

Research Article**Comparative performance of different feeding systems for raising turkey (*Meleagris gallopavo*) in the rural areas of Bangladesh**

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ABSTRACT

Turkey is a newly introduced poultry species which has recently been considered as one of the important sources of the leanest meats and eggs for human consumption. This study aimed to investigate if different feeding regimens had different effects on the productive performance of turkey. A total of 18 day-old unsexed turkey poults were divided into three different dietary treatment groups designated as T₁ (Commercial broiler feed + cabbage leaves), T₂ (Wheat and rice polish + cabbage leaves) and T₃ (Maize and rice polish + cabbage leaves) having six poults per treatment. Irrespective of sex, each bird in every pen was considered as the replicate and measurements were taken individually. Each group was offered equal amounts of feeds. The feed intake was recorded daily and the body weight was measured at two weeks interval up to the 8th week. Different dietary treatments exhibited significantly different live weight (LW), average daily gain (ADG) and feed efficiency (FE) at the end of the 2nd (p<0.01), 4th (p<0.001), 6th (p<0.001) and the 8th week (p<0.001). Supplementation of commercial broiler feed with cabbage leaves (T₁) substantially improved (p<0.001) final body weight, ADG and FE throughout the trial period compared with birds in the other groups. However, the maximum profitability calculated in terms of net profit per kg of live bird was recorded in the T₂ group (94.6 BDT/kg live bird) close to T₁ group (94.5 BDT/kg live bird) and the least profitability was recorded in the T₃ group (82.6 BDT/kg live bird) due to an extremely lower live weight gain of the birds regardless of the least cost of feed used in T₃. Therefore, commercial broiler pellet, as well as traditional wheat-rice polish-vegetable based feeding systems, may be suggested for turkey production in the rural areas of Bangladesh.

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1. INTRODUCTION

Turkey (*Meleagris gallopavo*) is a popular poultry species which is gaining popularity

among the rural farming community of Bangladesh for its higher meat production potential and preference over chicken meat with a change of taste and mood of the festival

(Asaduzzaman et al., 2017). Turkey belongs to the family *Meleagrididae*. The young turkey is commonly called poults, the male turkey is referred to as tom while the female turkey is called hen. There are two different breeds of turkey, i.e., domesticated broad-breasted and non-broad breasted or wild turkey and some other varieties such as black, bourbon, bronze, narragansett, royal palm, slate and white turkeys (Okeniyi and Raji, 2017). The farmers who are raising turkey have recently identified it as a good source of income generation (Soliven, 1984; Peter, 2006; Sampath et al., 2012; Yassin et al., 2013; Asaduzzaman et al., 2017; Hamid et al., 2017, Miah et al., 2020). The turkey has a faster growth potential like commercial broiler chicken which is suitable for slaughter within a short period (Karki, 1970; Ojewola et al., 2002; Biggs and Parsons, 2009; Jankowski et al., 2014; Okeniyi and Raji, 2017). Turkey farming for meat production is very popular than egg production in Bangladesh. The meat of turkey may be considered as one of the best options for alternative protein sources in Bangladesh since the meat has less amount of fat than the meat of other poultry species (Asaduzzaman et al., 2017). Turkey production is an important and highly profitable agribusiness because of its wide range of adaptability (Ogundipe and Dafwang, 1980) and resistance to the common tropical diseases (Sharma, 1997; Yakubu et al., 2013). The protein requirements of turkey poults are higher than the broiler chicks at the same age (NRC, 1994). Since the cost of protein supplement is very high, and readymade commercial feeds are very expensive for the rural farmers, several alternative feeding systems have been developed for reducing the feed cost of turkey production. Vegetable supplemented grain-based feeding systems have recently been popular in the rural areas of Bangladesh as an alternative to costly commercial feeds. It was argued that the dilution of a diet with whole wheat starting from 5% in starter to 35% in finisher diet could be used in turkey nutrition without affecting growth performance (Forbes and Covasa, 1995; Classen and Bennett, 1996).

The feeding behavior of turkey implies the utilization of forages and vegetables similar to ruminant livestock. They are better able to digest fiber due to large microbial population in their digestive tract (Brad et al., 2010). Therefore, unlike other species of poultry,

almost 50% of the total feed of turkey may be replaced by green vegetables and field grasses (Soliven, 1984). Limited information is available regarding performance of turkey under grain supplemented vegetable-based traditional feeding systems practiced in the rural areas. The growth performance of turkey is high in commercial pellet feed under intensive rearing system (Erener et al., 2005) but the net profit is questionable. We therefore, aimed to compare different systems of raising turkey in the rural areas of Bangladesh.

2. MATERIALS AND METHODS

Study area and duration

The present study was conducted from 1st December 2018 to 30th January 2019 in a poultry shed at Eidgah, Cox's Bazar.

Collection of poults

A total of eighteen (18) day old unsexed American Black turkey poults were purchased from the Rahaman Turkey farm, Khulshi, Chattogram, Bangladesh. All poults were examined for any abnormalities and uniform size. The poults were then transported carefully to the Cox's Bazar using regular chick cartoons.

Housing and management

The experimental shed was an open-sided tin shed house with brick cemented floor. The birds were reared on littered (rice husk) floor throughout the experimental period. Birds of different treatment groups were reared at separate sections that were prepared by using chick guards. Natural light at day time and artificial light (incandescent bulbs) at night were provided to the birds throughout the trial except the brooding when continuous artificial light was provided in addition to the day light to maintain the warmth of the brooder. Proper ventilation was maintained by using ceiling fans inside the shed and curtains on the open sides of the shed to prevent the accumulation of ammonia gas inside the shed. Standard floor, feeder and drinker space were provided to the birds throughout the experimental period.

Cleaning and Sanitation

The shed was thoroughly cleaned and washed by using tap water with caustic soda. For disinfection, phenyl solution (1% v/v) was

sprayed on the floor, corners and ceiling. Following spray, cleaning was done by using a brush and clean water. Brooding boxes, rearing cages and pens was cleaned in the same manner. After cleaning and disinfection, the house was left one week for proper drying. After drying, all doors and windows were closed. The room was then fumigated (using 35 ml of formalin to 10 g potassium permanganate per cubic meter) and then sealed for 24 hours. On the next day, lime was spread on the floor and around the shed. Footbath containing potassium permanganate (1% w/v) was kept at the entrance of the poultry shed and changed daily. Feeders were cleaned and washed with Timsen® solution (0.3% v/v) weekly before being used further. Drinkers were washed with potassium permanganate (1% w/v) and dried up daily in the morning. Separate foot wares were used inside the shed. Any unwanted openings or breakage around the shed were checked and sealed to prevent any unwanted entry, e.g., rat, mice, cats and others.

Experimental design

A total of 18-day old unsexed poultts were divided into three dietary treatment groups designated as T₁ (Commercial broiler feed + cabbage leaves), T₂ (Wheat and rice polish +

cabbage leaves) and T₃ (Maize and rice polish + cabbage leaves) having six poultts per treatment.

Experimental Diets

Commercial feed and other feed ingredients were purchased from the local market. During purchase, cleanliness and date of expiry were checked. Three different types of rations were formulated for three treatment groups, i.e., T₁ (Commercial broiler feed + cabbage leaves), T₂ (Wheat and rice polish + cabbage leaves) and T₃ (Maize and rice polish + cabbage leaves) having six poultts per treatment (Table 1). The birds of different treatments were fed these rations throughout the trial period.

Brooding

The poultts were brooded in the experimental shed following spot brooding system into separate brooders according to the treatment groups. Brooders were made up of hoover, chick guard and bulb and properly furnished with litter (rice husk), feeders and drinkers. Brooding space and number of feeder and drinker were adjusted according to the number of poultts followed by standard management conditions for turkey regularly with the age of the poultts.

Table 1. Dietary treatments of the experimental birds

Treatment groups	Age in week			
	2 nd -3 rd wk	4 th -5 th wk	6 th -7 th wk	8 th wk
T ₁ Commercial broiler feed (g)	15	30	50	65
Cabbage leaves (g)	-	-	60	80
T ₂ Wheat and rice polish (g)	15	30	50	65
Cabbage leaves (g)	-	-	60	80
T ₃ Maize and rice polish (g)	15	30	50	65
Cabbage leaves (g)	-	-	60	80

During brooding period, poultts were brooded at a temperature of 95 °F, 90 °F, 85 °F, 80 °F and 75 °F for the 1st, 2nd, 3rd, 4-7th and 8th weeks, respectively with the help of 200W incandescent bulbs. Temperature was measured by using room thermometer and then adjusted by increasing or decreasing the number of the bulb.

Feeding and watering

Feed and fresh drinking water were supplied *ad-libitum* to the birds throughout the trial period. Feed was supplied to the birds on the round small feeder for the first 7 days. Small round drinkers were used to provide fresh drinking

water in the first week. After 7th day, small round feeders and waterers were replaced by large round feeder (3 kg capacity) and round waterers (3 liter capacity) to provide for feed and water of the birds for rest of the trial period.

Vaccination and medication

All birds were vaccinated against Newcastle disease (BCRDV Live) on 4th day and then followed by booster on the 21st day. The birds were also vaccinated against fowl pox (FOWL POX vaccine) at 35 days of old. After each vaccination, multivitamin (Rena-WS, Renata; 1g/5 liter of drinking water) was supplied along

with vitamin-C to overcome the effect of stress due to vaccination.

Data collection

Live weight, weight gain, feed intake and feed efficiency (FE) of the birds were recorded at two weeks intervals. Weight gain was calculated by deducting initial body weight from the final body weight of the birds. Feed intake was calculated by deducting leftover from the total amounts of feed supplied to the birds. The FE was calculated dividing the feed intake by the weight gain.

Data analysis

Data were compiled in MS Excel. Raw data related to weight gain, feed intake and FCR were tested for outliers and multicollinearity by inter quartile range test and variance inflation factors. Normality of variable was checked by using a normal probability plot and equality of variances in the response variable was checked by the Shapiro Wilk test. Data were analyzed for ONE WAY ANOVA by using Stata 14.1 SE (Stata Corp LP, College Station, Texas, USA). Means showing significant differences were compared by Duncan's New Multiple Range

Test (Duncan, 1955). Statistical significance was accepted at $p < 0.05$ for Fisher's F-tests.

3. RESULTS

Performance

Despite the similar initial weight, turkey poults used in different dietary treatment groups exhibited significantly different live weight at the end of 2nd ($p < 0.01$), 4th ($p < 0.001$), 6th ($p < 0.001$) and 8th week ($p < 0.001$) (Table 2). Birds fed commercial broiler feed and cabbage leaves (T₁) in diet attained the highest body weight than other treatment groups and showed a substantial increase in gaining live weight in every two weeks. Among other two groups, live weight of poults offered wheat, rice polish and cabbage leaves (T₂) was found much lower than the T₁ group, but higher than the T₃ group, where birds attained the lowest body weight. Supplementation of commercial broiler feed with cabbage (T₁) substantially increased average daily gain (ADG) throughout the trial period which was significantly ($p < 0.001$) higher than the birds in other groups. Similar to live weight and weight gain, the FE was superior in T₁ followed by T₂ and T₃.

Table 2. Live weight (LW) (g/bird), average daily gain (ADG) (g/bird/day), feed intake (FI) (g/bird) and feed efficiency (FE) of turkey raised under traditional rural systems of rearing

Parameters	Age	Dietary treatments ¹			SEM ²	Significance ³
		T ₁	T ₂	T ₃		
LW (g/bird)	Initial	58.0	58.0	58.0	0.92	NS
	2 nd week	205.0	165.0	148.0	2.99	**
	4 th week	480.0	358.0	315.0	4.99	***
	6 th week	765.0	605.0	560.0	5.59	***
	8 th week	970.0	770.0	700.0	6.38	***
ADG (g/bird/day)	2 nd week	9.8	7.1	6.0	0.76	***
	4 th week	28.1	20.0	17.1	1.28	***
	6 th week	47.1	36.5	33.5	1.44	***
	8 th week	60.8	47.5	42.8	1.65	***
FI (g/bird)	2 nd week	15.0	15.0	15.0	0.00	NS
	4 th week	50.0	50.0	50.0	0.00	NS
	6 th week	110.0	110.0	110.0	0.00	NS
	8 th week	145.0	145.0	145.0	0.00	NS
FE	2 nd week	1.5	2.1	2.5	0.07	***
	4 th week	1.8	2.5	2.9	0.09	***
	6 th week	2.3	3.0	3.3	0.08	***
	8 th week	2.4	3.1	3.4	0.08	**

¹T₁= Commercial broiler feed + cabbage leaves; T₂= Wheat and rice polish + cabbage leaves; T₃= Maize and rice polish + cabbage leaves;

²SEM = Standard error of the means;

³NS = Non-significant ($p > 0.05$); * = Significant ($p < 0.05$); ** = Significant ($p < 0.01$);

*** = Significant ($p < 0.001$)

Cost-benefit analysis

Regardless of better live weight, ADG and superior FE of T₁ group, the maximum profitability calculated in terms with net profit per kg live bird was recorded in the T₂ group (94.6 BDT/kg live bird) which was almost similar to the profitability recorded in T₁ group (94.5 BDT/kg live bird) due to the lower cost of

feed used in T₂ (Table 3). Since the cost of other variables, i.e., chick, vaccine, medicine and price/kg live bird was constant for all the treatment groups, the only two variables that determined the profitability were feed cost and final live weight of the birds (Figure 1). The least profitability was recorded in the T₃ group regardless of the least cost of feed due to extremely lower live weight gain of the birds.

Table 3. Net profit analysis of turkey raised under traditional rural systems of rearing

Variables	Dietary treatments ¹			SEM ²
	T ₁	T ₂	T ₃	
Chick cost	300.0	300.0	300.0	0.00
Feed cost	852.0	545.0	488.0	113.0
Vaccination cost	40.0	40.0	40.0	0.00
Medication cost	70.0	70.0	70.0	0.00
Other costs ³	225.0	225.0	225.0	0.00
Total costs	1487.0	1180.0	1123.0	0.00
Cost/bird	247.8	196.7	187.2	18.8
Cost/kg live bird	255.5	255.4	267.4	4.0
Price/kg live bird	350.0	350.0	350.0	0.00
Price/bird	339.5	269.5	245.0	28.3
Net profit/bird	91.7	72.8	57.8	9.8
Net profit/kg live bird	94.5	94.6	82.6	4.0

¹T₁ = Commercial broiler feed + cabbage leaves; T₂ = Wheat and rice polish + cabbage leaves; T₃ = Maize and rice polish + cabbage leaves;

²SEM = Standard error of the means;

⁴Other costs = Costs of electricity, feeder, waterer, labor, depreciation of housing and other equipments.

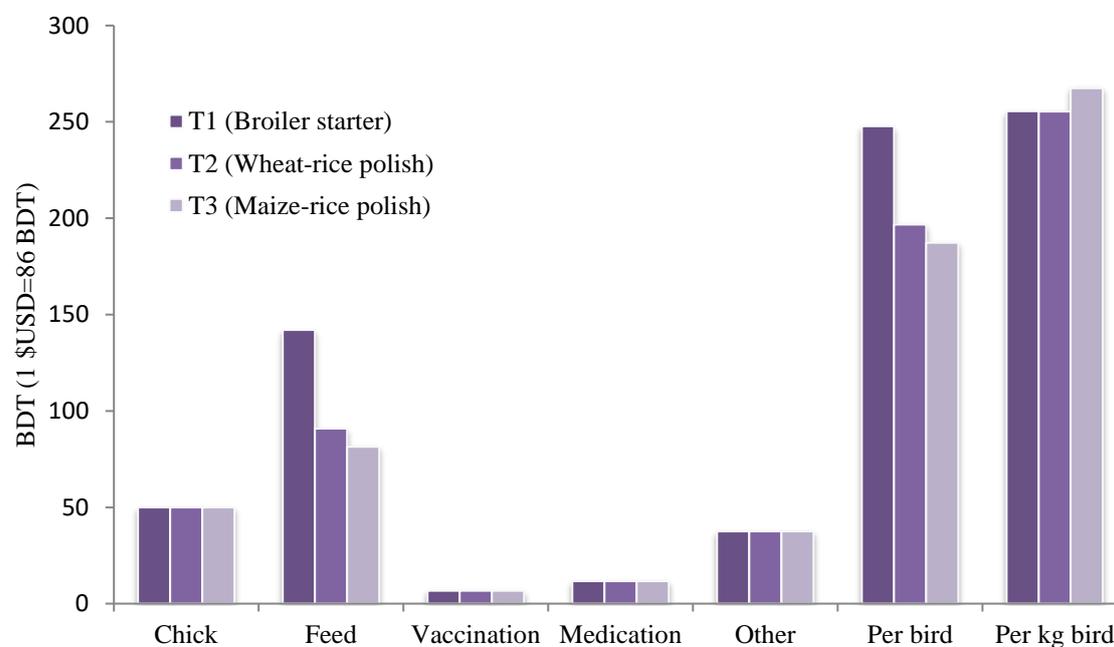


Figure 1. Comparative profile of the cost and return items for raising turkey in the rural areas of Bangladesh under traditional systems

4. DISCUSSION

In the present study, the amount feed intake in all groups of the birds was maintained similar but live weight, weight gain and FCR were found different from among the treatment groups because of the effects of differences in the nutrient composition of the feeds in each group. It was speculated that the final live weight was higher in T₁ (Commercial broiler feed + cabbage leaves) group of birds followed by the T₂ (Wheat-rice polish + cabbage leaves) and T₃ (Maize-rice polish + cabbage leaves). A similar result was reported in previous study explaining commercial pellet feed as the main responsible factor for higher efficiency in average daily gain (ADG) than broken maize and wheat-based feeding regimen in intensive rearing system (Erener et al., 2005). This is quite plausible that the pellet starter and grower feeds contain higher amounts of several nutrients, i.e., energy, proteins, vitamins, minerals, and other microelements than the single ingredients. Further, the pellet feeds are manufactured with steaming which increases palatability and digestibility due to the dilution effects (Abdollahi et al., 2010).

The live weight was also observed higher of the birds in the T₂ group than T₃ in this study. The higher weight gain perhaps was related to the fact that wheat was more palatable than maize. Similarly, the size and hardness of broken maize might have affected the final body weight because the gizzard of poults is underdeveloped at the early stage (Jin et al., 1998). Kiiskinen (1996) reported that the better result can be achieved when the whole wheat is used with starter pellets than with the grower pellets. It was further added that the use of whole wheat with pellet feeds reduced the abdominal fat of female birds from 47 to 38 g as a percentage of 2.7 to 2.3.

Our study revealed that the ADG gradually increased in T₁ group than T₂ and T₃. This could have been further due to the consumption of less amount of protein in T₂ and T₃ groups of birds than T₁. Because the protein value of the starter feed and cereal grains were different and also the nutrient contents of the starter feed were optimum for the turkey poults. This is the reason why the final weight and ADG were higher in T₁ groups. The reduced levels of protein might have impaired the early growth of turkey poults. In fact, 28 to 30% of protein is required until the

4th week for the early growth of turkey poults and that no more than 24% protein is necessary from the 6th to the 8th week. Scott et al. (1948) postulated that 20% protein level gave a similar result as 24% from the 8th to the 12th week. Therefore, it is hard to say if a 20% protein level would be satisfied after the 6th week (Atkinson et al., 1957).

Besides, feeding turkey poults with commercial starter feed compared with wheat and maize feeding can be attributed to enhancing energy to protein ratio balance for the requirements of energy and protein sources in their free choice feeding systems. Bennett and Classen (2003) found that a high level of diet dilution with wheat (21% to 29%) significantly reduced the final body weight of turkey and the weight of breast meat per bird, by 15% and 20%, respectively. Accordingly, the relative gizzard weight was increased by feeding wheat and maize in a series of studies (Bennett et al., 2002; Amerah and Ravindran, 2008; Biggs and Parsons, 2009; Jankowski et al., 2013). Gabriel et al. (2008) further suggested that the wheat grain improves gizzard function and nutrient digestibility, thus reduces the amount of substrate available for the proliferation of the intestinal microbes.

Our study demonstrated better FCR in T₁ compared with T₂ and T₃ up to 8 weeks of age. It might have been due to the higher efficiency of the birds in T₁ to convert feed to meat. Because the commercial pellet feed consists of easily digestible nutrients than wheat and maize. It seems that nutrients provided by the commercial pellet feed are more efficiently utilized than those supplied by maize and wheat. Our study exhibited better FCR in the wheat-based diet compared with maize. Similar results were reported elsewhere (Rose et al., 1986; Olver and Jonker, 1997) indicating better FCR in high protein and low energy feeds.

Feed conversion appears to be directly related to the energy level of the diet since regardless of the protein level there was an improvement in feed conversion (Atkinson et al., 1957). The low fat level of turkey meat and lowest cost of edible meat protein may appeal to the consumers and this advantage of low fat concentration in the turkey broiler is sharply reduced at 16–24 weeks of age (Shalev and Pasternak, 1989). Previous studies also reported that the turkey would

consume 2.29 to 2.45 kg of feed for 1 kg of weight gain (Kabir et al., 2014).

Tyagi (2001) suggested that turkey diet needs to have narrower energy to protein ratio as compared to chicken diet and he further reported that turkey required properly balanced diet for sustaining rapid growth and better feed efficiency. Karki (2004) observed that poor feed efficiency was associated with turkey poults fed broiler diets as compared to the standard formulation of 28% protein with 2800kcal ME up to 5 weeks and 24% protein with 2900kcal ME for 6-10 weeks. This indicated that commercially available broiler ration may not be able to sustain optimum growth of turkey, particularly at an early age due to low protein content and a wider energy ratio along with the lower percent of lysine and methionine. In general, commercial broiler starter ration has 23% protein and 2900 kcal ME (Panda et al., 1997). Sell et al. (1999) reported that the reduced level of protein can decrease the early growth in turkeys. Waitel et al. (2000) stressed that lysine and methionine are first and second limiting amino acids in soybean, corn meal diet for turkey. Alaoma (2016) added that the cumulative performance of formulated turkey feed and commercial starter or broiler feed has a different feed and nutritional value. This suggests that the nutritive values of most commercial feeds should be taken into consideration before use in turkey production.

The variations in the performance of turkey might also be due to the small variety of turkey, traditional housing systems and poor quality feed. Karki (2004) recommended that turkey could be raised under similar feed and management conditions as chicken but slow growth with poor feed efficiency was associated with the advancement of age while rearing under ordinary feed and management systems. Therefore, instead of waiting for highest body weight up to 28 weeks of age, it is better to sell turkey at 16 to 20 weeks of age to take maximum advantage of higher weight gain, higher efficiency of feed utilization and higher profit while rearing under ordinary feed and management conditions.

In the present study, the profitability analysis of the birds in the different dietary treatment groups revealed a surprising twist where the highest profitability calculated in terms of net profit/kg live bird was found in T2 group though

it did not surpass the maximum performance of, i.e., live weight, ADG and FE scored by the birds in the T1 group. The reasoning behind this unpredicted surge was clear at the end of the study. Despite the constant cost of some basic variables, e.g., chick, vaccination, medication, electricity, feeder, waterer, labor, depreciation of housing, equipment, the price of commercial broiler feed used in T1 group was much higher and the trends remained constant round the trial period whereas the cost of wheat, rice polish and cabbage was much cheaper. So the T2 diet might be considered as an alternate option for sustainable turkey farming in rural areas of Bangladesh using locally available conventional feed ingredients.

5. CONCLUSION

Overall productive performance of turkey was best while fed the commercial broiler feed but the cost-benefit index was the highest in the wheat-rice polish-vegetable based diets under traditional rural set up followed by the maize-rice polish-vegetable based blended diets. Both readymade commercial pellet feeds as well as the traditional cereal-based diets are suggested for the rural farming community for turkey production.

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