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Supplementation of Kitchen Food Waste on Growth Performance, Carcass Characteristics and Haematology of Weaner Rabbits

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Abstract

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. The goal of this study was to see how supplementing commercial diets (CD) with kitchen food waste (KFW) affected weaner rabbit growth performance, carcass characteristics, and haematology. Forty-five mixed-breed rabbits were used in this study. Six to eight weeks old, of both sexes, were randomly assigned to one of the three treatment groups (A, B, and C) in triplicate. Rabbits in group A (the control group) were fed only CD, while those in groups B and C were fed KFW+CD and only KFW, respectively. The results showed that the body weight and body weight gain of rabbits fed only CD and those fed KFW+CD differed non-statistically but significantly ($P < 0.05$) from those fed only KFW. Likewise, feed intake, feed conversion ratio, carcass characterization, and organ weight analyses were not statistically affected ($P > 0.05$). Weekly trend evaluation showed a significant ($P < 0.05$) effect of the treatments on rabbit granulocytes in the third week of the study, but no effect was observed in the sixth week. Therefore, KFW can be combined with CD to feed rabbits since it has no negative effect on their growth or haematology.

Keywords

Carcass characterization, Commercial diet, Kitchen food waste, Performance, and Rabbit

1. Introduction

Since the human population has been 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 monogastrics) is cereals. Animals and humans now compete for grains. For instance, from 2015 to 2018, South Africans used 5050 million metric tons (MMT) of corn for human consumption and 5300 MMT for animal feed [1]. Corn, like soy, is of interest because it is needed for human consumption, animal feed, and biofuels. Impliedly, the price of corn will continue to increase as biofuels become more standardized. In addition to the heavy reliance on corn as biofuel, it also remains a food source for many meat and dairy animals, as the demand for protein, especially meat-based protein, is increasing worldwide [2]. The demands for more feed crops are predicted to increase by 40% of the current harvest of corn and soybeans [3]. Some of the corn (and soy) that is needed for livestock feeding can be offset by the incorporation of kitchen food waste (KFW) and other food wastes into animal feed. As well, the incorporation of food waste can decrease the current greenhouse gas emissions (3.7 MMT of CO2) from the production of products directly intended for animal feed [4].

In the opinion of Parfitt et al. [5], food waste is viewed as a reflection on human behaviour rather than food quality. Bellemare et al. [6] have defined food waste as the difference between the amount of food produced and the sum of all food employed in any kind of productive use, whether it is food or not. In other words, food waste is the amount of food material produced and ultimately discarded during any stage of the food supply chain [7]. Gustavsson [8] reported that about 30–50% of food waste discarded and considered uneaten for humans [9] especially from hotels, hospitals, restaurants and homes. Currently, the magnitude of waste materials generated from household and industrial sources is one of the primary causes of environmental pollution [10]. Leftover foods and other KFW can reach levels of pollution in water, air, and soil when they are landfilled because of their high moisture content.

Feeding food scraps to animals has been in practice for many years. However, certain disadvantages may be encountered, including nutrient variability among batches of food waste, possible microbial and toxin contamination, and an inconsistent supply of waste [11]. Meanwhile, feeding waste food to animals is still feasible. For example, in 2010, 2.2 metric tons (MT) of food by-products were diverted to animal feed in the UK [12]. In Australia, there were multiple major retailers who reportedly donated approximately 40,000 MT of food to farmers as animal feed [13]. KFW and trash produced by the food industry are possible resources for lessening this competition.

The chemical composition of food wastes is 21–29% CP, 11–15% EE, 2–4% CF and 6–12% ash as DM basis [14]. Meanwhile, Luciano et al. [15] and Truong et al. [16] suggested that KFW could be used successfully for monogastric animals thereby mitigating the environmental pollution by utilized KFW through recycling, and used it in animal. Rabbits have the ability to utilize a variety of feed resources. There is an increasing interest in the growth potential of rabbits for meeting the animal protein requirements of humans. In recent years, rabbits have begun to gain recognition as an economic micro-livestock in Nigeria, and this has brought about the need to improve their nutrition and do so at the least cost possible in order to maximize profit for the farmers. It produces about 47 kg of meat per doe per year, which is enough to solely meet the animal protein requirements of a medium-sized family under small-scale rural farming systems [17]. Available literature shows that the white meat of rabbit is very nutritious, easily digestible, and extremely low in cholesterol and sodium levels [18]. KFW are nutrient-rich surplus materials that can be collected from households, hotels, hostels, restaurants, and other sources at a minimal price and fed to animals as such or after processing. This research is directed towards determining the effect of feeding kitchen food waste (KFW) as compared to a commercial diet on the growth performance, carcass characteristics, and blood parameters of weaner rabbits.

2. Methods

2.1 Experimental location, site and design

The study was carried out at the Rabbitry Unit of the Department of Theriogenology and Animal Production, Faculty of Veterinary Medicine, Usmanu Danfodiyo University, Sokoto. State, Nigeria. Sokoto is in the north-western political zone of Nigeria, between longitudes 4° 8' E and 6° 54' E and latitudes 12° N and 13° 58' N [19]. The design used for the study was completely randomized. The rabbits were acclimatized for 14 days, the experimental diets were given in a measured proportion, and fresh water was given ad libitum to the rabbits for a period of six weeks; thus, the rabbits were eight to ten weeks old at the time the experiment started and 12 to 14 weeks old at the time the experiment was terminated.

2.2 Management of experimental animals and data collection

Forty-five (45) weaner rabbits of mixed breeds (New Zealand white, Dutch black, and English spotted) of both sexes, with an average initial weight of 623 g and an age range of six to eight weeks, were purchased from the Zaria metropolitan market for the purpose of this study. When the animals arrived, they were dewormed with Levamisole and given Vitalyte as an anti-stress medication for the first three days of the 14-day acclimatization period, while being fed layer mash and vegetables beforehand. The rabbits were then randomly divided into 3 treatment groups (A, B, and C) with three replicates of 5 rabbits per replicate. Rabbits in treatment group A were the control group and were fed only commercial diets (CD) (Table 1), while those in groups B and C were fed kitchen food waste plus commercial diets in equal proportions (KFW+CD) and only kitchen food waste (KFW), respectively. The experimental diets were gradually introduced to replace the feed the animals were used to in the first two weeks of acclimatization. Before the arrival of the experimental rabbits, the pens were cleaned, washed, disinfected, and left to dry for 48 hours. Fifteen pens were selected for the experiment, and five animals were randomly assigned to individual pens. Both the pens and equipment were cleaned as the need arose.

At the beginning of the experiment, the individual weights of the animals in each experimental group were taken, and subsequently weekly for a period of six weeks. At the end of the feeding trials, the rabbits were starved for 12 hours, and three rabbits per replicate were randomly selected, weighed, and slaughtered using the Halal method and allowed five minutes to drain the blood. The animals were flayed, and the head, carpals, tarsals, and tail were removed. Using SF-400 electric kitchen scale, some viscera (liver, kidney, heart, and lungs) were removed and weighed separately and then carcass was split into hind limbs (femur), forelimbs (humerus), chest, and back and each cut was weighed separately. All measurements were made in grams. Blood samples were collected at the end of weeks three and six from the ear vein using a sterile disposable 5-ml syringe and 21-gauge needle. Two milliliters of blood were collected and placed in a properly labeled EDTA sample bottle for haematological analysis. The samples were analyzed using automated hemo analyzer. The data generated were subjected to one-way analysis of variance (ANOVA) using SPSS version 20.0. Where significant treatment effects were detected, means were compared using the least significant difference (LSD) at 5% probability.

Table 1. Composition of the commercial diet

Maize	25
Groundnut cake	8
Rice husk	30
Wheat offal	33
Fish meal	2
Bone meal	1
Salt	0.5
Premix	0.5
Total	100kg
Calculated	
Crude Protein (%)	12.65
Crude Fibre (%)	12.405
ME (kcal/kg)	2119.8

Key: ME = metabolizable energy

3. Results

Table 2 shows results on performance parameters for the experimental rabbits. There was a significant difference ($P< 0.05$) in the body weight and body weight gain of the experimental rabbits, while feed intake and the feed conversion ratio varied non-statistically. Experimental rabbits fed CD and KFW+CD significantly had the highest body weights of 808.52 ± 24.23 g and 795.55 ± 30.15 g, respectively, and body weight gains of 324.50 ± 57.23 g and 286.17 ± 47.11 g. The group fed KFW alone had the lowest body weight gain (269.67 ± 43.99 g) but converted feed most efficiently (9.14 ± 30.19). In this study, the carcass characteristics and organ weight of the experimental rabbits were not different statistically (Table 3). However, final body weight was biologically highest in the group fed KFW+CD (1093.50 ± 31.50 g), closely followed by those fed CD (1025.50 ± 123.50 g), and lowest in the group fed only KFW (828.50 ± 0.50 g). Similarly, the carcass percentage was highest in the group fed KFW+CD (45.91 ± 4.34 g) and lowest in those fed KFW (34.61 ± 2.60 g). As shown in Table 4, the dietary treatments had a significant

Table 2. Mean ± SE Performance parameters of experimental rabbits

Groups	Body weight (g)	Feed Intake (g)	Body Weight Gain (g)	Feed Conversion Ratio
CD	808.52±24.23 ^{a}	456.67±19.74	324.50±57.23 ^{a}	9.57±1.31
KFW	649.74±23.28 ^{b}	456.67±24.33	269.67±43.99 ^{b}	9.14±30.19
KFW+CD	795.55±30.15 ^{a}	456.67±23.90	286.17±47.11 ^{a}	10.66±1.65
p-value	0.005	0.998	0.005	0.998

Means within the same row with different superscripts $^{a, b}$ are significantly different at $P < 0.05$
CD = Commercial Diet; KFW = Kitchen Food Waste; KFW + CD = Kitchen Food Waste + Commercial diet

Table 3. Mean ± SE Carcass and organs' characteristics of experimental rabbits

Groups	Final Body Weight (g)	Carcass Weight (g)	SHF (%)	Limbs (%)	Heart (%)	Liver (%)	Lungs (%)	Kidney (%)
CD	1025.50 ± 123.50	45.07 ± 0.05	19.79 ± 0.61	20.07±0.54	0.28±0.02	3.03±0.24	0.53±0.06	0.83±0.11
KFW	828.50 ± 0.50	34.61 ± 2.60	18.55 ± 0.83	15.30±1.12	0.28±0.01	3.27±0.07	0.64±0.12	0.68±0.02
KFW+CD	1093.50 ± 31.50	45.91 ± 4.34	18.68 ± 0.63	19.55±1.47	0.23±0.01	2.71±0.07	0.49±0.01	0.74±0.05
p-value	0.164	0.053	0.436	0.093	0.093	0.158	0.451	0.395

CD = Commercial Diet; KFW = Kitchen Food Waste; KFW + CD = Kitchen Food Waste + Commercial diet, SHF = Skin, Head and Feet

Table 4. Mean ± SE Haematological Parameters of experimental rabbits at week 3 and week 6

Groups	PCV (%)	Hb (g/dl)	RBC ($\times 10^6$/mm^3)	MCV (fl)	MCH (pg)	MCHC (g/dl)	WBC ($\times 10^3$/mm^3)	Lymphocyte (%)	MID (%)	GRA (%)
					Week 3					
CD	27.77±3.60	10.23±1.13	4.07±0.45	68.00±3.25	25.13±0.52	37.07±1.07	6.67±0.78	46.90 ± 0.40	5.57±0.28	47.53 ±0.64^a
KFW	24.93±0.97	9.27 ± 0.15	3.94±0.12	63.13±0.70	23.50±0.36	37.23±0.84	5.37±0.90	45.40±22.78	6.10±3.10	15.17 ±7.99^c
KFW+CD	31.73±1.13	11.37±0.81	4.67±0.19	68.17±1.42	24.40±0.10	35.83±0.57	6.63±1.19	61.63±4.94	9.63±2.65	28.73 ±6.48^b
p-value	0.191	0.195	0.25	0.233	0.055	0.489	0.588	0.661	0.464	0.023
					Week 6					
CD	28.17±3.69	9.47±1.09	3.53±0.78	79.73±2.54	27.20±0.95	34.13±0.49	8.30±1.62	60.83±8.15	6.50±0.76	32.67±7.89
KFW	23.80±1.05	8.17± 0.30	3.30±0.22	72.17±1.68	24.70±0.53	34.27±0.41	7.89±1.22	53.13±4.59	5.50±0.72	41.37±5.22
KFW+CD	30.60±0.90	10.43±0.31	3.99±0.03	76.77±2.89	26.13±0.40	34.10±0.46	7.13±1.32	61.83±5.16	11.53±2.31	26.63±3.20
p-value	0.182	0.126	0.258	0.093	0.065	0.963	0.841	0.581	0.055	0.269
Reference	30-50	10-15	5-8	78-95	19-22	30-35	4.5-11	40-80	--	--

Means within the same row with different superscripts $^{a, b, c}$ are significantly different at $P < 0.05$
CD = Commercial Diet; KFW = Kitchen Food Waste; KFW + CD = Kitchen Food Waste + Commercial diet; MID = Other WBC (Not classified as lymphocytes or granulocyte); GRA = Granulocyte. Reference range adapted from Ibitoye et al. (2020)

4. Discussion

The results of this study are in agreement with those of Westendorf et al. [20] that weight gains of pigs fed 50% of cafeteria food waste (CFW) substituted for soybean meal were not different compared with 0% CFW diet. Similarly, we found a common ground with the opinion of Enasa et al. [21] and Farhat et al. [22] that an improvement in body weight gain was recorded in ducks fed diets containing 30% dried leftover food (DLF). They concluded that an increased level of kitchen food waste at 40% substitution in the diet decreased daily weight gain because of its low nutritive value, particularly in total digestible nitrogen and dietary crude protein values. The high crude protein content of KFW may boost the productivity of the rumen microflora, particularly the proteolytic and cellulytic bacteria, which increase the digestion of nutrients [23]. These results also agreed with the findings of Chen et al. [24], who reported that the addition of 5% dehydrated food waste product to broiler diets increased body weight gains from the 4th to the 8th week of age. This study however disagreed with the findings of Helal et al. [25] that rabbits fed on diets containing 30% KFW achieved significantly ($p < 0.05$) higher daily weight gain than the control. This might be due to higher (50%) KFW total substitution used in this study. The nonsignificant effect of the treatment on the carcass and organ characteristics of experimental rabbits implies that the dietary treatments had no adverse effect on the carcass traits of the rabbits. These findings corroborate those of Chen et al. [26] and Enasa et al. [27], who found that ducks' diets containing DLF had no significant effect ($p < 0.05$) on dressing percentage, carcass weight, and relative weights of the liver and heart. However, it contradicted the report of Cho et al. [28], who revealed that increasing the level of DLF in the diet significantly increased the dressing percentage and carcass weight of hens. This difference might be due to differences in the species of animals studied.

Alagbe [29] reported that hematological analysis is useful in disease diagnosis and nutritional stress. It also provides the opportunity to clinically investigate the presence of several metabolites and other constituents in the body. Nutrition and dietary contents affect the blood profile of healthy animals [30]. According to Esonu et al. [31], haematological parameters such as haematocrit value, hemoglobin concentration, white blood cell count, and red blood cell count determine the level of oxygen in the blood. Blood parameters are an excellent medium for measurement of potential biomarkers because their collection is relatively non-invasive, and they show an enormous range of physiological processes in the body at any given time. Changes in the blood profile can be due to disease, nutritional stress, age, sex, and breed. Haematology refers to the numerical and morphological study of the cellular elements of the blood in the diagnosis and monitoring of disease [32]. Moreover, hematological parameters are good markers of the physiological status of animals [33]. Dietary treatments had no significant ($p > 0.05$) effect on the haematology of the experimental rabbits, indicating that the diets had no negative impact on rabbit health or hemopoietic activities, correlating with the findings of Helal et al. [34] findings. However, the red blood cells in all the treatments fell below the normal range as reported by Ibitoye et al. [35], and this may have been attributed to the incidence of mange encountered in all the animals at the early stage of the experiment. It was noted that the MCV and MCHC of rabbits were non-significantly below normal; this may be due to reduced or a lack of dietary iron. White blood cell counts are an indication of the immune status of an animal. It was observed that the WBC of all experimental rabbits was within the normal range, which signifies that the dietary treatment had no reducing effect on the immune response of rabbits.

5. Conclusion

This study revealed the potential of KFW and its combination with CD in rabbit nutrition. The body weight and carcass weight of rabbits fed KFW+CD were favorably compared with those of the control. Also, supplementing the rabbit diet with KFW had no negative effect on the growth, carcass, or hematology. It was recommended that KFW, apart from being cheap, could be combined with commercial diets and serve as a good dietary treatment for rabbits without any adverse effect on the nutritional status or carcass characteristics of the rabbits. Nutrient composition, biological value, and a cost-benefit analysis of using kitchen food waste as part of the rabbit diet should be carried out.

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