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Research article

Effect of roughage-based diet on growth performances of rabbit

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ABSTRACT

A study was conducted to evaluate the effect of roughage-based diet on growth, hematological and sero-biochemical profile and nutrient digestibilityof growing rabbit. There were three dietary treatment groups viz. traditional diet, 50% concentrate+50% roughage, 100% roughage treated as T_0, T_1 and T_2, respectively.A total of forty-five (45) weaned crossbred New Zealand White growing rabbitswere distributed into three treatment groups each having three replications following Completely Randomized Design. From this study, it was found that weekly concentrate and DM intake was significantly influenced by 50% concentrate+50% roughage and 100% roughage diet though the FCR wasinsignificant. Final body weight, weeklybody weight and weight gain were notdiffered with roughage-baseddiet. The nutrient digestibility of DM, CP, CF, Ashand NFE was alsovaried significantly ($P<0.05$) among the treatment groups compared to the controlgroup except for EE.There was a significant difference existed in serological parameters ($P<0.05$) among the treatment groups. Our results indicate that rabbit can be reared feeding roughage although body weight gain waslittle decreased than the traditional diet and other concentrate groups.A little decreased body weight is less economic loss than feeding concentrate. So, it can be concluded that supplementation of aroughage-based diet can be used in the diet of growing rabbit.

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1. INTRODUCTION

Bangladesh is a densely populated country in South Asia with an acute crisis of human food. Agriculture is the main driving force of her national economy where the components of agriculture are crop, livestock, fisheries and horticulture. The role of livestock subsector is vital for the economic development of agro-based Bangladesh. The contribution of livestock and poultry to the National economy of Bangladesh as GDP is 3.47 percent which is 13.46 percent to Agricultural share (DLS, 2019). Poverty reduction, gender equity and empowerment of women are amongst eight set targets of Millennium Development Goals (MDG) of Bangladesh (Islam, 2011). Amongst the components, most of the development efforts in the past were concentrated on crop production and therefore, the livestock sector remained underdeveloped, which can be realized from the unavailability of the livestock products such as milk, meat and egg. Our availability is about 165.07 (ml/day/head) of milk, 124.99 (gm/day/head) of meat and 103.89 (numbers/year/head) of eggs (DLS, 2019) which is reflected as 10 to 12% of requirement of protein from animal sources compared to people of advanced countries where they consumed about 70% of their total protein requirement from animal sources (DLS, 2019). Hence, it is needless to say that urgent and effective steps should be taken to increase the availability of animal protein sources. So, Rabbit as a micro-livestock (Vietmeyer, 1985)

can be considered as another contributing source of meat along with cattle, goat, sheep and poultry. Domestic rabbit (*Oryctolaguscuniculus*) is emerging as a viable livestock species which is suited to small-scale production by backyard farming (Cheeke, 1986). Rabbit's meat is acknowledged as high-quality meat being high in protein but low in fat, cholesterol and sodium (Jones, 1990). Rabbit meat is advocated to people because it does not form uric acid during metabolism (Iyeghe-Erakpotobor, 2007). Rabbits are efficient converters of feed to meat and can utilize up to 30% crude fibre as against 10% by most of the poultry species (Egbo et al., 2001). To make rabbit rearing more viable as a small-scale business, it has been advocated the development of alternative feeding materials that will be relatively cheap when compared with commercial feeds or conventional feedstuffs(Alawa et al., 1990). Rabbit occupies a vital midway between ruminants and monogastric animals what can utilize cellulose rich feed with ration containing less than 20% grain. However, to nourish the rabbit, feed is the major important event to be thought out as it cost around 60-70% of its production cost.

Fibers are one of the main components of rabbits' diets (García et al., 2000) because they play a key role in rabbit feeding by contributing to cecum activity for efficient digestion (Gidenne, 1992). Crude fiber level in growing rabbits' diet varies from 14 to 16%, whereas in reproductive rabbits' diets that level is between 12 and 13% (Houndonougbo et al., 2012). According to the statement of previous researchers, it is identified that many works have been performed on rabbit feeding in a broad aspect; however, there is a few works have been conducted to observe the effect of only fiber-based diet on growth performances of rabbit. The main source of fiber is low in peri-urban areas, and farmers have difficulties to provide rabbits with grass. The processing of complete diets with the optimal level of fibers is therefore suitable to efficiently feed rabbits; hence the current research work has been undertaken with the following objectives:

a) To evaluate the effect of roughage-based diet on growth performance of broiler rabbit.
b) To observe the effect of roughage-based diet on serological profile of rabbit.

2. MATERIALS AND METHODS

The present study was conducted in the laboratory of animal research unit, Chattogram Veterinary and Animal Sciences University (CVASU), Chattogram during July to December 2017. The whole study includes the collection of feedstuffs, chemical analysis, diet formulation, management and feedings of rabbits and growth and digestibility trial.

Experimental design and dietary treatment groups

A total of 45 weaned rabbits of 50-60 days oldwere distributed into three treatment groups consisting of three replications having five rabbits each in a completely randomized design (CRD).All the rabbits were housed in iron cages (55cm × 40cm × 40 cm) during the experimental period. The rabbits were supplied feedtwice daily according to treatment groups. Dietary treatments werecontrol (traditional) asT_0, 50% concentrate + 50% roughage on DM basis as T_1 and 100% roughage as T_2. The diet was formulated (Table1) to meet the nutrient requirements of rabbits recommended by NRC (1977) and contained no antibiotics. Weekly body weight changes and daily feed intake of individual rabbit was monitored during the entire experimental period. The feed conversion ratio was estimated from dry matter intake and weight gain.

Experimental feeding and management practices

Fresh, clean and safe drinking water was supplied to the rabbits at all time. Concentrate and green grass ad-libitum were offered only to the control group. Green grass was collected every morning and afternoon followed by cleaning, chopped, weighed and supplied to the rabbits. Concentrate mixture and green grass was offered twice daily: morning at 8.00 am and afternoon at 4.00 pm. The rabbits of different treatment groups were provided with identical care and management throughout the experimental period.

Table 1: Proximate composition of diets for growingrabbits

Parameters (%)	T_0	T_1	T_2	Green grass
Dry matter	50.1	52.65	48.00	32.00
Crude Protein	16.86	16.27	15.88	15.13
Crude fibre	20.17	21.96	23.00	38.00
Ether extract	02.31	01.92	01.83	01.43
Ash	08.72	08.17	09.80	11.00
N_2-free extract	56.93	59.68	54.44	34.44

T_0= Concentrate+Green grass (Traditional diet);T_1=50%Concentrate+50% roughage and T_2= 100% roughage with noconcentrate.

Recording of feed intake (FI)

The rabbits were supplied experimental diets; twice daily and leftover was collected. The refusal of concentrate feed of the subsequent days was collected, weighed and recorded in the following morning before offering feed. Feed intake was calculated as follows:

FI (g/rabbit)= Feed supply (g) – left over (g)

Measurement of live weight, live weight gain and FCR

The rabbits were weighed individually at the beginning of the experiment and the average weight was taken as the initial body weight. Thereafter, the rabbits were weighed individually in every week by using an electric digital weighing balance before morning feeding. The weekly live weight gain and FCR was calculated as follows:

FCR=Total Feed intake (g)/Live weight gain (g)
Weight gain = (Final body weight – Initial bodyweight)

Co-efficient of digestibility

A digestibility trial was conducted at the last 7 days of the experimental period to evaluate the effect of roughage on digestibility of Nutrients. Feed supply and feces collection were performed two times daily. During the digestibility trial, the quantity of feed supplied and feces collected were recorded carefully. After collection of feces it was immediately stored in a freezer. Both the feed and feces were subjected to proximate analysis following the standard procedure (AOAC, 2004) to determine nutrient contents of feed and feces. The digestibility of each nutrient was estimated by the following formula.

Co-efficient of digestibility of Nutrient=

$$\frac{\text{Nutrient intake through feed (gm)} - \text{Nutrient in feces (gm)}}{\text{Nutrient intake through feed (gm)}} \times 100$$

Chemical analysis

Samples of feed, feces and green grass were analyzed for moisture, crude protein (CP), crude fiber (CF), ether extract (EE), ash and nitrogen-free extract (NFE) following the methods of AOAC (2004). All the samples were analyzed in duplicates and mean valueswere recorded.

Collection and preservation of blood sample

At the end of the feeding trial, two rabbits were sacrificed from each replicate, blood samples were collected through heart puncture about 4ml from each rabbit. Blood sample was taken into two separate vials. One containing EDTA (anticoagulant) for hematology and another do not contain anticoagulant which was used for serum preparation for biochemical analysis. The blood sample with anticoagulant was analyzed for HB, PCV, TEC and TLC within 24 hours. The separated serum samples were stored into a deep freeze at -18°C and biochemical analyses were done within 7 days.

Biochemical analysisof blood serum sample

The biochemical analysis was performed from the preserved serum sample. The samples were allowed to be in room temperature before starting the analysis. The serum total protein (TP), albumin, cholesterol, urea and creatinine level were estimated by using biochemical analyzer (Humalyzer-3000 chemistry analyzer) in biochemistry laboratory of CVASU. For each parameter, the commercial kit of RANDOX company (http://www. randox. com/ reagent) was used and followed the manufacturer's procedure.

Statistical analysis

All collected data and sample evaluated values were imported in Microsoft office excel-2007 and transferred to SPSS-16 software for analysis. Descriptive statistics of some parameters were performed. Quantitative performance parameters from different groups of dietary treatment, values of digestibility trial and hematological parameter were compared by one-way ANOVA by using SPSS-16. The differences of different parameters were considered significant when the p-value was < 0.05 and highly significant when p-value was <0.01.

3. RESULTS AND DISCUSSION

The findings on growth performances, digestibility of feeds along with different parameters are discussed hereafter following some different sub-headings.

Effect on Growth Performance and Digestibility

In 2nd and 3rd week of the trial period, the highest body weight was observed in T_0 group and the lowest body weight was observed in T_2 group(Table-2). Similarly, the highest body weight gain was observed in T_0 group and lowest in T_2 group at the age of 2nd and 3rd week (Table-3). However, there was insignificant differencesin

weekly FCR was observed among the treatment groups, though the numerically higher FCR was noticed inT_2 group and lower FCR was in T_0 group (Table-4).

A digestibility trial was conducted at the last week of the experimental period and the co-efficient of digestibility of different nutrients is presented in table 5.

Table 2: Effect on body weight (gm) of rabbit

Age	Body weight (Mean± SE)			Level of significance
	T_0	T_1	T_2	
Initial	349.3±0.56	348.74 ±0.49	351.23±0.52	NS
1st week	421.5 ±1.14	416.8 ±0.65	411.9 ±0.53	NS
2nd week	560.8^{b}±1.10	551.80^{ab} ±1.05	539.3^{a} ±1.01	*
3rd week	727.6^{b} ±1.24	712.04^{b} ±1.04	690.5^{a} ±1.01	**

N=3;S.E=Standard Error; NS=Non-Significant (P>0.05); **=Significant (P<0.01); a,b,c,Means with different superscripts inthe same row differ significantly (p> 0.05). T_0=Traditional diet; T_1= 50% Concentrate + 50% roughage on DM basis; T_2= 100% Roughage.

Table 3: Effect on Live weight gain (gm) in different

Age	Live weight gain (Mean± SE)			Level of significance
	T_0	T_1	T_2	
1st week	72.22±1.10	68.06±1.03	60.67±0.50	NS
2nd week	139.35^{a} ±1.24	135.0^{ab}±1.43	127.4^{b}±1.14	*
3rd week	166.75^{a} ±1.58	160.24^{ab} ±1.04	151.2^{b} ±1.46	**

N=3; S.E=Standard Error; NS=Non-Significant (P>0.05);**=Significant (P<0.01); a,b,c,..Means with different superscripts inthe same rowdiffer significantly (p> 0.05). T_0=control group; T_1= 50% Concentrate + 50% roughage on DM basis; T_2= 100% Roughage.

Table 4: Weekly feed conversion ratio (FCR).

Age	Weekly FCR (Mean± SE)			Level of significance
	T_0	T_1	T_2	
1st week	4.90±.07	4.91±.07	4.99±.03	NS
2nd week	3.07±.028	3.129±.03	3.175±.025	NS
3rd week	2.70 ±.02	2.786±.01	2.857 ±.02	NS

N=3; S.E=Standard Error; NS=Non-Significant (P>0.05);**=Significant (P<0.01); a,b,c,..Means with different superscripts in thesame row differ significantly (p> 0.05). T_0=control group; T_1= 50% Concentrate + 50% roughage on DM basis; T_2= 100% Roughage.

Table 5: Digestibility co-efficient of different nutrients

Parameters	Nutrient digestibility of different treatment groups (Mean± SE)			Level of significance
	T_0	T_1	T_2	
DM%	53.236^{a}±0.12	62.114^{b}±0.14	64.522^{ab}±0.19	**
CP%	55.65^{a} ±0.21	63.266^{b}±0.20	63.050^{b}±0.19	**
CF%	51.75^{a} ±0.21	55.48^{b} ±0.23	55.60^{b} ±0.29	*
EE%	54.83±0.21	55.64±0.12	55.51±0.30	NS
ASH%	53.99^{a}±0.19	63.072^{b}±0.21	62.74^{b}±0.22	**
NFE%	52.30^{a}±0.14	63.072^{b} ±0.21	62.74^{b}±0.22	**

N=3; S.E=Standard Error; NS=Non-Significant (P>0.05);**=Significant (P<0.01); a,b,c,..Means with different superscripts in the same row differ significantly (p> 0.05). T_0=Traditional diet; T_1= 50% Concentrate + 50% roughage on DM basis; T_2= 100% Roughage.

The result of the statistical analysis of the value of digestibility of DM showed highly significant (P<0.01) effect of treatment among all the groups where highest was found in T_2 and lowest in T_0. Similarly, the highest CP, Ash and NFE value was observed in T_1 and lowest in T_0 group whereas the T_2 stands moderate in position. Alternately, the statistical value of digestibility of CF and EE showed non-significant (P>0.05) effect among all groups.

From the current study, it was revealed that the live weight of different weeks like- initial, 1st week, 2nd week and 3rd week did not differ significantly among the various treatment groups. Although numerically the higher body weight was observed in traditional diet (control diet) group and lower body weight in 100% roughage group. The previous study revealed that roughage supplementation along with rice bran can be used as a potential nutrient for good growth performance of rabbit but only unconventional roughage like Maize offal can be used to increase live body weight of rabbit (Raharjo et al., 1987; Onifade and Tewe, 2010) which support the findings of the current study. Some other studies did not support the current study where unconventional roughage feeding was done and found that cassava root and cassava can be fed to rabbit as a strong energy booster for good growth performance of rabbit

(Omole and Onwudike, 1983). The reason may be the seasonal effect of the current work. The current findings were also supported by other researcher and found that Lucerne which is known as alfalfa grass rich in fibre helps to improve growth performance (Omole and Onwudike, 1983; Lowe, 2010). Another study revealed that star grass improves the digestibility of rabbit which promotes growth performance (Nehring et al., 1963). So, we can conclude that rabbit can be reared feeding roughage although body weight gain is little lower than the traditional diet and other concentrate groups because a little lower body weight is less economic loss than feeding concentrate.

Effect on Biochemical changes

Inregard to the biochemical analysis (Table-6) it was revealed that total protein level in blood was higher ($p< 0.05$) in T_2 and lower in T_0 (control) group. Similarly, the blood albumin level, phosphorus level, calcium level, glucose level, SGPT level and blood urea level was found significantly ($P<0.01$) higher in T_2 group and the lowest value was found T_0 except for the level of creatinine which was higher in T_0 and lower in T_2 group. In conclusion, it can be said that the increment of total protein, albumin, calcium, phosphorus, glucose, urea and SGPT was highly significant ($P<0.01$). Significant variations of serum biochemical parameters were observed in different treatment groups. As all animals were in the same environment and same age so the variation may be raised from the supplied feed. In this study blood albumin level was significantly ($P<0.01$) differed among different treatment groups where the highest value was found in T_1group and the lowest was in T_2 group. Highest phosphorus level was found in T_2 group and lowest found in T_1 group. Highest calcium found in T_2 group and lowest found in T_1 group. Highest glucose level found in group T_2 and lowest level found in T_1group which is not agreed with Onifade and Tewe (2010) where they found that the hypoglycemic impact of dietary fibre both in fasting and postprandial condition was reflected by a lower level of serum glucose in rabbits fed on cassava peel which is highly fibrous. Highest creatinine level found in T_0 group and lowest level found in group T_2 followed by T_1group. Highest SGPT level found in group T_2 and lowest level found in T_1 group. Blood urea level was also significantly ($P<0.01$) differed among treatment group where the highest value was found in T_2 group and the lowest value was found in T_1 group. These findings agreed with Njidda, et al. (2010) who revealed that there was a negative correlation between urea nitrogen and protein intake and the highest urea level in blood was found in those animals feeding roughage.

In conclusion, it can be said that the increment of total protein, albumin, calcium, phosphorus, glucose, urea and SGPT is highly significant ($P<0.01$) where there was no alteration of uric acid based on protein intake which is supported by Clifford(1977).There were no improved growth performances in supplementation with roughage only. However, the present study revealed that supplementation of roughage with some concentrate can improve growth performance.

Table 6: The effect of experimental diet on serum biochemical parameter of rabbits

Parameter	Serum biochemical parameter of rabbits (Mean± SE)			Sig.
	T_0	T_1	T_2	
Protein (g/dl)	4.53^{a}±0.02	5.28^{b}±0.09	5.56^{c} ±0.76	**
Albumin(g/l)	9.10^{a}±0.01	9.78^{b}±0.01	9.70^{b}±0.11	**
Phosphorus(mg/dl)	6.53^{a}±0.03	10.07^{b}±0.08	11.30^{b}±0.12	**
Calcium(mg/dl)	6.11^{a}±0.01	10.83^{b}±0.10	12.10^{b}±0.10	**
Glucose(mg/dl)	131.80^{a}±0.8	195.46^{b}±0.85	198.73^{b}±0.97	**
Creatinine(mg/dl)	0.78^{b}±0.01	0.44^{a}±0.03	0.44^{a}±0.02	**
Urea(mg/dl)	33.50^{a}±0.33	51.42^{b} ±0.46	57.31^{c}±0.34	**
SGPT (u/l)	45.01^{a}±0.35	51.47^{b}±0.67	56.15^{c} ±0.52	**

N=3; S.E=Standard Error; NS=Non-Significant ($P>0.05$); **=Significant ($P<0.01$); a,b,c,Means with different superscripts in the same row differs significantly ($p> 0.05$). T_0=Traditional diet; T_1= 50% Concentrate + 50% roughage on DM basis; T_2= 100% Roughage.

4. CONCLUSION

From this experiment, final body weight, weekly body weight and body weight gain of 100% roughage group was not improved significantly compared to the control group. There was an insignificant difference among the weekly FCR of rabbit among the treatment groups. However,

the numerically higher FCR was in 100% roughage group and lower FCR was in the controlgroup. The digestibility of nutrient found significant among the treatment groups for the value of DM, CP, CF, Ash and NFE but the insignificant difference in EE. DM digestibility was higher in 100% roughage group and CP digestibility was higher in 50% roughage + 50% concentrate group. In the serum biochemical study, the increment of total protein, albumin, calcium, phosphorus, glucose, creatinine, urea and SGPT is highly significant among the treatment groups. From these findings, it can be said that there were no improved growth performances in supplementation with roughage only, though body weight gain was little decreased than the traditional diet and other concentrate groups. A little decreased body weight is less economic loss than feeding concentrate. So, it can be concluded that supplementation of a roughage-based diet can be used in the diet of growing rabbit.

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