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Evaluation of dietary supplementation of fenugreek seed (*Trigonella foenum-graecum* L.) as a growth promoter in broiler diet and its impacts on growth performance, carcass quality and cost effectiveness

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ABSTRACT

This study was carried out to evaluate the efficacy of Fenugreek seeds (*Trigonella foenum-graecum* L.) on overall performance of broiler. A total of 96-day old Cobb-500 chicks were randomly divided into four dietary treatment groups namely T_0, T_1, T_2 and T_3 having three replications in each treatment group. Brooded chicks were randomly separated into replications wise separate pen to rear up to 4 weeks. Each treatment group contains 24 birds (8 birds in each replication). Experimental birds in T_1, T_2 and 3 were provided fenugreek seeds meal with 0.5%, 1% and 1.5% of feed while T_0 was provided with standard feed and considered as control group. The results of this study were indicated that final live weight gain and feed efficiency of birds was significantly ($P<0.05$) higher in T_3 compared to T_2, and T_0 respectively. The result also indicated that feed efficiency was increased at dose rate of 1.5% fenugreek seeds meal in T_3 compared to T_2, T_1 and control T_0 group respectively. In case of meat yield parameters there was significant ($P<0.05$) difference among treatment groups except liver weight. The carcass weight was significantly ($P<0.05$) higher in T_3 group compared to the control group. The lowest feed cost was found in T_0 and highest profit in T_3 group. Based on the current study, it is concluded that fenugreek seed meal at a dose of 1.5% can be used as growth promoter for the production of broiler chicken.

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Introduction

The usage of antibiotics as a growth promoter is widely banned by European Union-wide in 2006 due to their side effects on animal health and their residues in meat for human health (EU-wide, 2005). Novel and beneficial feed additives including different dietary fibers with adequate amount promotes the growth performances and maintain their immune and gut health (Jha et al., 2020; Jha and Mishra, 2021). Fenugreek is a popular medicinal plant grown in nature, mostly in India, Nepal, Pakistan, and China. Fenugreek seeds are hypoglycemic, antibacterial, anti-inflammatory, antipyretic and antimicrobial

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ingredentials seeds with multiple therapeutic impacts (Xue et al., 2007). This includes neurin, biotin, trimethylamine, and its effect on the nervous system appears to promote appetite (Al-Habori and Raman, 2002). It contains dietary proteins, carbohydrate, minerals and vitamins which are known to be a healthy source for humans as well as livestock (Michael and Kumawat, 2003).

The poultry is used as good source of meat and prepared money in crisis needs, thus giving food and economic securities to rural peoples mostly in developing countries (Mohamud et al., 2020). Broiler has a shorter life cycle and its production requires less capital compared to other meat producing animals. Since, the majority of the people irrespective of caste or religion prefer chicken meat (Mohamud et al., 2020), its demand is very high. Many illnesses such as coronary disease (Pan et al., 2012), type 2 diabetes (Pan et al., 2011), stroke (Kaluza et al., 2012), obesity (Vergnaud et al., 2010), some cancers (Ma and Chapman, 2009) and early mortality (Pan et al., 2012) have been shown to be directly linked with daily intake of red meats. As a result, global production and per capita intake of broiler meat in recent years have risen quickly (FAO, 2009).

Feed is a crucial component that influences the net return of the poultry business. In the broiler industry, feed costs are considered to be one of the greatest challenges, mainly in developing countries. It comprises around 60-80% of the total expense of poultry meat production (Thirumalaisamy et al., 2016). Protein supplementation is often essential to improve poultry performance, and this should be finished with respect to their requirements in addition to the balance of different nutrients available. The expansion of the poultry company depends to a large degree on the availability of sufficient and cost-effective high-quality feed to both farmers and consumers (Ravindran, 2013).

The research was therefore planned to forecast the impact of supplementation with Fenugreek seeds on growth efficiency, carcass characteristics, mortality, and also to assess the profitability of broiler diets.

Materials and methods

Chicken coops: Experiment shed was constructed with metal mesh and wooden materials having a compartment of housing for 8 birds. At first, the experimental house was washed and cleaned thoroughly using tap water. Ceiling, walls, and floor were thoroughly cleaned and subsequently disinfected with bleaching powder, and then the room was kept closed for two weeks. After that, the house was again disinfected with Virocid® solution 1ml/3liter water. At a same time, all feeders, drinkers and other necessary equipment were also properly cleaned, washed and disinfected with bleaching powder. After proper drying, the house was used for the birds rearing.

Source and preparation of Fenugreek seeds: Fenugreek seeds purchased from the commercial local markets of Dinajpur district in Bangladesh for incorporate in the diets of broiler chickens. Fenugreek seeds were washed with tap water and then sun dried under shade. Then the dried Fenugreek seeds were stored in sealed polyethene bags, and kept at room temperature until used in commercial diet.

Chickens: A total of ninety-six vigorous day-old Cobb-500 chicks were collected from Nourish Poultry and Hatchery Ltd., Bangladesh. The experiment was conducted for a time period of 28 days from 15 August to 12 September 2019 at Poultry Shed of Hajee Mohammad Danesh Science & Technology University, Dinajpur, Bangladesh.

Experimental design: The trial chicks were distributed randomly in four different treatment groups i.e. T_0: Only commercial diet (Control), T_1: Commercial diet + 0.5% Fenugreek seeds, T_2: Commercial diet + 1% Fenugreek seeds, T_3: Commercial diet + 1.5% Fenugreek seeds. Each treatment groups having 3 replicates of 8 chicks in each. The uniform and identical management practices were given to all groups.

Experimental diet: Ready feed was used for the experimental study. At first required amount of ready feed ingredients were weighted by digital weighing balance. Two phases (broiler-starter and broiler-grower) were used to separate the experimental duration. The broiler chicks were fed broiler starter for 0 and 14 days and broiler grower for 15 to 28 days of age. Composition of experimental diet is in Table 1.

Table 1. Calculated compositions of experimental diets

Nutrients	Amount (kg/100kg feed)	
	Starter (1-14 days)	Grower (15-28 days)
Crude protein (%)	22.0	21.00
Crude fiber (%)	3.00	3.00
Crude fat (%)	5.00	6.00
Lysine (%)	1.30	1.25
Methionine (%)	0.52	0.50
Calcium (%)	1.00	0.90
Phosphorus (%)	0.50	0.48
Moisture (%)	11.00	11.00
Metabolizable Energy, ME (kcal/kg)	3000	3100

Birds management: Initially, chicks were raised up to 7 days in the brooding house to adjust with the environmental condition and then housed on the floor and regularly handled like any other commercial broiler flock. Heating was provided by a single electric brooder, where the initial temperature was set at 35° C and decreased by 1°C per day to final temperature of 28°C at the end of experiment. Round plastic drinker and linear feeder were used at brooding period and later linear feeder was substituted by round plastic feeder. Water and feed were provided manually to the broiler as per the experimental schedule and per seven birds one drinker and feeder and were provided. During the experimental phase, all birds were subject to a continuous illumination of 23 hours and a dark phase of one hour per day. Electric bulb with 20 lux intensity was provided to the birds throughout the study. All broilers were vaccinated against New Castle (Ranikhet) Disease and Infectious Bursal (Gumboro) Disease. As a medication, in first week Gluco-C was used 50 g/L water. Water soluble vitamins and regular saline were also given for the first 3 days of brooding. Biosecurity and sanitation are strictly maintained throughout the experiment. Disinfectant was used to disinfect the shed premises regularly and foot bath was kept at the entrance of the shed area. The fumigation process was carried out before the birds arrived.

Clinical observation and recording of performances: All the birds inspected twice a day for any physical changes such as restlessness, lordosis, unusual gait, vices and depression as well as feeding. During the 28 days of experimental period, growth performance was evaluated. Before treatment, body weight was taken for each group of birds. Body weight and feed intake were documented weekly, and body gain and feed conversion were then assessed. During the entire study period, mortality was also documented.

Feed consumption: Feed consumption is the daily consumption of the feed. It has been measured on a daily basis for each treatment. The remainder of the feed was weight at the end of the day and was removed at the beginning of the day from the weight known of the feed. The total number of birds has been split. The commodity was divided by the number of birds in total. Feed intake = Feed intake in replication/ No. of birds in replication.

Body weight and gain (kg): At the beginning of the experimental trial, body weight was determined for all birds and it was performed daily at the beginning of the week at the same time. Live weight gain was determined by subtracting the live weight at the beginning of the week from the live body weight of the next week. Body Weight gain (kg) = Final weight – Initial weight.

Feed conversion ratio: Feed conversion ratio (FCR) was determined every week at the amount of feed intake per unit of body weight gain (average weekly feed consumption (g)/average weekly weight gain (g)). FCR = Feed intake (g) / Weight gain (g).

Evaluation of carcass characteristics: Prior to slaughtering, the birds were restricted to feed for 10 hours, but water was provided *ad libitum*. Two birds were randomly selected in each replication for slaughtering. The live weight of birds was taken individually before slaughtering. At the time of slaughtering, the birds were secured by holding both shanks with one hand and both wings with other hand by the help of an assistant to prevent struggling. Slaughtering was done by Halal method with sharp knife. After complete bleeding shank, head, and skin were removed. Finally, evisceration was done manually to separate liver, spleen, heart, gizzard, and meat yield.

The dressing percentage is based on the relationship between the weight of the dressed carcass and the weight of live birds after removal of things such as the hide and internal organs. The percentage of dressing can be determined by taking the carcass weight divided by the weight of live birds. Dressing percentage (%) = (Weight of the carcass (g) / Weight of live bird (g)) x 100.

Statistical analysis: The data from each procedure was collected and entered into the Excel datasheet and then exported for statistical analysis to SPSS, Version 22.0 (IBM Corp, 2013). All analyzed information were stated as Mean ± Standard Error (SE).

Results

Effect of fenugreek seeds on body weight: The effect of Fenugreek seed on body weight gain is shown in Table 2. The current research showed that there was no significant variation in initial body weight between the dietary groups ($P>0.05$), but final body weight and body weight gain were significantly differed ($P<0.05$) between the dietary groups.

Body weight gain in different dietary treatments during experimental periods, the differences were significant at $P<0.05$. The initial body weight was in T_0 (38.16±0.60), T_1 (39.20 ± 0.49), T_2 (39.26 ± 0.60), and T_3 (40.16 ± 0.57) respectively. At 7 days of age, the body weight was almost similar in all dietary groups. Significant different ($P<0.05$) were found at 14 days, 21 days and 28 days of age. The highest body weight gain was observed in treatment group T_3, followed by T_2, T_1 and T_0 respectively.

Table 2. Effect of dietary fenugreek seed meal supplementation on body weight of broiler chicken

		Body weight gain				
	Initial BW	7 d	14 d	21 d	28 d	1-28 d
T_0	38.16 ± 0.60	155.81 ± 2.02	185.57 ± 1.18^{a}	395.43 ± 1.79^{a}	475.44 ± 1.74^{a}	1250.41 ± 7.33^{a}
T_1	39.20 ± 0.49	156.42 ± 1.22	185.11 ± 19.01^{a}	414.26 ± 2.63^{b}	498.49 ± 1.42^{b}	1293.48 ± 24.77^{b}
T_2	39.26 ± 0.60	158.71 ± 0.89	212.88 ± 1.83^{ab}	431.81 ± 1.44^{c}	519.37 ± 4.87^{c}	1362.03 ± 9.63^{c}
T_3	40.16 ± 0.57	159.64 ± 0.89	230.46 ± 1.45^{b}	448.14 ± 1.56^{d}	539.28 ± 1.50^{d}	1417.68 ± 5.97^{d}
P value	NS	NS	*	*	*	*

a, b, c, d = means within a column without common superscripts differ significantly. BW = body weight. NS = non-significant; statistically significant difference are expressed as. * = P<0.05.

However, with the rise in age, there was a pattern of rising live weight (P<0.05). There was a tremendous increase of live weight for increasing Fenugreek seed at 14, 21, and 28 days of age in all treatment groups. The outcome of this study showed that 0.5%, 1% and 1.5% fenugreek seed supplementation of broiler diets resulted in increase in live weight than 0% fenugreek seed in broiler seeds. The broiler of T_3 and T_2 group was significantly higher in average of weekly live weight gain compared to T_1 and T_0. During the finisher and complete times, significant differences were detected in body weight gain.

Effect of fenugreek seed on feed consumption: Feed consumption (FC) values for day-old broiler supplemented with experimental diets are presented in Table 3. The highest values were recorded by birds fed with 1.5 percent fenugreek seed, but birds with 0.5 percent and 1 percent had the lowest values compared to the control group. Feed intake in different dietary treatments during experimental periods was almost statistically difference and the values were significant (P<0.05). The total feed intake was T_0 (1816.36±7.49), T_1 (1848.62±7.59), T_2 (1904.14±8.72) and T_3 (1928.03±5.94). So, inclusion of Fenugreek seeds in broiler diet resulted in increase in feed consumption at 7, 14, 21 and 28 days of age (P<0.05). It was found that at 0.5%, 1% and 1.5% dietary Fenugreek seeds group consumed the highest amount whereas lowest in control diet.

Effect of fenugreek seeds on feed conversion ratio: Weekly FCR of broilers on different dietary fenugreek seed differed (P<0.05) during 21 and 28 days of age. There are no significant differences were observed between control and treatment groups at the 7 and 14 days age. (Table 4)

Table 3. Effects of dietary fenugreek seed meal supplementation on feed intake in broiler chickens

	Feed intake (g)				
	7 d	14 d	21 d	28 d	1-28 d
T_0	160.48 ± 1.20^{a}	256.09 ± 1.14^{a}	601.05 ± 3.61^{a}	798.74 ± 1.54^{a}	1816.36 ± 7.49^{a}
T_1	159.55 ± 0.87^{a}	268.37 ± 1.76^{b}	613.10 ± 2.94^{b}	807.60 ± 2.02^{b}	1848.62 ± 7.59^{b}
T_2	165.06 ± .66^{b}	283.23 ± 2.10^{c}	630.44 ± 1.59^{c}	825.41 ± 3.37^{c}	1904.14 ± 8.72^{c}
T_3	170.81 ± .35^{c}	290.38 ± 1.03^{d}	636.35 ± 2.12^{c}	830.49 ± 1.44^{c}	1928.03 ± 5.94^{d}
P value	*	*	*	*	*

a, b, c, d = means within a column without common superscripts differ significantly. Statistically significant difference is expressed as * = P<0.05.

Table 4. Effects of dietary fenugreek seed meal supplementation on feed conversion ratio in broiler chickens

	FCR (%)				
	7 d	14 d	21 d	28 d	1-28 d
T_0	1.02 ± 0.02	1.38 ± 0.01	1.52 ± 0.01^{c}	1.67 ± 0.01^{c}	1.45 ± 1.02^{d}
T_1	1.02 ± 0.01	1.48 ± 0.17	1.48 ± 0.01^{b}	1.62 ± 0.01^{b}	1.42 ± 0.30^{c}
T_2	1.04 ± 0.01	1.33 ± 0.02	1.46 ± 0.01^{b}	1.59 ± 0.01^{b}	1.39 ± 0.90^{a}
T_3	1.07 ± 0.01	1.26 ± 0.01	1.42 ± 0.01^{a}	1.53 ± 0.01^{a}	1.36 ± 0.99^{b}
P value	NS	NS	*	*	*

a, b, c, d = means within a column without common superscripts differ significantly. NS = non-significant; statistically significant difference are expressed as * = P<0.05.

Table 5. Effects of dietary fenugreek seed meal supplementation on meat yield in broiler chickens

			Organs		
	Live weight	Carcass weight	Liver weight	Heart weight	Gizzard
T_0	1250.41 ± 7.33[a]	662.79 ± 1.39[a]	32.60 ± 1.08	4.32 ± 0.06[ab]	33.26 ± 0.70[a]
T_1	1293.48 ± 24.77[b]	719.19 ± 2.62[b]	33.42 ± 0.78	4.30 ± 0.02[a]	35.12 ± 0.55[a]
T_2	1362.03 ± 9.63[c]	778.31 ± 2.05[c]	32.18 ± 0.98	4.45 ± 0.03[b]	38.45 ± 0.88[b]
T_3	1417.68 ± 5.97[d]	850.67 ± 1.01[d]	34.26 ± 0.58	4.65 ± 0.02[c]	40.66 ± 0.45[c]
P value	*	*	NS	*	*

a, b, c, d = means within a column without common superscripts differ significantly. NS = non-significant. Statistically significant difference are expressed as *(P<0.05).

Effect of fenugreek seed on carcass quality and mortality of broiler: The effect of Fenugreek seeds on final live weight, dressed weight, heart, liver and gizzard of broiler is presented in Table 5. The highest final live weight was observed in T_3, followed by T_2, T_1 and the lowest T_0. The dressed weight was significantly higher in T_3 and T_2 group compared to 1 and T_0. The morality of broiler was seen only in T_0 i.e., 4.17%.

Cost-effectiveness of broiler production: The total rearing costs of broiler are kept under different treatment groups T_0, T_1, T_2 and T_3 was TK. 123,904, TK. 125,312, TK. 127,776, and TK. 128,832 respectively. Where, miscellaneous cost summed up TK. 8 per broiler, which included the estimated cost of electricity, labor, litter, and disinfectant. The average live weight/broiler in group T_0, T_1, T_2 and T_3 was 1.25 kg, 1.29 kg, 1.36 kg, and 1.41 kg respectively. The broiler was sold in live weight basis at the rate of Tk. 130/kg. The net profit/Kg live weight in the T_0, T_1, T_2 and T_3 group was found to be TK. 31.2, TK. 33.33, TK. 36.76, and TK. 39.71 respectively. The level of fenugreek seeds used in the ration exhibited their effect on the profit margin of the broiler. Cost of different groups of bird is shown in Table 6.

Discussion

Live weight: The increase in the live weight of broilers in the current experiment for the inclusion of fenugreek seeds in the diet correlates with the findings stated by Qureshi et al. (2015). They indicated that the addition of either whole, crushed or powder type of fenugreek seeds increased the live weight of broilers at different levels in broiler diets. The increase in the live weight of fenugreek seeds broilers may be due to the fact that fenugreek seeds contain essential fatty acids and high-quality proteins (Żuk-Gołaszewska and Wierzbowska, 2017) and has a stimulating impact on broiler villus height of the digestive system (Mamoun et al., 2014; Mahmood et al., 2015).

The findings obtained are consistent with those of El-Ghamry et al. (2004), who found the fenugreek additions at 1.5% level had significantly ($P < 0.05$) higher live body weight and body weight gain than those fed on control diet. Similarly, Morsy (1995) recorded that there was a substantial improvement in live body weight and body weight gain of Hubbard broiler chicks fed 500 g fenugreek per ton diet.

Table 6. Economics of broiler production kept under different treatment groups from day old chick to 28 days of age

Dietary groups with fenugreek seed (%)				
Parameters (TK)	T_O	T_1	T_2	T_3
Chick cost	26	26	26	26
Vaccine + medicine	10	10	10	10
Feed price/kg	44	44	44	44
Miscellaneous cost/ chick	8	8	8	8
Feed cost/ kg production	79904	81312	83776	84832
Total cost Tk. /broiler production	123904	125312	127776	128832
Average live weight (kg)/broiler	1.25	1.29	1.36	1.41
Sale price Tk./kg	130	130	130	130
Sale price /broiler	162.3	168.4	177	184.4
Net profit Tk./broiler	39	43	50	56
Profit/kg live weight	31.2	33.33	36.76	39.71

In term of organs, in our study liver weight changed non-significantly which is similar to the study of Abbas (2010) and the weight of heart and gizzard were changed which is opposite to the finding of Weerasingha and Atapattu (2013).

Feed consumption: Compared to the control group, birds fed 0.5%, 1% and 1.5% fenugreek showed the highest values, which may be due to the shift in feed taste, as stated by Stukie (1986), who suggested that birds have a sense of taste. Hernández et al. (2004) indicated that the change may be due to the presence of fatty acids or to the relaxing impact on the digestive system due to fenugreek diets. It is possible to assess the positive impact of fenugreek seed on feed intake on the basis of various perspectives that fenugreek has improved palatability as a natural feed additive and could be linked to carbohydrates and their main components, galactomannan, which stimulate the appetizing and digestive process. Michael and Kumawat (2003); Alloui et al. (2012) and are in agreement with this outcome. They stated that neurin, trimethylamine, and biotin are also found in fenugreek, which helps to stimulate appetite through their action on the nervous system.

Feed conversion ratio (FCR): The results of Abu-Dieyeh and Abu-Darwish (2008) agree with this finding. Fenugreek seed feed efficiency improvement may be linked to the production of gastrointestinal tissue morphological changes in broiler chick gut (Alloui et al., 2012; Amal et al., 2013; Weerasingha and Atapattu, 2013). Morphological variations in gastrointestinal tissues can be caused by differences in the microbial content of the intestines, including their metabolites (Xu et al., 2003). Yadav and Jha (2019) also mentioned in their study, gut microbiota and their metabolic products improve absorption and nutrient utilization in poultry.

Meat yield characteristics: Mamoun et al. (2014) reported that the 1% level supplementation of fenugreek seeds in the broiler chicken diet caused substantial improvements in the percentage of carcass and intestinal length. Due to the inclusion of fenugreek seeds in diet, a major impact on the digestive parts seen, increase in weight and length of intestines has been reported (Duru et al., 2013). However, Weerasingha and Atapattu (2013) reported that fenugreek seed supplementation had no significant impact on intestinal length per 100g of body weight when measured. In addition, Bhaisare et al. (2014) observed that dietary inclusion of Fenugreek seeds at 0.5% level in the eight-week diet of Nandanam Turkey poults resulted in substantial improvement in dressed weight ($P<0.05$) and attributed it to fenugreek's antimicrobial properties. Contact between digesta and mucosal epithelium might prolong the positive impact on intestinal morphology, which may be more efficient for nutrient absorption (Bogusławska-Tryk et al., 2012).

Conclusions

Based on the findings of the current experiment, it can be concluded that the seeds of fenugreek have a major impact on poultry production. The results of the study also indicate that the 1.5% dietary supplementation of fenugreek seeds has a high potential as a commercial application for broiler production efficiency. However, to clarify the active principle(s) of antimicrobial activity and other beneficial effects of fenugreek seeds, more research needs to be performed.

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