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Full Length Research Paper

Response of weaner rabbits to diets containing fermented mixtures of cassava peel and dried caged layers' manure

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Interest on non-conventional sources of energy in animal feeding has increased in recent time but these new ingredients still await an adequate nutritional evaluation. Milled dried cassava peel and caged layers' manure mixed in ratio 4:1(w/w), fermented for 7 and 14 days separately and screened for microbial load were used to replace maize in weaner rabbit diets designated as A (0% inclusion of the mixture), B (25%), C (50%), D (75%), E (100%) for 7 days fermentation and F (25%), G (50%), H (75%) and I (100%) for 14 days in a 2 × 4 factorial experiment. Fifty-four weaner rabbits, weighing 620 ± 0.23 g at 7 weeks were randomized into 9 treatments of 3 replicates each (one male and one female rabbit per replicate) and fed for 56 days. Fermentation duration significantly increased ($p<0.05$) crude protein and decreased crude fibre content in the fermented mixture of cassava peel and caged layers' manure (FCPCLM). Weaner rabbits fed diets A, B and F recorded higher ($p<0.05$) feed intake than others. Body weight gain, feed conversion ratio and protein efficiency ratio were higher ($p<0.05$) for rabbits fed diets B and F. Packed cell volume, haemoglobin, and red blood cell counts of rabbits on diets A, B and F were higher ($p<0.05$) than others. Mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration were also influenced ($p<0.05$). Aspartate amino transaminase and alanine amino transaminase activities of rabbits fed diets B and F were similar and decreased ($p<0.05$) as dietary inclusion of FCPCLM increased. Maize can be optimally replaced at 25% in the diet of weaner rabbits by FCPCLM fermented either at 7 or 14 days without adverse effect on their growth performance.

Key word: Alternative source, cereal, energy, microbial load.

INTRODUCTION

Cereal and legume grains supply has become inadequate with attendant prohibitive prices thereby making the cost of livestock feed very expensive. The search for a lower cost feed that will not compromise animal performance has further prompted the challenges in very recent time to investigate more of the agro industrial by-products and crop residues that are non-competitive alternative sources of energy for its use in livestock feeding. Therefore, adequate knowledge of available non-conventional feed resource is required to formulate least cost feed for a sustainable agricultural practice (Dairo et al., 2005)

Price of maize has been competitively high in recent years because of human use as food and biofuel production (Aletor, 2005). There are many crop residues and other farm by-products, many of which are not often adequately utilized for effective and sustainable agricultural production in lesser developed countries of the world. These crop residues are processed to facilitate utilization by farm animals. Dried cassava peel has been reported in many works as an important source of energy in animal feeding systems especially for ruminants and

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Table 1. Proximate composition of a mixture of dried cassava peel and caged layers' manure fermented for 7 and 14-day periods (%).

Parameter	FCPCLM fermented for 7 days Mean (X)	FCPCLM fermented for 14 days Mean (X)	t-values	P –values
Dry matter	96.05	95.94	0.46	0.67^{NS}
Crude protein	5.53	6.37	24.51	<.0001*
Crude fibre	30.65	29.96	- 1.57	0.192*
Nitrogen free extract	43.54	56.47	43.86	<.0001*
Ether extract	3.27	3.21	0.69	0.53 ^{NS}
Ash	9.80	16.12	23.75	<.0001*
Metabolizable energy (MJ/kg)	8.07	10.01	0.028	0.0022*

NS = Not significant at p>0.05; * = Significant at p<0.05; 7FCPCLM, 7 day fermented mixture of cassava peel and caged layers manure. 14FCPCLM, 14 day fermented mixture of cassava peel and caged layers.

herbivores, either as being part of the main basal diet or as a supplement (Okeudo and Adegbola, 1993; Omoikhoje et al., 2006).

Rabbit has long been known to thrive on farm and kitchen wastes of high fibre content. However, fibre digestion in the caecum is often limited but enhanced by caecotrophy (Omole, 1982; Belenguar et al., 2000). Low concentrate supply in rabbit diets especially at subsistence production level in the tropics do not facilitate optimum utilization of the fibrous wastes (Adegbola et al., 1985). Fermentation technique procedures have been employed to improve the nutritive quality of many farm wastes by reducing fibre proportion while increasing protein content; therefore making raw materials rich in non-digestible carbohydrates a functional livestock feed (Dairo and Ogunmodede, 2001; Fasuyi et al., 2010; Oboh et al., 2012). The protein content of cassava peels ranges from 1.12 to 3.15% (Amaefule et al., 2011; Fadiyimu et al., 2012) which could be improved for a nutrient enrichment of the diet. Poultry manure is a good source of nitrogen often wasted on farms when not put to use as crop fertilizer. This study evaluated the utilization of cassava peel when fermented with caged layers' manure to enhance its nutritive value in growing rabbit diet.

MATERIALS AND METHODS

Collection of experimental test ingredients

Dried cassava peel from sweet variety of cassava (*Manihot palmata*) was collected from the Cassava Processing Unit of the University Teaching and Research Farm. Fresh caged layers' manure was also collected for 8 h from the Layers Unit of the Poultry Section at the University Teaching and Research Farm. Both ingredients were collected mid-December 2009. The manure was sun dried, milled using a commercial feed milling machine (Artec, model 20) and stored in a cool dry open-sided house. Bovine rumen filtrate was collected fresh from the main abattoir at Bawa village in Ado-Ekiti as the slaughtering of animals was in progress. The bovine rumen filtrate was filtered using muslin cloth and used to inoculate the ground mixture of cassava peel and caged layers' manure.

Preparation of experimental diets

A mixture of dried cassava peels and caged layers' manure was prepared in ratio 4:1, sprayed with 100 ml of rumen filtrate using 1 litre spray gun and fermented for 7 and 14 days separately in a black polythene bag as described by Dairo et al. (2010). The filtrate served as the source of microbes for inoculation. The fermented cassava peel and caged layers' manure (FCPCLM) at 7 and 14 days were incorporated into the rabbit diets to replace maize at 25, 50, 75 and 100% in a pre-formulated control weaner rabbit diet (diet A in Table 1). These graded dietary levels of the fermented mixture constituted the nine experimental treatments (Table 1).

Experimental design and animal management

A total of 54 mixed cross-bred (most likely of New Zealand White X California White X Angora) weaner rabbits of 620 ± 0.23 g average live weight, aged 7 weeks were used in the feeding trial. Rabbits were randomly allotted to 9 treatment groups of 3 replicates per group (2 rabbits per replicate) in a 2 × 4 factorial design experiment plus control group. The fermentation days and the level of inclusion of the mixture tested represented the main factors. Rabbits were housed individually in two-tier wooden hutches (reinforced with wire mesh) of 90 cm × 90 cm × 95 cm dimension.

The control diet contained 0% of the tested ingredients and was designated as diet A while diets B to E contained 25, 50, 75 and 100%, respectively of seven-day fermented mixture of cassava peel and caged layers' manure. Diets F to I included the 14-day fermented mixture at 25, 50, 75 and 100%, respectively (Table 1). The weaner rabbits were generously supplied fresh cool clean water and fed the experimental diets at 8:00 h and 16:00 h *ad libitum* on a daily basis for a period of 70 days including a 14-day adjustment period.

Data collection

The average feed intake and body weight gain were measured from which secondary data such as feed conversion ratio (FCR) and protein efficiency ratio (PER) were calculated for the 56 day duration of the trial as shown as follows:

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Feed consumed}}{\text{Body weight gained}}$$

$$\text{Protein efficiency ratio (PER)} = \frac{\text{Body weight gained}}{\text{Protein consumed}}$$

About 5 ml of blood sample was collected per replicate from the marginal vein of rabbits into well-labelled sample bottles and allowed to clot at ambient temperature. Blood was collected into two separate labelled sample bottles for each replicate for the determination of haematology and serum chemistry. For haematological study, about 3 ml of blood sample was also collected in bottles containing ethylene di-amine tetra-acetic acid (EDTA) as an anticoagulant. Samples were immediately taken to the laboratory for analysis. The serum for each replicate was separated by centrifugation at 2500 revolutions per min in a bench top Harris Centrifuge (Model C2474/2), decanted, stored in a refrigerator at 4°C and later analyzed for total protein, albumin, aspartate amino transaminase (AST) (EC 2.6.1.1.1) and alanine amino transaminase (ALT) (EC 2.6.1.1.2)

Microbial screening of test ingredient

The fermented mixture of cassava peel and dried caged layers' manure was screened for *Salmonella*, *Clostridium* and enterobacteria using the method described by Fawole and Oso (1995) to detect possible health hazards. Enterobacteria were determined using desoxycholate citrate agar lactose (DCL) while Salmonella-Schigella agar was used for Salmonella. Both media were incubated at 37°C for 24 h. Earlier, plate count agar was used to obtain the standard plate count of the microbial load of the test ingredient. It was incubated for 72 h at 30°C. *Clostridium* was determined after heat activation at about 80°C incubated on *Clostridium* agar incubated at 30°C for 48 h.

Chemical and statistical analyses

The test ingredients and the experimental diets were analyzed for proximate composition as described by AOAC (2005) and metabolizable energy was calculated using prediction equation M. E. = 37 × %CP + 81.8 × %EE + 35.5 × %NFE (Pauzenga, 1985). Essential amino acid content of FCPCLM and maize was determined using amino acid analyzer (Model 80-2107 Auto Loader). From the whole blood, the packed cell volume (PCV), red blood cell count (RBC), white blood cell count (WBC) and haemoglobin (Hb) were determined using Wintrobe micro-haematocrit, Neuber haematocyatometer and cyanohaemoglobin procedures respectively described by Coles (1986). The mean corpuscular volume (MCV), the mean corpuscular haemoglobin (MCH), and the mean corpuscular haemoglobin concentration (MCHC) were all calculated as described by Sastri (2004). Total serum protein and albumin was determined using methods described by Peters et al. (1982) while the globulin was obtained by difference. Serum enzymes alanine amino transaminase and aspartate amino transaminase were determined according to the method of Reitman and Frankel (1957).

All the data were subjected to statistical analysis using SAS (1987) computer package for ANOVA and means separated by Duncan Multiple Range Test. The performance indices, haematology and blood chemistry constituted the variables.

RESULTS AND DISCUSSION

The chemical composition of the test ingredients is shown in Table 2. Crude protein content (6.37%) of 14-day fermented mixture of cassava peel and caged layers' manure (FCPCLM) was significantly higher ($p<0.05$) than the average value obtained for the 7-day fermented mixture (5.53%). Nitrogen free extract (56.47%) and ash (16.12%) were significantly higher ($p<0.05$) in 14-day than in 7-day FCPCLM while crude fibre (29.96%) was lower ($p<0.05$). It is evident that a longer fermentation of the mixture improved the nutritional value of the ingredients tested. As a result, the metabolizable energy content was increased by 24.04%. The rumen filtrate used contained microbes that can synthesize β-glucanase, an enzyme with ability to digest and break branched 1→6 glycosidic bonds in the cellulose and hemicellulose contained in the cassava fibre (Sniffen, 1987; Dairo et al., 2010). Consequently, nutrients locked up in the fibre matrix may become accessible and utilizable by animals for improved performance.

The calculated metabolizable energy (ME) contents obtained in this work (Table 2) agree with the findings of Fadiyimu et al. (2012). Metabolizable energy obtained in this study also compared fairly well with 13.73 MJ/Kg documented for white maize (Aduku, 1993). Similar results were obtained by Adeyemi and Familade (2003) when fermented corn cob was used to replace maize in broiler diets and also by Osei and Duodu (1988) in their studies where cassava peels were fermented to replace maize in layers diets.

The values obtained for the microbial count when FCPCLM was screened (Table 3) indicated that the fermented product is safe to use as feed component (Sniffen, 1987). The microbial load is low because fermentation process lowers the environmental pH and increased acidity impairs microbial growth (Sniffen, 1987; El-Jalil et al., 2001).

The growth performance indices are shown in Table 4. The average daily feed intake of rabbits fed diet A, 61.42 g (control group), diet B, 60.03 g (25% replacement of maize by 7-day fermented FCPCLM), and diet F, 60.15 g (25% replacement of maize by 14 days fermented FCPCLM) were similar but significantly higher ($p<0.05$) than the others. Generally, the feed intake decreased as the dietary inclusion of FCPCLM increased irrespective of the fermentation duration.

Body weight gains were similar for rabbits fed with diets B and F (15.58 g and 15.27 g, respectively) but significantly higher ($p<0.05$) than the others. For the length of the feeding trial, the feed conversion ratio (FCR) followed the same trend as the feed intake and body weight gain. Feed conversion ratios obtained for rabbits fed diets B and F were similar (3.87 and 3.92 respectively) and the best of all feeding treatments. Rabbits on diet E (100% replacement of maize by FCPCLM fermented for 7 days) exhibited the poorest ($p<0.05$) FCR (5.60). The protein consumed and protein efficiency ratio (PER) were similar and significantly higher ($p<0.05$) in rabbits fed with diets A, B and F. Observed decreased feed intake as the dietary level of FCPCLM increased was perhaps due to a concomitant increase in the crude fibre content of the experimental diets. The dietary crude fibre increased from

Table 2. Composition of experimental diets (%).

Ingredients	% Maize replaced by FCPCLM fermented for 7 days					% Maize replaced by FCPCLM fermented for 14 days			
	A	B	C	D	E	F	G	H	I
	0	25%	50%	75%	100%	25%	50%	75%	100%
Maize	40.00	30.00	20.00	10.00	-	30.00	20.00	10.00	-
Palm kernel cake	14.00	14.00	14.00	14.00	14.00	16.00	16.00	16.00	16.00
Rice bran	7.50	7.50	7.50	7.50	7.50	5.50	5.50	5.50	5.50
Wheat offal	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
Brewers' dried grain	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
Groundnut cake	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Oyster shell	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Bone meal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
*FCPCLM	-	10.00	20.00	30.00	40.00	10.00	20.00	30.00	40.00
** Premix	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Total	100	100	100	100	100	100	100	100	100
Determined analysis (%)									
Crude protein	15.90	15.56	15.50	15.48	15.45	15.81	15.68	15.55	15.51
Crude fibre	8.32	11.02	13.91	16.69	19.49	10.87	13.77	16.67	19.58
Metabolizable energy (kcal/kg)	2504 15	2388.84	2273.54	2158.23	2042.92	2373.16	2236.66	2095.17	1953.67

*FCPCLM, Fermented mixture of dried cassava peel and caged layers' manure. **The Premix supplied the following kg^{-1} of nutrients: Vitamins A 500 iu. D_2 1500 iu; Vit. E 3 iu; Vit. K 2 mg; RiboflavinS 3 mg; Panthothenic acid 6 mg; Niacin 15 mg; Vit B_{12} 0.8 mg; Chlorine 3 mg; Folic acid 4 mg; Mn 8 mg; Zn 0.5 mg; Iodine 1.0 mg; Cobalt 1.2 mg.

Table 3. Enterobacteria, Salmonella and Clostridium load of fermented mixtures of cassava peel and caged layers' manure for 14 days used to partially replace maize in weaner rabbits' diets (cfu/g).

Microbes	Concentration
Enterobacteria	6×10^3
Salmonella	ND
Clostridium	3.78×10^3

ND= Not detected.

from 8.32% in the control diet to 19.58% where maize was fully replaced with FCPCLM fermented for 14 days. Crude fibre increase among the experimental diets ranged from 16.77 to 32.45%. Average daily body weight gained was very low for all the rabbits which agree with the findings of Carabano et al. (2008) and Amaefule et al. (2011).

Table 5 presents the haematology of the rabbits fed the experimental diets. Values recorded for packed cell volume (PCV) in rabbits fed with diets B and F were similar and higher ($p<0.05$) than others while the haemoglobin reached the lowest value for rabbits fed on 75 and 100% replacement of maize with FCPCLM, irrespective of the fermentation duration. The PCV range in rabbit is 25 to 45% having 34% as mean (Kronfield and Mediway, 1975; Mitruka and Rawnsley, 1977). The values obtained in this study indicated a normal health status for rabbits except for those fed diets in which FCPCLM replaced maize at 75 and 100%, both at 7 and 14 days fermentation period. As the dietary level of FCPCLM increased there was a progressive decline in PCV and the haemoglobin values, which suggests some level of inadequacy in the product of fermentation. Inadequate detoxification of the cassava peel using fermentation techniques has been reported by Ahamefule et al. (2006) as responsible for poor PCV values in rabbits fed fermented cassava peel. However, cassava peel used in this study was well dried before fermentation. The possibility of an infestation from the caged layer's manure cannot be ruled out even though the test ingredient was screened for microbial load. This becomes clearer with the values obtained for the white blood cell count for rabbits fed diets D (5.88×10^6 mm^3), E (8.14×10^6 mm^3), H (5.25×10^6 mm^3) and I (5.01×10^6 mm^3) that were all higher than those on diets A (4.58×10^6 mm^3), B (4.34×10^6 mm^3), C (4.36×10^6 mm^3), F (4.99×10^6 mm^3) and G (4.34×10^6 mm^3). However, the red blood cell count (RBC) values were directly opposite in trend ($p<0.05$). High values of white blood cell counts indicated some level of infestation in the blood of the rabbits which was consistent with the observed poorer growth performance of rabbits fed these diets. It further confirms the poorer utilization of FCPCLM by rabbits as its dietary inclusion increased (Ahamefule et al., 2006).

Table 4. Growth performance of weaner rabbits fed a fermented mixture of cassava peel and caged layers' manure (FCPCLM).

Diets	% Maize replaced by FCPCLM fermented for 7 days					% Maize replaced by FCPCLM fermented for 14 days				SEM
	A	B	C	D	E	F	G	H	I	
	0%	25%	50%	75%	100%	25%	50%	75%	100%	
Feed Intake (g/d)	61.42[a]	60.03[a]	53.55[e]	54.98[de]	57.21[bc]	60.15[a]	58.15[b]	57.31[bc]	56.13[cd]	1.72
Body weight gain (g/d)	14.95[b]	15.58[a]	13.58[c]	11.03[e]	10.45[f]	15.27[ab]	13.24[cd]	13.18[cd]	12.87[d]	0.96
Feed conversion ratio	4.11[c]	3.87[a]	3.97[b]	5.07[e]	5.60[f]	3.92[a]	4.42[d]	4.34[d]	4.36[d]	0.03
Protein intake (g)	9.76[ab]	9.33[ab]	8.38[b]	8.56[ab]	10.44[a]	9.60[ab]	9.14[ab]	8.90[ab]	8.70[ab]	0.92
Protein efficiency ratio	1.54[ab]	1.67[a]	1.62[ab]	1.29[e]	1.17[f]	1.59[ab]	1.44[d]	1.49[cd]	1.47[cd]	0.002

[a,b,c] Means with different superscripts in the same row differs significantly (p<0.05).

Table 5. Haematology of weaner rabbits fed a fermented mixture of cassava peel and caged layers' manure (FCPCLM).

Diets	% maize replaced by FCPCLM fermented for 7 days					% maize replaced by FCPCLM fermented for 14 days				SEM
	A	B	C	D	E	F	G	H	I	
	0%	25%	50%	75%	100%	25%	50%	75%	100%	
Packed cell volume (%)	38.06[a]	37.22[b]	31.67[d]	25.94[f]	23.22[g]	37.27[b]	34.30[c]	27.37[e]	22.43[h]	0.12
Haemoglobin (g/dl)	7.24[b]	6.92[bc]	8.15[a]	6.02[d]	5.08[e]	6.79[bc]	6.69[c]	5.54[de]	4.59[f]	0.09
Red blood cell $\times 10^6$/mm^3	4.00[c]	4.10[b]	3.39[d]	3.10[e]	3.09[e]	4.16[a]	4.05[bc]	3.07[e]	3.09[e]	0.001
White blood cell $\times 10^6$/mm^3	4.58[de]	4.34[e]	4.36[e]	5.88[b]	8.14[a]	4.99[cd]	4.34[e]	5.25[c]	5.01[cd]	0.07
MCV (%)	95.22[a]	89.37[b]	93.42[a]	83.60[c]	75.06[e]	79.87[d]	84.60[c]	89.04[b]	73.15[f]	1.14
MCH (%)	18.12[bc]	16.87[cd]	24.02[a]	19.43[b]	16.44[cd]	16.32[d]	16.44[cd]	18.02[bcd]	14.63[e]	0.86
MCHC (%)	19.03[d]	18.88[d]	25.72[a]	23.22[b]	21.90[bc]	20.70[cd]	19.41[d]	20.25[cd]	20.46[cd]	1.05

[a,b,c]Means with different superscripts in the same row differs significantly (p<0.05).

The mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) for rabbits on diet C (50% replacement of maize by FCPCLM fermented for 7 days) were higher (p<0.05) than those recorded in rabbits on all other diets.

The mean corpuscular volume, mean corpuscular haemaglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) are generally low for all the rabbits on the test diets which is an indication of anaemic condition. However, the rabbits did not show this in their physical condition.

Serum total protein, albumin and globulin and the serum enzymes activities are presented in Table 6. All these parameters were influenced by FCPCLM dietary inclusion (p<0.05).

The values of the parameters were lower (p<0.05) for rabbits fed 75 and 100% replacement of maize by FCPCLM which is an indication of poor utilization at these inclusion levels.

Aspartate amino transaminase (AST) (EC 2.6.1.1.2) were similar in rabbits fed with diets B and F and signify-cantly decreased (p<0.05) as the inclusion of FCPCLM increased (either fermented for 7 or 14 days). Alanine amino transaminase (ALT) (EC 2.6.1.1.1) values followed the same trend as AST. It implies a progressive decline in the utilization of the diets as the test ingredients increased (Dairo et al., 2010). Haematological indices monitored indicated a better utilization of FCPCLM when it replaced maize up to 50% in the diet of weaner rabbits.

There was no disease outbreak during the trial. However, histopathological examinations of the internal organs would be of importance in subsequent investi-gations even though the experimental animals did not show any anaemic condition.

Table 7 present the interaction of fermentation duration and dietary levels of inclusion of FCPCLM on the growth performance of the rabbit while Table 8 shows the interactive effect of fermentation duration and dietary inclusion of FCPCLM on haematology and serum chemistry for the feeding trial.

Fermentation period had positive interactions on the parameters monitored. Fermentation for 14 days was significantly higher (p<0.05) for performance indices such as daily feed intake (58.63 g), daily body weight gain (13.90 g) and PER (1.51).

Haematological values such as PCV (31.87%), haemoglobin (6.17 g/dl), RBC (3.67 × 10^6 /mm^3) and globulin (3.76 g/dl) were all significantly influenced by the

Table 6. Serum chemistry of weaner rabbits fed a fermented mixture of cassava peel and caged layers' manure (FCPCLM).

Diets	% Maize replaced by FCPCLM fermented for 7 days					% Maize replaced by FCPCLM fermented for14 days				SEM
	A 0%	B 25%	C 50%	D 75%	E 100%	F 25%	G 50%	H 75%	I 100%	
Total protein (g/dl)	5.35^{d}	7.26^{a}	6.53^{bc}	6.37^{c}	5.45^{d}	6.84^{b}	7.53^{a}	6.53^{bc}	5.68^{d}	0.05
Albumin (g/dl)	3.34^{a}	2.54^{b}	2.58^{b}	2.51^{b}	2.69^{b}	2.02^{c}	2.35^{bc}	2.68^{b}	2.58^{b}	0.05
Globulin (g/dl)	2.02^{e}	4.72^{a}	3.95^{b}	3.87^{b}	2.77^{d}	4.82^{a}	5.19^{a}	3.68^{bc}	3.09^{cd}	0.11
ALT (μl)	17.00^{d}	27.00^{a}	21.33^{bc}	22.33^{b}	18.67^{cd}	25.67^{a}	17.67^{d}	21.00^{bc}	11.67^{e}	2.42
AST (μl)	25.67^{g}	63.33^{a}	51.33^{c}	41.00^{d}	36.00^{e}	51.33^{c}	55.67^{b}	37.67^{de}	31.33^{f}	5.51

^{a,b,c}Means with different superscripts in the same row differs significantly (p<0.05).

Table 7. Interactions of fermentation duration and dietary inclusion levels of *FCPCLM on the growth performance of weaner rabbits.

Parameter	FCPCLM Fermentation for 7 days	FCPCLM Fermentation for 14 days	Interaction effect	Significance
Feed intake (g/d)	57.44^{b}	58.63^{a}	8.74	0.0001*
Body weight gain (g/d)	13.12^{b}	13.90^{a}	30.22	0.0001*
Feed conversion ratio	4.52^{a}	4.24^{b}	27.29	0.0001*
Protein intake (g/d)	9.29^{a}	9.22^{b}	1.56	0.224*
Protein efficiency ratio	1.46^{b}	1.51^{a}	29.17	0.001*

^{a,b,c}Means with different superscripts in the same row differs significantly (p<0.05). *FCPCLM, Fermented mixture of cassava peel and caged layer's manure.

Table 8. Interactions of fermentation duration and dietary inclusion levels of *FCPCLM on haematology and serum chemistry of weaner rabbits.

Parameter	FCPCLM fermented for 7 days	FCPCLM fermented for 14 days	Interaction effect	Significance
Packed cell volume (%)	31.11^{b}	31.87^{a}	20.9	0.0001*
Haemoglobin (g/dl)	6.68^{b}	6.17^{a}	6.21	0.0002*
Red blood cell $\times 10^6$/mm^3	3.54^{b}	3.67^{a}	10.97	0.0001*
White blood cell $\times 10^6$/mm^3	5.62^{a}	4.83^{b}	68.77	0.001*
Total protein (g/dl)	6.19^{b}	6.39^{a}	7.79	0.001*
Albumin (g/dl)	2.73^{a}	2.59^{b}	2.38	0.086*
Globulin (g/dl)	3.46^{b}	3.76^{a}	4.32	0.011*
MCV (%)	87.39^{a}	84.38^{b}	51.41	0.001*
MCH (%)	18.98^{a}	16.71^{b}	18.07	0.001*
MCHC (%)	21.75^{a}	19.97^{b}	14.97	0.001*
ALT (μL)	21.27^{a}	18.60^{b}	4.57	0.009*
AST (μL)	43.67^{a}	40.33^{b}	9.87	0.001*

^{a,b,c}Means with different superscripts in the same row differs significantly (p<0.05). *FCPCLM = Fermented mixture of cassava peel and caged layer's manure.

14-day fermentation of FCPCLM. It implies that FCPCLM may be optimally utilized when it replaced maize both at 25 and 50% either fermented for 7 or 14 days.

Conclusion

It can be concluded from this study that a fermented mixture of cassava peel and caged layers' manure could be used in weaner rabbit diets to replace maize, optimally at a 25% replacement. Nutritive value of cassava peel produced as wastes by subsistent farmers could be improved by the use of poultry manure (instead of synthetic enzymes often not available in rural locations) through fermentation technique to replace maize often competed for by the farmers' household as food.

REFERENCES

Adegbola TA, Tibi EU, Adogwa DC (1985). Feed intake and digestibility in rabbits on all forage plus concentrate and all concentrate diet. J.Anim. Prod. Res. 5:15-16.

Adeyemi OA, Familade FO (2003). Replacement of maize by rumen filtrate fermented corn-cob in layer diets. Bioresour. Technol. 90:221-224.

Aduku AO (1993). Tropical feedstuff analysis table. Department of Animal Science, Faculty of Agriculture, Ahamadu Bello University, Samaru, Zaria. Nigeria. p. 3.

Aletor VO (2005). Alternative energy and protein feed resources in livestock feeding: A revisit of possibilities and constraints. An invited paper at the Annual conference of ASAN September, 2005, University of Ado-Ekiti, Nigeria. p. 7.

AOAC (2005). Official Methods of Analysis, 18th ed., Association of Official Analytical Chemist, Washington, DC,

Ahamefule FO, Eduok GO, Usman A, Amaefule KU, Obua BE, Oguike SA (2006). Blood biochemistry and haematology of weaner rabbits fed sundried, ensiled and fermented cassava peel based diets. Pak. J. Nutr. 5(3):248-253

Amaefule KU, Mbonu UE, Amaka V (2011). Performance and nutrient utilization of growing rabbits fed graded levels of raw Bambara Groundnut [*Vigna subterranean* (L.) *Verdc*] offal diets. Pak. J. Nutr. 10 (5):463-469,

Belenguar A, Fondevila M, Balcells J, Torre C (2000). Effect of the source and level of cereal in diet on the rabbit caecal environment and microbial population. In: Proc. 7th World Rabbit Congress, vol. C, pp. 95-100.

Coles EH (1986). Veterinary Clinical Pathology. 4^{th} Ed., Saunders Comp. Philadelphia, London, Toronto.

Carabano R, Villamide MJ, Garcia J, Nicodemus N, Llorente A, Chamorro S, Menoyo D, Garcia-Rebollar P, Garcia AI, de Lebas JC (2008). New concepts and objectives for protein-amino acid nutrition in rabbits. In: Proc. 9th World Rabbit Congress, June 10-13, 2008, Verona, Italy. pp. 477- 490.

Dairo FAS, Ogunmodede BK (2001). The nutritive value of fermented copra meal on the broiler performance and serum chemistry. Nig. Poult. Sci. J. 1:61-74

Dairo FAS, Aina OO, Asafa AR (2005). Performance evaluation of growing rabbits fed varying levels of rumen content and blood rumen content mixture. Nig. J. Anim. Prod. 32(1):67-72

Dairo FAS, Umeh DC, Oluwasola TA, Adegun MK (2010). Utilization of fermented corn cob and caged layers' manure mixtures by weaner rabbits. Nig. J. Anim. Sci. 12:63-71

El-Jalil MH, Faid M, Elyachioui M (2001). A biotechnological process for treatment and recycling poultry wastes manure as a feed ingredient. Biomass Bioener. 21:301-309

Fadiyimu AA, Fajemisin AN, Arigbede AO, Alokan JA (2012). Rumen dry matter degradability and preference by West African Dwarf goatsfor selected multipurpose trees in Nigeria. Livestock Res. Rural Develop. p. 24.

Fawole MO, Oso BA (1995). *Laboratory Manual of Microbiology. 1^{st} Edn.,* Spectrum Books Limited, Ibadan. pp. 74-76.

Fasuyi AO, Dairo FAS, Ibitayo FJ (2010). Ensiling wild sunflower (*Tithonia diversifolia*) leaves with sugar cane molasses. *Livestock Research for Rural Development 22(3):2010.* www.lrrd.org/lrrd22/fasu22042.htm

Kronfield OW, Mediway NC (1975). Blood Chemistry In: Textbook of Veterinary Clinical Pathology. Publ. Williams and Williams Co.,Baltimore. pp. 81-96.

Mitruka BM, Rawnsley HM (1977). Clinical Biochemical and Haematological reference values in normal experimental animal. Masson Publ. Co.New York. pp.102-117.

Oboh G, Ademosun AO, Lajide L (2012). Improvement of the nutritive value and antioxidant properties of citrus peels through <I>*Saccharomyces cerevisae*</I> solid substrate fermentation for utilization in livestock feed. Livestock Research for Rural Development. .p. 24.

Okeudo NJ, Adegbola AA (1993). Utilization of dried caged-hen manure and cassava peels for intensive sheep production. Trop. Anim. Health Prod. 25(4):234-238

Omoikhoje SO, Bamgbose AO, Aruna MB, Asubiaro SM (2006). Growth response of weaned rabbits fed varying levels of unpeeled cassava root meal. Proceedings of the 31^{st} Annual Conference on Nigerian Society for Animal Production, March 12-15, 2006, Nigeria. pp. 290-294.

Omole TA (1982). The effect of level of dietary protein on growth and reproductive performance of rabbits. J. Appl. Rabbit. Res. pp.5383-5385

Osei SA, Duodu S (1988). Effects of fermented cassava peel meal on the performance of broiler. Br. Poult. Sci.29 (3):671-675

Pauzenga U (1985). Feeding parent stock. *Zootechnica International,* pp. 22 -24.

Peters T, Biamonte GT, Doumas BT (1982). Protein (Total Protein) in Serum, Urine and Cerebrospinal Fluid; Album in Serum. Selected Method of Clinical Chemistry. Vol. 9 (Paulkner, W.R. and S. Meites (Eds.). American Association for Clinical Chemistry, Washington, D.C. USA.,

Reitman S, Frankel S (1957). A colorimetric method for the determination of Serum glutamate pyruvate transaminase and serum glutamate oxaloacetate transaminase. Am. J. Clin. Path. 28: 56-62.

SAS (1987). SAS/STASt. *Guide for personal computers*. Version 6. Ed. pp. 697- 978.

Sastri GA (2004). Veterinary Clinical Pathology. CBS Publishers and Distributors, New Delhi, India. pp. 1-41.

Sniffen CJ (1987). Rumen Microbial Ecology. In: *Biotechnology in the Feed Industry*, (Lyons, T.P. (Ed.).) Alltech Technical Publication, Nicholasville.