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Research Article

Replacement Effect of Roughage by Kitchen Waste on Growth Performance of Rabbit

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Abstract

We conducted the current study to evaluate the replacement effect of roughage by kitchen waste on growth performance, serum-biochemical profile and nutrient digestibility of growing rabbit. Forty-five weaned crossbred New Zealand White growing rabbits (aged about 40 days) were distributed into three treatment groups in a completely randomized design for 30 days. The feed conversion ratio was not significantly differed among the treatment groups, where the highest feed conversion ratio was found in 40 gm concentrate and ad libitum kitchen waste group. The nutrient digestibility of different proximate components differed significantly (p<0.05) among different treatment groups. The digestibility of dry matter and crude fiber, and availability of ash were found the highest (63.45%, 56.47% and 63.53%, respectively) in the T3 group (kitchen waste group). The digestibility of crude protein (63.53%), ether extract (56.78%) and nitrogen-free extract (56.71%) was the highest in the T2 treatment group (Roadside grass group). The serum biochemical parameters like- total protein, albumin, phosphorus, calcium, glucose, creatinine, urea and SGPT varied significantly among the treatment groups but the values were within the normal limits. The kitchen waste might be efficiently used as a roughage replacer in broiler rabbit diet without affecting the performance of the animals.

Keywords: Cost-Benefit; Nutrient digestibility; FCR; Serum Biochemistry.

Introduction

Micro-livestock such as the rabbit, guinea pig, grass-cutter, giant rat, iguana, and pigeons have been suggested [1] as a rapid mean of obtaining animal proteins. To maximize food production in Bangladesh, all reasonable options must be considered and evaluated. Among those, the use of micro livestock such as rabbit will be the option rather than other species of animal agriculture. Furthermore, there is an increasing interest in the diversification of animal production system in Bangladesh to produce products, which are not surplus nationally. The climatic condition, commercial factors, local environment, religious points of view, social practices as well as technological aspects support the rabbit raising potentials in Bangladesh [2]. Hamill, Marty, Neher, Sakmann and Sigworth [3] emphasized that, in developing countries where critical national meat shortage exists, the potential for rabbit production was greatest. Nevertheless, rabbits are easy to handle and can be raised under primitive condition. They require little financial involvement and women, and children can accomplish their husbandry at home. Therefore, farmers who are interested in an alternative livestock enterprise with low capital and labor investment may consider rabbit farming in this country.

Rabbit is a small burrowing mammal of the hare family with long ear, short tails, and long hind legs. Their foods are roughages, homegrown vegetable, cereal grains, concentrate made into pellets, grasses, among others. It can be said that the rabbit is an efficient animal for converting kitchen waste and nonconventional feedstuffs into meat in the same vein. Rabbit adapt to Simple environment, in hutches, that all the breeds of rabbit are prolific breeders. It is also a good source of white meat, with-low fat, and cholesterol, with useful wool (fur), skin, manure [4]. Rabbit production is a new development in the region, which plays an important role because of the economic risks by the spread of Asian bird flu [5]. According to the FAO (2001), backyard rabbit keeping provides additional income and supplies additional protein for poor rural and urban households with low investment and labor inputs. Rabbits have a small body size, short generation interval, high reproductive potential, rapid growth rate, genetic diversity, and the ability to utilize forages and by-products as major diet components that make the animal appropriate for small livestock keeping in developing countries [6]. Rabbit can be maintained as a viable instrument and an aspect of a tool capable of promoting and surviving meat availability [7].

Kitchen wastes are nutrient rich surplus materials, which have higher Crude protein and energy value [8] and can be used as regular feeds for pigs [9]. These can be collected from households, hotel, hostel, restaurants, and other sources at a minimal price, and fed pigs as such or after boiling. These nutrient-dense surplus bio-wastes can be fed to rabbits in their early growing stage for better growth rate. This favorable early growth may have a positive effect on overall production, reproduction, and carcass quality in later stages.

Considering the above discussions in mind, the current research work was designed to familiarize rabbit as a source of animal protein by using kitchen waste as a sole source of feed with the following objectives:

1.To evaluate the growth performance of rabbit using kitchen waste as roughage.

2.To evaluate the effect of kitchen waste in FCR of rabbit by replacing roughage.

3.To prepare the least cost ration for rabbit using kitchen wastes.

Materials and Methods

Location and Duration of Experiment

Chattogram is the second largest city of Bangladesh located at 22021′N and 91048′E with an average temperature ranged from 13-320Cand 70-80% humidity [10]. This city has a substantial number of higher educational institutes where Chattogram Veterinary and Animal Sciences University (CVASU) is one of the specialized institute renowned for higher education and research located at the center of the city. This university has a well-organized laboratory animal research unit run by the Animal Science and Nutrition Department. The present experimental study has been conducted from July 2015 to February 2016 under the command of laboratory animal research unit of CVASU.

Experimental Design, Dietary Treatment Groups and Feedstuffs formulation

A total number of 45 weaned white albino breed of rabbits having same age were procured from the local market (Riazuddin Bazar) of Chattogram. All the rabbit was randomly divided into three treatment groups identified as T1, T2 and T3 based on the similarities of body weight (suppl table 1). Each treatment group was further subdivided into three replications with 5 individuals in each. The study was formulated based on the principle of Completely Randomized Design (CRD) as described by [11], where three different treatments of a combination of 40-gram concentrate with ad libitum fodder, a combination of 40 gm concentrate and ad libitum roadside grass and combination of 40 gm concentrate and ad libitum kitchen waste were applied on T1, T2 and T3 group respectively. All the rabbits were housed in 3 iron cages of 88000 cm3 per treatment group of 15 rabbits. All the rabbits had access to drinking water, green grass and concentrate feed that was offered twice daily, at 8.00 am and 4.00 pm. Kitchen waste was collected locally from the nearby household whereas the fodder includes the mixture of Napier and Para grass which was collected from the fodder plot of CVASU. After collection of kitchen waste, roadside grass and fodder, they were washed using water and chopped before offering to the rabbits. The concentrate mixture was formulated as Dry Matter (DM) basis as per the standard requirement estimated by National Research Council (NRC) [12] described by Halls [13] using the locally available feed ingredients including maize, wheat bran, rice polish, pea bran, soybean meal, mustard oil cake, DCP and salt (Suppl Table 2). The proximate analysis was performed maintaining the standard procedure described by Sonone, Chavan and Tanpure [14] (Suppl Table 3). Weekly body weight changes and daily feed intake of an individual rabbit was measured during the experimental period.

Management Practices

At the beginning of the experimental setup, the rabbit cages along with all feeders and water pots were cleaned and washed with detergent and sun-dried, the room was also cleaned and fumigated(Suppl Table 4). During the experiment, feeder and waterer were cleaned every day whereas disinfected once in a week along with cages and floor of the room. The feces were taken away aseptically to a safe place to provide a proper hygienic condition of the experimental shed. The rabbits of different treatment groups were provided with identical care and management throughout the experimental period.

Suppl Table 1: Initial mean live weight (in gm) of rabbits in different treatment groups.

Treatment groups	T_1	T_2	T_3
Body weight (Mean)	354.5	353.7	354.2
T_1= 40-gram concentrate and ad libitum fodder, T_2= 40-gram concentrate and ad libitum roadside grass and T_3= 40-gram concentrate and ad libitum kitchen waste.			

Suppl Table 2: Ingredient composition of concentrate mixture for growing rabbits.

Ingredients	Amount (%)
Maize broken	52.5
Wheat bran	6
Rice polish	11
Pea bran	4
Mustard oil cake	3
Soybean meal	21
DCP	2.25
Salt	0.25
Total	**100**

Suppl Table 3: Proximate composition of supplied concentrate mixture.

Parameters	Amount (%)
Dry Matter (DM)	88
Crude Protein (CP)	18.86
Crude Fibre (CF)	6.47
Ether Extract (EE)	6.02
Total Ash	4.62
Nitrogen Free Extracts (NFE)	64.03

Suppl Table 4: Proximate composition of green grass and kitchen waste.

Parameters	Proximate Components (%)					
	DM	CP	CF	Ash	EE	NFE
Fodder (Napier and Para)	32	15.13	38	11	1.43	34.44
Roadside grass	30	15.24	35	12	1.44	35.13
Kitchen waste	31	16.17	39	10.5	1.39	34.11

Recording of Feed Intake

The rabbits were given with experimental diets; twice daily and left-over and wasted feed of both roughages and concentrate was collected, weighed, and recorded on the next day morning before offering feed of the following day. Feed intake was calculated (in gram) after subtracting the left-over feed and wasted feed from the total supplied feed (gram).

Measurement of Live Weight, Live Weight Gain, FCR (Feed Efficiency) and Livability

The rabbits were weighed individually at the beginning of the experiment and the average weight was taken as the initial body weight. Rabbits were weighed individually in every week by using an electric digital weighing balance before morning feeding. The weekly live weight gain was calculated by subtracting the live weight (gram) at starting of the week from the end weight (gram) of the subsequent week. The cumulative live weight was calculated by adding the weight at starting of the week with the end of the week. Feed Conversion Ratio (FCR) was calculated as the ratio between total feed intake (gram) and live weight gain (gram). Feed intake, FCR and live weight gain was estimated on dry matter basis of the supplied diets. The livability of the rabbit was calculated after deducting the dead one from the initial total and was expressed as a percentage. Every died rabbit was gone through postmortem examination.

Digestibility Trial

A digestibility trial was conducted at the later part of the experimental period to evaluate the coefficient of digestibility of nutrients of kitchen waste and other feed materials used in different treatment groups. 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 [14] to determine nutrient contents of feed and feces. The digestibility of each nutrient was estimated as the proportion between the difference in nutrient in feces (gram) from feed (gram) with total nutrient in the feed. The values were expressed in percentage.

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 described by Sonone, Chavan [14]. All the samples were analyzed in duplicates and mean value were recorded carefully.

Collection and Preservation of Blood Samples

At the end of the feeding trial, 4 rabbits were selected from each treatment group, blood samples were collected through heart puncture and ear vein @ about 4ml from each rabbit. Blood sample was taken into two separate vials, one containing EDTA (anticoagulant) for hematology and the other was not contained anticoagulant which was used for serum preparation for biochemical analysis. The blood samples with anticoagulant were analyzed for Hemoglobin, Packed cell volume, Total erythrocyte count and Total leucocyte count within 24 hours of collection maintaining a standard procedure as described by Bain, Lewis and Bates [15]. The separated serum samples were preserved into a deep freeze at -18°C and further biochemical analysis were done within 7 days.

Biochemical Analysis

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, Phosphorus, Calcium, Glucose, Urea, Creatinine and SGPT level was estimated by using biochemical analyzer (Humalyzer-3000 chemistry analyzer, semi-automated Benchtop chemistry photometer, China) based on the standard user manual provided by the company in biochemistry laboratory of CVASU. For each parameter, the commercial kit of RANDOX Company (http://www.randox.com/reagent) was used and the manufacturer's procedure was followed.

Statistical Analysis

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

Cost-Benefit has been estimated in Bangladeshi Taka (BDT) based on cost items including Rabbit cost, total feed cost and management cost whereas benefit items included market selling price of per kg rabbit. In the cost items, the total feed cost was the feed raw materials cost and management cost included labor cost, electricity cost and disinfectant cost. In case of benefit, total selling market was estimated based on per kg of rabbit selling price and thus the net profit of per kg rabbit was calculated by deducting the total cost of per kg rabbit from the net return of per kg rabbit.

Results

Replacement Effect on Growth Performance of Rabbit

The present experiment estimated no significant ($p>0.05$) difference of mean weekly DM intake among treatment groups at 1st week, 2nd week and 3rd week of the experiment. However, the slightly higher numerical value in mean weekly DM intake was observed in the T3 group and lower mean weekly DM intake was found in T1 group (Table 1). Again, the estimated mean body weight at first, second and third weeks of the experimental animals were almost similar and the values did not differ significantly ($p>0.05$).

Moreover, the mean cumulative body weight at the first and second week of the trial seemed to be almost similar and the average body weight of each group did not differ significantly ($p>0.05$) (Table 1). The experiment revealed no significant difference ($p>0.05$) of mean live weight gain among all treatment groups at 1st week, 2nd week and 3rd week of the experiment (Table 1). The Feed Conversion Ratio (FCR) was not differed significantly ($p>0.05$) among all treatment groups in different weeks of experiment whereas, numerically better (slightly lower) FCR was found in T1 group.

Table 1: Replacement effect of different parameters in different treatment groups under each experimental period.

Parameters	Digestibility (%)			SEM	Level of significance
	T_1	T_2	T_3		
DM	54.23^c	62.24^b	63.45^a	0.11	***
CP	56.52^c	63.53^a	62.31^b	0.09	***
CF	52.71^b	52.75^b	56.47^a	0.06	***
EE	56.50^{ab}	56.78^a	56.44^b	0.08	*
NFE	52.77^c	56.71^a	56.42^b	0.08	***
ASH	54.26^b	63.60^a	63.61^a	0.13	***

OM	45.74[a]	36.40[b]	36.39[b]	0.1	***
*N=15; SEM=Standard Error of Mean; NS=Non-Significant (p>0.05); *=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_1= 40-gram concentrate and ad libitum fodder, T_2= 40-gram concentrate and ad libitum roadside grass; T_3= 40-gram concentrate and ad libitum kitchen waste.*					

Replacement Effect on the livability of Rabbit

The livability of the rabbit was found as 96% in all the groups. The livability of the rabbit was found as 98%, 94% and 98% in T1, T2 and T3 groups respectively where postmortem findings did not evidence of any pathologic lesions.

Digestibility Co-efficient of Different Nutrients

The digestibility co-efficient of DM was estimated as 54.23%, 62.24% and 63.45% for T1, T2 and T3 group respectively (Table 2). The values varied from 54.23% to 63.45% being highest in T3 and lowest in T1 group revealed the extremely significant (P<0.05) effect of treatment among the groups. The digestibility co-efficient of CP was calculated as 56.52%, 63.53% and 62.31% respectively for T1, T2 and T3 group. The values varied from 56.52% to 63.31% being highest in T2 and lowest in T1 group revealed the extremely significant (P<0.05) effect of treatment among the groups. Again, the digestibility co-efficient of CF was 52.71%, 52.75% and 56.47% respectively for T1, T2 and T3 group. The values varied from 52.71 to 56.47 per cent being highest in T3 and lowest in T1 group indicating the extremely significant (P<0.05) effect of treatment among all groups. For EE, the digestibility co-efficient significantly varied from 56.44% to 56.78% being highest in T2 and lowest in T3. The NFE was varied significantly from 52.77% to 56.71% being highest in T2 and lowest in T1 group whereas digestibility co-efficient of Ash was varied significantly with a value of 54.26%, 63.60% and 63.61% respectively among T1, T2 and T3 group. Almost 45.74%, 36.40% and 36.39% of digestibility co-efficient has been estimated among T1, T2 and T3 group respectively (Table 2).

Table 2: Digestibility co-efficient of nutrients.

Parameter	Experimental period	Treatment group				Level of significance
		T1	T2	T3	SEM	
Effect of roughage on DM intake	1st week	352.81	352.94	353.18	0.3	NS
	2nd week	427.14	427.24	427.44	0.01	NS
	3rd week	449.45	449.62	449.83	0.01	NS
Effect of roughage on body weight	Initial	354.3	353.74	354.16	0.53	NS
	1st week	425.86	425.4	425.04	0.65	NS
	2nd week	561.88	560.8	561.34	1.04	NS
	3rd week	728.63	727.1	727.52	1.03	NS
Cumulative body weight	1st week	780.17	779.14	779.21	0.8	NS
	2nd week	987.74	986.2	986.39	1.25	NS
	3rd week	1290.51	1287.9	1288.86	1.55	NS
Live weight gain	1st week	71.56	71.66	70.88	0.82	NS
	2nd week	136.01	135.39	136.3	1.07	NS
	3rd week	166.75	166.3	166.17	1.35	NS
Feed Conversion Ratio (FCR)	1st week	4.94	4.94	4.99	0.05	NS
	2nd week	3.14	3.16	3.14	0.02	NS
	3rd week	2.7	2.71	2.71	0.02	NS
N=15; NS=Non-Significant (p>0.05); T1= 40-gram concentrate and ad libitum fodder, T2= 40-gram concentrate and ad libitum roadside grass; T3= 40-gram concentrate and ad libitum kitchen waste.						

Replacement Effect of Roughage by Kitchen Waste on Biochemical parameters

Biochemical analysis revealed statistically significant (p< 0.05) effect of feed on serum protein which was observed in mean value estimated higher in T3 and lower in the T1 group. However, the Albumin level in serum of T1, T2 and T3 groups were 9.10, 9.88, and 9.52 g/dl respectively varied significantly (Table 3). Again, the Phosphorus level in serum of T1, T2 and T3 groups were 6.53, 10.17, 9.95 mg/dl respectively (p< 0.05). The serum calcium level among T1, T2 and T3 groups were 6.11, 11.93, 11.94 mg/dl respectively and the variation was statistically significant. The glucose level in serum of T1, T2 and T3 groups were 131.80, 196.46 and 198.73 mg/dl respectively. The comparison of means of statistical analysis revealed that highly significant ($p < 0.05$) effect of feed on serum glucose was observed having higher in T3 and lower in the T1 group. For Serum Creatinine level, the comparison of means of revealed statistically significant ($p< 0.05$) effect of feed on serum Creatinine which was observed higher in T1 (0.783 mg/dl) and lower in both T3 (0.446mg/dl) and T2 (0.446mg/dl) group. The mean Serum Urea value varied statistically significantly among the T1 (33.50 mg/dl), T2 (55.42 mg/dl) and T3 (57.31 mg/dl) group. The overall mean Serum Glutamic- Pyruvic Transaminase values varied significantly which was higher in T3 and lower in T1 group (Table 3).

Table 3: Effect of kitchen waste on serum biochemical parameter of rabbits (n=4).

Parameters	Serum biochemical parameter of rabbits				Level of significance
	T_1	T_2	T_3	SEM	
Protein (g/dl)	4.53^c	5.38^b	6.56^a	0.06	***
Albumin (g/dl)	9.10^c	9.88^a	9.52^b	0.04	***
Phosphorus mg/dl)	6.53^c	10.17^a	9.95^b	0.07	***
Calcium (mg/dl)	6.11^c	11.93^b	11.94^a	0.07	***
Glucose (mg/dl)	131.80^c	196.46^b	198.73^a	0.89	***
Creatinine (mg/dl)	0.783^a	0.446^b	0.446^b	0.02	***
Urea (mg/dl)	33.50^c	55.42^b	57.31^a	0.38	***
SGPT (u/l)	45.01^c	53.47^b	55.15^a	0.51	***

*N=4; SEM=Standard Error of Mean; 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_1= 40-gram concentrate and ad libitum fodder, T_2= 40-gram concentrate and ad libitum roadside grass; T_3= 40-gram concentrate and ad libitum kitchen waste.*

Cost-benefit analysis

The present experiment revealed a significant difference between the cost and benefit of the different treatment groups of T1, T2 and T3. The mean net benefit estimated as highest in T3 (8.65 BDT) followed by T1 (6.75 BDT) and T2 (5.86 BDT) (Table 4).

Table 4: Cost Benefit analysis in different treatment groups.

Item	Parameters	T_1	T_2	T_3	Level of significance
		Mean ± SEM	Mean ± SEM	Mean ± SEM	
Cost (in bdt)	Purchase cost (per Rabbit)	200	200	200	NS
	Total feed cost (per Kg)	36.06	35.15	30.7	**
	Management cost (per Rabbit)	17	17	17	NS
	Total. feed cost (per Rabbit)	82.88^a±0.03	80.33^b±0.14	76.40^c±0.10	**
	Total cost (per Rabbit)	170.90^a±0.03	169.0^b±0.09	146.5^c±0.15	**
	Total cost (per Kg live Rabbit)	129.25^a±0.46	127.74^b±0.25	120.35^c±0.78	**
Benefit (in bdt)	Market sale price (per Kg Rabbit)	417	417	417	NS
	Total sale price (per Rabbit)	410.23^a±0.72	405.81^c±0.81	408.85^b±0.71	**
	Net Profit (per Rabbit)	80.33^a±0.71	78.8^c±0.69	85.3^b±0.58	**
	Net Profit (per Kg live Rabbit)	6.75^b±0.24	5.86^c±0.16	8.65^a±0.78	**

*T_1= 40-gram concentrate and ad libitum fodder, T_2= 40-gram concentrate and ad libitum roadside grass; T_3= 40-gram concentrate and ad libitum kitchen waste. Mean values having uncommon superscripts differ significantly, SEM = Standard error of mean NS=Non-Significant (p>0.05); *=Significant (P<0.05); **=Significant (P<0.05); (a,b,c,..) Means with different superscripts in the same row differ significantly (p> 0.05), total feed cost included feed raw materials cost and management cost included, labor cost, electricity cost, disinfectant cost [1 US $=78 Taka (approx.)]*

Discussion

Replacement Effect of Roughage by Kitchen Waste on Growth Performances of Rabbit

This experimental study revealed no significant ($p>0.05$) difference of mean weekly DM intake, live weight, cumulative body weight, live weight gain and feed conversion ratio among all treatment groups of rabbit in the entire experimental period indicated an adverse effect of kitchen waste on growth performances of rabbit up to its market age. So the rabbit can be reared feeding kitchen waste which is corroborated with many earlier studies conducted by Lukefahr and Goldman [16] in Cameroon and

Nakkitset, Mikled and Ledin [17] in Thailand. The digestibility co-efficient of all the proximate components of this study revealed the extremely significant (P<0.05) effect of treatment among all groups having higher in T3 in most of the components and lower in T1 in all components which signify the digestive potentiality of kitchen waste by rabbit as compared to the other roughages when supplemented with 40% concentrate mixture in the ration. This statement is supported by Lukefahr and Goldman [16] and Nakkitset, Mikled [17] where they used different kitchen vegetable residues like water spinach or sweet potato wines, lettuce residues as well as kitchen crop residues like damaged bananas, mangoes or other fruits to the rabbit as a feed supplement and observed the similar results. In overall growth performance perspective, the current study has also been supported by the earlier studies conducted by Onu and Aja [18] and Farinu [19] who recommended on the use of non-conventional feed as supplemented feed ingredients for broiler rabbit.

Replacement Effect of Roughage by Kitchen Waste on Serum Biochemical Changes of Rabbit

It is revealed that total protein, calcium, glucose, urea, and SGPT level in serum was significantly higher in T3 group of rabbit where 40 gm concentrate and ad libitum kitchen waste was offered as compared to theT2 group where 40-gram concentrate and ad libitum fodder was offered to the rabbit. In biochemical parameter, the most significant parameter - protein percentage in T2 and T3 group was within the normal protein value whereas T3 was near the maximum normal blood protein level which might be due to the presence of high CP% in kitchen waste. This study suggested that the inclusion of kitchen waste would be of benefit in raising grower rabbit in this country perspective which can be corroborated with the findings of [20] and [21].

Conclusion

This experiment depicted that the final body weight and weekly body weight gain and cumulative body weight gain did not differ significantly among all the treatment groups. The result indicated that the replacement effect of roughage by kitchen waste had no detrimental effect on final body weight and body weight gain as well as on growth parameters of growing rabbit. In contrast, the digestibility co-efficient of different nutrients (DM, CP, CF, Ash and NFE) in rabbit, the mean digestibility of all the proximate components differed significantly among all treatment groups which were higher in T3 for most of the components which group was treated with 40 gm concentrate and ad libitum kitchen waste. This finding is said that the kitchen waste has the potentials to be digested smoothly by rabbit as compared to the other roughages when supplemented with 40% concentrate mixture in the ration. Finally, it can be recommended on the use of kitchen waste as a suitable alternative to rear growing rabbit where it can be supplemented with 40 gm of concentrate mixture for economic production.

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Conflict of interests

No conflict of interest to declare

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