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Growth Rate and Biochemical Traits of Broiler Chicks as Affected by Commercial Diet Density, Seed Supplementation of *Lagerstroemia speciosa* and *Nigella sativa*

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Authors' contributions

This work was carried out in collaboration among all authors. Author PSS designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author NN did the experimental work, performed the statistical analysis. Author SP managed the analyses of the study, managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation aimed to investigate the effects of dietary seed supplementation on broiler chicks' ability to grow and biochemical properties that are impacted by commercial feed density and seed supplementation of *Lagerstroemia speciosa*. The research was carried out at the Government Arts College in Coimbatore-18, Tamil Nadu, India's Animal House, Department of Zoology, and Postgraduate and Research Department. Secondary metabolites, including steroids, terpenoids, glycosides, and phenolic compounds, are the primary bioactive substances in *L.*

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speciosa seeds, including phytochemical compounds and essential oils. The experimental groups consisted of dried seeds of *L. speciosa* and *N. sativa* added to the organic feed. The experimental animals show that the growth rate of the control group shows 41±3.21d initial weight and a 124±4bc final weight, while the growth rate of group II shows 135±4.04b. Body weight is a little higher than in the control group. Commercial feed is drastic in weight gain, and it shows 489±10.44a in group III. The experimental groups IV and V are active and healthier than the other groups, but the weight is poor in group IV 78±9.29d and 105±7.62bcd are in group V. The *N. sativa* seeds consist of thymoquinone, a bio-compound to reduce the body weight 78±9.29d in Group IV. Table 5 shows the haematological parameters of chicks in each group. The control group has the highest concentration of urea (10.7±0.55a), while group IV has the lowest concentration. The amount of uric acid is lowest in group IV and largest in group V. Cholesterol levels are highest in group II (green leafy vegetables) and lowest in group IV. Triglyceride levels are highest in Group V, while they are lowest in the control group. Group V has the least total protein, whereas the control group has the most. The control group has the highest albumin level, while group II has the lowest level.

Keywords: Broilers; growth rate; immunity; Lagerstroemia speciosa; black seeds; blood profile.

1. INTRODUCTION

Broiler chickens grow quickly and reach maturity in 8-10 weeks, with a tender-meated skin that is soft and pliable [1]. Selective breeding has been used to increase the weight of the breast muscle for better nutrition and production [2]. India is the fifth largest producer of broiler meat in the world with an annual production of 2.47 million [3]. Breeding scientists select chickens with better growth rates, more efficient feed conversions, and stronger immunity to disease [4]. The demand for meat is increasing, so broiler chickens have been intensively bred and selected for high growth rate, increased feed conversion, and meat yield [5]. Organic broiler production has a better economic performance due to the ratio between feed prices and sales price per kg of broiler meat [6]. Consumers are increasingly interested in naturally-produced or environmentally-friendly products that have high nutritional level of nutrition, no contaminants and good flavour [7].

Organic poultry production is becoming increasingly popular in India due to the ill effects of conventional farming, and consumers are willing to pay a premium for certified organic chicken meat [8,9]. The cost of organic broiler production is higher than conventional systems due to the higher prices of organic cereals and soybeans [6]. Chickens exhibit typical behaviours such as foraging, pecking, and scratching, as well as preening and dust-bathing [10]. Their lives are divided into two phases for meat production. In the organic system, slow-growing broilers were placed in an open-sided, naturally ventilated broiler house with two circular hanging feeders, a bell drinker, a tree-tier perch and an outdoor area of 4 m^2 per broiler [6]. Feed intake is an important factor in the performance of broilers in terms of body weight gain, feed efficiency, survivability and meat yield [11,12]. Growth models are used to predict the weight of body parts at any age [13].

The medicinal activities of *Lagerstroemia speciosa* plants are due to their secondary metabolites, such as steroids, terpenoids, glycosides, phenolic compounds, amino acids, saponins, starch, alkaloids, carbohydrates, organic acids, flavonoids, reducing sugars, tannins and many other active metabolites. Black seeds have great nutritional potential, comprising 35.5% fat and 21 percent protein, and containing the crucial fatty acid linoleic acid. A research study was carried out to evaluate the impact of varying levels of black seed added to feed on the general performance, immunity, and economics of broiler chicks. Green leafy vegetables are rich in vitamins, minerals, protein, and energy [14]. *Nigella sativa* seeds have been shown to have positive effects on broiler chicks' performance, including body weight gain and conversion ratio, as well as dressing weight percentage [15,16]. A feeding trial will be conducted in commercial broiler chicken for six weeks to assess the performance of birds fed diets with different levels of black cumin seeds, replacing an antibiotic growth promoter.

2. MATERIALS AND METHODS

2.1 Plant Collection and Authentication

The whole plant of *Lagerstroemia speciosa* was collected at the PG Girls Hostel, Government

Arts College, Coimbatore-18. The seeds were used as narcotics. The identification of the plant was authenticated by the Botanical Survey of India, Coimbatore. (NO: BSI/SRC/5/23/2020/ Tech/50).

2.2 Cleaning and Processing of Seeds

There were two types of experimental samples taken. The first sample is *Lagerstroemia speciosa* seeds the second one is *Nigella sativa* seeds. The one is to clean the outer layer and then dried in the shadow of the sun. The second one is too cheap. Ayurveda store Ganesan Naatu Marundhu Kadai, Pollachi. Both the seeds were taken 100 grams and coarsely ground. The ground seeds were kept in a separate, airtight container.

2.3 Phytochemical Analysis

The preliminary phytochemical investigation of *L. speciosa* seed showed that they contained steroids, terpenoids, glycosides, phenolic compounds, amino acids, saponins, starch, alkaloids, carbohydrates, organic acids, flavonoids, reducing sugars, and tannins. The *N. sativa* seeds contain steroids, tannins, terpenoids, flavonoids, anthocyanins, leucoanthocyanin, cardiac glycosides, saponins, and diterpenes.

2.4 Feed Preparation

The coarsely ground seeds were divided into 100 grams each. The experimentally prepared feed was mixed with certified organic poultry feed. The remaining groups were fed with green, leafy vegetables, and commercially available feed. The experimental groups, consisting of dried seeds of *L. speciosa* and *N. sativa* added to the organic feed as a roughage source. Broiler starter and grower diets were given to the fast-growing broilers between 0 and 21 and 22 and 42 days. The contribution of vegetation and proteins obtained at range in the diet of poultry are currently undervalued and should receive more recognition in organic standards and in ration formulation for poultry (Table 2). The feeds were obtained from a feed factory as declared according to National Research Council 1994 recommendations [17].

2.5 Experimental Animal

The Cornish crosses broiler chicks commonly known as Cornish-game miniature broilers, are small and light-bodied [18]. It has white feathers and yellow skin colour and white or cream-coloured ears. The young chicks were placed in the brooder. The temperature must be 95^{o} F, and it must be dropped by 5^{o} F every following week. Proper feed at the proper ratio must be given to chicks, and clean water must be available every time in the brooder.

2.6 Acute Toxicity Study

Chicks were fed with 0.1g of seed extract water each day to observe the activity of the chicks to test the toxicity of experimental samples. There is no mortality that occurs in a week. The toxicological study was done for 7 days to find out the mortality rate, if any. It was found to be safe, so the experiment was continued.

2.7 Experimental Birds and Management

The chicks were aged from 2 to 4 weeks. Broiler chicks were used for the experiment. They were randomly assigned to the five experimental diets in a completely randomised design (CRD) with five (05) birds per replicate, given a total number of 25 birds per treatment diet. G1 normal diet served as a control, and G2 fed green leafy vegetables. And commercially available feed in G3, G4, and G5 served as coarse powder for experimental plant seeds, *L. speciosa*, and *N. sativa*. The regular feed and water were given ad libitum and to avoid vaccinations in all the experimental groups.

Group I - Control group
Group II - GLV (4.0gm/100gm BW/Green leafy vegetables)
Group III - CAF (4.0gm/100gm BW/Commercially available feed)
Group IV - SNS (4.0gm/100gm BW/Seeds of *Nigella sativa*)
Group V - SLS (4.0gm/100gm BW/Seeds of *Lagerstroemia speciosa*)

2.8 Experiments Diets

In chicks having an age of 2 - 4 weeks, the protein level must be 10–20% protein. The higher level of protein helps increase the growth of chicks. For growers, the protein level must be 15–16% in their diet, and for layers, the protein level must be 18% in their diet. 10% of the carbohydrate is allowed for the total diet.

2.9 Analysis of Growth Promoter

Activity, Body weight gain, amount of feed intake, feed conversion ratio, survivability, and meat

yield parameters were recorded for each replication. The chicks were weighed. Individually at the beginning of the experimental period and thereafter weekly to calculate BW gain. Replicate-wise feed intake was also recorded at weekly intervals and FCR (feed intake / weight gain) and performance index [19] of broilers during different periods of growth were calculated. Body growth is determined by the deposition of protein, fat, and water and ash in the body [20]. With the exception of the diet, all of the birds were raised for six weeks in a litter system. Using the same management techniques. Each set of five chicks was divided up. We recorded the chicks' initial weight. In addition to 2 grams each of *N. sativa* and *L. speciosa* seed powder, they were given 20 grams of formulated feed. Measurements were made of the birds' food consumption, including leftovers, and their water intake. At five-day intervals along the track, the weight of each bird was measured. Prior to blood being collected for biochemical analysis, each bird's final weight was weighed and recorded.

2.10 Analysis of the Biochemical Traits

About 5 ml of blood samples were collected for the analysis. The blood samples were taken from the wing vein of the bird using a disposable needle and syringe. For haematological analysis, about 2 ml used for analysis were stored in a bottle containing an anticoagulant, ethylene di amine tetra acetic acid (EDTA) to prevent clotting, and subsequently analysed to determine the following: parameters: urea, total protein, albumin, uric acid, creatinine, cholesterol, and triglycerides.

2.11 Feed Convention Rate

The following parameters were collected on feed intake (g) by feed given to both organic groups, and control groups were weighed out daily. Before serving, and the remnants in the Feeders were then removed and kept separately. The total feed given and total leftovers were calculated at the end of each week. Feed consumption for each day was obtained by the difference between the total feed given and leftovers on each day. Average feed consumption per bird per replicate for the day was calculated by dividing the total weight of feed. Consumed by the number of birds in each replicate Body weight (gm). Birds in each replicate were weighed on arrival and subsequently weighed at the end of each week for the duration of the experiment. The average body weight per week was obtained from each replicate by dividing the total body weight in each replicate. By the total number of birds in the replicate. Body weight gain (gm) was calculated from the difference between the body weight for the given week and that of the previous week. Feed conversion ratio (f/g) as determined by the data obtained on average feed intake and body weight gains were to evaluate feed conversion efficiency using the expression.

$$\text{Feed conversion ratio} = \frac{Average\ feed\ intake\ per\ week\ (kg)}{Average\ body\ weight\ gain\ per\ week\ (kg)}$$

The feed offered to each room was recorded daily with an automatic weighing machine. At the end of each week, feed residues were weighed, and feed consumption was therefore recorded on a weekly basis and then calculated as feed consumed per day over the periods: hatch-1 week, 2, 3, 4, 5, and 6 weeks. The feed conversion ratios could then be calculated for the time periods: hatch-1 week, 2, 3, 4, 5, and 6 weeks expressed as feed. Conversion ratio: feed consumed/weight gain the mortality rate was determined weekly as a cumulative percentage, all dead birds were removed daily (morning) and weighed. Their feed Consumption was estimated and discounted from the total feed given to the group during that week.

2.12 Statistical Analysis

All the experimental values are expressed as mean ± SEM. Statistical significance by One-way ANOVA followed by Duncan's Multiple Range Test. ***P*=0.05 calculated by comparing treated group with control group. Statistical significance by two way ANOVA followed by Duncan's Multiple Range Test. ***P*=0.05 calculated by comparing treated group with control group.

3. RESULTS

3.1 Result 1 - Phytochemical Analysis

The majority of bioactive compounds in plants are secondary metabolites. The seeds of *L. speciosa* revealed that it contained steroids, terpenoids, glycosides, phenolic compounds, amino acids, saponins, starch, alkaloids, carbohydrates, organic acids, flavonoids, reducing sugars, tannins, and many other active metabolites. Plant secondary metabolites and essential Oils, also known as phytogenic compounds, are biologically active compounds (Table 1).

Table 1. Phytochemical analysis of *Lagerstroemia speciosa* seed and *Nigella sativa* seed

S. No	Phytocompounds	*Lagerstroemia speciosa* seed	*Nigella sativa* seed
1	Steroids	+	+
2	Terpenoids	+	++
3	Glycosides	++	_
4	Phenolic	+	+
5	α-amino acid	+	+
6	Saponins	++	++
7	Starch	+	_
8	Alkaloids	+	+
9	Carbohydrates	+	+
10	Organic acids	+	+
11	Flavonoids	++	++
12	Reducing sugars	+	+
13	Tannins	++	++

"++" indicates the highly presence of active constituents
"+" indicates the presence of active constituents
"-"indicates the absence of active constituents

Table 2. Feed ingredients

Ingredients	Starter feed	Finisher feed
Maize	50.00	50.00
Maize Gluten	7.50	5.20
Deoiled Rice Bran	9.00	10.00
Rice Polish	5.00	9.50
De-Oiled Soya Cake	8.70	5.00
Ground Nut Cake	9.00	7.50
Protolive	7.90	9.90
Constant	2.90	2.90
Total (%)	100	100

Patel, et al., [21]

3.2 Result 2 - Growth Promoter Activities

Table 3 shows the weight of the chicks in each group. The control group shows 41±3.21d initial weight and the 124±4bc final weight the group II shows 135±4.04b. Body weight is a little higher than the control group. Commercial feed is drastic in weight gain and it shows 489±10.44a in group III. The experimental groups IV and V are active and healthier than the other groups, but the weight is poor in group IV 78±9.29d, and 105±7.62bcd are in group V. The above result is shown in the Table 3.

3.3 Result 3 - Feed Intake

The initial rate of feed intake in the control group was 278 ± 3 dcc on day one. The Highest rate of feed intake is 3540 ± 25a in Group III. Group II and Group V show a moderate amount of feed intake of 289 ± 7b and 211 ± 7d, respectively (Table 4).

Table 3. Body weight

Group	Initial weight in grams	Final weight in grams
Control group	41±3.21d	124±4bc
Group II	41±3.61	135±4.04b
Group III	92±6.50cd	489±10.44a
Group IV	52±2.08d	78±9.29d
Group V	48±4.04d	105±7.62bcd
SEd CD (p<0.05)	2.49730±7.77050**	

**Mean ± S.E. Mean in a column followed by a same letter (s) are not significantly (P=0.05) different according to Duncan's Multiple Range Test. ** Significant at P=0.05 respectively; NS – Non Significant*

Table 4. Feed intake

Group	1-10 days	11-20 days	21-30 days	31-40 days
Control	278±3dcc	293±6ca	348±6b	405±4a
Group II	281±6dbc	303±6	281±6bc	289±7b
Group III	604±6a	1450±20	2240±10	3540±25a
Group IV	213±6ed	180±5e	100±5f	40±6g
Group V	483±6b	381±4	361±7	211±7d
SEd CD (p<0.05)	4.38078 ±8.86851**			

**Mean ± SEM. Mean in a column followed by a same letter (s) are not significantly (P=0.05) different according to Duncan's Multiple Range Test. ** Significant at P=0.05 respectively; NS - Non Significant*

Table 5. Haematological parameters

Sample	Urea (mg/dL)	Creatinine (mg/dL)	Uric acid (mg/dL)	Cholesterol (mg/dL)	Triglycerides (mg/dL)	Total Protein (g/dL)	Albumin (g/dL)
Control I	10.7±0.55a	0.2±0.10	1.7±0.55c	170±6.0d	75±4.51b	5.1±0.65a	3.8±0.65a
Group II	2.00±0.50c	0.14±0.04	0.11±0.08d	460±6.0a	1.82±0.60e	2.06±0.40d	2.06±0.35b
Group III	1.40±0.55c	0.11±0.04	2.2±0.60c	173.5±4.5d	58.3±4.90c	3.52±0.65bc	1.64±0.45b
Group IV	1.90±0.55c	0.11±0.04	5.2±0.70b	279±6.0b	47.3±4.00d	3.03±0.60c	1.23±0.70b
Group V	3.00±0.50b	0.19±0.10	13.6±0.55a	260.8±6.5c	266±6.51a	4.51±0.65ab	1.42±0.52b
SEd CD (p<0.05)	0.4336 ±0.9661**	0.0562 ±0.1253 ns	0.4416 ±0.9839**	4.7684 ±10.6246**	3.7073 ±8.2604**	0.6508 ±1.4501**	0.4486 ±0.9995**

**Mean ± S. Mean in a column followed by a same letter (s) are not significantly (P=0.05) different according to Duncan's Multiple Range Test. ** Significant at P=0.05 respectively; NS – Non Significant*

3.4 Result 4 - Haematological Parameters

Table 5 above shows the haematological parameters of chicks in each group. The control group has the highest concentration of urea, while group IV has the lowest concentration. The amount of uric acid is lowest in group IV and largest in group V. Cholesterol levels are highest in group II (green leafy vegetables) and lowest in group IV. Triglyceride levels are highest in Group V, while they are lowest in the control group. Group V has the least total protein, whereas the control group has the most. The control group has the greatest albumin level, while group II has the lowest level. The control group shows the 10.7±0.55a highest amount of urea and the lowest amount of 1.40±0.55c present in group III. The uric acid level is highest in group V, at 13.6±0.55a, and the lowest amount is 5.2±0.70b in group IV. Cholesterol level is 460±6.0a higher in (green leafy vegetable) group II and the lowest amount of 279±6.0b present in group IV. Group V shows the 266±6.51a highest amount of triglycerides, and the control group shows the 75±4.51b least amount. Control group shows the highest amount (5.1±0.65a) of total protein, and group II shows 2.06±0.40d the lowest amount. Albumin level is 3.8±0.65a highest in the control group and group II shows 2.06±0.35b as the lowest amount.

4. DISCUSSION

Broiler poultry are meat-producing machines that consume food quickly and become suitable for slaughter within a short time [22]. *L. speciosa* seeds contain carbohydrates and reducing sugars, while *N. sativa* seeds contain thymoquinone to reduce body weight [23]. The phytochemicals in *L. speciosa* seeds contain carbohydrates and reducing sugars are responsible for the weight gain of Group V, which shows 105±7.62bcd. The medicinal plant seeds consist of active ingredients used in the diet of broiler chicken to completely ignore the commercial feed and reduce the cost of the antibiotic tablets [245]. The *N. sativa* seeds consist of thymoquinone, a bio-compound to reduce the body weight 78±9.29d in Group IV. Souri et al., [25] reported that the addition of medicinal plants to the diet of broiler chickens reduced plasma triglyceride concentrations due to the presence of granuloma, cineole, citral, and borneol compounds. Eliminating antibiotics from the animal diet reflected poorly on growth and feed efficiency. Secondary metabolites act as antibiotics instead of being of animal origin [26].

Bioactive compounds are plant secondary metabolites and essential oils that promote the gut ecosystem and its functions [27]. In *L. speciosa*, the alkaloid is the main secondary metabolite and acts as a thirst-quenching quenching to reduce heat and stress [28]. Adding sugar syrup to the broiler rations significantly decreased blood cholesterol and triglycerides in chickens fed the sugar syrup diet compared to birds fed the control diet [29]. The terpenoid is the highest compound in seeds of *L. speciosa* that prevent disease. The positive effect of the terpenoid compounds used in commercial preparations for poultry is that they disinfect the bronchi, preventing respiratory infections [30-32]. Tannins are contained in several feed ingredients commonly used in broiler diets, such as sorghum and barley [33]. Tannins are produced by green plants in different levels and qualities. In broiler chickens, the inclusion of up to 3% dietary tannins can improve gut health and digestive performance. The experimental plant consists of high amounts of tannins in seeds [34]. This compound supports the body weight of the chicks in Group V. The initial and final feed intakes of chicks were analysed using herbs and phytogenic products. The supplementary diet, consisting of Tannins, flavonoids, Glycosides, and saponins, reduced feed intake by 50% compared to the control group. These compounds have appetite- and digestion-stimulating properties and antimicrobial effects, aiding digestion. The lowest feed intake was 40 ± 6g for Group IV [35,36].

5. CONCLUSION

Plant derivatives are commonly used in animal nutrition and are applied as promoters of growth due to their antioxidant and antimicrobial properties. Antibiotics have been widely used in animal production for decades to treat and improve animal growth rate, health, and feed conversion ratio. Herbal medicines also stimulate the growth of cells, resulting in increased immunity. The Lythraceae family is widely distributed all over the world and contains alkaloids which have a wide range of pharmacological activities. *L. speciosa* plays a vital role in growth and reproduction of the broiler chicks, improving organic farming and motivating farmers to reduce the cost of poultry feed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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