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PERFORMANCE AND DIGESTIBILITY OF GROWING RABBITS FED CASHEW NUT WASTE BASED DIETS

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ABSTRACT

A 56 day feeding trial was conducted to evaluate the performance and digestibility of growing rabbits fed Cashew Nut Waste (CNW) based diets. Twenty four (24) 8-9 weeks old, mixed breed rabbits with weight range of 980 - 1100g were used for the study. The rabbits were allotted to six treatments, with four rabbits per treatment, a rabbit represented a replicate in a Completely Randomized Design (CRD) arrangement. CNW replaced maize at 0, 15, 30, 45, 60, and 75% in diets T_0, T_{15}, T_{30}, T_{45}, T_{60} and T_{75}, respectively. The proximate composition of CNW was; dry matter 90.48%, crude protein 15.25%, ether extract 46.88%, crude fibre 3.34%, ash 4.58% and nitrogen free extract 20.34%. Performance characteristics showed significant ($P<0.01$) differences among treatments. Observed ranges were 1781.25(T_0) –2031.50 (T_{75}), 14.17(T_0) – 18.75(T_{75}), 66.94(T_0) -87.48(T_{75}) for final weight, daily weight gain/rabbit and average daily feed intake, respectively. There was significant ($P<0.05$) difference for feed conversion ratio in favour of T_{75}. All the parameters evaluated on economics of production showed significant ($P<0.01$) differences in favour of T_{75}. Digestibility parameters evaluated showed significant ($P<0.01$) differences in favour of T_{75}. Rabbits fed diet containing 75% replacement value for maize performed better than other dietary treatments and it is thus concluded that rabbits can tolerate up to 75% level of CNW as replacement for maize.

Keyword: Cashew nut, digestibility, maize, proximate composition, rabbit, unconventional

INTRODUCTION

The demand for protein of animal origin in developing countries like Nigeria is higher than the supply (Ani and Adiegwu, 2005). According to Onyimonyi and Onukwufor (2003), the average consumption of animal protein in Nigeria was 4.5 g/head/day as against the minimum requirement of 30 g/head/day reported by Dafwang (2006). This problem has generally been attributed to the exhorbitant cost of animal products due to increased cost of production arising from high cost of conventional feed stuffs (Akinmutimi and Onwukwe, 2002) and concentration of animal production on few animal species (Ezea, 2004). Two feasible solutions to the aforementioned problem were suggested. These are the use of mini or micro livestock like rabbits for meat production and adoption of feeding strategies that maximize the use of under-utilized feed resources and waste in our environment (Akinmutimi and Ezea, 2006). Rabbit production has enormous potentials in alleviating the problem of animal protein supply in developing economies (Biobaku and Dosumu, 2003). Unfortunately, intensive livestock farming in Nigeria has been greatly affected by high cost of feed stuffs and feed, especially the conventional; protein and energy feed stuffs like soya bean cake, groundnut cake and maize (Ani and Adiegwu, 2005).

Feed accounts for about 70% of the total cost of rabbit production (Akinmutimi and Ezea, 2006). This high cost has been attributed to competition among man, industry and livestock for conventional feedstuffs (Akinmutimi, 2004). There is therefore the need to source for alternative livestock feedstuffs that are cheap, readily available and not competed for by man and industry. The attempt to source for locally available low cost but nutritionally adequate feed stuffs for rabbit has brought to lime light Cashew Nut Waste (CNW). Processing of cashew nuts generate some by-products which are discarded because they are not suitable for human consumption. It is estimated that up to 30% of cashew kernel may be lost in this manner depending on the quality of nuts (Oddoye *et al*., 2011). Although not suitable for human consumption, processed cashew nut reject or waste may find some use in animal feeding. Fanimo *et al.* (2003) reported that Cashew Nut Waste gave good result when used in growing pig diets at the rate of 200 and 100g kg^{-1}. Oddoye *et al.* (2011) also included the CNW in finishing pig diets at 300g per kg^{-1} without adverse effect. Reports by Odunsi (2002) and Ojewol*a et al.* (2004) also indicated its use in diets of early laying pullets and broilers respectively. The objectives of the feeding trial were to determine the growth performance and digestibility of rabbits fed graded levels of cashew nut waste.

MATERIALS AND METHODS

Description of Experimental Site

The study was conducted at the Rabbitry Unit of the Teaching and Research Farm of the Department of Animal Production, Kogi State University Anyigba; which is located between Latitude $7^0$15'and $7^0$29'N of the equator and Longitude $7^0$11' and $7^0$32' East, with average altitude of 420 metres above sea level. The area falls within tropical wet and dry regions and the Guinea savanna (Ifatimehin *et al.*, 2015).

Source of Cashew Nut Waste (CNW)

The cashew nut waste used for this feeding trial was collected from the cashew processing plant within the premises of Kogi State University, Anyigba. Other feed ingredients were purchased from open market in Lokoja, Kogi State. The test ingredient, Cashew Nut Waste (CNW) replaced 0%, 15%, 30%, 45%, 60% and 75% dietary maize in the diets, coded T_0, T_{15}, T_{30}, T_{45}, T_{60} and T_{75}, respectively (Table 1).

Table 1. Composition of Experimental Diets for Growing Rabbits (%)

Ingredients	T_0	T_{15}	T_{30}	T_{45}	T_{60}	T_{75}
Maize	50.00	42.50	35.00	27.50	20.00	12.50
CNW	0.00	7.50	15.00	22.50	30.00	37.50
Fullfat soyabean	12.40	12.40	12.40	12.40	12.40	12.40
Maize milling waste	20.00	20.00	20.00	20.00	20.00	20.00
Bone meal	2.80	2.80	2.80	2.80	2.80	2.80
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Premix	0.50	0.50	0.50	0.50	0.50	0.50
BKT Waste	14.00	14.00	14.00	14.00	14.00	14.00
Total	100	100	100	100	100	100
Calculated Analysis						
Crude protein (%)	15.39	15.85	16.31	16.77	17.23	17.69
Crude fibre (%)	4.93	5.01	5.09	5.17	5.25	5.33

CNW : Cashew Nut Waste, BKT: Burukutu waste

Management of Experimental Animals

Twenty four (24) mixed breeds growing rabbits of initial weight of 980-1100 g were used for the feeding trial which lasted for 56 days, after an adaptation period of 7 days. The rabbits were allocated randomly to the six (6) compounded diets in a Completely Randomized Design. Each dietary group comprised of four (4) rabbits, while each rabbit represented a replicate. The rabbits were housed separately in hutches measuring 35 x 30 x 30cm, equipped with drinkers and feeders. On arrival, the animals were dewormed with piperazine in water, while ivomec injection was administered on the rabbits subcutaneously to control both internal and external parasites. Feed and water were administered to the animals *ad libitum*. Performance parameters measured during the trial were Daily Weight Gain (DWG), Daily Feed Intake (DFI), Feed Conversion Ratio (FCR), feed cost/kg, cost of feed consumed/day and feed cost /kg gain.

At the 8th week of the experiment, a digestibility trial was conducted. Two rabbits from each treatment were selected and used for data collection. Weighed quantities of each assigned diet was given to corresponding rabbits daily, while faecal samples were collected separately for 7 days, using aluminum foil.

Proximate analyses of CNW, diets and faecal samples were conducted according to the procedure of AOAC (2000). Apparent digestibility of nutrients was determined using the formular:

$$\text{Apparent digestibility \%} = \frac{\text{Nutrient in feed consumed - Nutrient in faeces}}{\text{Nutrient in feed consumed}} \times \frac{100}{1}$$

Statistical Analysis

All data obtained were subjected to One Way Analysis of Variance (ANOVA) and where differences existed among treatment means, they were separated by means of Duncan's Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Proximate Composition of Cashew Nut Waste (CNW)

The proximate composition of Cashew Nut Waste is presented in Table 2. Observed crude protein, ether extract, crude fibre, ash, nitrogen free extract and energy were 15.25%, 46.88%, 3.43%, 4.58%, 20.34%, and 5121.10 kcal/kg, respectively. Observed dry matter content of 90.48% for cashew nut waste (CNW) obtained in this study was close to 93.67% reported by Okpanachi *et al*. (2013) for cashew kernel processing waste. Values for crude protein content of 15.25% obtained in this study was closed to the reported value of 15.80% for cashew kernel processing waste (Okpanachi *et al*., 2013), but lower than 19.00% reported for cashew nut testa (Armstrong *et al*., 2012).

Table 2: Proximate Composition of Cashew nut waste

Nutrients (%)	Value
Dry matter	90.48
Crude Protein	15.25
Ether extract	46.88
Crude fibre	3.43
Ash	4.58
Nitrogen free extract	20.34

These differences may be attributed to the differences in processing methods and composition of the waste. The value of 4.58% for ash observed in this study is high indicating high mineral content for CNW. Ether extract content of 46.88% was higher than 20.10% (Armstrong *et al*., 2012) and 16.10 % (Ojewola *et al*., 2004). The differences may be due to the composition of the waste which may contain some undefatted rejects that might have increased the ether extract level obtained in this study. Varietal differences and processing might also have contributed to this.

Performance of Growing Rabbits Fed Experimental Diets

Table 3 shows the growth performance of growing rabbits. Initial weight, final weight, total weight gain, daily weight gain, average daily feed intake and feed conversion ratio values ranged from 975.00 - 987.50 g, 1781.25 - 2037.50 g, 793.75 - 1050.00 g, 14.17 - 18.75 g, 66.94 - 87.48 g and 4.68 - 5.21%, respectively. There was no significant ($p>0.01$) difference among the initial weights of growing rabbits used for the study. Significant ($p< 0.01$) differences were noted in final weight (g), total weight gain (g), daily weight gain (g/d) and average daily feed intake (g). Feed conversion ratio showed significant ($p< 0.05$) difference with the best performance of 4.68 (T_{75}).

Table 3: Growth Performance of Rabbits Fed Experimental Diets

Performance and Digestibility of Growing Rabbits Fed Cashew Nut Waste Based Diets

Average weight gain (g)	793.75^{c}	820.00^{c}	833.75^{c}	1000.00^{a}	937.50^{b}	1050.00^{a}	26.27	**
Daily weight gain (g/day)	14.17^{c}	14.64^{c}	14.89^{c}	17.86^{a}	16.74^{b}	18.75^{a}	0.47	**
Average daily feed intake (g)	66.94^{e}	76.18^{d}	80.31^{c}	83.71^{b}	80.79^{c}	87.48^{a}	20.76	**
Feed conversion ratio	5.00^{ab}	5.21^{b}	5.46^{b}	4.69^{a}	4.83^{ab}	4.68^{a}	0.12	*

abcde: Means with different superscript across rows differ significantly (*=p<0.05; **=p<0.01).

NS: Not significant; LOS: Level of significance; SEM: Standard error of mean

The observed range for final body weight of 1781.25 - 2037.50 g is comparable to 1715 – 1916 g reported by Ojebiyi and Saliu (2014) when they fed bovine rumen content blood meal mixture based diets to growing rabbits, 1805.00 - 2040.00 g obtained by Abubakar *et al*. (2011) when dietary maize was replaced by malted or unmalted sorghum in rabbit diet, and 1640 – 1840 g for rabbits fed processed cassava peel meal (Olafadehan, 2011). The breeds, initial weights, diets and duration of the experiment are among the factors that may be responsible for the differences in final live weight of the rabbits. Fanimo *et al*. (2003) had shown that rabbits fed diets that contained 20 and 30% dried cashew apple waste gained weight faster than those fed the control diet. That rabbits fed diets containing higher levels of CNW had better performance is evidenced in this study by the daily weight gain observed for rabbits fed diets T_{45}, T_{60} and T_{75} (17.86, 16.74 and 18.75). These observed values were higher than the values of 11.71 – 15.01 reported by Frederick (2010) when he fed moringa leaf meal to weaner rabbits and comparable to the range of 15.00 to 18.90 reported by Fanimo *et al.* (2003). The increasing weight gains with increasing level of cashew by product inclusion observed in this study are in agreement with the findings of Fanimo *et al*. (2003). Though feed intake had no definite trend of variation, the higher intake of CNW based diets may be due to their palatability and acceptability to the experimental animals. According to Mcleod (1982) the proportion of dietary energy obtained from fats versus carbohydrates exert an effect on appetite through a physiological 'appetite control centre' responsible for the blood levels of certain nutrients such as glucose and amino acids. According to Carew and Hill (1964), such an effect might involve an increased ability of the animal to convert dietary energy from fat into stored energy, thereby permitting a greater increase in dietary intake. Whitehead and Fisher (1975) observed that dietary fat did improve efficiency of feed utilization of poultry diets and the improvement was attributed to the high energy concentration of fats, while Homer and Schiable (1980) attributed it to both increased density and improved palatability. Stockstad *et al*. (1983) suggested that fats may also energize utilization of other dietary constituents, and dietary fat is well utilized by rabbits and improves diet palatability and increases energy level without causing carbohydrate overload of the hindgut (Pond *et al*., 1995). Observed feed conversion ratio range was poorer than 2.90 - 3.12 reported by Okorie (2013), but was comparable to the values 4.85 - 5.77 reported by Iyayi *et al*. (2003); when they fed varying cyanide levels to rabbits for six weeks. The observed feed conversion ratio values indicate that the experimental rabbits utilized CNW based diets better than the control.

Bioeconomic Performance

The bioeconomic performance of growing rabbits fed Cashew Nut Waste (CNW) based diets is presented in Table 4. Observed values for cost of feed/kg (₦), cost of daily feed intake (₦) and cost / kg gain are ₦ 34.81 - ₦ 45.31, ₦ 2.98 - ₦3.31 and ₦162.83 - ₦226.70, respectively. All the measured parameters except cost of feed consumed/day decreased ($p<0.01$) linearly as CNW increased in the diets. Economic indicators studied showed the advantage of the test diets over the control. It is a consensus that inclusion of unconventional ingredients in feed formulation will lower feed cost (Igwebuike *et al*., 1998; Armstrong *et al*., 2004; Ojewola *et al*., 2004; Olafedehan, 2011).

Table 4: Economic Performance of Growing Rabbits Fed Experimental Diets

Parameters	T_0	T_{15}	T_{30}	T_{45}	T_{60}	T_{75}	SEM	LOS
Cost of feed /kg (₦)	45.31^a	43.21^b	41.21^c	39.01^d	36.91^e	34.81^f	0.00	**
Cost of daily feed intake (₦)	3.03^b	3.29^a	3.31^a	3.26^a	2.98^b	3.04^b	0.01	**
Cost/kg gain (₦)	226.70^c	225.00^b	224.97^b	182.86^a	178.24^a	162.83^a	5.11	**

abcdef: Means on the same row with different superscript differ significantly (**=p<0.01)
NS: Not significant, LOS: Level of significance , SEM: Standard error of mean

Nutrient Digestibility of Growing Rabbits Fed Experimental Diets

Table 5 presents the apparent nutrient digestibility of the growing rabbits fed the experimental diet. Observed values for dry matter (%), crude protein (%), ether extract (%), crude fibre (%), ash (%) and nitrogen free extract (%) were 87.15 - 91.90 %, 90.47 - 94.98 %, 96.49 - 97.57 %, 79.23 - 89.16 %, 69.80 - 77.90 % and 72.99 - 83.43 %, respectively. Significant ($P< 0.01$) differences existed among dietary treatments for dry matter, crude protein, ether extract, crude fibre and nitrogen free extract retention. While no significant ($p>0.01$) difference existed for ash retention. Retention values for crude protein and ether extract values ranged from 90.47 - 94.98 and 96.49 - 97.57, and were comparatively higher than 84.51 - 85.84 and 84.51 - 85.80 (respectively) reported by Fanimo *et al*. (2003) NFE values were comparable. These high retention values points to the high digestibility coefficient of experimental diets and its ready utilization by rabbits. The dry matter values (87.15 - 91.90) obtained is comparable to 85.35- 95.84 observed when raw bambara groundnut offal diets were fed to rabbits (Amaefule *et al*., 2011). Crude fibre digestibility of 79.23 - 89.16 % observed was within the range of 65.88 - 90.49 reported by Amaefule *et al*. (2011). This increasing apparent digestibility with increasing level of the test ingredient inclusion indicates that rabbits can tolerate up to 75% replacement of maize with the test ingredient.

Table 5: Nutrient Digestibility of Growing Rabbits Fed Experimental Diets

Parameters	T_0	T_{15}	T_{30}	T_{45}	T_{60}	T_{75}	SEM	LOS
Dry matter (%)	87.15^b	88.69^a	90.35^a	91.89^a	90.35^a	91.90^a	0.23	**
Crude protein (%)	90.47^b	92.44^a	93.76^a	94.39^a	94.08^a	94.98^a	0.15	**
Ether extract (%)	96.49^b	96.82^a	96.58^a	97.46^a	97.05^a	97.57^a	0.07	**
Crude fibre (%)	79.23^b	81.81^{ab}	83.93^a	88.09^a	79.81^b	89.16^a	0.41	**
Ash (%)	69.80	77.15	77.90	76.34	72.53	76.88	2.98	NS
Nitrogen free extract (%)	72.99^b	77.27^a	82.23^a	84.17^a	81.20^a	83.43^a	0.45	**

ab: Means on the same row with different superscript differ significantly (**=p<0.01), NS: not significant

LOS: Level of significance; SEM: Standard error of mean.

CONCLUSION

From the various performance indicators measured, rabbits fed diets containing 75% CNW for maize were superior to other dietary treatments and it is thus concluded that rabbits can tolerate up to 75% inclusion level of CNW as replacement for maize without any adverse effects on performance and digestibility. Utilization of CNW resulted in cheaper diets and lower costs.

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