 1%, respectively in the diet. Birds were vaccinated against F_1 strain of Ranikhet disease on 3rd day and IBD on 14th day.

The chicks were kept hygienically on floor litter system in separate pens. The chicks were brooded at 35ºC during the first week. The weekly record of the feed offered and residual amount was maintained for each replicate to calculate the feed consumption per bird. The birds were weighed individually at weekly intervals and the body weights were recorded to calculate body weight gain up to 6 weeks of age. Feed Conversion Ratio (FCR) for each replicate was calculated as follows:

FCR=Total feed consumed (g)/Total body weight gain (g).

A metabolism trial was conducted at the end of growth period. One bird from each replicate was randomly selected; preliminary period of three days was given for adaptation to the birds to new system of housing and management, followed by a collection period of three days. A representative sample of excreta from each replication was collected daily in same plastic bottles and bottles were again kept in deep freeze to determine moisture and nitrogen contents. The availability of nutrients for each replicate was calculated by dividing the amount of retained nutrients (ingested nutrients – excreted nutrients) with the amount of ingested nutrients. The gross energy of oven dried feed; weigh back and excreta samples were determined by standard procedure using Bomb Calorimeter.

The data were analyzed using general linear model procedure of statistical package for social sciences 20th version (SPSS) [25] and comparison of means tested using Duncan's multiple range test (DMRT) [9] and significance was considered at $P<0.05$.

Table 1: Ingredient composition of experimental diets during different phases of growth

Ingredient (kg /100 of feed)	0-4 wk	4-6 wk
Maize	58	60
Soybean meal	30	25
Fish meal	7	7
Vegetable oil	3	6
Mineral mixture	2	2
Feed additives (g/100 kg feed)		
Spectromix[1]	10	10
Spectromix BE[2]	20	20
Veldot[3]	50	50
Choline chloride[4]	50	50
Lysine[5]	50	50
DL-methionine[6]	150	150

1. Spectromix: Powder (Ranbaxy Animal Health, New Delhi). Each g. contained VitaminA- 82,500 IU, Vit D3-12000 IU, Vit B2-50 mg and Vit.K-10 mg. Mixing rate: 10 g/100 kg of feed.
2. Spectromix BE: Powder (Ranbaxy Animal Health, New Delhi). Each g contained Vit.B1- 8 mg, Vit.B6- 16 mg, Vit.B12- 80 mg, niacin-120mg, calcium pentothenate-80 mg, Vit. E-160 mg, Lysine hydrochloride-10 mg, DL-methionine-10 mg and calcium 260 mg.Mixing rate: 20g/100 kg of feed.
3. Veldot: Venkeys- Dinitro-O-Toluamide (Coccidiostat).Mixing rate: 50 g/100 kg of feed.
4. Choline chloride: Contain 60 percent choline.Mixing rate: 50 g/100 kg of feed.
5. Lysine: Contained 98% lysine.Mixing rate: 50 g/100 kg of feed.
6. DL-methionine: Contained 98% methionine.Mixing rate: 150 g/100 kg of feed.

Results and Discussions

Average feed intake

The average feed intake of experimental broiler birds during different growth periods under different dietary treatments has been presented in Table 2. During growth period (15-28 d) of experimental period average feed intake of the broiler birds showed a significant difference between the control group and the giloy supplemented group and average feed intake ranged from 1307.1g (T_1) to 1396.9g (T_4). Average feed intake during 29-42days ranged from 1827.3g (T_1) to 2008.1g (T_4). Birds receiving giloy @ 0.25 (T_3), 0.5 (T_4), 0.75 (T_5) and 1% (T_6) consumed significantly ($P<0.05$) more feed 3673g, 3876.9g, 3754.7g, and 3739.1g respectively as compared to the control group Feed intake was highest in 0.5% giloy supplemented group (T_4) and lowest in control group(T_1), followed by 0.25% giloy supplemented group(T_3). Over all feed intake ranged between 3606 (T_1) to 3876.9 (T_4) and lowest feed intake was found in control. The results obtained in experiment corroborate well with the findings of Sarag [20] who observed that the feed supplementation of *Tinospora* at 0.5% resulted in superior feed consumption and feed efficiency compared to other treatments. The feed consumption decrease at higher levels of giloy supplemented group than control group might be due to better utilization of nutrients. The findings of present study are in accordance with those of Singh[22] who reported significant effect of giloy alone and mixture of bael and giloy on average feed intake and observed birds receiving mixture @ 0.5% (G1) and 0.5% (B1G1) consumed more feed (3265.87g, 3405.08 g) than

higher level of giloy@1%(G2) and 1%(B2G2). It might be due to deleterious effects of high level of inclusion of giloy in diet on the palatability of the diet.

Table 2: Average feed intake (g/bird) of broilers during different growth periods under different dietary treatments

Treatment	0-14d	15-28d	29-42d	Total
T_1	473.33 ±3.78	1307.10^{bc} ± 6.98	1827.35^{a} ±8.64	3606.05^{a} ±4.97
T_2	472.42 ±1.65	1273.92^{a} ±3.06	1966.88^{c} ±7.35	3709.68^{c}± 4.68
T_3	470.28 ±1.55	1292.86^{b} ±3.55	1912.78^{b} ±14.82	3673.74^{b} ±11.24
T_4	478.08 ±4.38	1396.98^{d} ±3.01	2008.18^{d} ±10.45	3876.90^{e} ±10.49
T_5	469.03 ±2.03	1358.46^{e} ±2.14	1927.45^{bc} ±16.37	3754.77^{d} ±14.24
T_6	462.30 ±2.33	1324.55^{c} ±2.30	1948.42^{c} ±11.95	3736.10^{d} ±10.87

Means bearing different superscripts in a column differ significantly ($P<0.05$)

Average body weight gain

The data on effect of giloy supplementation on average BW gain are presented in Table 3 and Fig 1. During first two weeks of the experimental period, average BW gain(g/bird) in treatment T_6) (293.7) was significantly($P<0.05$) lower as compared to the control (301.7) During next growth phase of the experimental period (15-28 d) the results depicted a significant difference with respect to average BW gain (g/bird) and it was significantly ($P<0.05$) highest in treatment T_4 (904.5) supplemented with giloy @ 0.5% followed by T_5 (853) and T_6 (811) group as compared to the control (712). During finisher phase of growth (29-42 days of age), BW gain (g/bird) was significantly ($P<0.05$) highest in treatment T_4 (1023.6) as compared to the control group (816.4). Other treatment also exhibited significant difference with control group.

With respect to the whole experimental period the average BW gain (g/bird) in T_4 (2236.5) was significantly ($P<0.05$) higher as compared to control (1831) and other treatment groups. The present observation are also in conformity with the study of Ali *et al.* (1994) in which livol supplement contains *Tinospora cordifolia* as one of ingredient @ 0.25%, 0.50%, 0.75% of broiler diet and reported significant improvement in weight gain and growth rate due to improved appetite, digestion, absorption and anabolic effect of herbal drug. Similar findings were reported by Singh[22] reported increase in body weight when birds were supplemented with giloy (G1) and mixture of giloy and bael (B1G1) containing 0.5% of diet as compare to higher dietary supplementation of giloy(G2)@ 1% in diet and control group.

Findings of present study are in agreement with Joshi [13] in which the higher weekly body weight gains were observed in *Tinospora cordifolia* supplemented groups compared to the control. The positive effect on growth performance of broilers may be attributed to active principles of *Tinospora cordifolia* (tinosporine) which limits the metabolic signs of stress and alleviate the physiological consequences of stress. Phytogenic additives has antibacterial, antioxidant, antistress, gut microflora manipulation, immune enhancement properties and digestive enzymes stimulation could be the probable reasons for the positive effects exerted by them on the growth and health performance of animals [10;11].

Table 3: Average BW gain (g/bird) of broilers during different growth periods under different dietary treatments

Treatment	0-14d	15-28d	29-42d	Total
T_1	301.74^{b} ±1.80	712.86^{a} ±2.64	816.46^{a} ±4.62	1831.06^{a} ±7.48
T_2	303.84^{bc} ±2.92	808.68^{bc} ±3.41	893.02^{b} ±2.29	2005.54^{b} ±5.77
T_3	302.74^{bc} ±1.19	796.28^{b} ±7.89	890.58^{b} ±7.92	1986.60^{b} ±8.36
T_4	308.16^{c} ±1.49	904.54^{d} ±3.67	1023.80^{d} ±3.23	2236.50^{e} ±7.43
T_5	298.78^{ab} ±2.18	853.28^{c} ±2.80	992.85^{c} ±12.54	2144.64^{d} ±10.72
T_6	293.74^{a} ±1.59	811.57^{c} ±3.70	975.78^{c} ±8.38	2081.60^{c} ±5.20

Means bearing different superscripts in a column differ significantly ($P<0.05$)

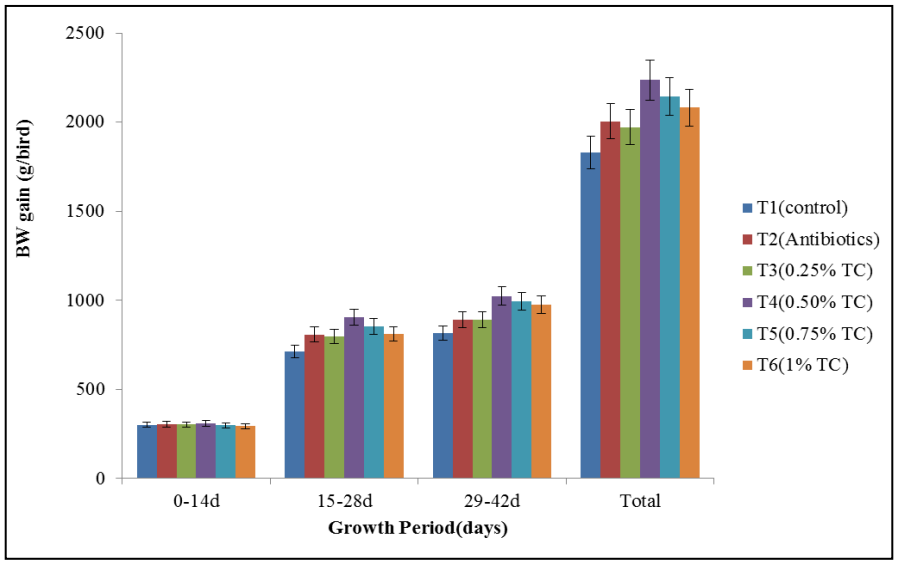

Fig 1: Average BW gain (g/bird) of broilers under different dietary treatments

Feed conversion ratio (FCR)

During first two weeks of growth phase of experimental period the FCR did not showed any significant difference among different groups (Table 4). During next phase of growth period (15-28 d), the FCR of treatment T_1 (1.82) was significantly higher as compared with other treatment groups. During finisher phase of the growth period (29-42 d), FCR of giloy supplemented group T_5 (1.94), T_4 (1.96), T_6 (1.99) were significantly better and lower as compared to the control and antibiotics group. With respect to the whole experimental period, FCR of the treatment group provided with giloy supplementation @ 0.5 % (1.73) was significantly (P<0.05) better and lower as compared to control group T_1 (1.96).

Consistent with results of present study Singh *et al.* (2014) conducted an experiment in which giloy supplementation @ 0.5% (G_1) showed better FCR as compared to control. The results of study in text i.e. increase in FCR with higher level of Giloy also get support from the study of Sarag [20] recorded improvement in FCR with decrease in level of Giloy supplemented in the diet of broilers.

Kulkarni [14] studied the performance of broiler chicks fed diets with or without addition of Giloy (*Tinospora cordifolia*) during the extreme summer season. There was no significant difference in body weight gain during starter phase but during the finisher phase the broilers fed diet with 0.1% stem powder had higher weight gain and FCR. Feed intake was lower and FCR improved on addition of giloy at higher level.

Table 4: Feed conversion ratio of the broilers under different dietary treatments during different growth periods

Treatment	0-14d	15-28d	29-42d	Total
T_1	1.58 ±0.01	1.82^{e} ±0.07	2.23^{c} ±0.01	1.96^{d}± 0.01
T_2	1.55 ±0.02	1.57^{b} ±0.046	2.20^{c} ±0.01	1.85^{c} ±0.01
T_3	1.54 ±0.01	1.62^{d} ±0.01	2.15^{b} ±0.03	1.84^{c} ±0.04
T_4	1.55 ±0.02	1.54^{a} ±0.02	1.96^{a} ±0.01	1.73^{a} ±0.01
T_5	1.57 ±0.04	1.59^{bc} ±0.07	1.94^{a} ±0.02	1.76^{b} ±0.03
T_6	1.57 ±0.01	1.61^{cd} ±0.08	1.99^{a} ±0.01	1.79^{b} ±0.04

Means bearing different superscripts in a column differ significantly (P<0.05)

Nutrient metabolizability

Dry matter, nitrogen and gross energy metabolizability of the experimental birds under different dietary treatments are given in Table 5. Supplementation of giloy powder @ 0.50%, 0.75% and 1% resulted in significantly (P<0.05) higher DM metabolizability among all different dietary treatments. Nitrogen metabolizability was the highest in giloy supplemented group @ 0.5%, 0.75% and 1% and were significantly (P<0.05) better as compared to the treatment groups T_1 (60.96), T_2 (62.54) and T_3 (62.77). Also giloy supplementation @ 0.50 % (66.42) showed non significant difference with 0.75% (66.13) and 1.0% (65.89) resulted in better and higher N metabolizability.

Table 5: Dry matter, Nitrogen and Gross energy Metabolizability of the experimental birds under different dietary treatments

Treatment	DM Metabolizability	N Metabolizability	GE Metabolizability
T_1	62.86^{a} ±0.96	60.96^{a} ±0.16	62.29^{a} ±1.62
T_2	65.15^{b} ±0.53	62.54^{b} ±0.12	65.34^{b} ±1.47
T_3	66.26^{bc} ±0.54	62.77^{b} ±0.11	67.32^{c} ±0.92
T_4	68.00^{c} ±0.43	66.42^{c} ±0.13	69.32^{d} ±1.02
T_5	67.96^{c} ±0.55	66.13^{c} ±0.09	69.17^{d} ±0.62
T_6	67.07^{c} ±0.47	65.89^{c} ±0.12	68.53^{cd} ±0.57

Means bearing different superscripts in a column differ significantly (P<0.05)

Gross energy metabolizability in different dietary treatments ranged between 62.29 % (T_1) to 69.32 % (T_4). Gross energy metabolizability of the treatment group T_4 (69.32) was higher and significantly (P<0.05) better as compared to the treatment group T_1 (62.29) but showed non-significant difference to the treatment group T_5 (69.17), T_6 (68.53). Gross energy metabolizability of antibiotics supplemented group T_2 (65.34) and T_3 (67.32) were higher and significantly better as compared to the control group T_1 (62.29). Phytogenic feed additives improves the gut microflora [18], modify the digestive secretion, morphology [12]. Singh [23] also conducted metabolic trial at the end of experiment to evaluate nutrient utilization parameters. Dry matter, Percent protein, energy were significantly higher in group supplemented with herbal liver tonic product than control.

Conclusion

Based upon above findings, dietary supplementation of giloy was as effective as antibiotic growth promoters. Giloy showed better growth performance of birds in terms of body weight gain, improved FCR and resulted in better nutrient metabolizability. Thus, in the light of these findings, it can be concluded that giloy powder at the dietary level of 0.50% can be effectively replace the antibiotic growth promoter in broiler ration.

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