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# Nutgall (*Rhus semialata*) powder as a feed supplement in broiler chicken

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**Abstract**
The present research work entitled "Nutgall (*Rhus semialata* Murr.) Powder as a feed supplement in broiler chicken" was conducted to investigate the effects of different levels of nutgall powder on body weight, body weight gain, feed consumption and feed conversion efficiency, carcass characteristics and mortality, blood profiles and economics of the broiler birds. A total of one hundred and twenty, day-old broilers (Cobb-340Y) were equally assigned to the four-dietary treatment ($T_1$, $T_2$, $T_3$ and $T_4$) groups with five replicates per treatment following Complete Randomized Design. The treatments consisted of basal diet (Control) and basal diet with 3 g, 5 g and 7 g/kg sumac powder. The whole experimental period was for 42 days. Weekly body weight and feed intake was recorded daily. Body weight gain and feed conversion efficiency was calculated accordingly. Blood sample was collected at the end of the experimental period from two birds each treatment to evaluate Haematological and Biochemical blood parameters. On the 42$^{nd}$ day five birds from each treatment were sacrificed to evaluate the carcass characteristics. Statistical analysis indicated that supplementing nutgall powder had no effect on broiler body weight. Feed consumption was observed highest in control group. Body weight gain, Feed conversion efficiency, performance index significantly improved in broilers fed with 7 g of nutgall powder. Similarly, HDL, cholesterol, triglycerides, LDL constituents were influenced in broilers fed with 7 g nutgall powder. The blood constituents of Hb, RBC were observed better in control group whereas PCV and WBC in $T_2$ group (3 g of nutgall powder). The net profit per kg birds was observed in decreasing order with the increased level of nutgall powder supplemented in the broiler diet. No mortality was observed during the entire experimental period. The results suggested that dietary inclusion of 7 g/kg nutgall powder can be used for the dietary supplementation of broiler birds.

**Keywords:** *Rhus semialata*, Nutgall Fruits, Haematology, Biochemical, Carcass, Dressing, Serum lipid

## Introduction
The poultry industry is one of the biggest and fastest growing industries in the whole world and ranked as one of the most important sectors globally. The global poultry production is massive in scale with ten billion of chickens, turkey, ducks, etc. every year for meat and egg production. The important factors such as population growth, income level growth and urbanisation help contribute in the growth of the global poultry meat production and poultry meat consumption. According to FAO (Food and Agriculture Organisation), in the year 2020, total meat production was 40.6% which is 337.3 million tons belongs to the poultry group. In year 2020, the market value of the poultry sector was 310.7 billion dollar and is expected to reach 422.97 billion dollars in the year 2025 with CAGR (Compound Annual Growth Rate) of 7%. In the year 2021, United State stood first at the chicken meat production among all other countries producing about 20.5 MT followed by china with 15 MT, Brazil ranked third with 13.7 MT of meat production. As per the poultry meat consumption status, China positioned first with 20 MT, U.S ranked second with 19 MT and Brazil in third with 12 MT.
Indian poultry industry is one of the vibrant and faster growing segments of the agricultural sector with around 80% growth rate per annum and has undergone a tremendous progress in the overall structure and operations, emerging from a small backyard activity into a fully-fledged agro-based industry over a period of two decades.
While the agricultural sector has been increasing at the rate of 1.5% to 2% per annum, the broiler and eggs has been rising at the rate of 8 to 10% per annum.

Today, India is one of fastest growing countries in world in the field of economic development, having a large and rapidly expanding poultry sector.

India stands in the 3rd position in egg production next to China and USA with 114.38 billion eggs with growth rate of 10.19% (FAO, 2019) [10]. India rank fifth in the broiler production in the world with an annual production of 2.45 MT. Andhra Pradesh is the leading producer both in poultry and egg production followed by West Bengal, Tamil Nadu, Bihar, Kerala and Maharashtra and rank sixth among the chicken meat producing countries in the world. India has made tremendous progress in broiler production during last three decades and produces 3.8 million tonnes of poultry meat from 3000 million broilers per annum in India.

Broiler chicken is one the most popular and profitable livestock business in India which can be grown and marketed within 5-6 weeks of age and required very less investment for any starter. Broiler production is having a great scope for meeting the demands of meat in the state and by virtue of its genetic traits; it is not only suitable for commercial production but also is an important tool for alleviation of poverty, rural livelihood and eradication of malnutrition. The poultry sector of India not only accounts for meat but also generates employment opportunities to a larger section of the population. Today poultry sector of India provide employment opportunities to about 6 million of people either directly or indirectly under the backyard poultry production system or contract farming with the integrated players or under small scale commercial broiler farming units. It is important to note that this sector not only provide employment to skilled and literate population but also to unskilled rural farmers, illiterate labours and women and thereby providing income to the vulnerable groups.

Poultry plays an important role in our day to day human life as it is one of the main sources of daily protein requirement of human population through the meat and egg. And in poultry, broiler is one of the fastest growing meat sources as we can rear them in huge amount in short time. In developing countries like India, the major problem with poultry in the scarcity and economically higher prices of conventional poultry feed, especially the small-scale business are finding themselves in problem due to the high cost of feeds available in the market. However, economic poultry production can be made possible by minimising the use of chemical additives in the poultry feeds and this can be obtained by using effective medicinal plants. Among many medicinal plants, research scientists have found an effective use of sumac and its extracts and noted that it contains a favourable potential as a feed ingredient with anti-fibro genic, anti-fungal, anti-inflammatory, antimicrobial, ant-oxidant and antitumor properties (Janbaz *et al*., 2014) [18]. Also, sumac has been used traditionally as a medicinal plant in humans and also for the preservation of the food (Fazeli *et al*., 2007) [9]. However, the literature on usage of sumac in animal feed is very limited especially with respect to poultry. *Rhus semialata* Murr. (Anacardiaceae) is deciduous trees which are mostly found in the Himalayan ranges at an altitude of 3,000–7,000 ft. In India, these trees are commonly found in the hills of Naga, Khasia, Assam and Sikkim (Gurung, 2002 and Bhattacharjee, 1998) [16, 6]. The upper Burma, China and Japan (Kiritikar and Basu, 1987) [22] are the other countries which are also a home for *R. semialata* Murr. The fruit are edible and has a sharp acidic taste and are rich in tannin, gallic acid, vitamin B and flavonoids. The fruit are commonly known as sumac and its extracts are traditionally used to control diarrhoea and dysentery. Traditionally sumac has been also used for the treatment of gastritis, stomach cancer and arteriosclerosis (Rayne and Mazza, 2007) [32] and for the protection of antiquities (Kurucu *et al*., 1993) [23].

Hence, keeping the above facts in view and considering its promising potential, the present research entitled "Nutgall powder as a feed supplement in Broiler chicken" was conducted to evaluate and study the effect of different levels of nutgall powder on broiler chicken with the following objectives:

1. To study the effect of dietary supplementation of Nutgall powder on body weight and growth rate of broiler chicken.
2. To study feed consumption and feed conversion efficiency of broiler chicken fed with Nutgall powder supplemented feed.
3. To assess the feed of dietary supplementation on carcass traits and mortality of broiler chicken fed with Nutgall powder supplemented feed.
4. To study the effect of dietary supplementation on blood profile of broiler chicken fed with Nutgall powder supplemented feed.
5. To assess the economics of production of broiler chicken fed with supplementation of Nutgall powder.

## Materials and Methods

### Experimental birds and treatment

A total of one hundred and twenty, day old broiler chicks of Cobb 340Y strain were obtained from an organised single hatchery named SK Poultry Shop, Dimapur, Nagaland. The chicks were vaccinated against Marek's disease at the hatchery itself. A total of thirty birds were weighed together at the time of arrival and randomly assigned to one of the dietary treatment group as $T_1$, $T_2$, $T_3$, and $T_4$. Each treatment was divided into five replications comprising of six birds per replications by using Completely Randomized Design. The day-old chicks were reared for 21 days in the brooder house under deep litter system and for the rest 21 days in finisher house in cages. The chicks were fed with standard broiler starter from 0- 3 weeks of age followed by standard broiler finisher from 4-6 weeks of age. $T_1$ served as control was provided with basal diet. The chicks in the other treatment groups were also provided with the same basal diet as in $T_1$ but supplemented with Nutgall powder at the rate of 3g, 5g, and 7g per kg of feed.

### Body weight and body weight gain

The initial body weights of the chicks per treatment were recorded on the day of arrival. Thereafter, the average body weights of the chicks were recorded on weekly basis in the morning hours prior to the feeding time. A digital weighing machine having a maximum weighing capacity of 10 kg was used throughout the experimental period for the weighing of chicks. During the first three weeks, the chicks were weighed in a group and recorded. This was done by placing 10 chicks each in pre-weighed cartoon box. After completion of 3 weeks the birds were weighed individually at weekly intervals till they attained six weeks of age.

### Feed consumption and Feed Conversion Efficiency

Feed and Water was provided *ad libitum* to all the experimental birds throughout the experimental period. The amount of feed supplied to the birds was recorded daily. The feed residue if any, from the previous day was also recorded prior to the feeding to calculate the amount of feed consumed

by the birds per day. The feed residues were subtracted from the total amount of feed supplied the previous day to get the exact quantity of feed consumed by the birds per day. From these data, the average and weekly feed consumption was calculated for each bird in each group and expressed in grams. The feed conversion efficiency (FCE) of the different experimental groups was calculated by using the following formula:

$$\text{Feed Conversion Efficiency (FCE)} = \frac{\text{Quantity of feed consumed (g)}}{\text{Total body weight gain (g)}}$$

**Carcass Characteristics and Mortality**

At the end of the experiment, five birds were selected and sacrifice from each treatment i.e. a total of 20 birds were sacrificed from four different treatments to evaluate the dressing percentage, carcass yield and organ weight. Live weights of the individual birds were recorded before sacrificing. Sacrificing was done by using Kosher Method. The dressed weight of the birds was obtained after complete bleeding and removal of feathers. Heart, liver, gizzard and spleen were also weighed individually and average of each of the organ was recorded for the four respective treatments. The percentage of the dressed weight was calculated by using the following formula:

$$\text{Dressing (\%)} = \frac{\text{Dressed weight (g)}}{\text{Live weight (g)}} \text{x } 100$$

Mortality of the birds was recorded on daily basis throughout the experimental periods and was expressed in percentage. Mortality was calculated by using the following formula:

$$\text{Mortality (\%)} = \frac{\textbf{Total no.of birds died}}{\textbf{Total no.of live birds}} \text{ x } 100$$

Livability percentage was calculated by subtracting the mortality percentage from 100.

Performance Index (PI) was calculated by using following formula of Bird (1995):

$$\text{PI} = \frac{\textbf{Average body weight (g)} \times \textbf{\% livability}}{\textbf{Cumulative FCE} \times \textbf{No.of days}} \div 10$$

**Blood Profile**

At the end of the experimental period, two birds from each treatment from any five replications were randomly selected for the collection of the blood sample. The blood was collected from the brachial vein of the wing of the birds by rubbing and sterilizing an area with a disinfectant and a cotton ball. A total of 2 ml blood sample was collected from each bird by using 2 ml sterilized needle into well labeled sterilized tubes. The blood sample collected was used for the analysis of various blood parameters such as Haematological and Bio-chemicals. Haematological includes Red Blood Cell (RBC), White Blood Cell (WBC), Packed Cell Volume (PCV) and Haemoglobin (Hb) and Bio-chemicals include High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), Cholesterol and Triglycerides. For the collection of blood sample for haematology test, the Purple tube containing EDTA (ethylene di-amine tetra acetic) which act as a potent anticoagulant were used. And for Bio-chemical test, the Red tube containing silica particles which act as clot activator were used.

## Results and Discussion

**Body weight**

The highest body weight was found in $T_4$ group followed by $T_3$, $T_2$ and $T_1$ groups. The average body weight was found statistically non-significant among the different treatment groups under prevailing agro-climatic condition ($p$>0.05).

**Gain in Body weight**

Statistically, significant different was observed in body weight gain among different treatment groups fed with different level of nutgall powder ($p$<0.05). This observation was similar to that of Lee *et al*. (2003) [24]; Kheiri *et al.* (2015) [21]; Valiollahi *et al*. (2014) [40] who concluded significant in body weight gain due to the supplementation of sumac.

**Feed Consumption**

The result of present study was corroborated with the findings of Ghasemi *et al.* (2014) [11] and Alloui *et al.* (2014) [2] who had also observed significant effects of sumac powder supplementation on the feed intake of the broiler birds.

**Feed conversion efficiency**

The statistical analysis shows significant difference between $T_1$ and $T_4$ groups at ($p$<0.05) supplemented with nutgall powder in the broiler diet. These findings were similar to those of Mansoob (2011) [25] and Toghyani and Nahal (2017) [39] who had also observed significant difference among different treatment groups supplemented with sumac.

**Carcass Characteristics**

Non-significant difference was observed in carcass weight and dressing percentage. However, significant differences were found between $T_1$ and $T_3$, $T_3$ and $T_4$ groups of weight of the liver. Significant difference was also recorded among different treatment groups in weight of the spleen and heart. Similarly, significant difference in gizzard weight was found between $T_1$ and $T_4$, $T_3$ and $T_4$ group respectively. These may be due to the positive influence of nutgall powder that had led to gain in organ weight of the broiler birds. These findings were similar to Mazloom (2011) [28] and Ghasemi *et al.* (2014) [11] who had observed increase in carcass trait when sumac powder was supplemented in the diet of the broiler.

**Mortality/ liveability and Performance index**

The mortality percentage from day old to six weeks of age of all the treatment groups was observed as zero. And the livabilty percentage was recorded as 100 per cent in all treatment groups. $T_4$ was observed highest in performance index followed by $T_3$, $T_1$ and $T_2$ group.

**Blood profile**

**Haematological characteristics**

In the above table, a significant difference in WBC was observed between $T_1$ and $T_2$, $T_2$ and $T_3$, $T_2$ and $T_4$ groups. Significant differences in RBC were found between the different treatment groups such as $T_1$ and $T_3$, $T_2$ and $T_3$, $T_4$ and $T_3$. Similarly, significant difference in Hb was observed between different treatment group's *viz*. $T_1$ and $T_2$, $T_1$ and $T_3$, $T_1$ and $T_4$. Likewise, significant effect of nutgall powder supplemented feed was found between $T_1$ and $T_3$, $T_2$ and $T_3$ groups. The results evidence that the addition of nutgall in broiler feeds have significant effects on the haematological parameters. However, these findings were opposite to that of Maxwell and Robertson (1998) [27] who had reported that sumac had no effect on some haematological parameters such as lymphocytes.

**Table 1:** Effect of different dietary supplementation of Nutgall powder on the haematological characteristics of broiler chicken.

| Treatments | Haematological characteristics | | | |
|---|---|---|---|---|
| | WBC (cumm) | RBC (µl) | Hb (gm/dl) | PCV (%) |
| ($T_1$) | 197.10$^{b}$ | 14.45$^{a}$ | 3.76$^{a}$ | 29.95$^{a}$ |
| ($T_2$) | 216.25$^{a}$ | 13.80$^{a}$ | 2.42$^{b}$ | 30.15$^{a}$ |
| ($T_3$) | 195.00$^{b}$ | 12.35$^{b}$ | 2.22$^{b}$ | 27.25$^{b}$ |
| ($T_4$) | 203.25$^{b}$ | 13.45$^{a}$ | 2.27$^{b}$ | 28.20$^{ab}$ |
| SEm± | 4.02 | 0.37 | 0.12 | 0.64 |
| CD (P=0.05) | 12.06 | 1.10 | 0.35 | 1.91 |

$^{a,b}$ signifies different superscripts in a column differ significantly ($p$<0.05).

**Biochemical characteristics**

The above table states that serum cholesterol was significantly affected by dietary treatments and it tended to be lower in broiler fed with different level of nutgall powder. Similarly, serum triglycerides showed significant difference among all the treatment and is tended to be lower in broiler fed with different levels of nutgall powder. Valiollahi *et al.*, (2014) [40] reported the lower serum concentration of triglyceride and cholesterol in broilers fed sumac powder. The significant difference in High Density Lipoprotein was reported between $T_1$ and $T_3$, $T_3$ and $T_4$ group respectively. Statistically, significance difference in Low density lipoprotein was observed between $T_1$ and $T_2$, $T_3$ and $T_4$ groups reporting the positive effect of nutgall powder supplemented dietary feed. These findings were similar to that of Mazloom (2011) [28] who had also reported that biochemical parameters was enhanced on birds fed with sumac powder based diet and Kheiri *et al.* (2015) [21] who had reported that LDL level were decreased and HDL level were increased in birds fed with different level sumac powder.

**Table 2:** Effect of different dietary supplementation of Nutgall powder on the biochemical characteristics of broiler chicken.

| Treatments | Biochemical characteristics | | | |
|---|---|---|---|---|
| | Total cholesterol (mg/dl) | HDL (mg/dl) | LDL (mg/dl) | Triglycerides (mg/dl) |
| ($T_1$) | 130.16$^{a}$ | 34.05$^{a}$ | 75.20$^{a}$ | 104.36$^{a}$ |
| ($T_2$) | 123.81$^{b}$ | 33.35$^{ab}$ | 69.78$^{bc}$ | 104.60$^{a}$ |
| ($T_3$) | 124.19$^{b}$ | 31.30$^{b}$ | 73.96$^{ab}$ | 98.16$^{ab}$ |
| ($T_4$) | 122.41$^{b}$ | 34.50$^{a}$ | 68.54$^{c}$ | 96.87$^{b}$ |
| SEm± | 1.67 | 0.79 | 1.72 | 2.09 |
| CD (P=0.05) | 5.01 | 2.35 | 5.16 | 6.26 |

$^{a,b,c}$ signifies different superscripts in a column differ significantly ($p$<0.05).

**Economics of production**

The cost of production for $T_1$, $T_2$, $T_3$ and $T_4$ was 313.3, 327.18, 343.29 and 344.92 rupees per bird respectively. The corresponding values for cost of production of per kg live weight of bird per treatment were 126.84, 135.75, 138.42 and 137.41 rupees. The net profit per bird was 59.45, 36.57, 30.96 and 33.83 rupees for $T_1$, $T_2$, $T_3$ and $T_4$ groups respectively and the corresponding values for the net profit per kg live weight broiler bird was 24.06, 15.17, 12.48 and 13.47 rupees. The net profit per kg live weight of broiler was seen highest in $T_1$ and lowest in $T_4$.

**Conclusion**

From the results of the present study, it can be concluded that performance of broiler birds in terms of body weight gain, feed consumption, feed conversion efficiency, blood profiles, carcass characteristics, mortality, and performance index had shown positive influence due to the dietary supplementation of nutgall powder in broiler birds. However, different level of dietary supplementation of nutgall did not show any effect on body weight and net profit of the broiler birds.

**Recommendation**

Nutgall powder supplement @ 7 g/kg feeds can be recommended as it was found that performance of broiler birds were better in $T_4$ group as compared to other treatment groups. The net profit per kg live weight was lowest in $T_4$ group due to high cost of test material per bird.

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