



UTILIZATION OF KITCHEN FOOD WASTES SUPPLEMENTED WITH GARLIC IN THE DIETS OF GROWING RABBITS

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ABSTRACT

The study was conducted to investigate the utilization of kitchen food wastes supplemented with graded levels of garlic as feed additive on growth performance, carcass characteristics and blood profile of growing rabbits. Twenty (20) rabbits (541 to 611 g) were randomly assigned to four (4) treatment groups in a completely randomized design and each treatment had five (5) rabbits. Four diets were formulated with inclusion levels of garlic (0.00, 0.25, 0.50 and 0.75%) designated as treatments 1, 2, 3, and 4 respectively. The results revealed that there were no significant ($P < 0.05$) differences among the treatments with respect to total weight gain (511.40, 499.20, 488.20, and 476.20), daily weight gain (12.18, 11.89, 11.62, and 11.34) and feed conversion ratio (5.76, 5.59, 5.53, and 5.41). However, total feed intake (TFI) and daily feed intake (DFI) were significantly ($P < 0.05$) different among the treatments, in which treatment 4 recorded higher total feed intake (2830.60 g) and daily feed intake (67.39 g) compared to other treatments and the least TFI (2576.20) and DFI (61.34) was recorded under control. In terms of carcass weights, a significant ($P < 0.05$) difference was observed among the treatments in which treatment 4 recorded the highest values (602.00 g) and treatment 1 is the least (506.00). The highest dressing percentage (53.70%) was recorded under treatment 4 and treatment 1 is the least (47.03%). The hematological parameters with the exception of eosinophil were not affected by the treatments, however, total protein, globulin and alanine aminotransferase of serum biochemical parameters were affected by the treatments. The lowest feed cost (N/g gain) was observed in treatment (1). In conclusion feeding kitchen food wastes supplemented with garlic did not adversely affect the growth performance of growing rabbits. Based on result of this study, incorporation of kitchen food wastes supplemented with garlic (at 0.75%) increased feed intake and dressing percentage of growing rabbits and is recommended for rabbit farmers in the study area.

Keywords: Kitchen, Food, Waste, Garlic, Supplement

INTRODUCTION

Human population is expanding; more crop and animal products must be produced to satisfy the rising human food demand. The common point of convergence on the food web for both humans and animals (especially monogastric) is cereals which animals and humans now compete for (USAD-FAS, 2022). A significant proportion of the Nigerian population is currently experiencing issues related to hunger and malnutrition due to insufficient protein intake in their diets (Maidala and Bakoji, 2016). The need for increase in animal production is absolutely critical and this can be achieved by producing highly productive animals with short generation intervals like (broiler and rabbit). Rabbits are cheap source of high-quality protein that can substantially improve the level of animal protein consumption in developing countries (Wafar *et al.*, 2018). Rabbits are suitable to rise for meat because of their high fecundity, short gestation period and high feed conversion efficiency (Attia, 2019). Rabbit



have fast reproductive and growth rates, and are excellent species in converting feed into body weight, also known to yield high quality protein meat and low fat. Conventional animal production systems have put humans and animals in competition for grains; kitchen food waste has the potential to reduce competition, particularly among small-scale rabbit farmers (Ibitoye *et al.*, 2023). Livestock production in many developing countries is constrained because of poor quality and the short supply source of animal feeds (IAEA, 2011). In livestock production systems, the cost of animal feed represents about 70–85% of the total recurring cost (FEFAC, 2015), therefore, it is necessary to find low cost feeds incorporated in the rations of animals and poultry. The use of alternative energy resources in non-ruminant feeding reduced the over dependence on maize and cost of production significantly (Kpehe *et al.*, 2020). Kitchen wastes are nutrient rich surplus materials, which have higher crude protein and energy value and can be used as regular feeds for pigs (Saikia and Bhar. 2010). These can be collected from households, hotel, restaurants, and other sources at a minimal price, and fed pigs as such or after boiling. These nutrient-dense surplus biowastes can be fed to rabbits in their early growing stage for better growth rate. Many countries tend to prevent the application of antibiotics for their side effects on both animal and human. The ban on nutritive antibiotic use in the world and the augmented awareness of the consumers triggered a need for natural and safe feed additives to achieve better production results of farm animals, therefore, nowadays growth promoters from herbal sources (phytogenic extracts) are used very commonly (Ortserga *et al.*, 2018). This study, therefore, was directed towards determining the utilization of feeding kitchen food waste (KFW) supplemented with garlic on the growth performance, carcass characteristics, and blood profile of growing Rabbits.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at Teaching and Research farm of the Bauchi State College of Agriculture, Bauchi. The college is located at Yalwan Makaranta along Bauchi-Dass road, Bauchi Nigeria. The area is located within the Southern Guinea Savannah on latitude 10o 18'37.2 N and longitude 9o50'38.0 E, characterized by two well-defined seasons; Rainy season (May - October) and dry season (November - April). The average annual rainfall of Bauchi is about 1009 mm, highest relative humidity 94% (August) and the lowest 35 % (February). Temperatures are between 13 – 17oC (December – February) and 36 – 37o C (March – April) (World Atlas, 2015).

Experimental Diets

Four (4) experimental diets were formulated in such a way that garlic is included at (0.00, 0.25, 0.50 and 0.75%) designated as treatments 1, 2, 3 and 4 respectively. The ingredients and chemical composition of the experimental diets are shown in Tables 1 and 2.

Table 1: Composition of Experimental Diets Containing Graded Levels of Garlic (%)

Ingredients	T1 (0.00%)	T2 (0.25%)	T3 (0.50%)	T4 (0.75%)
Kitchen food waste	58.26	58.29	58.14	57.99
Soya bean	18.74	18.46	18.36	18.26
Wheat offal	10.00	10.00	10.00	10.00
Groundnut haulm	10.00	1.00	10.00	10.00
Garlic	0.00	0.25	0.50	0.75
Bone meal	2.00	2.00	2.00	2.00
Premix	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00

Table 2: Proximate Composition of Experimental Diets Fed to Growing Rabbits (%)

Nutrients	T1	T2	T3	T4
Dry matter	8.26	91.29	90.14	89.70
Organic matter	93.70	90.53	93.36	89.26
Ash	6.30	9.47	6.64	10.74
Crude protein	15.98	16.10	16.47	15.90
Crude fiber	5.80	6.25	5.50	4.75
Ether extract	3.90	4.50	4.10	3.92
Nitrogen free extract	64.50	70.20	67.30	73.10
ME (kcal/kg)	3168.07	3423.70	3300.98	3472.21

ME = Metabolizable energy; calculated using **Pauzenga (1985)**.

Management of Experimental Animals

A total of twenty (20) rabbits (weighed 541-611 g) were used in this study. The rabbits were housed in wooden cages. A week before the arrival of the experimental animals, all the soiled bedding was removed from the cages, thoroughly washed and disinfected using sodium hypochlorite diluted at 1/2 cup of sodium hypochlorite bleach (6%) to one gallon of potable water scrub with nylon bristle brush to disinfected the cages and allowed to dry for seven days. Feeders and drinkers were provided in each cage and cages was labeled according to the treatments. On the arrival of the experimental rabbits, clean fresh water and feed was provided to them. The rabbits were allowed for preliminary feeding period of seven days to enable them acclimatize with confinement. Ivermectin and oxytetracycline 0.25ml was injected to the rabbits against internal and external parasite before the commencement of the experiment, after which they were randomly assigned to four dietary treatments of five rabbits each, the initial weight of each rabbit was taken after assigning them to one of the four dietary treatments. A measured quantity of the treatment diet was served daily for each rabbits and water was provided ad-libitum, left over feed was weighed every day and the quantity consumed was determined by difference for a period of six (6) weeks.

Methods of Data Collection

Performance parameters

Performance parameters measured include initial body weight, final body weight, weight gain, feed intake, and feed conversion ratio. Feed intake was taken daily and body weight gain was taken weekly and calculated thus:

Feed intake (g) = feed offered (g) – left over feed (g) on daily basis

Weight gain= weight of the current week -weight of previous week (g)

Feed Conversion Ratio = Feed consumed (g)/Weight gain (g)

Blood Profile Studies

Blood sampling

The blood sample were collected from 2 rabbits of each treatment, in which 4ml of blood sample was taken from the ear vein with a sterile syringe. 2 ml of the blood was put into a bottle containing ethylene diamine tetracetic acid (EDTA) as an anticoagulant for hematological assay. The remaining 2ml of the blood sample was put into a sterile plain tube without an anticoagulant for serum biochemical analysis.

Hematological Parameters Determined

The hematological assay was carried out to determine erythrocyte indices such as packed cell volume (PCV), hemoglobin (Hb), Red blood cell (RBC), white blood cell count (WBC), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin volume (MCHV), mean corpuscular hemoglobin concentration (MCHV), lymphocytes, neutrophil, eosinophil, basophil and monocytes respectively.



Serum Biochemical Parameters

The serum biochemical indices determined were; serum protein, albumin, urea, creatine and blood cholesterol, glucose, total bilirubin, alanine aminotransferase, aspartate aminotransferase, and alkaline phosphate.

Carcass Evaluation

At the end of the study period, eight (8) rabbits (2 from each treatment) were randomly selected and slaughtered. Prior to slaughtering, they were fasted for 12 hours and weighed to determine the final live weight. Skinning and evisceration were carried out immediately by removing the viscera and intestines. Internal organs harvested were weighed such as liver, kidney (left and right), lungs, heart and spleen. The weights were expressed as the percentage of the live weight.

Experimental Design

The experiment was conducted in a completely randomized design (CRD) with four treatments of five rabbits each.

Chemical Analysis

The proximate composition of the experimental diets was determined using the procedures of the Association of Analytical Chemist (AOAC, 2010).

Statistical Analysis

The data collected were subjected to Analysis of Variance (ANOVA) using statistical package for social science (SPSS) and means were separated using Least Significant Difference (LSD).

RESULTS AND DISCUSSION

Feed Intake and Growth Performance of Growing Rabbit Fed Kitchen Food Wastes Supplemented with Garlic

The results of this study revealed a significant ($P < 0.05$) differences in total feed intake (TFI) and daily feed intake (DFI) across the treatments as showed in Table 3. The highest TFI (2830 g) and DFI (67.39 g/d) was observed for rabbits under treatment 4 and the least TFI (2576.20 g) and DFI (61.34 g/d) was recorded for rabbits under control treatments. This implies that, the feed intake of rabbits increased with increasing level of garlic. The increased feed intake as observed in this study agreed with the report of Onu and Aja (2017) who reported that feed intake enhanced with garlic and ginger supplementation. The results are also in lined with the findings of Ignatius and Kingsley (2020) who reported that the daily feed intake per rabbit per day increased significantly with the increase in the inclusion level of garlic and time. No significant difference was recorded in total weight gain (511.40, 499.20, 488.20 and 476.20 g), daily weight gain (12.18, 11.89, 11.62 and 11.34 g) and feed conversion ratio (5.76, 5.59, 5.53 and 5.41) across the treatments. The finding agrees with the report of Amith *et al.* (2020) who reported that the replacement effect of roughage by kitchen waste had no detrimental effect on final body weight and body weight gain of growing rabbits. The result of this study contradicts the report of Ignatius and Kingsley (2020) who demonstrated that live weight gain of rabbits increased with an increase in dietary inclusion level of garlic.



Table 3: Growth Performance of Growing Rabbits Fed Kitchen Food Wastes Supplemented with Graded Levels of Garlic

Parameters	T1	T2	T3	T4	SEM
Initial weight (g)	608.80	609.40	609.80	609.60	0.03 ^{NS}
Final weight (g)	1085.00	1108.60	1098.00	1121.00	1.02 ^{NS}
Total weight gain (g)	476.20	499.20	488.20	511.40	1.34 ^{NS}
Total feed intake (g)	2576.20 ^d	2794.20 ^{abc}	2810.60 ^{ab}	2830.60 ^a	9.69 ^{**}
Daily feed intake (g)	61.34 ^c	66.53 ^c	66.92 ^{ab}	67.39 ^a	0.24 ^{**}
Daily weight gain (g)	11.34	11.89	11.62	12.18	0.04 ^{NS}
Feed conversion ratio	5.41	5.59	5.76	5.53	0.05 ^{NS}

^{abcd} Means in the same row with different superscript differs significantly, MES = Standard error of mean, NS= No significant, ** = significant at (P< 0.05).

Carcass, Organs and Guts Characteristics of Growing Rabbit Fed Kitchen Food Wastes Supplemented with Garlic

The results of carcass, organs and guts characteristics of growing Rabbits fed kitchen food wastes supplemented with garlic is presented in Table 4. The result revealed that, the treatments significantly affected (P<0.05) the carcass weight, the weights of the head, pelt and tail. The highest carcass weight (602 g) and dressing percentage (53.70%) was recorded for rabbits under treatments 4 and the least carcass weight (506.00 g) and dressing percentage (47.03) was observed for rabbits under treatment 1. The findings of this study were against that of Mousa *et al.* (2018) who found that duck's diets contain dry leftover food had no significant effect (P<0.05) on dressing %, carcass weight relative weights of liver and heart. The results also opposed the report of Alagawany *et al.* (2016) who revealed that dietary garlic treatments did not affect carcass weight/yield as well as spleen and dressing percentages of rabbits. The results however, did not reveal significant difference on the weights of the spleen (0.18-0.21 g) and heart (0.28-0.36) across the treatments. This implies that the diets had no adverse effect on the carcass traits of rabbits. It is believed that, if there are any major effects of anti-nutritional factors, organs like heart and liver should be significantly affected (Akinmutimi *et al.*, 2004). The results of hemoglobin indices were not affected by the treatments.

Table 4: Carcass, Organs and Guts Characteristics of Growing Rabbits fed Kitchen Food Wastes Supplemented with Graded Level of Garlic

Parameters	T1	T2	T3	T4	SEM
Live weight (g)	1085.00	1108.6	1098	1121	1.02 ^{NS}
Carcass weight (g)	506.00 ^c	557 ^b	554 ^c	602 ^a	6.18*
Dressing percentage (%)	47.03 ^b	50.24 ^b	50.46 ^b	53.70 ^a	0.626*
Head (% LW)	9.26 ^b	11.59 ^a	10.75 ^{ab}	10.35 ^{ab}	0.566*
Skin (%IW)	6.73 ^{ab}	9.11 ^{ab}	10.29 ^a	5.35 ^c	0.486*
Fore/hind limbs (% LW)	2.76	3.02	3.05	3.08	0.103*
Tail (% LW)	0.51 ^b	0.72 ^a	0.59 ^{ab}	0.58 ^{ab}	0.019*
Organs (% LW)					
Heart	0.28	0.32	0.36	0.31	0.01 ^{NS}
Spleen	0.18	0.18	0.20	0.21	0.01 ^{NS}
Kidney	0.65 ^b	0.81 ^a	0.77 ^{ab}	0.67 ^{ab}	0.02*
Liver	3.04 ^b	3.02 ^b	3.87 ^a	2.99 ^b	0.09*
Lung	0.97 ^b	1.26 ^a	0.96 ^b	0.67 ^b	0.08*
Guts (% LW)					
Caecum	1.84	1.44	1.86	1.69	0.04 ^{NS}
Small intestine	7.14 ^b	6.40 ^b	8.46 ^a	5.57 ^b	0.27*
Large intestine	8.24 ^b	8.70 ^{ab}	6.06 ^c	10.08 ^a	0.36*
Stomach	4.88 ^b	3.47 ^b	5.46 ^a	3.61 ^b	0.21*
Visceral fat	0.23 ^b	0.27 ^b	0.73 ^a	1.25 ^a	0.11*

^{abcd} Means in the same row with different superscript differs significantly, MES = Standard error of mean, NS= No significant, * = significant at (P< 0.05), LW= Live weight

Hematological Indices of Growing Rabbits Fed Kitchen Food Wastes Supplemented with Garlic

The results for hemoglobin concentration in this study were (9.17, 9.34, 12.16, and 10.62 g/dl) for rabbits in treatment 1, 2, 3, and 4 respectively. The results are in agreement with the report of Alagbe and Oluwafemi (2019) who reported a range values of 8.61 -13.30 and in lined within the normal range values of 9.5-13.7 for healthy Rabbit as reported by NCBI (2024). The packed cell volumes (PCV) in this study were (28.33, 34.00, 36.33, and 38.50%) for rabbits in treatment 1, 2, 3 and 4 respectively. The results is in agreement with range values (23-50) reported by NCBI (2024) and Medirabbit (2011), this indicated clearly that the rabbits were healthy not anemic. The red and white blood cells determined in this study were in lined with normal range values of apparently healthy rabbit reported by NCBI (2024) and against the finding of Onu and Aja (2017) who reported that there is a general increase in PCV, RBC, WBC and Hb of rabbits fed diet supplemented with ginger and garlic. The percentage eosinophils determined in this study were (8.00, 5.00, 4.86, and 8.00%) for rabbits in treatment 1, 2, 3 and 4 respectively. The value obtained is higher than the normal range values (0.5-3.5) as outlined by NCBI (2024) and Medirabbit (2011). The results of mean corpuscular hemoglobin volume (MCV) were (49.53, 60.19, 48.08, 56.62 fi) for rabbits in treatment 1, 2, 3 and 4. The results were in agreement with the MCV content (59-69) reported by Alagbe and Oluwafemi (2019). The results of serum biochemical indices of growing Rabbits fed kitchen food wastes supplemented with garlic showed thar treatments affected some parameters (total protein, globulin and alanine aminotransferase) determined. But all other parameters determined were within the normal range values, therefore, not affected by the treatments.

Table 5: Hematological Indices of Growing Rabbits Fed Kitchen Food Wastes Supplemented with Graded Levels of Garlic

Parameters	T1	T2	T3	T4	SEM	Ref, Range value
Hemoglobin (g/dl)	9.17	9.43	12.16	10.62	0.30	9.5 – 13.7
PCV (%)	28.33	34.00	36.33	38.50	1.05	23 – 50
RBC (x 108/mm ³)	5.72	4.71	7.56	6.80	0.20	4.6 – 7.6
MCV (fi)	49.53	60.19	48.06	56.62	2.32	42 – 50
MCH (pg)	16.03	20.02	16.08	15.62	0.45	11 – 23
MCHC (%)	32.37	27.74	33.47	27.58	0.69	25 – 38
WBC(x109/mm ³)	5.82	7.30	6.80	8.34	0.35	3.3 – 12.2
Lymphocytes (%)	67.33	72.00	75.00	80.00	1.15	57 – 70
Neutrophils (%)	15.00	16.20	17.80	20.65	0.53	11 – 74
Eosinophils (%)	8.00	5.00	4.96	8.00	0.07	0.5 – 3.5
Basophils (%)	0.20	0.60	0.85	0.90	0.08	0.07 – 0.90
Monocytes (%)	1.76	1.99	2.00	2.00	0.04	0.04 – 2.9

MCV=Mean corpuscular volume, MCH= Mean corpuscular hemoglobin, MCHV= Mean corpuscular hemoglobin concentration, PCV= Packed cell volume, RBC= Red blood cell, WBC= White blood cell, fi= Fentoliter, pg= picogram, g/dl= gram per deciliter

Serum Biochemical Indices of Growing Rabbits Fed Kitchen Food Wastes Supplemented with Garlic

The serum total protein content of this study was 8.78, 8.08, 8.73 and 9.36 g/dl for rabbits under treatment 1, 2, 3 and 4 respectively. The results is higher than the normal range values (5.4-7.5) reported by Medirabbit (2011). The finding of this study is against the report of Hassan *et al.* (2022) who reported that there is reduction of total protein of New Zealand rabbit fed diet supplemented with 2% garlic powder. The results of globulin were 4.25, 5.30, 4.90 and 5.60 g/dl for rabbits in treatment 1, 2, 3 and 4 respectively. The values obtained were higher than the normal range values (2.41-3.19) reported by Henry *et al.* (2017). The results of alanine aminotransferase were 25.40, 27.60, 36.53, and 32.40 for rabbits in treatment 1, 2, 3 and 4 respectively. The values obtained are lower than the normal range values (45-80) reported by Archetti *et al.* (2008). All other serum biochemical indices determined were not affected by the treatments because are in lined with normal range values of apparently healthy rabbit as reported by Medirabbit (2011).

Table 6: Serum Biochemical Indices of Growing Rabbit fed kitchen Food Wastes Supplemented with Garlic.

Parameters	T1	T2	T3	T4	SEM	Ref. Range values
Total protein (g/dl)	8.76	8.08	8.73	9.36	0.12	5.4 – 7.5
Globulin (g/dl)	4.25	5.0	4.90	5.60	0.13	1.5 – 2.7
Abumin (g/dl)	3.50	3.50	3.55	5.70	0.24	2.7 – 5.8
Urea (mg/dl)	28.52	31.50	34.20	29.08	0.56	20 – 45
Creatine (mg/dl)	1.53	2.60	1.54	2.23	0.15	0.5 – 2.5
Cholesterol (mg/dl)	98.00	91.20	80.71	81.74	0.85	28 – 98
Glucose (mg/dl)	99.60	90.60	98.00	995.00	0.86	75 – 155
Total bilirubin (mg/dl)	0.40	0.39	0.53	0.49	0.02	0.00 – 0.7
ALT (µl)	25.40	27.60	36.58	32.40	0.07	45 – 80
AST (µl)	32.60	53.50	29.58	34.80	0.58	35 – 130
ALP (µl)	20.10	22.30	18.90	19.20	0.34	12 – 96

ALT= Alanine aminotransferase, AST= Aspartate aminotransferase, ALP= Alkaline phosphatase.



Cost Benefits of Growing Rabbits Fed Kitchen Food Wastes Supplemented with Garlic

The results of cost benefits of growing rabbits fed kitchen food wastes supplemented with garlic as presented in Table 7 revealed that, Feed cost/kg formulated was lowest in control (N309) and highest in treatment 4 (N324). This implies that the variation in the feed formulation cost was due to addition of garlic in the diets. As the rabbits feed intake enhanced with the increase levels of garlic in the diet so also the cost of feeding (N/Rabbit/d). The least cost (1.67) naira per gram gain was recorded in treatment 1 (control with 0.00%) of garlic inclusion while the highest cost was recorded in treatment 4 which have (0.75%) inclusion level of garlic.

Table 7: Cost Benefits of Growing Rabbits fed Kitchen Food Wastes Supplemented with Graded Level of Garlic

Parameters	T1	T2	T3	T4
Cost of feed (N/kg)	309.00	311.00	318.00	325.00
Overall feed intake (kg)	2576.20	27810.20	2810.60	2830.60
Total cost of feed consumes (N)	795.05	869.99	894.77	910.75
Cost of feed intake per day (N)	18.95	20.69	21.28	21.90
Daily weight gain (g)	11.34	11.89	11.62	12.18
Feed cost/N/g gain	1.67	1.74	1.83	1.98

CONCLUSION AND RECOMMENDATION

From the study, it is concluded that feeding kitchen food wastes supplemented with graded levels of garlic did not adversely affect the growth performance of growing rabbits. The inclusion of kitchen food wastes supplemented with graded levels of garlic in the diets of growing rabbits increased feed intake and dressing percentage. However, feeding kitchen food wastes supplemented with garlic (at 0.75%) is recommended for higher daily feed intake (67.39 g/day) and good dressing percentage (53.70 g) for growing rabbits in the study area.

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