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DIETARY EFFECTS OF HYDROPONIC WHEAT SPROUTED FODDER ON GROWTH PERFORMANCE OF TURKEY

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A B S T R A C T

The study was conducted at Faculty of Veterinary and Animal Science, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, Bangladesh to determine the nutritional composition and economic value of hydroponic wheat sprouted fodder (HWSF) replaced by commercial concentrate feed (CCF) and it's effect on growth performance of turkey. A total of 75 poults were selected and randomly assigned into five groups (T_1, T_2, T_3, T_4 and T_5), each group with 3 replications having 15 birds in each. T_1 considered as control group and fed only CCF, where T_2, T_3, T_4 and T_5 groups fed 95, 90, 85 and 80% CCF along with 5, 10, 15 and 20% HWSF, respectively. The amount of DM, CP and NFE were significantly higher ($P<0.01$) in hydroponic maize sprouted fodder than hydroponic wheat and sesbania sprouted fodder where Ash, OM, CF, DM and EE were not significant. Live weight of turkey was increased in T_1 (2074.86 g), T_2 (2130.4 g), T_3 (2125.75 g) and T_4 (2085.53 g) except T_5 (1959.4 g) groups. The live weight gain was almost similar in the turkey of T_2 (29.55 g/d), T_3 (29.26 g/d), T_4 (28.44 g/d) and T_1 (27.69 g/d) groups except T_5 (23.85 g/d) group. The lowest but best feed efficiency was observed in T_2 (2.60) group. Cost benefit analysis showed higher benefit in T_2, T_3 and T_4 than in T_1 and T_5 group. Therefore, the overall results revealed that dietary supplementation of HWSF up to 15% may improve live weight, feed efficiency of turkey as well as reduce total feed cost.

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INTRODUCTION

Poultry keeping is an important part of the rural household that provides family income for the small, marginal and landless poor. The farmers who cannot afford to rear cattle and goat, can easily rear poultry. However, among the livestock sector, the poultry industry (specially, commercial broiler and layer) is in the line to be destroyed due to severity various poultry diseases. Thus, it is crying need to find out the alternatives of animal protein sources to meet up the increasing demand. In order to maximize food production and meet protein requirements in developing countries like Bangladesh, variable options need to be explored and evaluated (Owen et al.,2008). Turkey meat may be a one of the best options for alternative protein source. Turkey production is an important and highly profitable agricultural industry with a rising global demand for its products (Yakubu et al., 2013), and they are adaptable to wide range of climatic conditions (Ogundipe and Dafwang, 1980). Consumption of turkeys and broilers as white meat was rising world-wide and a similar trend also existed in developing countries (Karki, 2005). Turkey is an excellent forager and most crops that are troubled by insect invasion including vegetables are candidates for insect control by turkeys (Grimes et al., 2007). Turkey thrives better under arid conditions, heat resistant, ranges farther and has higher quality meat (Yakubu et al., 2013). But turkey production has not yet been fully exploited in developing countries despite its huge potential over other poultry species.

Presently turkey farmers depend on commercial concentrated feed that incurs high feed cost. Therefore, an alternative way of replacing expensive concentrate feed by green fodder can lower the feed cost. The word hydroponic has been derived from the Greek word ‘water working’ where hydro means ‘water’ and ponic means ‘working’. Thus, forage produced by growing plants in water or nutrient rich solution in absence of soil is known as hydroponic forage or fodder or sprouted grains, which are produced generally in greenhouses under controlled environmental conditions within a short period (Sneath and McIntosh, 2003; Dung et al., 2010). However, hydroponic fodder can be produced well by the use of fresh water only and the use of nutrient rich solution is not obligatory. The added expenses of the nutrient solution also do not justify its use rather than the fresh water unless there is significant improvement in the feeding value of the hydroponic fodder due to the use of the nutrient solution. The metabolism of the nutrient reserves of the seeds is enough to fuels the growth of the fodder plant for a short duration. It has high feed quality, rich with proteins, fiber, vitamins and mineral (Chung et al., 1989). As a reason, hydroponic culture is one of the most important agricultural techniques currently in use for green fodder production in many countries. However, there is a limited studies conducted on the feeding effect of HWSF on turkey production. Therefore, the present study has been designed to know the nutrient composition of hydroponic sprouted fodder, investigate the productive performance of turkey and study the cost-benefit of using hydroponic wheat sprouted fodder for turkey production in Bangladesh.

MATERIALS AND METHODS

The study was conducted at the Advance Animal Research Farm of the faculty of Veterinary and Animal Science at Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, Bangladesh.

Preparation of hydroponic sprouted fodder shed

The hydroponic sprouted fodder shed was made by polythene, bamboo and wood at the farm yard. Polythene Shed of 20×12 square feet was set-up with a number of stacks to keep trays. The trays of 2.5×2 square feet were made by aluminum sheet for sprouting fodder.

Preparation of turkey shed

Five pens were made in the shed using bamboo and net. All necessary equipment was set properly and performed complete fumigation. A foot bath was made in front of the door of the house and it was dipped with potassium permanganate to maintain strict bio-security.

Production of hydroponic sprouted fodder

The hydroponic system and treatment of seeds

Hydroponic sprouted fodder was produced under intensive care at the hydroponic sprouted fodder shed. Wheat seeds were bought from the Wheat Research Institute, Dinajpur. The seeds were cleaned fully from debris and other foreign materials. The dead and broken seeds were removed from the seeds. Then the seeds were washed and cleaned well. The seeds were soaked with fungicide (Provax, HECCL) mixed with clean tap water for 12 hours. After 12 hours the excess water was removed from the seed and then the seeds were wrapped by clean cloth and kept under a clean and dark environment with anaerobic condition before planting.

Seed sowing and irrigation

The germinated seeds of hydroponic wheat sprouted fodder were planted in the trays uniformly; the trays having holes in the bottom for excess water drain out during irrigation. The required amount of wheat seed (200g/tray) was sown in 6 trays for each day. The hydroponic sprouted fodder was irrigated four times a day, two times before the noon and two times of the afternoon. The irrigation was performed by manually or using hand spraying machine.

Experimental design

A total of 100 fertile turkey eggs were purchased from Mamun Turkey Farm, Sirajganj, Bangladesh. The eggs were incubated and hatched by an incubator, finally got 96 poults. Then poults were vaccinated with BCRDV and brooded for 4 weeks maintaining proper temperature.

A total of seventy-five poults (8-weeks old) having uniform body weight were selected and randomly assigned into five dietary treatment groups (T_1, T_2, T_3, T_4 and T_5), each group consisting of 3 replications having 15 birds in each.

T_1 = 100% commercial concentrate feed (CCF)
T_2 = 95% CCF + 5% hydroponic wheat sprouted fodder
T_3 =90% CCF +10% hydroponic wheat sprouted fodder
T_4=85% CCF + 15% hydroponic wheat sprouted fodder
T_5=80% CCF+20% hydroponic wheat sprouted fodder

General management practices

The turkeys of both control and experimental groups were housed in well-ventilated conventional sheds maintained in good hygienic condition and are stall fed throughout the experimental period. Feed and water were supplied in plastic feeders and waterers. Before starting the experiment, the birds were kept as adjustment period to be comfortable with their respective experimental diets. The amount of hydroponic fodder was determined on the basis of DM requirement supplied to the treatment groups except control group (T_1). Rice husk was used as litter. Each turkey was marked with colored plastic beads for proper identification. The experimental temperature was between 28-35°C and lighting schedule was 16 h light and 8 h dark. Entrance of personnel was restricted.

Record keeping

A standard record book was maintained throughout the experimental period. Following parameters were recorded in the record book:

- Daily supplied amount of commercial concentrate feed and hydroponic wheat sprouted fodder
- Amount of residual commercial concentrate feed and hydroponic sprouted fodder
- Weight of the turkey in each group per week
- Feed conversion ratio (FCR)
- No. of dead turkeys
- Any diseases or abnormal condition of the turkeys

Data collection procedure

Calculation of parameters

Live weight gain of turkey (LWGT)

It was calculated at 56 days of period by using the following formula.

$LWT_{56} = LWT_{56} - LWT_0$

Where, LWT_0 = initial weight of turkey at the time of start the experiment

LWT_{56}= final live weight of turkey at 56 days of experiment

Growth rate=

$$\frac{\text{Total weight gain in certain time}}{\text{Total days of the experiment}}$$

Feed conversion ratio (FCR)=

$$\frac{\text{Feed Intake}}{\text{Live weight gain}}$$

Where, FCR = feed conversion ratio

Profitability index

Profitability index (PI) means the net farm income (NFI) per unit of gross revenue (GR) and the ratio is calculated as follows-

$$=\frac{NFI}{GR}$$

Rate of return on investment (RRI)

Rate of the return on investment is the performance measure which is used to evaluate the efficiency of an investment or to compare the efficiency of different investments. It was calculated using the following equation:

$$=\frac{NFI}{TC}$$

Where, RRI = Rate of return on investment, NFI = Net farm income and TC = Total cost.

Depreciation cost

Depreciation cost was measured using the following equation

$$=\frac{\text{Purchase Price}}{\text{Number of useful years of the asset}}$$

Capital turnover (CTO)

Capital turnover was measured using the following equation

$$=\frac{TR}{TC}$$

Where, CTO = Capital turnover, TR = Total revenue and TC = Total cost

Statistical analysis

Data were analyzed using the using SPSS (Version 22.00).All data were expressed as Mean ± Standard Error of Mean (SEM). Differences were considered significant at level of $P<0.01$ and $P<0.05$.

RESULTS AND DISCUSSION

Nutritional composition of hydroponic sprouted fodder

The amount of dry matter (DM), crude protein (CP) and nitrogen free extract (NFE) was significantly higher (P<0.01) in hydroponic maize sprouted fodder than hydroponic sesbania and wheat sprouted fodder. But the amount of ash, organic matter (OM), ether extract (EE) and crude fiber (CF) were not significantly (P>0.05) differed among the sprouted fodder. The present study is in agreement with the results reported by Kantale et al., (2017) who observed the protein content of hydroponics wheat fodder and it was highest on 8th day (15.75%) which was higher than conventional green fodder wheat (11.02%). The ether extract content of hydroponics fodder wheat was highest on 8th day (2.80%). The crude fiber content of the wheat seed was 2.40% and increased up to 5.20% on 8th day of growth. The crude fiber content in hydroponics system was much lower than the conventional fodder. The total ash content of the hydroponics fodder wheat was 3.00% on 8th day, which was lower t (P <0.01) than conventional fodder (8.28%). The nitrogen free extract content of the wheat seed decreased to (73.25%) on 8th day of growth as compared to seed (83.40%), however it was more than conventional cereal fodders. However, Chung et al., (1989) also reported an increase in crude fiber content during sprouting of wheat might be due to the synthesis of structural carbohydrates such as cellulose and hemicelluloses. The present results are in line with the results reported by Dung et al., (2010) who demonstrated the increase in protein content may be attributed to the loss in dry weight, particularly carbohydrates, through respiration during germination and thus longer sprouting time was responsible for the greater losses in dry weight and increasing trend in protein content. The CP content of hydroponics wheat in the present study was more than hydroponics reported by Naik et al., (2016).

Table 1. Comparison of nutritional composition of hydroponic sprouted fodder(s)

Hydroponic Fodder	DM	Ash	OM	% DM basis			
				CP	CF	EE	NFE
Wheat	8.64±1.04^{b}	4.09±0.02	95.91±11.01	18.10±3.01^{b}	3.40±0.04	3.29±0.04	71.12±7.03^{b}
Maize	14.79±1.52^{ab}	2.50±0.02	97.5±11.02	10.92±1.12^{a}	5.30±0.02	2.94±0.04	78.34±7.02^{b}
Sesbania	9.46±1.01^{a}	3.41±0.03	96.6±10.03	37.26±4.2^{c}	7.21±0.01	3.71±0.05	48.41±4.43^{a}
Level of significance	**	NS	NS	**	NS	NS	*

^{ab}Mean values with different superscripts within the same row differ significantly (P<0.05) and (P<0.01); NS = Non significant (P>0.05), * = Significant (P<0.05), ** =Highly significant (P<0.01)

Effect of hydroponic wheat sprouted fodder on feed intake in turkey

Effects of dietary supplementation of hydroponic wheat sprouted fodder on feed intake (g/d) in turkey are presented in Figure 1. The present study revealed that the total DM intake was almost similar among the turkey of T_1 (74.44 g/d), T_2 (76.94 g/d), T_3 (79.35 g/d) and T_4 (79.18 g/d) and T_5 (81.53 g/d) group, whereas the intake of HWSF was increased as accordance with increasing level of its supply. This is an agreement with the findings of Shtaya (2004) who found that feed intake was not affected by feeding ewes at different levels of hydroponic sprouted fodder. Similarly, Shanti et al. (2017) studied that dry matter, feed intake and growth rate decreased linearly by 1.16±0.080 g/d (P<0.001) and 0.998±0.062 g/d (P<0.001) per unit of hydroponic fodder increase. This was also confirmed by Abbas and Musharaf (2008). It has been observed that it's not the hydroponic fodder but the level of sprouted grains used that might be responsible for reduced intake (Fafiolu et al., 2002).

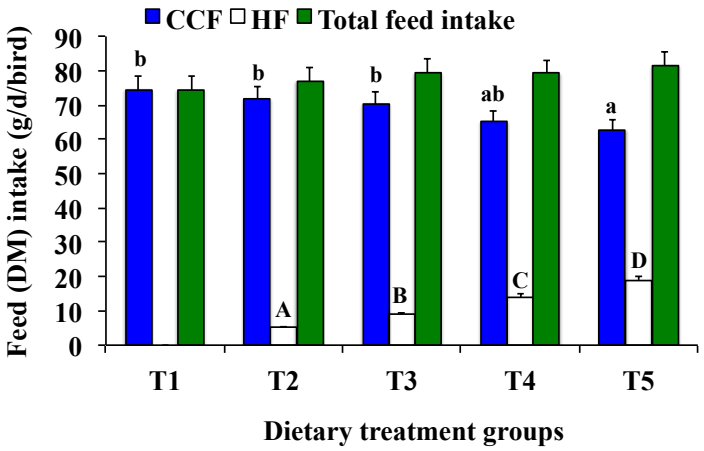

Figure 1. Effect of feeding hydroponic wheat sprouted fodder (HWSF) on DM intake of turkey. Here, T_1=100% commercial concentrate feed (CCF), T_2= 95% CCF + 5% HWSF, T_3=90% CCF +10% HWSF, T_4 = 85% CCF +15% HWSF and T_5 = 80% CCF + 20% HWSF. Each bar with error bar represents Mean ± SEM value. Differences were significant at 5% level of significance (P<0.05).

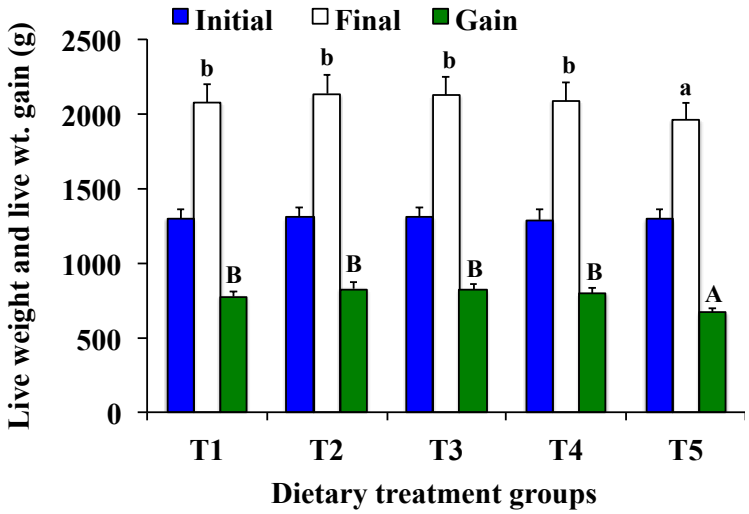

Figure 2. Effect of hydroponic wheat sprouted fodder (HWSF) on initial live weight (g), final live weight (g) and live weight gain (g) in turkey. Here, T_1=100% commercial concentrate feed (CCF), T_2= 95% CCF + 5% HWSF, T_3=90% CCF +10% HWSF, T_4 = 85% CCF +15% HWSF and T_5 = 80% CCF + 20% HWSF. Each bar with error bar represents Mean ± SEM value. Differences were significant at 5% level of significance (P<0.05).

Effect of hydroponic wheat sprouted fodder on live weight and live weight gain in turkey

Dietary effect of hydroponic wheat sprouted fodder on live weight and live weight gain in turkey during the experiment is shown in Figure 2. In the present study, the results express that there was no significant effect of feeding HWSF on the live weight and live weight gain of turkey among the dietary treatment groups. The live weight was decreased in the turkey fed 20% of hydroponic wheat sprouted fodder. On the other hand, the live weight gain was almost similar in the turkey of T_2 (29.55 g/d), T_3 (29.26g/d), T_4 (28.44 g/d) and T_1 (27.69 g/d) groups except T_5 (23.85 g/d) group. Live weight was lower inT_5group of turkey which was provided with 20% HWSF. According the present results hydroponic wheat sprouted fodder has positive effects up to 15% of HWSF but at 20% level have negative effects on final live weight and live weight gain of turkey. This is an agreement with the of results Gebremedhin (2015) who reported that highest live weight gain was found in Konkan Kanyal goats fed with Finger millet straw 60% and 40% hydroponic fodder. Similarly, Naik et al., (2014) also noticed that, the higher performance in the body weight gain of animals supplemented with 40% hydroponic fodder could be due to the ability of the supplements to supply necessary nutrients. Tudor et al., (2003) reported an increase in weight gain of lambs received hydroponic sprouts fodder may be attributed to enhancing of microbial activity in the rumen. Other researchers also revealed that hydroponic sprouted fodder improve the performance of birds and animals up to 8%. Moreover, feeding hydroponic sprouted fodder mixed with poor quality hay to drought master steers gained more by 1.01 kg/head/day when compared to steers fed concentrate diets (Muhammad et al., 2013).

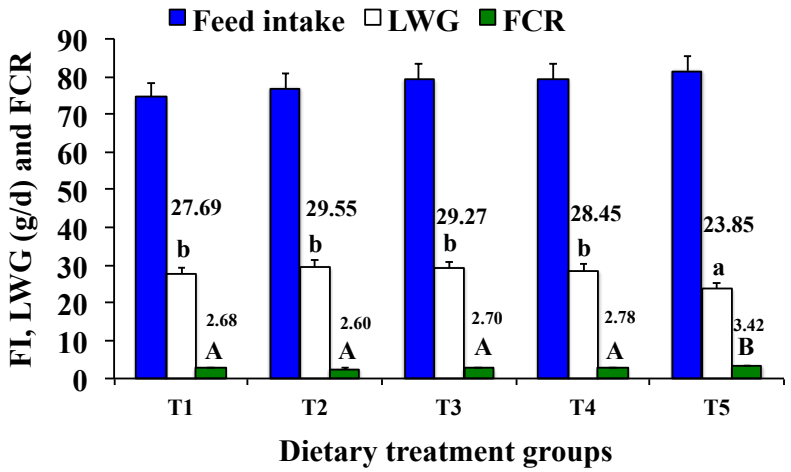

Figure 3. Effect of hydroponic wheat sprouted fodder (HWSF) on feed efficiency in turkey. Here, T_1=100% commercial concentrate feed (CCF), T_2= 95% CCF + 5% HWSF, T_3=90% CCF +10% HWSF, T_4 = 85% CCF +15% HWSF and T_5 = 80% CCF + 20% HWSF. Each bar with error bar represents Mean ± SEM value. Differences were significant at 5% level of significance (P<0.05).

Effect of hydroponic wheat sprouted fodder on feed efficiency in turkey

Effects of dietary supplementation of hydroponic wheat sprouted fodder on feed efficiency in turkey are presented in Figure 3.The feed efficiency was significantly (P<0.05) better in T_2 (2.60) group compared to the other groups. The present findings are in line with the result of Gebremedhin (2015) who reported that feeding hydroponic barley sprouted fodder for growing goats increased total DM intake and live weight gain but lowered FCR than goats fed concentrate diets. Similarly, Weldegerima et al., (2015) also concluded that feeding of hydroponically sprouted fodder up to 40 % substitution (DMI) increased the digestibility of nutrients, better FE and live weight gain of growing goats. Intissar and Eshtayeh (2004) observed that using hydroponic sprouted grains with olive cakes fed to ewes gave lower FE results than ewes fed the control diets and that might be due to the higher crude protein and energy contents of the hydroponic barley diet which provided absorbable nutrients.

Table 2. Cost and returns for turkey production (calculation was made in BDT)

Parameters	Dietary treatment groups					Level of significance
	T_1	T_2	T_3	T_4	T_5	
A. Variable Costs						
Labor	200.0	200.0	200.0	200.0	200.0	NS
Feeds	164.0±1.5^{c}	127.10±1.24^{b}	111.79±1.35^{a}	104.5±1.5^{a}	99.4±1.2^{a}	*
Hydroponic fodder	-	23.6±0.5^{a}	35.5±0.5^{b}	40.7±1.6^{c}	41.7±1.7^{c}	*
Medication	15.0	15.00	15.00	15.00	15.00	NS
Miscellaneous	152.0	152.00	152.00	152.00	152.00	NS
Total Variable Cost (TVC)	531.4±1.5^{b}	517.2±1.7^{a}	514.2±1.8^{a}	512.9±2.5^{a}	508.1±2.9^{a}	*
B. Fixed Costs						
Cost of poult	1150.0	1150.0	1150.0	1150.0	1150.0	NS
Depreciation on housing @5%	35.22	35.22	35.22	35.22	35.22	NS
Depreciation on equipment@10%	2.22	2.22	2.22	2.22	2.22	NS
Total Fixed Cost (TFC)	1184.44	1184.44	1184.44	1184.44	1184.44	NS
Total cost	1715.8±1.55^{b}	1701.6±1.79^{a}	1698.7±1.86^{a}	1697.4±2.5^{a}	1692±2.99^{a}	*
C. Revenue						
Sales of per turkey	2634±9.45^{b}	3000±8.44^{e}	2900±7.51^{d}	2790±8.27^{c}	2460±0.81^{a}	*
Sales of litter	11.00	11.00	11.00	11.00	11.00	NS
Total revenue (TR)	2645±6.58^{b}	3011±6.57^{e}	2911±7.53^{d}	2801±8.47^{c}	2471±0.81^{a}	*
Net farm income (NFI)	929.13±3.02^{b}	1309.35±4.78^{e}	1212.29±1.51^{d}	1103.6±5.9^{c}	788.4±2.18^{a}	*
Profitability index (PI)	0.35 ±0.03^{a}	0.43 ±0.01^{b}	0.42±0.01^{b}	0.39 ±0.02^{ab}	0.31±2.69^{a}	NS
Rate of return on investment (RRI)	58.41±1.33^{b}	78.00±1.11^{cd}	70.07±1.23^{d}	65.96±1.53^{c}	45.44±0.7^{a}	NS
Capital turnover (CTO)	1.54 ±0.07^{a}	1.77 ±0.05^{b}	1.71 ±0.01^{b}	1.65±0.07^{b}	1.46 ±0.27^{a}	*

Values are Means ± SEM, $^{a, b, c, d, e}$ Means within a row without common superscripts differ significantly; NS-non-significant; statistically significant difference is expressed as *($P < 0.05$). Here, T_1=100% commercial concentrate feed (CCF), T_2= 95% CCF + 5% HWSF, T_3= 90% CCF +10% HWSF, T_4=85% CCF + 15% HWSF and T_5 = 80% commercial concentrate feed (CCF) + 20% of HWSF.

Cost benefit analysis of turkey production (calculation was made in BDT)

The cost benefit analysis for turkey production based on hydroponic wheat sprouted fodder replaced by commercial concentrate feed is expressed in Table 2.Total cost per bird was higher in control group than other dietary treatment groups. Total cost per bird was T_1 (1715.87 Tk.), T_2 (1701.65 Tk.), T_3 (1698.71 Tk.), T_4 (1697.4 Tk.) and T_5 (1692.55 Tk.) group. Total revenue per bird was higher in T_2 (3011.00Tk.) while 2645.00 Tk., 2911.00 Tk., 2801.00 Tk. and 2741.00 Tk. were for T_1, T_3, T_4 and T_5 groups, respectively. However, the higher net farm income was found in T_2 (1309.35 Tk.), T_3 (1212.29 Tk.) and T_4 (1103.6 Tk.) while the lowest net farm income was found in T_1 (929.13 Tk.) and T_5 (788.45 Tk.) groups. Capital turnover (CTO) per bird was higher in T_2 (1.77) group when compared to T_1 (1.54), T_3 (1.71), T_4 (1.65) and T_5 (1.46) groups. Feeding hydroponic wheat sprouted fodder up to 15% may improve the growth performance of turkey and as well as reduce feed cost and total production cost. Similar findings were observed by Helal (2015) who stated that

feed cost was improved by 34.15% in goats supplemented with hydroponic sprouted fodder. The present results are similar with results reported by Naik et al., (2014) who conducted a research on effect of feeding hydroponic maize sprouted fodder (HMSF) on digestibility of nutrients and milk production in lactating cows and found a higher net profit of Rs. 12.67 per cow/d on feeding hydroponic fodder. They concluded feeding of HMSF to lactating cows increased the digestibility of nutrients and milk production leading to increase in net profit. Chinnam (2015) reported similar types of findings. Higher feed cost per kg milk production with hydroponic fodder was also reported earlier due to higher costs involved in hydroponic fodder production (Naik et al., 2014). However, Rahim et al., (2015) found that when hydroponic barley can be used as feed for lactating sheep as cost of feed can be reduced by 42%.

CONCLUSION

The present study revealed that the total DM intake (g/d) was almost similar among the dietary treatment groups. The results also expressed that, there was significant (P>0.05) effect of feeding HWSF on live weight gain and live weight of turkey among the dietary treatment groups. The live weight was decreased in the turkey fed 20% of hydroponic wheat sprouted. The higher net farm income was found in T_2 (1309.35 Tk.), T_3 (1212.29 Tk.) and T_4 (1103.6 Tk.) but highest net farm income was found in T_2 group while the lowest net farm income was found in T_1 (929.13 Tk.) and T_5 (788.45 Tk.) groups respectively. Capital turnover (CTO) per bird was higher in T_2 (1.77) group when compared to T_1 (1.54), T_3 (1.71), T_4 (1.65) and T_5 (1.46) groups. In conclusion, the feeding of HWSF up to 15% may improve the growth performance of turkey and as well as reduce feed cost and total production cost; finally, increase net farm income.

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