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Research article

Optimizing broiler production: A comprehensive study on the economic and biological effects of mahogany (*Swieteniamacrophylla*) and chalta (*Dilleniaindica L.*) leaf supplementation

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ABSTRACT

The purpose of the study was to assess the dietary effects of dried Mahogany and Chalta leaves supplementation on growth performance, carcass characteristics, biochemical parameter and oxidative stability of meat in broiler. The study was conducted by a total of 96 unsexed Ross 308 day old chicks were distributed intofour dietary treatment groups: T1 = control (basal diet), T2 = (basal diet + 0.4% dried Mahogany leaves), T3 = (basal diet + 0.4% dried Chalta leaves) and T4 = (basal diet + 0.2% dried Mahogany and 0.2% dried Chalta mixed leaves). Each treatment also randomly sub-grouped into three replications having 8 birds in each in a completely randomized design. The results revealed that overall average daily gain (ADG) ($P<0.05$) and average daily feed intake (ADFI) ($P<0.01$) increased significantly in all treatment groups compared to the control. The overall FCR was decreased ($P<0.05$) significanlty in all treatment groups than control group. An increased HDL ($P<0.05$) level was observed while LDL, triglyceride and blood cholesterol level remain unchanged in treatment groups than the control. A significant higher CP content in T_3, EE content in T_4 while total ash content did not differ significantly ($P>0.05$). Carcass parameters including dressed weight and drumstick weight increased but heart weight decreased in treatments group compared to control group ($P<0.05$). Oxidative rancidity reduced ($P<0.05$) in all treatment groups. Better net profit was recorded in Mahogany and Chalta mixed leaves supplemented group than control. Finally, dried Mahogany and Chalta leaves increased ADG, serum HDL level, net profit and decreased FCR, and thiobarbituric acid reactive substance (TBARS) of meat. Hence, dried Mahogany and Chalta leaves meal showed beneficial effects on broiler and can be used as a potential feed source in broiler.

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1.INTRODUCTION

Broiler farming is very popular in Bangladesh due to having less initial cost and quick financial return. The broiler farming in

developing countries is continuously facing some challenges such as high feed cost and prevailing diseases (Abbas, 2013). For this, farmers in Bangladesh are always seeking some growth promoters to boost-up growth beyond the feed cost. Numerous efforts have been made to overcome these challenges, and one of which is the use of antibiotics in feed. Antibiotics have been used as growth promoters and to prevent outbreak of diseases (Thomke and Elwinger, 1998; Phillips et al., 2004). But the use of antibiotics as growth promoter has recently been negatively suggested due to having residual effects in developing resistant microorganisms for both livestock and human being. Poultry farmers are therefore search in for an alternative to antibiotics.

Medicinal plants and their products containing plant extracts or essential oils are known possible candidates for use in broiler diets, where they have beneficial effects as phytogenic feed additives has been proven (Veríssimo et al., 1995; Bolukbasi and Erhan, 2007; Soltan and El-katcha, 2008). Several studies have demonstrated that phytobiotics, the plant derived compounds, in the diets of farm animals improved feed intake, gut integrity, nutrient absorption, antioxidant activity and immunity. Use of herbal plants as alternative growth promoter and their bioactive compound more important because of their antimicrobial effects and digestion-enhancing capacities.

In recent years, extensive research has been performed on the use of phytochemicals such as bitter leaf meal and moringa leaf meal as alternative to antibiotic growth promoters in poultry diets (Daramola, 2019). Phytochemical screening of bitter leaf and moringa leaf meals revealed the presence of phenolic acids, flavonoids, tannins, cardiac glycosides, saponin and glucosinolates (Odukoya, 2019). These compounds are of great value in preventing the onset or progression of many human and animal diseases. The leaves of Cashew nut (*Anacardiumoccidentale*) have astringent, antidiarrheal, antioxidant, and antimicrobial properties, due to the presence of polyphenols (mainly tannins) and coumarins (Okpashiand Obi-Abang, 2014). Their use in poultry diets improves the growth performance and quality of eggs and decreases the incidence of diarrhea (Liangpanth and Tongdeesoontorn, 2018).

Swietenia is the genus of chinaberry family (Meliaceae). It was brought into Asian countries form the native Caribbean, Mexico and Southern to Central America. Among three different species, Mahogany is used as medicinal pant in India, Indonesia, and Africa (Patel et al., 2012). This plant also a source of numerous phytochemicals used through a variety of herbal remedies and foodstuffs with curative properties. Mahogany has been used in Asia and many other countries to treat diverse ailments based on its antimicrobial, anti-inflammatory, antioxidant effects, anti-mutagenic, anticancer, antitumor and anti-diabetic activities (Moghadamtousi et al., 2013). Almost all parts of the plant are used in traditional medicine for the treatment of various human ailments. The fruit of mahogany has been used commercially in health care products for the improvement of blood circulation and skin condition (Ch'ng et al., 2018). The seeds have many uses such as in the treatment of hypertension, against chest pain, insect repellent, relieve constipation and menstrual pain, lessen the cholesterol level, increase appetite, fight free radical, prevent colon cancer, boost the immune system and against leishmaniasis. It also contains many natural nutrients that can sustain a healthy body and increase the overall energy of the human body such as protein, minerals, vitamins, fiber, carbohydrates, folic acid, essential fatty acid and so on (Das et al., 2009). The leaf of mahogany contains a sizeable amount of total phenolic, tannins and flavonoid contents. The leaves are anti-diabetic, anti-bacterial, anti-oxidant, anti-microbial, anti-fungal, antidiarrheal, anti-malarial and anti-inflammatory (Tan et al., 2009).

The *Dilleniaindica*, commonly known as chalta, is an ethno-medicinally important plant used for the treatment of several diseases like cancer anddiarrhea. It is an important medicinal plant in ayurvedic medicine for curing a plethora disease such as digestive, respiratory and central nervous system disorders. In addition, different parts of chalta are used for the relief of indigestion, asthma, influenza, dysentery, jaundice, weakness and rheumatic pain

(Amritveer et al., 2016). Major chemical compounds the betulin (pentacyclictriterpenoid) and betulinic acid show wide spectrum of pharmacological activities like anti-HIV, anti-inflammatory, anti-cancer, anti-malarial etc. (Kumar et al., 2010; Chauhan, 2014). The plant is a rich source of triterpenoids, flavonoids and tannins (Gandhi and Mehta, 2013). The leaves of chalta are rich source of flavonoids and triterpenoids exhibited anti-inflammatory activity (Vaidya, 2013). Researchers demonstrated that the leaf extract of chalta has anti-inflammatory, antimicrobial, antidiabetic, hypolipidemic and antidiarrheal properties (Yeshwante et al., 2009; Apu et al., 2010; Kumar et al., 2011). Antinociceptive and antioxidant activities were demonstrated for the methanolic extract of *Dilleniaindica* bark (Alam et al., 2010), and anti-leucemic, anti-diarrheal and anti-inflammatory actions were demonstrated for the extracts from the fruit of *Dilleniaindica*(Kumar and Prakash, 2011).

While previous studies might have explored the benefits of mahogany and chalta leaf supplementation, the optimal dosage and inclusion period for maximizing growth performance, feed efficiency, and immune response in broilers still unclear. Considering the above significant health benefits of mahogany and chalta, we hypothesized that incorporation of these two leaves in diet will enhance growth performance of broiler. Therefore, the study was designed to judge the effect of dietary supplementation of mahogany and chalta leaves on growth performance, serum biochemical parameters, meat quality and carcass characteristics in broiler chicken. A comparative cost-benefit analysis was also performed to ensure that supplementation of mahogany and chalta leaves in broiler diet is economically viable.

2.MATERIALS AND METHODS

Experimental birds

The day-old unsexed broiler chicks (DOC) were brought from Nahar Agro Complex Limited, Chattogram, Bangladesh. All the chicks were inspected for the presence of any abnormalities and chicks having no noticeable abnormalities were selected for the study. We also measured the body weight of the chicks for the uniformity in size and a variation of more than 5 grams from the mean weight were excluded from the study. The average body weight of the selected DOCs was around 36g. The birds were placed in wire-floored, closed cages of poultry shed under the department of Animal Science and Nutrition. Each cage is equipped with a circular feeder and drinker to provide adlibitum food and water.

Preparation of leaf meal

Mahogany and Chalta leaves were collected from different area of Chattogram and then left under a shed at 27 - 32°C temperature for 4-5 days for drying the leaves. After drying, the leaves were grinded into a fine powder using an electrical grinder (Panasonic, MX-AC 300) to ensure effective mixing with other feed ingredients. The grinded leaf meal was then kept in airtight container until use.

Design of the experiment

A total of 96 birds were randomly allocated into 4 treatment groups based on feed composition differed by without (Control: T_1) or with inclusion (Treatments: T_2, T_3 and T_4) of mahogany and chalta leaves for a 28 days growth trial. Each group was subdivided into three replications containing 8 birds per replication in a completely randomized design. Dietary treatment groups were, T_1 = Control, represent the birds fed diet without mahogany and chalta leaves in ration, T_2 = Inclusion of 0.4% dried mahogany leaves, T_3 = Inclusion of 0.4% dried chalta leaves and T_4 =Inclusion of 0.2% dried mahogany + 0.2% dried chalta leaves on DM basis. Ingredients and chemical composition of 100 kg diet for control and treatment groups are presented in Table 1.

Housing and management

Each replication (consisting of 8 birds) was housed in separate well-ventilated iron made multi-storied cases where the size of each compartment was 3.5 feet (Length)× 1.63 feet (Width) × 4 feet (Height). Floor space was 0.71 square feet per bird though out the trial period. Before housing the birds, the shed and cases were thoroughly washed and disinfected. A footbath at the entrance of the shed containing 1% potassium permanganate solution was kept throughout the trail period which was changed every 3-days-interval. All feed ingredients were purchased from Pahartali, Chattogram and

ration was prepared by mixing different ingredients according to the ration composition. Two different types of diets were supplied at different stages of rearing i.e. starter feed from day 1 to 14 and grower feed from day 14 to day 35. The birds were vaccinated against only two highly prevalent viral diseases: the New Castle Disease (ND) on day 4 (BCRDV) followed by 21 days (Booster dose) and Infectious Bursal Disease (IBD) on day 12 and 17.

Analysis of measurements

Growth performance and carcass characteristics

All required parameters for experiment were recorded at weekly intervals. The weight gain for a particular week was calculated by subtracting the live weight of bird at the beginning of a week from live weight at the end of a week. Three birds were randomly selected from each replication at the end of the feeding trial. The weight of each selected bird was recorded. The birds were then slaughtered and recorded to calculate the dressing percentage. The carcass was then cuts into 10 parts and recorded the weight of each cutting part, all visceral organs and visceral fats were observed define the carcass characteristics.

Table 1. Ingredient and chemical composition of basal diet (100 kg).

Ingredients	Control (T_1)		Treatment (T_2)		Treatment (T_3)		Treatment (T_4)	
	Starter (kg)	Grower (kg)	Starter (kg)	Grower (kg)	Starter (kg)	Grower (kg)	Starter (kg)	Grower (kg)
Corn	51.88	52.98	51.88	52.98	51.88	52.98	51.88	52.98
Wheat	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Rice polish	2.50	3.20	2.10	2.80	2.10	2.80	2.10	2.80
Soybean meal	32.00	29.20	32.00	29.20	32.00	29.20	32.00	29.20
Fishmeal	4.00	3.50	4.00	3.50	4.00	3.50	4.00	3.50
Palm oil	3.50	5.00	3.50	5.00	3.50	5.00	3.50	5.00
DCP	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79
Limestone	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
NaCl	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Choline chloride	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Vitamin min premix	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
L-lysine	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
DL- methionine	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Toxin binder	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Enzymes	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Mahogany leaf	-	-	0.4	0.4	-	-	0.2	0.2
Chalta leaf	-	-			0.4	0.4	0.2	0.2
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Calculated composition								
ME (kcal/kg)	3000	3100	2990	3088	2990	3088	2990	3088
CP (%)	22.09	20.70	22.05	20.65	22.05	20.65	22.05	20.65
CF %	3.76	3.67	3.71	3.62	3.71	3.62	3.71	3.62
EE %	3.67	3.67	3.62	3.62	3.62	3.62	3.62	3.62
Ca %	1.28	1.26	1.30	1.26	1.30	1.26	1.30	1.26
P %	0.71	0.70	0.72	0.69	0.72	0.69	0.72	0.69

In this study, starter period from day 1 to 14 and grower period from day 15 to 35. For inclusion of dried mahogany and/or chalta leaves in treatment groups, we have replaced rice polish because of very similar chemical composition.

Chemical composition of meat

Fifteen grams of breast meat sample were collected from each slaughtered bird. The collected samples were grinded in a meat grinder kept in polyethylene bags with a zipper lock and stored in freezer at -20^0 C for the analysis of proximate components. Chemical analysis of the meat samples was performed according to the standard method described in Association of Official Agricultural Chemists (AOAC, 2006).

Meat oxidative stability

The oxidative rancidity of the meat was determined based on the amount of thiobarbituric acid reactive substance (TBARS) in meat. The freeze-stored (-20^0 C) grinded meat samples were thawed and kept at 4^0 C. The TBARS was then measured at day 3, 5 and 7 to estimate rancidity over time. TBARS was also measured just after thawing for comparison as control. TBARS was measured according to the method described by Hossain (2015). TBARS values were expressed as micromoles of malondialdehyde (MDA) per 100 gm of meat sample.

Serum biochemical parameters

Blood samples were collected from the brachial vein of two birds from each replicate using a 5 ml sterile syringe and a 23-gauge needle. From each bird, 5 ml blood sample was transferred immediately into a sterile tube without anticoagulant. Clotted blood in the vacutainer tube was centrifuged at 3000 rpm for 20 minutes and prepared serum was collected into the 1.5-ml microcentrifuge tube using micropipette. The levels of cholesterol, triglyceride, low-density lipoprotein (LDL) and high-density lipoprotein (HDL) were measured from the prepared serum in the Post Graduate Laboratory under the Department of Animal Science and Nutrition, CVASU using standard kits (BioMereux, France) and semi-automatic analyzer (Humalyzer 3000 Merck®, Germany) according to the manufacturer's instruction.

Statistical analysis

Data were compiled in MS Excel. Raw data related to weight gain, feed intake, FCR, carcass characteristics were tested for normality by using normal probability plot and analyzed for ANOVA by using STATA (2017). Means showing significant differences were compared by Duncan's New Multiple Range Test (Duncan, 1955). Statistical significance was accepted when P value was less than 0.05.

3. RESULTS

The dietary effects of mahogany and chalta leaves on growth performance of broiler was measured by live weight, weight gain, feed intake and feed conversion ratio (FCR) from 1^{st} to 5^{th} weeks of growth trial. The performance parameters were also calculated by combining the data from 1^{st} week to 5^{th} week of trial and presented at overall performance (Table 2).

Live weight

Live weight of the experimental broiler was recorded weekly basis throughout the experimental period. Results indicated that the average live weight from 2^{nd} to 5^{th} weeks of age were increased significantly ($P<0.05$) in all treatment groups compared to control group. In overall performance, the highest (1253.75 g/bird) and lowest (942.08 g/bird) mean live weight was recorded respectively in T_4 and T_1 treatment groups.

Weight gain

Compared to control (T_1), significant differences ($P<0.01$) were observed in average daily weight gain (ADG) in all treatment groups at 2^{nd}, 3^{rd} weeks as well as overall period of this growth trial. The highest (58.51 g/bird/day) and lowest (48.46 g/bird/day) ADG were observed respectively in T_4 and T_1 groups in overall performance representing that inclusion of mahogany and chalta mixed leaves performed better than control group terms of weight gain.

Feed intake

In comparison to control (T_1), the average daily feed intake (ADFI) was increased significantly ($P<0.05$) in all treatment groups at 2nd and 3rd weeks, and groups T_2 and T_4 at 4th weeks of age. The overall ADFI were higher in all treatment ($P<0.001$) groups compared to control where the highest ADFI was observed in T3 group (95.33 g/bird/day).

Feed conversion ratio

The feed conversion ratio (FCR) showed significant reduction ($P<0.05$) in all dietary groups compared to control at 3rd week of growth trial. The overall FCR also reduced significantly ($P<0.05$) in treatment groups compared to control. In overall period, the lowest (1.88) and highest (2.25) FCR were observed in T_4 and T_1, respectively. These results indicate that the birds fed ration with inclusion of mahogany and chalta leaves were performed better in terms of feed conversion efficiency compared to ration only one type of leaf (Only mahogany, T_2 / only chalta, T_3) or no leaf (T_1).

Table 2.Effects of dietary supplementation of mahogany and chalta leaves on growth performance of broiler

Parameters	Control	Treatments			SEM	P Value
	T_1	T_2	T_3	T_4		
1st week						
Initial weight (g)	36.84	36.67	36.13	36.63	0.16	0.08
Final weight (g)	97.92	100.84	98.96	104.96	3.63	0.66
ADG (g/b/d)	8.72	9.16	8.98	9.76	0.51	0.65
ADFI (g/b/d)	9.70	9.84	10.01	10.35	0.56	0.86
FCR	1.11	1.07	1.12	1.07	0.05	0.86
2nd week						
Initial weight (g)	97.92	100.84	98.96	104.96	3.63	0.66
Final weight (g)	188.09^{b}	243.88^{a}	241.75^{a}	259.00^{a}	9.24	0.01
ADG (g/b/d)	12.88^{b}	20.44^{a}	20.40^{a}	22.01^{a}	0.96	0.001
ADFI (g/b/d)	28.39^{c}	38.96^{b}	40.76^{a}	40.80^{a}	0.22	<0.001
FCR	2.22	1.92	2.00	1.87	0.10	0.14
3rd week						
Initial weight (g)	188.09^{b}	243.88^{a}	241.75^{a}	259.00^{a}	9.24	0.01
Final weight (g)	334.42^{b}	501.42^{a}	487.54^{a}	543.21^{a}	16.63	0.001
ADG (g/b/d)	20.91^{b}	36.79^{a}	35.11^{a}	40.60^{a}	2.06	0.002
ADFI (g/b/d)	59.58^{b}	81.79^{a}	81.67^{a}	81.15^{a}	0.66	<0.001
FCR	2.86^{a}	2.23^{b}	2.35^{b}	2.04^{b}	0.14	0.02
4th week						
Initial weight (g)	334.42^{b}	501.42^{a}	487.54^{a}	543.21^{a}	16.63	0.001
Final weight (g)	602.88^{b}	815.00^{a}	789.17^{a}	844.17^{a}	17.38	<0.001
ADG (g/b/d)	38.35	44.80	43.09	43.00	1.97	0.29
ADFI (g/b/d)	87.68^{b}	95.33^{a}	92.77^{ab}	87.47^{b}	1.35	0.03
FCR	2.29^{a}	2.13^{a}	2.17^{a}	2.06^{a}	0.10	0.62
5th week						
Initial weight (g)	602.88^{b}	815.00^{a}	789.17^{a}	844.17^{a}	17.38	<0.001
Final weight (g)	942.08^{b}	1182.92^{a}	1169.57^{a}	1253.75^{a}	30.44	0.002
ADG (g/b/d)	48.46	52.56	54.34	58.51	3.48	0.45
ADFI (g/b/d)	88.25	88.25	89.05	88.25	0.26	0.45
FCR	1.82	1.68	1.66	1.55	0.09	0.37
1-5th week (Overall)						
Initial weight (g)	36.84^{a}	36.67^{ab}	36.13^{b}	36.63^{ab}	0.16	0.08
Final weight (g)	942.08^{b}	1182.92^{a}	1169.57^{a}	1253.75^{a}	30.44	0.002
ADG (g/b/d)	25.87^{b}	32.75^{a}	32.38^{a}	34.78^{a}	0.87	0.002
ADFI (g/b/d)	58.29^{b}	66.40^{a}	67.27^{a}	65.17^{a}	0.45	<.001
FCR	2.25^{a}	2.03^{b}	2.08^{ab}	1.88^{b}	0.06	0.02

The mean values denoted by different letters in the same row differ significantly. Data are obtained from the mean value of 3 replications with 8 birds per replication (n = 24). Dietary treatment groups are: T_1 = Control (basal diet), T_2 = 0.4% dried mahogany leaves in ration, T_3 = 0.4% dried chalta leaves in ration and T_4 = 0.2%

dried mahogany + 0.2% dried chalta leaves. ADG: Average daily gain; ADFI: Average daily feed intake. g/b/d = g/bird/day. SEM: Standard error of means.

In summary, the results on growth performance indicates that in all cases inclusion of mahogany and chalta leaves in broiler ration performed better than ration containing only one type of leaf (Only mahogany, T_2 / only chalta, T_3) or no leaf (T_1).

Serum biochemical parameters

Different blood serum biochemical parameters were quantified and presented in (Table 3). The blood cholesterol and triglyceride (TG), high density lipoprotein (HDL) and low-density lipoprotein (LDL) contents were quantified and compared between treatment groups with control. According to the obtained results, all the quantified parameters were unchanged upon dietary treatment of mahogany and chalta leaves compared to control except for HDL which was increased significantly ($P<0.01$). The lowest (47.00 mg/dl) and highest (58.67 mg/dl) concentration of serum HDL were recorded respectively in T_1 and T_4 group.

Chemical composition of meat

Dietary effects of mahogany and chalta leaves on proximate composition of broiler meat are represented in Table 4. Results showed that dry matter, crude protein and ether extract were significantly differed ($P<0.05$) between control and treatment groups. Compared to control (24.07%), the dry matter was reduced in the T_2 group (22.57%) whereas it was unchanged in T_3 (23.37%) and T_4 (23.99%). The crude protein was increased in only in T_3 group (22.07%) compared to control (20.66%). In the case of ether extract, it was increased more than 2.35 times (0.73% in control vs. 1.72% in T_4 ($P<0.001$) in treatment T_4 upon dietary supplementation of mahogany and chalta leaves. The total ash was unchanged ($P>0.05$) among the treatment groups compared to control group.

Carcass characteristics

The carcass characteristics were evaluated by measuring the dressing percentage, weight of major meat cuts of chicken, organs weight and abdominal fat weight both in control and treatment groups (Table 5). Most of the carcass parameters remain unchanged ($P>0.05$) upon dietary treatments with mahogany and chalta leaves except dressing percentage, drumstick weight and heart weight which were differed significantly ($P<0.05$). Compared to control (55.78%), dressing percentage was higher ($P<0.01$) in T_2 group. Drumstick weight was significantly higher in ($P<0.01$) T_3 group (9.42 gm in T_3 vs. 8.29 gm in control). The heart weight was lower in T4 group (0.47 gm in T_4 vs. 0.62 gm in control).

Table 3.Effects of dietary supplementation of mahogany and chalta leaves on serum biochemical parameters in broiler.

Parameters	Control	Treatments			SEM	P value
	T_1	T_2	T_3	T_4		
Cholesterol (mg/dl)	178.73	181.67	199.20	176.90	13.00	0.68
Triglyceride (mg/dl)	71.83	71.83	80.20	93.93	24.18	0.90
HDL (mg/dl)	47.00^{c}	55.67^{ab}	49.33^{bc}	58.67^{a}	1.85	0.01
LDL (mg/dl)	117.37	111.63	133.83	99.45	8.77	0.21

The values denoted by superscripts in the same row differ significantly. Data are obtained from the mean value of 3 replications with 8 birds per replication (n = 24). Dietary treatment groups are: T_1 = Control (basal diet), T_2 = 0.4% dried mahogany leaves in ration, T_3 = 0.4% dried chalta leaves in ration and T_4 = 0.2% dried mahogany + 0.2% dried chalta leaves. SEM: Standard error of means.

Table 4.Effects of dietary supplementation of mahogany and chalta leaves on proximate components of broiler meat

Parameters	Control	Treatments			SEM	P Value
	T_1	T_2	T_3	T_4		
Dry matter (%)	24.07^{a}	22.57^{b}	23.37^{ab}	23.99^{a}	0.24	0.01
Crude protein (%)	20.66^{b}	19.75^{b}	22.07^{a}	20.43^{b}	0.23	0.003
Ether extract (%)	0.73^{b}	0.60^{b}	0.51^{b}	1.72^{a}	0.07	<0.001
Total ash (%)	1.11	1.09	1.14	1.10	0.02	0.71

The mean values denoted by superscripts in the same row differ significantly. Data are obtained from the mean value of 3 replications with 2 birds per replication (n = 6). Dietary treatment groups are: T1 = Control (basal diet), T2 = 0.4% dried mahogany leaves in ration, T3 = 0.4% dried chalta leaves in ration and T4 = 0.2% dried mahogany + 0.2% dried chalta leaves. SEM: Standard error of means.

Oxidative stability of meat

The oxidative stability of meat was determined by measuring the TBARS values of meat from different treatment groups after keeping the breast meat of broiler at 4^0 C for 3 weeks are shown in (Table 6). Insignificant differences in TBARS values were observed in fresh meat among the groups whereas the values in treatments were decreased ($P<0.05$) after keeping for 3 or more days suggesting that dietary treatment with mahogany and chalta leaves protected oxidative rancidity of broiler meat. The meat was more stable in treatment group T_4 in terms of oxidative rancidity.

Cost-benefit analysis

In cost-benefit analysis, considered expenses variable parameters like cost for feed, vaccine and medicine. The study also considered selling price of birds are only income source. Since expenses in many sectors such as manpower, housing, electricity, water etc. and earnings from manure are common to all groups, they have not been considered them in cost-benefit analysis. Therefore, cost-benefit is not an absolute calculation rather is a comparative difference among the dietary studied. It revealed that, the net profit was significantly ($P<0.01$) higher is all treatment groups and it was highest in T_4 (Tk. 42.35/ Kg live weight) (Table 7).

Table 5.Effects of dietary supplementation of mahogany and chalta leaves on carcass characteristics of broiler.

Parameters (Relative weight in %)	**Control**	**Treatments**			**SEM**	**P Value**
	T_1	**T_2**	**T_3**	**T_4**		
Dressing percentage	55.78^b	54.87^b	57.48^a	55.32^b	0.27	0.001
Breast meat weight (%)	12.34	11.19	11.77	12.31	0.71	0.69
Thigh weight (%)	10.29	10.45	10.13	9.88	0.37	0.74
Head weight (%)	2.72	3.03	3.00	2.78	0.09	0.15
Drumstick weight (%)	8.29^c	8.86^b	9.42^a	8.37^c	0.10	<0.001
Heart weight (%)	0.62^a	0.51^a	0.63^a	0.47^b	0.02	0.01
Liver weight (%)	2.09	2.05	2.04	2.42	0.15	0.42
Gizzard weight (%)	3.61	3.71	3.58	3.23	0.15	0.31
Spleen weight (%)	0.09	0.08	0.07	0.07	0.01	0.24
Bursa weight (%)	0.23	1.11	0.25	0.24	0.24	0.46
Abdominal fat weight (%)	0.93	0.72	0.69	0.72	0.20	0.84

The mean values denoted by superscripts in the same row differ significantly. Data are obtained from the mean value of 3 replications with 2 birds per replication (n = 6). Dietary treatment groups are: T1 = Control (basal diet), T2 = 0.4% dried mahogany leaves in ration, T3 = 0.4% dried chalta leaves in ration and T4 = 0.2% dried mahogany + 0.2% dried chalta leaves. SEM = Standard error of means.

Table 6.Effects of dietary supplementation of mahogany and chalta leaves on thiobarbituric acid reactive substances (µmol MDA/100g of meat)

Parameters	**Control**	**Treatment**			**SEM**	**P Value**
	T_1	**T_2**	**T_3**	**T_4**		
Fresh	1.66	1.04	0.91	0.81	0.25	0.52
Day 3	3.62^a	1.97^b	1.35^b	0.87^b	0.40	0.02
Day 5	4.35^a	3.12^{ab}	2.59^{bc}	1.25^c	0.41	0.01
Day 7	5.31^a	3.78^{ab}	2.33^b	1.54^b	0.63	0.02
Average	3.73^a	2.48^b	1.80^{bc}	1.12^c	0.30	0.002

The mean values denoted by superscripts in the same row differ significantly. Data are obtained from the mean value of 3 replications with 2 birds per replication (n = 6). Dietary treatment groups are: T1 = Control (basal

diet), T2 = 0.4% dried mahogany leaves in ration, T3 = 0.4% dried chalta leaves in ration and T4 = 0.2% dried mahogany + 0.2% dried chalta leaves. SEM = Standard error of means. MDA = malondialdehyde.

Table 7.Cost benefit analysis of broiler diets supplemented with dry mahogany and chalta leaves.

Parameters	**Control**	**Treatment**			**SEM**	**P Value**
	T_1	**T_2**	**T_3**	**T_4**		
Live weight (g)	942.08[b]	1182.92[a]	1169.57[a]	1253.75[a]	30.44	0.002
Feed intake/bird (g)	2040.21[b]	2324.13[a]	2354.54[a]	2281.13[a]	38.52	<0.001
Feed cost/bird (Tk)	77.53[b]	88.32[a]	89.47[a]	86.68[a]	1.46	<0.001
Chick, vaccines and medicine cost	60.00	60.00	60.00	60.00	0.00	
Total cost	137.53[b]	148.32[a]	149.47[a]	146.68[a]	1.46	<0.001
Selling price (TK.)	150.73[b]	189.27[a]	187.13[a]	200.60[a]	4.87	0.002
Net profit (Tk.)	13.21[b]	40.95[a]	37.66[a]	53.92[a]	5.16	0.01
Net profit/ kg (Tk.)	14.00[b]	34.50[a]	32.11[a]	42.35[a]	3.51	0.004

The mean values denoted by superscripts in the same row differ significantly. Data are obtained from the mean value of 3 replications with 8 birds per replication (n = 24). Dietary treatment groups are: T1 = Control (basal diet), T2 = 0.4% dried mahogany leaves in ration, T3 = 0.4% dried chalta leaves in ration and T4 = 0.2% dried mahogany + 0.2% dried chalta leaves. SEM = Standard error of means.

4. DISCUSSION

In this study, the effect of mahogany and chalta leaves on growth performances such as live weight, weight gain, feed intake and FCR, blood serum parameter, chemical composition and stability of meat and carcass characteristics were investigated. Globally many studies have been conducted using various parts of mahogany and chalta trees. The exclusive use of only leave portion and combining with chalta leaves produced a new dimension in this study. Moreover, investigating meat quality and stability of meat added further insights in this study. As far we explored, the effect of mahogany and chalta leaves on broiler performance have not studied yet in Bangladesh. The average body weight was remarkably increased in treatment groups in comparison to control groups. The highest body weight gain observed at treatment groups supplemented with mahogany and chalta leaves might be due to having growth boosting properties in their contents. A study by Abdel-Wareth et al. (2014) observed an increase in growth of rabbit by diet supplemented with 35% and 65% of African mahogany (*Khaya senegalensis)* leaf meal. The performance parameters and carcass criteria, including daily body weight gain, final body weight, and the percentage of dressing, were increased in rabbits fed 35% African mahogany (*Khaya senegalensis)* leaf meal when compared to the control group.

In addition to enhancement of growth and performance, oral administration of ethanolic extract of *Khaya senegalensis* at a dose rate of

50 mg/kg body weight showed a significant decrease ($P<0.05$) in blood glucose level, although the extract had no effect on the lipid profile or body weight of rabbits (Essé Agossou, 2015). Daily oral administration of *Dilleniaindica* methyl extract (250 and 500 mg/kg body weight) in mice showed beneficial effects on blood glucose level and body weight gain (Yeshwante et al., 2009).The better body weight gain in our research by the inclusion of mahogany leaves could be attributed to the presence of polyphenolic compounds (tannins, anthocyanins, leuco anthocyanin) of saponins, steroids and anthracene compounds (o-glycosides).

Like mahogany popular leaf of meliaceae family the neem(*Azadirachtaindica)* showed enhanced broiler performance when supplemented in feed at a dose rate of 1-3 gm dried leaf powder per kg of ration. The neem leaf fed groups showed a significant increase in live body weight, weekly weight gain and feed efficiency as compared to the control group (Wanker et al., 2009). The increased performance by supplementing neem leaf could be due to antimicrobial and anti-

protozoal properties of neem leaves, which might help to reduce the microbial load of birds and improved the feed consumption and feed efficiency of the birds. A study by Kannan et al.(2019) showed quite relevance with this information where they applied 0, 0.25, 0.5, 0.75 and 1% neem powder added to the basal diet. At the end of the study, dietary supplementation of 0.5% neem leaf powder induced significant improvement in body weight up to fourth weeks of age of Japanese quail.
In the current study result showed that highest overall body weight gain observed in treatment groups fed mahogany and chalta mixed dry leaves powder. It could be due to phytochemicals contents having numerous biological properties including antimicrobial, antioxidant, anti-stress and immune enhancement effects (Hashemi and Davoodi, 2010).

In present study, the feed intake increase was highly significant (P<0.001) among the different dietary treatment groups. Mahmud et al. (2015) found an increase feed intake by dietary inclusion of neem leaf meal on Japanese quail. The higher feed intake observed in this research by inclusion of mahogany and chalta might be due to pharmacological effect of these leaves on digestive system by bioactive compound (Obikaonu, 2012).

The FCR shows a significant decreased in all dietary group compared to control where lowest FCR value was obtained in group fed on mahogany and chalta mixed dry leaves powder containing ration. It may be due to the presence of phytochemicals. In accordance with our study, feed efficiency was improved in Japanese quail fed on neem supplemented ration (Mahmud et al., 2015). The improvement of feed efficiency by mahogany and chalta might be due to having polyphenolic compounds which may increase the activity of digestive enzymes, decrease pathogenic microorganisms and inhibits toxins present in feed (Younan et al., 2019).

According to the serum parameters in the study, a significant increase in HDL level were found in all treatment groups. Although it is unclear to us how HDL increased by mahogany and chalta feeding in broiler, phytochemicals present in these plants may contribute in alteration of lipid metabolism (Nath and Kumar, 2021) and thereby increase HDL.

Proximate analysis for meat composition showed that crude protein and ether extract were higher in chalta and mahogany and chalta mixed leaves treated group compared to control. It may be because of synergistic effects different bioactive compounds and plant phytochemicals.
The chalta leaf containing ration fed group of broiler birds exhibited a significant increase in dressing percentage, drumstick weight and heart weight. Previous study of Shafey et al. (2013) based on supplementing ethanoic extract of olive leaf extract in broiler showed a significant difference in carcass characteristics. The increased dressing percentage and some selective organ weight might be due to relative increased in body size among chalta leaf fed group.

In the current study, diet containing dried mahogany and chalta leaves significantly reduced overall TBARS value compared to control in breast meat when stored 4°C for 3 to7 days. Chalta (*Dilleniaindica*) and mahogany (*Swieteniamacrophylla*) leaves are a good source of antioxidant and also have free radical scavenging activity (Yp and Urooj, 2015) that might have contributed to these results.

A significant high net profit was obtained from all dietary treatment groups in comparison with control (P<0.001) group. The highest net profit was recorded from group fed with 0.2% dry mahogany and 0.2% chalta mixed leaves. Actually, better profit in treatment groups might resulted in yielding better body weight gain and improved feed efficiency.

5. CONCLUSION

The study investigated the dietary effects of dried mahogany and chalta leaves supplementation on growth performance, carcass characteristics, biochemical parameter and oxidative stability of meat in broiler. It was revealed that, there was a positive relationship between of dried mahogany and chalta leaves supplementation and growth performance of commercial broiler. Statistically remarkable results were found on growth, FCR, and oxidative rancidity of meat in treatment group supplemented with dried leaf meal. The blood HDL level also increased in treatment group

whereas LDL level recorded low compared to control group. In case of chemical composition of meat, there was a significant increase in crude protein and ether extract contents in treatment group while dry matter increased in control group. A significant reduction of TBARS of meat derived from broiler fed mahogany and chalta leaves was found, suggesting the antioxidant potentials of these leaves. The inclusion of mahogany and chalta in broiler diet significantly improved growth performances, contributed meat and carcass quality, and inhibited the oxidative rancidity. These plants are also good sources of phytochemicals such as flavonoids, saponins, tannins, alkaloids etc. that are potential for maintaining intestinal microflora. This study therefore, suggesting that dried mahogany and chalta leaves might be potential feed supplements for broiler as it is grown everywhere in Bangladesh. However, a long-term investigation with larger sample size and multidimensional temporal pattern is suggested for increasing sensitivity and validity of the study under field condition.

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REFERENCES

Abbas, T. 2013. The use of *Moringa oleifera* in poultry diets. Turkish Journal of Veterinary and Animal Sciences, 37: 492–496.

Abdel-Wareth, A.A.A., Hammad, S. and Ahmed, H. 2014. Effects of *Khaya senegalensis* leaves on performance, carcass traits, hemtological and biochemical parameters in rabbits. EXCLI Journal, 13: 502–512.

Agossou, E., Ahpkpe, M., Behanzin, J. and Takin, M. 2015. Effect of the Ethanolic Extract of *Khaya senegalensis* on Some Biochemical Parameters on Rabbit's in Glucose Overload Condition. American Journal of Plant Sciences, 6(1): 240-248

Alam, M.B., Hossain, M.S. andHaque, M.E. 2010.Evaluation of antimicrobial and toxicity of different fractions of *Dilleniaindica* Linn. bark extract.Journal of Global Pharma Technology, 2: 975–8542.

Amritveer, B., Niazi, J., Bajwa, N., and Singh, P. A. 2016. A review update on *Dilleniaindica* F. elongata (Miq.) Miq. Journal of Drug Delivery & Therapeutics, 6(2): 62-70.

Bolukbasi, S. C. and Erhan, M. K. 2007. Effect of dietary thyme (Thymus vulgaris) on laying hens performance and *Escherichia coli* (E. coli) concentration in feces. International Journal of Natural and Engineering Sciences, 1 (2): 55-58.

Ch'ng, Y. S., Loh, Y. C., Tan, C. S., Ahmad, M., Asmawi, M. Z., Wan Omar, W. M. and Yam, M. F. 2018. Vasodilation and antihypertensive activities of *Swieteniamacrophylla* (Mahogany) seed extract. Journal of Medicinal Food, 21(3): 289-301.

Daramola, O. T. 2019. Medicinal plants leaf meal supplementation in broiler chicken diet: effects on performance characteristics, serum metabolite and antioxidant status. Animal Research International, 16(2): 3334-42.

Das, A., Sunilson, J. A. J., Gopinath, R., Radhamani, S. and Nilugal, K. 2009. Antinociceptive Activity of the Fruits of *Swieteniamacrophylla* King. Journal of Pharmacy Research, 2(9): 1367-1369.

Hashemi, S. R. and Davoodi, H. 2010. Phytogenics as New Class of Feed Additive in Poultry Industry. Journal of Animal and Veterinary Advances, 9: 2295–2304.

Hossain, M. 2015.Silviculture of Plantation Tress of Bangladesh. Arannayk Foundation.Dhaka, 361.

Kumar, D, Mallick, S, Vedasiromoni, J. R. and Pal, B. P. 2010. Anti-leukemic activity of *Dilleniaindica* L. fruit extract and quantification of betulinic acid by HPLC. Phytomedicine, 17(6): 431–435.

Kumar, S., Kumar, V. and Prakash, O. 2011. Antidiabetic, hypolipidemic and histopathological analysis of *Dilleniaindica* (L.) leaves extract on alloxan induced diabetic rats. Asian Pacific Journal of Tropical Medicine, 4(5): 347–352.

Liangpanth, M. and Tongdeesoontorn, W. 2018. Antioxidant and antimicrobial properties of cashew (*Anacardiumoccidentale* L.) leaf extracts. In The International Conference on Food and Applied Bioscience, pp. 154-162.

Mahmud, M., Peter, S., James, G. and Wosilat, A. 2015. Growth performance of growing quails (*Coturnix japonica*) fed graded levels of Neem. International Journal of Applied Research, 1: 4–7.

Moghadamtousi, S. Z., Goh, B. H., Chan, C. K., Shabab, T. and Kadir, H. A. 2013. Biological activities and phytochemicals of

Swieteniamacrophylla King. Molecules, 18(9): 10465-10483.

Nath,S. and Kumar, A. 2021. Role of Flavonoids in Poultry Nutrition. Acta Scientific Veterinary Sciences, 3:88–91.

Obikaonu, H. 2012. Evaluation of the nutritional value of Neem (*Azadirachtaindica*) leaf meal on the performance of finisher broilers, 15: 1235–1239.

Odukoya, A. A. 2019. Biochemical response of weanling wistar rats administered crude extracts of *Moringa oleifera* (Lam) leaf (Doctoral dissertation).

Okpashi, V.E., Bayim, B.P. and Obi-abang, M. 2014. Comparative Effects of Some Medicinal Plants: *Anacardiumoccidentale*, *Eucalyptus globulus*, *Psidiumguajava*, and *Xylopiaaethiopica* Extracts in Alloxan-Induced Diabetic Male Wistar Albino Rats. Biochemistry Research International, 2014:1-13.

Patel, D. K., Prasad, S. K., Kumar, R. and Hemalatha, S. 2012. An overview on antidiabetic medicinal plants having insulin mimetic property. Asian Pacific Journal of Tropical Biomedicine, 2(4): 320–330.

Phillips, I., Casewell, M., Cox, T., Groo, B. D., Friis, C., Jones, R., Nightingale, C., Preston, R. and Waddell, J. 2004. Does the use of antibiotics in food animals pose a risk to human health? A critical review of published data. The Journal of Antimicrobial Chemotherapy, 53(1): 28–52.

Shafey, T., Al-Mufarrej, S. and Albatshan, H. 2013. Effect of Feeding Olive Leaves on the Performance, Intestinal and Carcass Characteristics of Broiler Chickens. International Journal of Agriculture and Biology,15: 585–589.

Soltan, M. A., Shewita, R. S. and El-katcha, M. I. 2008. Effect of Dietary Anise Seeds Supplementation on Growth Performance, Immune Response, Carcass Traits and Some Blood Parameters of Broiler Chickens. International Journal of Poultry Science, 7(11): 1078-1088.

Tan,S. K., Osman, H., Wong, K. C., Boey, P. B. and Ibrahim, P. 2009. Antimicrobial and antioxidant activities of *Swieteniamacrophylla* leaf extracts. Asian Journal of Food and Agro-Industry, 2(02): 181-188.

Thomke, S. and Elwinger, K. 1998. Growth promotants in feeding pigs and poultry.Growth and feed efficiency responses to antibiotic growth promotants. Annales de Zootechnie, 47(2): 85–97.

Veríssimo, Barretoa, P., Tarifa, T. and Christopher, P. 1995. Extraction of a high-value natural resource in Amazonia: the case of mahogany. Forest Ecology and Management, 72(1): 39–60.

Wanker, A., Shirbhate, R. N., Bahiram, K. B., Dhenge, S. A. and Jasutkar, R. A. 2009. Effect of Neem (*Azadirachtaindica*) leaf powder supplementation on growth in broilers. Veterinary World, 2(10): 396–397.

Yeshwante, S. B., Y., Juveka,r A. R., Pimprikar, R. B., Kakade, R. T., Tabrej, M., Kale, M. K. and Firke, S. D. 2009. Anti-Diarrheal Activity of Methanolic and Aqueous Extracts of *Dilleniaindica* L. Research. Journal of Pharmacology and Pharmacodynamics, 1(3):140–142.

Younan, G., ohamed, M. andMorsy, W. 2019. Effect of dietry supplementation of olive leaf extract on productive performance, blood parameters and carcass traits of growing rabbits. Egyptian Journal of Nutrition and Feeds, 22:173–182.

Yp, N, Urooj, A. 2015. Phytochemical, proximate composition and antioxidant potential of *Swieteniamahagoni* leaves. Asian Journal of Pharmaceutical Research, 5:161–166.