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Dietary inclusion of neem leaf powder on growth performance, blood biochemical parameters and profitability of broilers

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Abstract

The experiment was carried out to investigate the effects of neem (*Azadirachta indica*) leaf powder (NLP) over a period of 35 days on the growth performance, dressing parameters, serum biochemical parameters and profitability of broiler meat. Day old broiler chicks (n = 320) were randomly assigned to five dietary groups, each with four replicates. The dietary treatment groups were; control (basal diet; no additives), antibiotic (basal diet + antibiotic), NLP 0.25% (basal diet + 0.25% NLP), NLP 0.375% (basal diet + 0.375% NLP) and NLP 0.50% (basal diet + 0.50% NLP). Results showed that the body weight, body weight gain, feed intake and FCR were differed significantly ($P<0.05$) among the treatment groups. Body weight and body weight gain were higher in antibiotic, NLP 0.25% and NLP 0.375% group compare to the NLP 0.50% group. Total feed intake was not different significantly ($P>0.05$). Better ($P<0.05$) FCR was observed in NLP 0.25% group as such as antibiotic group compare to the control and NLP 0.50% group. The results also showed that dressing parameters were not significantly ($P>0.05$) different among the dietary groups. Serum glucose, triglyceride, GOT, GPT and cholesterol level were non-significant ($P>0.05$) among the dietary groups. However, HDL was significantly ($P<0.05$) higher in NLP 0.25% group compared to the control group. Higher profitability was found in NLP-0.25% group and antibiotic group when all the birds were sold at market price. It can be concluded that the addition of NLP to broiler diet had a positive effect on growth performances but no negative effect on dressing parameters and serum biochemical parameters. Moreover, NLP at the level of 0.25% increases HDL level and improve profitability. It can be suggested that neem leaf powder up to 0.375% could be potential feed additive in broiler diet.

Keywords: Neem, growth, blood, profitability, broiler

Introduction

Broiler industry in Bangladesh has grown dramatically in the past two decades. Numerous researches and breeding programs further enhanced feed utilization, growth rate and profitability. Broiler industry is the most economical and effective converter of grain into animal protein. In broiler farming feed costs is approximately 70% of total production cost. Also, nutrients lost through feces either undigested or unabsorbed for the intestinal microbial population either by parasitic action or occupation of receptors on the intestinal epithelium could results in economic loss to the farmer (Lu and Walker, 2001). The use of antibiotics in the poultry diet is mainly as growth promoter and prevention of several diseases. However, use of antibiotics in feeds caused development of resistant bacteria which could be transferred from animals to humans (Stanton, 2013). Because of these antibiotic resistant bacteria in animal farm, several countries ban the use of certain antibiotics as growth promoter and feed additive (FAO, 2003). After the ban of antibiotics, poultry industry now needs alternatives to antibiotics growth promoters to keep poultry farming profitable. During finding alternatives to antibiotic feed additives to control diseases as well as increase production efficiency in poultry, scientists tried different types of additive alternative including probiotics, prebiotics, enzymes, organic acids, and medicinal plants (Islam *et al.*, 2012; Hossain *et al.,* 2012; El-Latif *et al*., 2013; Hossain and Yang, 2014; Hasan *et al.*, 2018; Rashid *et al.*, 2020), which showed encouraging results. Among the medicinal plants, some available plants in our country such as neem, nishinda, tulsi, ashok etc. and spices like garlic, ginger, black cumin etc. are used in poultry

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industries. A great number of plant extracts contain chemical compounds exhibiting antioxidant (Kähkönen *et al.*, 1999) and antimicrobial (Hsieh *et al*., 2001) properties.

Neem (*Azadirachta indica)* has a wide range of bioactive components such as azadiractin, nimbin, nimbindin, quercetin and others (Makeri *et al*., 2007). These components have anti-microbial, anti-fungal, anti-paraparasitic, antioxidants (Elangovan *et al*., 2000) and have medicinal properties (Bonsu, 2012). Islam *et al*. (2019) found that addition of neem to the broiler diet positively affects growth parameters and profitability without affecting meat yield, bone development and dressing parameters. Several scientific studies showed that inclusion of neem leaf meal in poultry diet showed significant enhancement in immunity, decreased LDL cholesterol levels and increased body weight gain. Ansari *et al*. (2012) reported that the neem leaf meal has potentiated immune response in experimental broilers and even the weight of lymphoid organs increased. Neem has been used in animal feed as a growth promoter due to its distinguished antimicrobial capacity as well as its anticoccidial effect in birds (Tipu *et al.,* 2006). Laboni *et al.* (2007) showed in their experiment that NLM up to 20 g/kg dietary level minimizes mortality and morbidity and therefore improves health status of broiler chickens. Chowdhury *et al*. (2004) reported that both live weight and FCR did not differ significantly when neem leaf meal was used up to 20 g/kg dietary level but at 40 g/kg level it decreased live weight and increased FCR in broiler chickens. This study has been designed to evaluate the use of neem leaf powder as a potential feed additive in broiler chicken's feed, aiming at improving growth and feed efficiency, ultimately the production of antibiotic free broiler.

Materials and Methods

Experimental birds, diet and management

A total of 320 Cobb 500, one-day-old chicks were reared in this experiment. All the chicks were randomly allotted into five equal groups of mixed-sex. The chicks were housed in a clean, disinfected and well ventilated room. Diets were formulated based on corn and soybean meal to meet the requirements according to meet nutrient requirements of Cobb-500 commercial broiler (Cobb Breeder Management Guide, 2012). The dietary treatment groups were; Control (basal diet; no additives), antibiotic (basal diet + antibiotic), NLP-0.25% (basal diet+0.25% neem leaf powder), NLP 0.375% (basal diet+0.375% neem leaf powder) and NLP 0.50% (basal diet+0.50% neem leaf powder). Two types of broiler diets were formulated namely starter and grower (Table 1).

Starter diet was provided for the first 21 days and a grower diet was provided to the broiler up to 35 days of age. Fresh neem leaf was collected from neem tree, cleaned, sun-dried and grounded. Trade name of the antibiotics used in the experiment was "Renamycin". Feeds and water were supplied ad-libitum. Prophylactic measures against the most common infectious diseases were carried out. Fresh and dried rice husk was used as litter material. After arrival, the day-old-chicks were placed randomly on the floor of pens. Their initial body weight was recorded just after arrival. For the first few days, feeds were given on a newspaper along with one plastic drinker in each pen. After some days, two round plastic tube feeders and one medium plastic drinker were used.

Data collection and record keeping

Weekly body weight, body weight gain and feed intake of chicks in different groups were recorded. Feed conversion ratio (FCR) was calculated according to Lambert *et al*. (1936). At the end of the experiment, one chick from each replication group was randomly selected and slaughtered. After complete bleeding, edible and non-edible byproducts like feather, head, legs, viscera, skin were removed for determination of dressing percentage and carcass weight. Dressed broilers were cut into different major parts such as breast, thigh, drumstick, and wings, and all cutup parts were weighed and recorded. Relative weights of dressing parameters (head, neck, skin and abdominal fat) and internal organs (liver, heart and gizzard) were also determined by calculating the weight of each parameter or organ with respect to body weight. Blood samples were collected from the jugular vein through slaughtering and the samples were centrifuged at 3000 rpm for 10 min and the serum was stored −20°C until analyzed. The total serum cholesterol, triglyceride and high density lipoproteins (HDL) concentrations were measured according to

previous methods described by Allain *et al.* (1974), Bucolo and David (1973) and Alen *et al.* (1979). Glucose was evaluated using commercial test kit. Serum glutamic-puruvic transaminase (GPT) and glutamic oxaloacetic transaminase (GOT) were determined using methods described by Bahman *et al.* (2011).

Table 1: Ingredient and nutrient composition of basal diets (100 kg).

Ingredients	Starter diet (0–21 days)	Grower diet (22–35 days)
Maize	54	60
Soybean meal	30.50	24.10
Protein concentrate	8	8
Dicalcium phosphate	1.35	1.35
Limestone	0.8	0.7
Soybean oil	4.5	5
Lysine	0.10	0.1
Methionine	0.12	0.12
Vitamin-mineral premix*	0.30	0.30
Common salt	0.33	0.32
Nutrient composition (Calculated)		
Metabolizable energy (kcal/kg)	3113	3187
Crude protein %	23	20.6
Calcium %	0.83	1.05
Available phosphorus %	0.44	0.42
Methionine %	0.51	0.48
Lysine %	1.25	1.06

**Vitamin mineral premix (Rena-broiler; 2.5kg); Vitamin A 12000000IU, D3 2400000IU, E 23g, K3 2g, B1 2.5g, B2 5g, B6 4g, B12 12mg, Niacinamide 40g, D pantothenete 12.5g, Folate 800mg, Biotin 100mg, Co 400mg, Cu 10g, Fe 60g, I 400mg, Mn 60g, Zn 50g, Se 150mg, Methionine 100g, Lysine 60g, Calcium 679.58g.*

Cost of production and profit calculation

The production cost was calculated including prices of day-old chicks, feeding cost, electricity, heating, medication, management and housing cost at the time of experiment. Selling price was calculated by multiplying total live body weight of the broilers produced by the price per unit weight commonly offered in the market. Some of this cost varies due to fluctuating marketing price. Profit was calculated for both per broiler and per kg broiler by excluding the total cost of production from the total price of birds.

Statistical analysis

Data of body weight, body weight gain, feed intake, FCR, dressing parameters and serum biochemical parameters of broilers were subjected to analysis of variance in a completely randomized design by using the general linear models of SAS (2009). Duncan's Multiple Range Test was used to compare the differences in mean values. The level of significance was set at $P<0.05$.

Results

Growth performances

Supplementation of NLP showed significant difference in body weight and body weight gain at the end of the experiment (Table 2). At 5th week of age, significantly ($P<0.05$) higher body weight and body weight gain were found in NLP at 0.25% and 0.375% groups as such as antibiotic group compared to the NLP-0.50% group. Total feed intake was not differ significantly among the dietary groups ($P>0.5$). In this study, weekly FCR was not consistent in a regular manner. However, improved ($P<0.05$) total FCR was found in NLP-0.25% group as such antibiotic group compared to the control and NLP-0.50% groups (Figure 1). Among the NLP supplemented group NLP at 0.25% and 0.375% groups performed better.

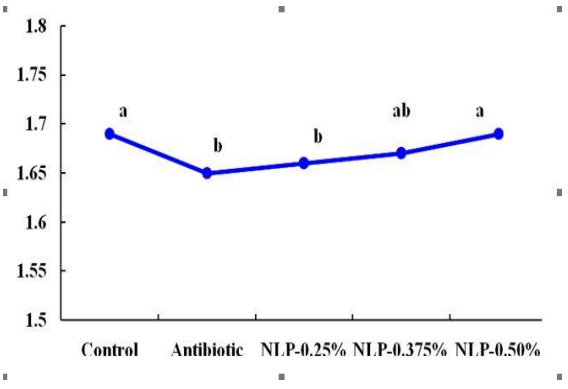

Figure 1: Feed conversion ratio of broiler in different dietary treatments. Within the FCR, different letters indicate significant differences ($P<0.05$).

Dressing parameters

Table 3 shows the dressing percentage and meat yield of different dietary groups**.** Dressing percentage and meat yields did not show any significant differences (P>0.5) among the dietary groups. Numerically, the highest dressing percentage was found in birds of NLP-0.25% group. The higher value (14.48%) for breast meat and wing meat (6.44%) was observed in NLP-0.25% group. However, highest drumstick (6.94%) and thigh meat (8.28%) were found in NLP-0.50% group. Inclusion of NLP had no significant effect on other dressing parameters (head, neck, liver, gizzard, skin, abdominal fat) in this study.

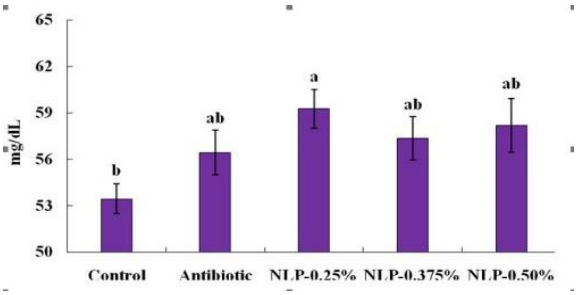

Figure 2: Serum HDL content of broiler in different dietary treatments. Bars not sharing a common letter are significantly different (P<0.05).

Table 2: Body weight, body weight gain and feed intake of broiler in different dietary treatments.

Parameter	Treatments					Level of significance
	Control	Antibiotic	NLP-0.25%	NLP-0.375%	NLP-0.50%	
Final Body Weight	1346.88^{ab} ± 6.42	1374^{a} ± 10.61	1363.34^{a} ± 5.79	1365.78^{a} ± 8.54	1331.25^{b} ± 12.31	*
Total Body Weight Gain	1299.88^{ab} ± 6.42	1327^{a} ± 10.61	1316.34^{a} ± 5.79	1318.78^{a} ± 8.5	1284.25^{b} ± 12.31	*
Total Feed Intake	2198.75 ± 15.32	2190.25 ±25.12	2181 ± 5.80	2197 ± 20.04	2164.25 ± 21.99	NS

** a,b values with different superscripts in the same row differ significantly (P<0.05); Data are presented as mean±SE; n=320.*

Serum biochemical parameters

Serum biochemical parameters of broiler fed different levels of NLP are presented in table 4 and Figure 2. The result indicate that NLP had no effect (P>0.05) on glucose, TG, serum total cholesterol, GPT and GOT. Numerically lower total cholesterol value was found in NLP-0.25% group compare to the other groups. Birds fed NLP at 0.25% showed significantly (P<0.05) higher HDL compared to the control group. HDL in other treatment groups is statistically similar.

Cost-benefit analysis

Cost-benefit analysis among different dietary treatments is shown in Figure 3. Cost of production per kg live broiler was numerically higher in control and NLP-0.50% groups compare to the other groups. Moreover, when live broiler was sold per kg at equal market price antibiotic group had higher (12.83 tk) profit/kg live bird followed by NLP-0.25% (12.56 tk), NLP-0.375% (12.00 tk), control (10.01 tk) and NLP-0.50% (9.24 tk), respectively.

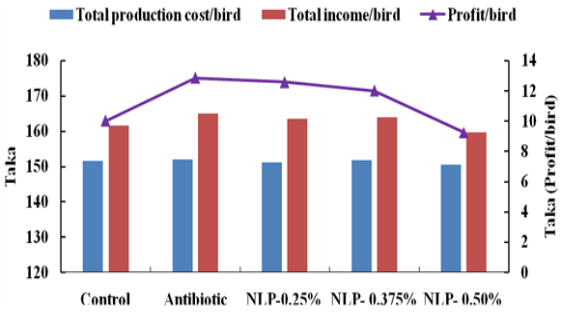

Figure 3: Cost-benefit analysis of broiler in different dietary treatments.

Discussion

Growth performances

Supplementation of NLP up to 0.375% improved body weight as such as antibiotic group than that of control group. A similar result was found by several scientists (Islam *et al.*, 2019; Alam *et al*., 2015; Ansari *et al.,* 2012) who found significantly higher body weight in neem leaf treated groups

compared to the control group. Onyimonyi *et al.* (2009) showed significant improvement in body weight and body weight gain when neem leaves powder were used in broiler diet at a rate of 0.50%. Similarly, Wankar *et al.* (2009) showed significant improvement in the average of body weight when adding neem leaves powder to broiler diet at a rate of 1, 2, 3 g/kg. Sarker *et al*. (2014) reported that broilers supplemented with 1.0% neem leaf extract gained significantly higher (P<0.001) live weight compared to the untreated control group. Ansari *et al.* (2012) also found diets supplemented with 2.5 g/kg of leaf meal had significantly greater body weight than those fed diets with 1.25, 5.0 g/kg of leaf meal. These results may be due to neem containing a vast array of chemically diverse and biologically active ingredients (Devakumar and Sukett, 1993) which have antimicrobial and anti-protozoal properties (Kale *et al*., 2003; Bishnu *et al*., 2009) that help to reduce the microbial load and improved the growth of the birds (Ketkar, 1976). However, Bonsu *et al*. (2012) reported that body weight gain was significantly depressed in birds fed by NLM when compared to the control group. Landy *et al.* (2011) showed a significant decline in the average of body weight when adding powder neem leaves at a rate of 7 and 12 g/kg to broiler diet at age

Table 3: Dressing percentage and meat yield of broiler in different dietary treatments (% relation to body weight).

Parameter	Treatments					Level of significance
	Control	Antibiotic	NLP-0.25%	NLP-0.375%	NLP-0.50%	
Dressing percentage	62.36±1.4	64.52±2.1	65.29±1.9	62.18±.9	65.16±1.6	NS
Breast meat	12.23±1.63	14.22±0.97	14.48±0.56	13.16±0.94	12.45±0.90	NS
Thigh meat	7.06±0.06	7.65±0.19	6.73±0.34	5.95±1.0	8.28±2.46	NS
Drumstick meat	5.89±0.14	6.43±0.57	6.24±0.62	6.57±0.69	6.94±1.23	NS
Wing meat	4.77±1.44	5.50±0.86	6.44±0.22	6.37±0.30	6.05±0.35	NS

NS, not significant; n=2.

Table 4: Blood biochemical parameters of broiler in different dietary treatments.

Parameter	Treatments					Level of significance
	Control	Antibiotic	NLP-0.25%	NLP-0.375%	NLP-0.50%	
Glucose (mg/dL)	104.55 ±3.66	107.43 ±2.69	109.95 ±2.45	112.13 ±2.85	110.20 ±1.93	NS
Cholesterol (mg/dL)	166.32 ±13.42	165.26 ±11.79	155.27 ±9.23	166.18 ±7.01	168.18 ±9.22	NS
Triglyceride (mg/dL)	172.93 ±2.88	196.97 ±15.04	174.81 ±6.36	180.14 ±4.51	178.58 ±6.82	NS
GOT (U/L)	3.77 ±0.16	4.21 ±0.16	3.94 ±0.28	4.06 ±0.36	4.13 ±0.31	NS
GPT (U/L)	2.93 ±0.30	2.89 ±0.20	2.98 ±0.24	3.08 ±0.08	3.13 ±0.49	NS

GOT=Glutamic oxaloacetic transaminase, GPT=Glutamic pyruvic transaminase; NS, Not significant; n=20.

of 42 days, the reason for this may be to bitter taste for neem.

Supplementation of NLP didn't show significant effect on feed intake. These findings is supported by Landy *et al.* (2011), who found that there were no significant differences between treatments in feed intake when adding a powder neem leaves at a rate of 7 and 12 g/kg to broiler diet at age of 42 days. Gowda *et al*. (1998) reported significantly lower feed intake ($P<0.01$) for diets with neem kernel meal at 150 and 200 g/kg diet in White Leghorns. On the other hand, Shihab (2017) found significant improvement in the feed intake when adding neem leaves powder (2g/kg) to broiler diet. However, no detrimental effect of NLP was found in feed intake of broiler.

Improved total FCR was found in NLP-0.25% supplemented group in this study. This result agrees with Ansari *et al.* (2012) who reported that, broiler fed diets supplemented with 2.5 g/kg of leaf meal had significantly greater better FCR than those fed diets with 1.25, 5.0 g/kg of neem leaf meal. Moreover, Sarkar *et al.* (2021) and Arshad *et al.* (2021) observed better FCR in neem leaf extract fed broilers and neem leaf powder fed Japanese quail. Kale *et al*. (2003) reported that antimicrobial and antiprotozoal properties of neem leaves reduced the microbial load of the birds, may absorb more nutrients and thus improved the feed efficiency.

Dressing parameters

In the present experiment, dressing parameters of broiler chicken were not significantly affected by supplementation of NLP. Some other researchers (Bonsu *et al*., 2012; Landy *et al.*, 2011) also got the same findings by using neem products that had no significant influence on the dressing percentage of broiler chicken. Dressing percentage was not influenced using NLM at 0%, 1.5%, 2.0% and 2.5% (Bonsu *et al.,* 2012). Ansari *et al.* (2012) found no marked variation in dressing percentage in the broiler supplementation with NLM at 1.25, 2.5 and 5.0 g leaf meal/kg of feed at 28 days of age. Where, at 42 days of age birds fed with 2.5g/kg of leaf meal showed significantly highest dressing percentage compared to other treatment groups. Alam *et al.* (2014) also found that polyherbal extract did not exhibit any effect on the dressing percentage values of broiler chicken. The results of the present study were slightly different from the findings of Laboni and Chowdhury (2007) who studied the effects of feeding neem leaf meal on the performance, survival and meat yield characteristics of broilers.

Blood biochemical parameters

Serum biochemical parameters of broiler fed different levels of NLP are presented in Table 4 and Figure 2. Serum cholesterol in NLP-fed broilers was numerically lower than those of the control birds. This finding agree with Ogbuewu *et al*. (2011), Uko *et al*. (2006) and Bonsu *et al*. (2012), Shihab *et al.* (2017) who reported hypocholesteromic effects of NLP in rabbits and broilers respectively. Values obtained in this study showed no detrimental effect to the broiler. Inclusion of NLP at 0.25% increased serum HDL level in this study. This result coincide with Sonhafouo *et al.* (2019), who observed numerically higher HDL value when graded levels of neem oil was used in broiler diet. HDL is called good cholesterol which has high anti-oxidant and anti-inflammatory activities that are associated with protection from cardiovascular disease. Liver functioning, the activities of GOT and GPT in serum were not affected significantly by inclusion of neem in broiler diet. However, Ansari *et al*. (2012) reported decreasing of the same parameters in birds fed on neem leaf meal. Neem and its products contain a hepatoprotective agent and this protective activity may be due to its antioxidant and normalization of impaired membrane function activity (Mohamed *et al*., 2010).

Cost-benefit analysis

Higher profitability was found in NLP-0.25% group and antibiotic group when all the birds were sold at market price. These findings is supported by Mostofa *et al*. (2013), who reported that neem leave extract supplementation in the broiler rations may be useful for the safe, economical and efficient production of broiler. However, people now a day are searching for safe, organic, antibiotic residue free food. They will pay extra if the product is antibiotic free. In that case, profitability in neem group will be higher compared to the antibiotic group.

Conclusion

Supplementation of neem leaf meal powder to the broiler diet positively affects growth performance, feed conversion ratio and serum HDL level. Neem leaf powder up to 0.375% showed better performances as such as antibiotic fed group. Moreover, higher profitability was found in lower

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level of NLP and antibiotic group when all the birds were sold at market price. Therefore, it can be suggested that neem leaf powder is a potential feed additive and can be added to broiler diet up to 0.375% for the production of safe broiler meat.

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Conflict of interest: The authors would like to declare that there is no conflict of interest.

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