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Growth performance and digestibility of nutrients by weaner rabbits *(Oryctolagus cuniculus)* fed diets containing varying levels of cowpea *(Vigna unguiculata)* milling waste

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Abstract

Conventional feed resources for livestock are increasingly becoming more expensive, due to competition with man; hence nutritionists are searching for cheaper, locally-available alternatives. A total of forty five (45) mixed sex weaner rabbits, aged 5 – 6 weeks, with average initial weights of between 694.42 and 761.10 g were used to investigate the effect of varying levels of cowpea milling waste (CMW) diets on their growth performance and nutrient digestibility. They were randomly allotted to five dietary treatments with nine rabbits per treatment. The control treatment (T_1) contained 0 % CMW while treatments T_2, T_3, T_4 and T_5 had 10, 20, 30 and 40 % CMW dietary inclusion levels, respectively. Clean water and feed were offered ad libitum daily to the rabbits, and record of their feed intake and growth performance were taken for 12 weeks. At the end of the 11th week, a nutrient digestibility trial was carried out. Results show that there were no significant (P>0.05) differences in final body weight, body weight gain, total feed intake and mortality among the dietary treatments. Feed conversion ratio (FCR) for diets T_4 (6.65) and T_5 (6.66) containing 30 and 40 % CMW respectively, were as good as that of the control diet (6.11). Dry matter and crude protein digestibility showed no significant (P>0.05) difference across the treatments. Digestibility of crude fibre (72.64, 80.16, 84.04 and 80.90 % for T_2, T_3, T_4 and T_5 respectively), ether extract (95.98, 94.90, 96.04 and 94.38 % for T_2, T_3, T_4 and T_5 respectively), nitrogen free extract (94.30, 95.18, 93.58 and 94.90 % for T_2, T_3, T_4 and T_5 respectively), as well as total digestible nutrient (83.69, 76.11, 81.67 and 80.02 % for T_2, T_3, T_4 and T_5 respectively) of the test diets compared favourably with that of the control diet (72.94, 95.23, 96.04 and 80.47 % for CF, EE, NFE and TDN respectively). Hence, it can be concluded that CMW can be used safely as a protein source and included up to 40 % in weaner rabbit diets with no detrimental effect on their growth performance and nutrient digestibility.

Keywords: Cowpea milling waste, growth performance, nutrient digestibility, weaner rabbits.

Introduction

Inadequate consumption of animal protein is a major problem of most developing economies of the world today, including Nigeria. It is estimated that on the average, animal protein consumed per person per day (4.5 g) falls short of the recommended 35 g requirement (FAO, 2009). The increasing demand for animal protein necessitates the need to intensify livestock production. Increased rabbit production is a fast means of meeting the animal protein requirements of the Nigerian populace (Iyeghe-Erakpotobor *et al.,* 2002). This is because of its high fecundity, high genetic potential, raid growth rate and relatively low cost of production. Rabbit (*Oryctolagus cuniculus*) has short generation interval, high prolificacy, good mothering ability and easy management requirements, with ability to utilize waste and other non-conventional feed sources. Although, they are herbivores, rabbits can feed on a wide variety of feeds from grasses, herbs, leafy weeds and vegetables to household wastes or garbage. Besides,

rabbit meat is high in protein content (about 22 %), low in fat (about 4 %) and cholesterol (about 5 %) which can contribute positively towards improving the good health of the populace (Aduku and Olukosi, 1990). The world population, estimated to be 6 billion in the year 2000, is expected to increase to more than 7.5 billion by 2020 (Persley, 2000). This increasing human population may require a doubling of animal protein production. To achieve the desired goal of meeting this demand, animals that have high genetic potentials such as rabbits, pigs and poultry are required.

Feed accounts for about 70 % of the total cost of production in livestock and is a major threat to the expansion of the sector in Nigeria (Ojebiyi and Saliu, 2014). Research findings have shown that rabbits can do well on non-conventional feed ingredients. Ayanwale *et al*. (2001), Adeniji and Jimoh (2007) and Tabinda and Butt (2012) used *Colocasia esculentum*, rumen content and chicken intestine to feed rabbits, pullet chicks and fish fry respectively and the results showed that feed conversion ratio, weight gain and carcass characteristics were sustained, with no detrimental effects on the animals' performance. Cowpea, a legume crop, contains adequate amounts of protein, essential amino acids, dietary fibre and essential minerals and vitamins when compared to the other common legumes (Bhat and Karim, 2009). Studies have shown that 20 % dietary inclusion of cowpea seed produced better performance with no reported negative effect on weaner rabbits (Matondi *et al.,* 2015). Cowpea milling waste is a by-product obtained from the industrial processing of cowpea seed grains into cowpea flour used for the preparation of fried bean cakes (called "Akara" in Yoruba or "kosei" in Hausa) and "moin-moin". They are readily used as feed for ruminants such as cattle, sheep and goats. However, there is paucity of information on the use of cowpea milling waste as a non-conventional feedstuff for feeding weaner rabbits; hence this research study is aimed at determining the growth performance and nutrient digestibility of weaner rabbits fed diets containing varying levels of cowpea milling waste.

Materials and methods

Experimental location

This research study was carried out at the Rabbitry Unit of the Ministry of Livestock and Fisheries Development, Minna, Niger State. Minna lies within the Guinea Savannah zone of Nigeria. It is located within latitude 9°37' North and longitude 6°33' East, with annual rainfall of 1000-1500 mm and average temperature of 32°C (Niger State Agricultural Development Project, 2009).

Experimental animals and their management

A total of 45 weaner rabbits of mixed sex aged between 5-6 weeks and average weights of between 694.42 and 761.10 g were sourced from the Rabbitry Unit of National Animal Production Research Institute (NAPRI), Zaria and were randomly divided into five treatments and further sub-divided into three replicates with three rabbits per replicate in a Completely Randomized Design (CRD) Experiment. Specially constructed wooden cages of height 60 cm, length 45 cm and width 40 cm, with floor space of 0.39 to 0.55 cm^2 and net fitted floor were used for the experiment. Prior to the commencements of the experiment, the cages were thoroughly washed with disinfectant (Izal® solution). Feeders and drinkers were provided in each cage for easy access by the animals. The rabbits were de-wormed using Albendazole®; broad spectrum antibiotic and Vitalyte® were administered via the drinking water to reduce stress. The rabbits were allowed to

acclimatize to the new environment for one week while being fed with the Control Diet (T_1). During this period, they were given Ivermectin® injection (a parasiticide) to eliminate both internal and external parasites. Thereafter, the experimental diets T_2, T_3, T_4 and T_5 (containing 10, 20, 30 and 40 % CMW respectively) and water were served *ad-libitum* to the rabbits in each replicate respectively for 12 weeks. During this period, data were collected from the animals in each replicate on feed intake, weight gain and mortality. The composition of the experimental diets is shown in Table 1. The animals were fed twice daily with measured quantities of feed, at 8:00 am and 4:00 pm. The left over, uneaten feed were collected the following day and weighed. Difference between the supplied feed and the left over uneaten feed gave the feed intake. Clean drinking water were supplied *ad libitum*.

Nutrient digestibility study

At the end of the 11th week of the feeding trial, a nutrient digestibility trial was carried out using two animals per replicate, housed in specially constructed metabolism cages. Known quantities of feed were fed to the animals in each replicate in the morning and left over collected the following morning for five days, after three days adjustment period in the cages. Using the total collection method, faecal droppings were collected daily in aluminum foils, weighed, preserved with boric acid and oven dried at 80 ^{0}C for 24 hours. At the end of the experiment, the dry matter, crude protein, crude fibre, ether extract, nitrogen free extract and ash content of the experimental diets, collected faecal samples and CMW were determined using the procedures of AOAC (2000). All data collected were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS). Where treatment means were significant ($P<0.05$), Duncan's Multiple Range Test was used to separate the means (Duncan, 1955).

Table 1: Composition of the experimental diets for weaner rabbits

Ingredients (%)	Diet 1 (0%)	Diet 2 (10%)	Diet 3 (20%)	Diet 4 (30%)	Diet 5 (40%)
Maize	43.38	37.21	31.62	26.03	20.50
Groundnut cake	29.62	25.79	21.38	16.97	12.50
Cowpea milling waste	00.00	10.00	20.00	30.00	40.00
Rice husk	20.00	20.00	20.00	20.00	20.00
Palm oil	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50
Lysine	0.50	0.50	0.50	0.50	0.50
Methionine	0.45	0.45	0.45	0.45	0.45
Salt	0.30	0.30	0.30	0.30	0.30
*Premix	0.25	0.25	0.25	0.25	0.25
	100	**100**	**100**	**100**	**100**
Calculated Analysis					
Crude Protein	18.21	18.43	18.42	18.24	18.40
ME (Kcal/kg)	2712	2699	2690	2682	2674
Crude fibre	10.75	11.85	12.93	14.02	15.09
Protein: calorie	1:149	1:146	1:146	1:147	1:145
Calcium	1.39	1.37	1.36	1.35	1.33
Phosphorous	0.85	0.83	0.82	0.80	0.80
Lysine	1.27	1.38	1.53	1.79	1.79
Methionine	0.73	0.85	0.94	1.05	1.15

*2.5 kg of the premix supplied the following nutrients: Vitamin A, 500 IU; Vitamin D_3, 1500 IU; Vitamin E, 3 IU; Vitamin K, 2 mg; Riboflavin, 3 mg; Pantothenic acid, 6 mg; Niacin, 15 mg; Vitamin, B_{12} 0.8 mg; Chlorine, 3 mg; Folic acid, 4 mg; Manganese, 8 mg; Zinc, 0.5 mg; Iodine, 1.0 mg and Cobalt, 1.2 mg.ME = Metabolizable energy

Results and discussion

The proximate composition and energy value of cowpea milling waste (Table 2) shows that it is a potential source of protein and energy in livestock diets. The results of this study show that cowpea milling waste had higher composition of nutrients, as obtained in this study than the results obtained for cowpea hull by Orji (2009) with dry matter of 91.00 %, crude protein of 13.56 %, ether extract of 2.5 %, ash of 3.05 % and nitrogen-free extract 43.39 %. Only the crude fibre content of cowpea hull (28.50 %) was higher than that of cowpea milling waste (14.00 %) (Table 2). Table 3 shows the growth performance of weaner rabbits fed diets containing varying levels of cowpea milling waste (CMW). The results show that there were no significant (P>0.05) differences among the dietary treatments in final body weight, total body weight gain and total feed intake. This disagree with the findings of Iyeghe-Erakpotobor *et al.* (2006) who fed crossbred weaner rabbits with five treatment diets consisting of 100, 75, 50 and 25 % levels of soybean cheese waste/maize offal diet (SBW). Intake of concentrate was significantly higher for weaner rabbits fed the control diet than the 100 % diet of soybeans cheese waste (similar concentrate intake was observed for 75 and 50 % diets of soya beans cheese waste). This similarity in feed intake among the treatment groups is perhaps an indication of the adequacy of CMW in meeting the nutritional needs of the animals at different dietary inclusion levels. This is because even at higher levels of inclusion of CMW (30 and 40 %), their FCR were comparable to that of the Control (0 % CMW).

Table 2: Proximate composition and calculated energy value of cowpea milling waste (CMW)

Parameters	% Composition
Dry matter	97.00
Ash	9.00
Crude protein	24.85
Crude fibre	14.00
Ether extract	5.00
Nitrogen free extract	44.15
Metabolizable energy (Kcal/kg)	2892

Table 3: Growth performance of weaner rabbits fed diets containing varying levels of cowpea milling waste

Parameters (%)	$T_{1(0\%)}$	$T_{2(10\%)}$	$T_{3(20\%)}$	$T_{4(30\%)}$	$T_{5(40\%)}$	SEM	P-Value
Initial body weight (g)	733.33	694.42	761.10	711.13	744.47	14.68	0.6905
Final body weight (g)	1788.90	1711.20	1727.80	1816.70	1852.80	34.15	0.7203
Body weight gain (g)	1038.90	1016.70	966.70	1105.50	1108.30	40.00	0.8213
Total feed intake (g)	6238.40	7555.60	7487.20	7316.40	7294.40	259.38	0.5889
FCR	6.11^{a}	7.46^{b}	7.70^{b}	6.63^{ab}	6.66^{ab}	0.21	0.0836
Mortality	0.00	0.67	0.33	0.33	0.33	0.15	0.8335

^{ab}Means with different superscripts on the same row were significantly (P<0.05) different.
SEM = Standard error of mean. FCR = Feed Conversion ratio.

Table 4 shows the apparent nutrient digestibility of weaner rabbits fed diets containing varying levels of CMW. Dry matter and crude protein digestibility showed no significant (p>0.05) difference across the treatments. Digestibility of crude fibre (CF), ether extract (EE), ash and nitrogen free extract (NFE), as well as total digestible nutrient (TDN) of the test diets compared favourably with that of the

control diet. This result disagreed with the report of Orji (2009) who observed significant (P<0.05) differences in dry matter and crude protein digestibility in hybrid rabbits fed cowpea hulls (CPH) at 0, 10, 20 and 30 % dietary inclusion levels. Their study also revealed significant (P<0.05) differences in digestibility of crude fibre, ether extract and nitrogen free extracts. Generally, digestibility decreased gradually with increase in the addition of CPH in the diets, due to increase in the crude fibre content. However, in this research study, crude fibre digestibility improved with higher inclusion levels of CMW. This could be due to differences in the composition of the crude fibre content of CMW compared to CPH, with varying ratio of cellulose, hemicellulose and lignin.

Table 4: Apparent nutrient digestibility of weaner rabbits fed diets containing varying levels of cowpea milling waste

Parameters	$T_{1(0\%)}$	$T_{2(10\%)}$	$T_{3(20\%)}$	$T_{4(30\%)}$	$T_{5(40\%)}$	SEM	P-value
Dry matter	86.98	86.40	87.56	87.97	86.81	0.30	0.5468
Crude protein	81.42	81.41	82.29	81.26	81.85	4.92	0.4952
Crude fibre	72.94^{b}	72.64^{b}	80.16^{a}	84.04^{a}	80.90^{a}	1.29	0.0001
Ether extract	95.23^{ab}	95.98^{a}	94.90^{b}	96.04^{a}	94.38^{b}	0.20	0.0152
Ash	43.74^{c}	54.62^{b}	63.54^{a}	50.15^{bc}	44.07^{c}	2.17	0.0010
NFE	96.04^{a}	94.30^{bc}	95.18^{ab}	93.58^{c}	94.90^{ab}	0.26	0.0001
TDN	80.47^{c}	83.69^{a}	76.11^{d}	81.67^{b}	80.02^{c}	0.67	0.0001

^{abcd}Means with different superscripts on the same row were significantly (P<0.05) different.
SEM = Standard error of means, NFE = Nitrogen free extract, TDN = Total digestible nut rients

Conclusion and recommendations

From the results of this research study, it can be concluded that cowpea milling waste can be used safely as a protein source and included up to 40 % in the diet of weaner rabbits with no detrimental effect on their growth performance and nutrient digestibility. Hence, it is recommended to animal nutritionists, feed millers and animal scientists to use cowpea milling waste as a cheaper and quality protein and energy source for production of rabbits at 40 % dietary inclusion level.

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