PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

OPEN ACCESS Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2020.303.308

Research Article
Growth Performance, Nutrient Digestibility and Cost of Production of Weaned Rabbits Fed Processed Unripe Plantain Peel Meal Based-Diets

[1]A.N. Robert, [1]A.A. Ayuk, [1]P.O. Ozung and [2]B. J. Harry

[1]Department of Animal Science, Faculty of Agriculture, Forestry and Wildlife Resources Management, University of Calabar, Calabar, Nigeria
[2]Institute of Agricultural Research and Training, Moore Plantation, Ibadan, Nigeria

Abstract

Objective: This study evaluated the effect of processed unripe plantain peel meal (UPPM) based-diets on the growth performance, nutrient digestibility and cost of production of weaned rabbits. **Materials and Methods:** Twenty five weaned rabbits of both sexes with an average initial weight of 670.60±2.71 g rabbit^{-1} were used. The rabbits were assigned to five experimental diets in a Completely Randomized Design (CRD). The diets were formulated using various processed forms of UPPM (sun-dried, toasted, fermented and urea-treated) to replace maize at 50% level each for T_2, T_3, T_4 and T_5, respectively. The control diet (T_1) contained 100% maize without UPPM. Data on growth performance, nutrient digestibility and production cost were determined and analysed using one-way ANOVA. **Results:** The results showed that final body weight, total feed intake, total weight gain and feed conversion ratio in the treatment groups were significantly ($p<0.05$) lower than corresponding values in the control treatment. The fermented UPPM showed significantly ($p<0.05$) higher digestible dry matter, crude protein and crude fibre than other diets. The cost of feed was the highest in T_1(₦103.89) and least in T_2 (₦ 85.10) but the cost per kilogram weight gain was least in T_4 (₦450.10) and highest in T_1 (₦475.05). Although, the control diet performed better in terms of final body weight and total weight gain, it was however cheaper to produce 1kg of meat with the fermented UPPM. **Conclusion:** The study concluded that replacing maize at 50% with fermented UPPM could enhance growth performance and nutrient digestibility without compromising economic gain in rabbit production.

Key words: Plantain peel, rabbit, malnutrition, animal protein, growth performance

Received: May 04, 2019 Accepted: May 09, 2020 Published: May 15, 2020

Citation: A.N. Robert, A.A. Ayuk, P.O. Ozung and B. J. Harry, 2020. Growth performance, nutrient digestibility and cost of production of weaned rabbits fed processed unripe plantain peel meal based-diets. Pak. J. Nutr., 19: 303-308.

Corresponding Author: P.O. Ozung, Department of Animal Science, Faculty of Agriculture, Forestry & Wildlife Resources Management, University of Calabar, Calabar, Nigeria Tel: +2348180802103

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Protein-energy malnutrition is a serious health issue faced by developing countries[1], especially with regards to animal protein intake[2]. The very low intake of animal protein leads to malnutrition with severe effect especially on children[3]. Low protein consumption is quite common in Nigeria as well as in most developing countries[4]. Evidence shows that malnutrition has a negative effect on the reproductive system and physiological processes[5], as well as the well-being of children[6]. It is necessary therefore that the populace be well fed. The National Bureau of Statistics[7] reported that the population growth in Nigeria is increasing rapidly with a total population of 173.60 million people. Economic analysis shows that this rapid population growth would emerge more consumers[8].

Therefore, the search for alternative animal protein sources to meet the large population requirement is crucial. The rabbit (*Oryctolagus cuniculus)* described as a micro livestock species[9], seems to be the cheapest and sustainable means of producing high quality animal protein[10,11] for the third world countries. There is a stiff competition for the use of conventional ingredients such as grains between man and livestock[12]. It has become important to explore the potentials of various agro-by products (AIBs) to replace the expensive grains[13]. This has prompted the evaluation of less expensive feedstuffs as substitutes[14]. Many agricultural wastes including plantain peels are abundant in the remote areas of South-South geo-political zone of Nigeria, especially Cross River State where they are under-utilized by small holder farmers[14,15]. Nutritional studies have shown that unripe plantain peels contain 13.73% crude protein, 9.46% crude fat, 51.86 % total carbohydrate, 10.30% ash and 6% crude fibre[16]. There is paucity of research information on the potential of plantain peels as feedstuff for animals; hence this study was designed to determine the effect of various processed forms of unripe plantain peel meal based- diets on the growth performance, nutrient digestibility and production cost of weaned rabbits.

MATERIALS AND METHODS

Location of the study: The study was carried out at the Rabbitry Unit of the Teaching and Research Farm, University of Calabar, Calabar, Cross River State. Calabar is located in Southern Nigeria, which falls between latitude 4°57'N of the equator and longitude 8°19'E of the Greenwich meridian with mean annual rainfall between 1260 and 1280 mm, average daily temperature between 25° and 30°C with a relative humidity of 70-90% at an elevation of 99 m above sea level[17].

Processing of unripe plantain peel meal and experimental diets: Fresh composite unripe plantain peels were collected from fast food outlets, restaurants, plantain chip and roasted plantain stalls within Calabar metropolis and its environs. The peels were washed and cut into slices of 5-7 mm thick for ease of drying. The cut pieces were spread on clean concrete floor for 7 days and were turned at intervals for even and quick drying to constant weight. Bristled and crispy peels of 10% moisture content were packed into air tight bags and raised 0.05 m above the floor to avoid absorption of moisture. The bulked peels were divided into four portions for further processing. The first portion was further sun-dried to less than 10% moisture content and thereafter milled in a hammer mill using a 3 mm sieve size to obtain sun-dried unripe plantain peel meal (SUPPM); the second portion was toasted for 15 min in a cast iron pot and thereafter milled in a hammer mill of 3 mm sieve size to obtain toasted unripe plantain peel meal (TUPPM); the third portion was fermented for 4 days thereafter, it was sun-dried and milled in a hammer mill of 3 mm sieve size to obtain fermented unripe plantain peel meal (FUPPM) while the fourth portion was treated with urea according to the procedure outlined by Ayuk *et al.*[18] to obtain urea treated unripe plantain peel meal (UUPPM), respectively. The five experimental diets had 100% maize (control, T_1), 50% SUPPM (T_2), 50% TUPPM (T_3), 50% FUPPM (T_4) and 50% UUPPM (T_5). The gross composition of the experimental diets is presented in Table 1. The processed forms of UPPM were analysed in triplicates for proximate composition according to AOAC[19] methods and the result is presented in Table 2.

Experimental animals and management: Twenty five cross bred weaned rabbits of mixed sexes of 6-7 weeks old with mean initial weight of 670.60±2.71 g rabbit^{-1} were randomly assigned to five dietary treatment groups, such that each treatment had five rabbits in a Completely Randomized Design (CRD) experiment. The rabbits were housed individually in a two-tier hutch system with provision for feeding and drinking troughs. The animals were maintained on their respective diets throughout the experimental period. Feed and water were given *ad libitum*. After the initial two weeks adjustment period, the animals were subjected to 9 weeks (63 days) feeding trial during which growth performance, digestibility and cost (economics) of production were evaluated.

Digestibility trial: The direct method (*in vivo*) involving feeding rabbits with experimental diets was used in this study as outlined by Oyenuga[20]. The digestibility trial was carried out

Table 1: Gross composition of experimental diets

Ingredient	T_1 (100% maize)	T_2 (50% SUPPM)	T_3 (50% TUPPM)	T_4 (50% FUPPM)	T_5 (50% UUPPM)
Maize	35.00	17.50	17.50	17.50	17.50
SUPPM	0.00	17.50	0.00	0.00	0.00
TUPPM	0.00	0.00	17.50	0.00	0.00
FUPPM	0.00	0.00	0.00	17.50	0.00
UUPPM	0.00	0.00	0.00	0.00	17.50
SBM	13.00	16.00	16.00	15.00	15.00
Fish meal	2.50	3.00	3.00	3.00	3.00
PKC	9.00	8.00	5.00	5.00	5.00
Wheat offals	15.50	13.00	13.00	16.00	16.00
Rice husk	20.30	20.30	21.80	20.30	20.30
Bone meal	2.00	2.00	2.00	2.00	2.00
Palm oil	2.00	3.00	3.50	3.00	3.00
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
CP%	17.21	17.36	17.50	17.60	17.96
CF%	8.46	9.23	10.50	9.43	9.56
ME (kcal kg^{-1})	2552.14	2521.37	2505.89	2505.89	2522.74
Determined analysis					
CP%	16.01	17.15	17.11	17.87	17.45
CF%	9.65	10.23	12.42	8.46	11.36

SUPPM: Sun-dried unripe plantain peel, TUPPM: Toasted plantain peel meal, FUPPM: Fermented unripe plantain peel meal and UUPPM: Urea treated unripe plantain peel meal

Table 2: Proximate and energy composition of processed unripe plantain peel meal

Parameters (%)	SUPPM	TUPPM	FUPPM	UUPPM	SEM
Dry matter	79.49^{d}	87.92^{b}	87.38^{c}	88.08^{a}	0.03
Crude protein	8.93^{d}	9.48^{c}	10.17^{a}	9.85^{b}	0.01
Crude fibre	9.19^{c}	12.61^{a}	7.92^{d}	10.54^{b}	0.26
Ether extract	4.64^{d}	5.11^{c}	5.32^{b}	5.60^{a}	0.02
Ash	5.80^{d}	14.81^{b}	12.75^{c}	17.50^{a}	0.06
NFE	44.58^{b}	42.90^{b}	52.25^{a}	50.90^{b}	1.15
ME (kcal kg^{-1})	2618.00	2292.00	2833.00	2718.00	11.40

^{a,b,c,d}Means on the same row with different superscripts are significantly different ($p<0.05$), SUPPM: Sun-dried unripe plantain peel, TUPPM: Toasted unripe plantain peel meal, FUPPM: Fermented unripe plantain peel meal and UUPPM: Urea treated unripe plantain peel meal

at the ninth week and lasted for 15 days, using twenty rabbits (i.e. 4 rabbits) per treatment. No faeces were collected for the first 7 days but faecal samples and feed intake were recorded for the last 8 days. Faecal samples collected from each day were oven-dried at 60°C, preserved in bags and stored in a refrigerator. At the end, all faecal samples collected from each replicate were pooled together for the determination of proximate composition using the AOAC[19] methods. Percentage digestibility of diets was obtained as follows:

$$\text{Percent digestibility} = \frac{\text{Quantity of nutrient in feed} - \text{quantity of nutrient in faeces}}{\text{Quantity of nutrient in feed}} \times 100$$

Statistical analysis: Data obtained were subjected to one-way analysis of variance (ANOVA). Duncan Multiple Range Test was used to separate significant means at 5% level of probability ($p<0.05$) as applicable[21].

RESULTS AND DISCUSSION

Proximate and energy composition of processed unripe plantain peel meal (UPPM): Table 2 shows the results of the proximate and energy composition of the processed forms of UPPM. The nutrient composition of sun-dried UPPM was significantly lower than that of other processed forms. The crude protein of fermented UPPM was significantly ($p<0.05$) higher than that of other forms. The range of crude protein in sun-dried, toasted, fermented and urea-treated UPPM obtained in this study (8.93-10.17%) was lower than the values reported by Agbabiaka *et al.*[16] (13.73%) for sundried unripe plantain peel meal and Uwalaka *et al.*[22] (10.64%) for unripe plantain peel meal respectively. However, the values of crude protein were comparable with the value 9.86% recorded for soaked ripe plantain peels reported by Akinmutimi[23]. However,

Table 3: Growth performance characteristics of weaned rabbits fed processed forms of UPPM

Performance traits	T_1 (100% maize)	T_2 (50% SUPPM)	T_3 (50% TUPPM)	T_4 (50% FUPPM)	T_5 (50% UTUPPM)	SEM
Initial weight (g rabbit^{-1})	667.20	685.56	679.36	678.11	672.26	2.31
Final weight (g rabbit^{-1})	1602.20^{a}	1418.06^{d}	1452.11^{c}	1552.56^{b}	1302.01^{d}	53.39
Total feed intake (g rabbit^{-1})	4572.63^{a}	4059.63^{ab}	4120.56^{ab}	4364.55^{b}	3751.83^{c}	39.50
Weekly feed intake (g rabbit^{-1})	508.07^{a}	451.07^{ab}	457.84^{ab}	484.95^{b}	416.87^{c}	15.50
ADG (g rabbit^{-1} day^{-1})	14.84^{a}	11.63^{ab}	12.27^{ab}	13.88^{a}	10.00^{b}	0.85
Total weight gain (g rabbit^{-1})	935.00^{a}	732.5^{bc}	772.75^{b}	874.45^{a}	629.75^{c}	53.59
Weekly weight gain (g rabbit^{-1})	103.89^{a}	81.39^{bc}	85.86^{bc}	97.16^{b}	69.97^{c}	5.96
ADF	72.58^{a}	64.44^{ab}	65.41^{ab}	69.28^{b}	59.55^{c}	2.22
FCR	4.93^{b}	5.47^{ab}	5.67^{ab}	4.78^{b}	6.08^{a}	0.19
Mortality (%)	20.00	0.00	20.00	0.00	0.00	4.90

^{a,b,c}Means on the same row with different superscripts are significantly different ($p<0.05$). SEM: Standard error of mean

Table 4: Nutrient digestibility of rabbits fed processed UPPM based-diets

Digestible nutrient (%)	T_1 (100% maize)	T_2 (50% SUPPM)	T_3 (50% TUPPM)	T_4 (50% FUPPM)	T_5 (50% UTUPPM)	SEM
DM	96.27^{d}	97.91^{c}	97.81^{c}	98.60^{a}	98.22^{b}	0.04
CP	72.72^{b}	67.47^{b}	67.49^{b}	98.27^{a}	63.10^{c}	0.06
CF	80.83^{b}	71.78^{d}	75.70^{c}	81.47^{a}	69.34^{e}	0.07
EE	93.36^{a}	86.15^{d}	89.36^{c}	90.76^{b}	85.21^{e}	0.04
Ash	83.36^{b}	76.08^{d}	90.81^{a}	77.28^{c}	72.56^{e}	0.04

^{a,b,c,d,e}Means on the same row with different superscripts are significantly different ($p<0.05$), DM: Dry matter, CP: Crude protein, CF: Crude fibre, EE: Ether extract, SEM: Standard Error of Mean

the values of crude fibre, ether extract, nitrogen free extracts (NFE) and metabolizable energy did not agree with the reports of other researchers[22-26]. These differences observed could be due to the variety of plantain, soil and other climatic factors that influence the availability of nutrients in plants.

Growth performance characteristics of rabbits fed processed unripe plantain peel meal based-diets: There were significant ($p<0.05$) differences in the replacement levels of maize with processed forms of UPPM based-diets among weaned rabbits in all parameters (Table 3). The effect on live weight and weight gain recorded in the fermented diet could be due to the fact that micro - flora in fermented feed enhance digestibility of nutrients. The superior growth performance could also be attributed to the balance of amino acids in the experimental diets. These results suggest that processing of plantain peels could positively influence body weight gain changes of weaned rabbits; since the experimental animals showed preference for processed plantain peel meal diets. However, Lebas *et al*.[27] reported lower average daily gain (ADG) under tropical conditions which can be due to several factors such as breed, nutrition, climate, stress, disease and management systems. The poor performance observed in the urea treated group (T_5) implies that the level of urea (4%) in the diet was probably too high that could not be well tolerated by the rabbits. Daily feed intake range obtained in this study (59.55-72.58 g rabbit^{-1} day^{-1}) was lower than those reported by other scientists (77.64-87.51[28] and 87.13-104.12 g rabbit^{-1} per day[29]). It was observed that the odour, texture and colour of the experimental diets influenced feed intake. This observation was in line with the reports of Arnold *et al*.[30], Olabanji *et al*.[31] and Duwa *et al*.[32]. The best feed conversion ratio (FCR) was observed in fermented UPPM diet (4.78) and the worst (6.08) was observed in rabbits fed urea-treated UPPPM diet. This result showed that replacing maize with processed UPPM based diets had adverse effect on feed consumption in rabbits due to high crude fibre content and this is in line with the report of Ramchurn[33] who stated that crude fibre plays significant role in feed intake of rabbits. The FCR values in this study were lower (7.21-9.15) than those reported by Ogunsipe and Agbede[29] for rabbits fed sun-dried UPPM. The control and fermented diets had the best FCR, indicating a higher efficiency of the feed in inducing growth in weaned rabbits compared to rabbits fed on other diets.

Nutrient digestibility of rabbits fed processed unripe plantain peel meal (UPPM) based-diets: The results of nutrient digestibility of rabbits fed processed UPPM based-diets is presented in Table 4. The digestible nutrients were properly digested by the rabbits, due to the high values of nutrient digestibility recorded in this study. Significant ($p<0.05$) differences were observed in all parameters across dietary treatments. This result was in consonance with the finding of Ajayi *et al*.[34]. However, the results obtained did not agree with the findings of Iyayi *et al*.[35] who reported no significant ($p>0.05$) effect of dietary treatments on growing rabbits fed *Albizia saman* pod based-diets. The disparity in digestibility responses could be attributed to the different test ingredients used in the separate studies. The faster growth rate observed in rabbits fed fermented UPPM diet could be

Table 5: Economics of production of weaned rabbit fed processed UPPM based-diets

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Cost kg^{-1} feed (₦kg^{-1})	103.89[a]	85.10[d]	91.53[c]	90.20[c]	94.37[b]	3.11
Cost kg^{-1} $weight^{-1}$ gain	508.02[a]	471.45[b]	487.85[b]	450.10[c]	502.45[a]	10.58
Total feed cost/rabbit (₦kg^{-1})	475.05[a]	345.47[c]	377.15[b]	393.68[b]	354.06[c]	23.11
Cost differential	0	36.57[b]	20.17[c]	57.92[a]	5.57[d]	11.24
Relative cost advantage (%)	0	7.20[b]	3.97[c]	11.40[a]	1.10[d]	2.21

[a,b,c]Means along the same row with different superscripts are significantly different ($p<0.05$)

due to increased digestibility of nutrients, which might have resulted in better utilization of nutrients for better growth performance recorded in this study. The nutrient digestibility of rabbits fed sundried and toasted diets were comparable, the consistent decrease in nutrient digestibility of rabbits fed the urea-treated UPPM diet might be due to low feed intake of the diet as a result of the presence of urea.

Economics (cost) of production of weaned rabbits fed unripe plantain peel meal based-diets: The replacement of maize with processed UPPM proved a good alternative because it reduced the cost of feeds and increased the farmers' income (Table 5). Processed unripe plantain peel meal based- diets had lower feed cost than the control diet. This was simply the result of high price of maize per kilogramme (₦103.89) which led to high total feed cost (₦475.05) in the control diet, when compared to sun-dried UPPM diet (₦350.47), toasted UPPM diet (₦377.15), fermented UPPM diet (₦393.68) and urea-treated UPPM diet (₦354.06). The results showed that replacement of maize with UPPM would increase the economic efficiency of the diets. This is in agreement with the findings of Iyeghe-Erakpotobor *et al.*[36] and Akinmutimi and Osuagwu[37] who documented lower cost of production in rabbits fed agro by-products. Among the various processing methods adopted in this study, fermentation proved to be the most cost effective.

CONCLUSION

The crude protein and crude fibre contents of UPPM were higher than that of maize and the metabolizable energy compared favourably with that of maize. Rabbits fed UPPM based - diets had improved performance and digestibility characteristics compared to the control diet. Among the processing methods used in this study, fermentation recorded optimum performance with respect to live weight and reduced cost of production. The study concluded that fermented UPPM produced best growth performance indices, nutrient digestibility and reduced the cost of production of rabbits in the tropics. The fermentation method is hereby recommended for rabbit farmers as an ideal method of processing unripe plantain peels. The fermented UPPM can conveniently replace maize at 50% level without fear of comprising growth performance and nutrient retention with the additional benefit of cost effectiveness.

SIGNIFICANCE STATEMENT

The study discovered the possibility of utilizing agro-industrial wastes namely plantain peels in the feeding of rabbits. Plantain being a tropical crop is common in Nigeria with a lot of peels produced annually by agro-industrial companies. The unripe peels could be processed into different forms such as sundried, toasted, fermented and urea-treated. The study has shown that unripe plantain peel meal could replace maize at 50% in animal diets without deleterious effects. This study will help the researchers to uncover the critical areas of animal feed adequacy from unconventional feedstuffs that many researchers have not been able to explore. Thus, a new theory on quality and quantity of feedstuff from unripe plantain peels has been achieved.

REFERENCES

1. FAO., 1986. Natural resources and the human environment for food and agriculture in Africa. FAO Environment and Energy Paper No. 6, Food and Agriculture Organization, Rome, Italy, pp: 88.
2. Gueye, E.F., 1998. Village egg and fowl meat production in Africa. Word Poult. Sci. J., 54: 73-86.
3. Wogar, G.S.I. and A.A. Ayuk, 2012. By-products as protein source for lactating grasscutters. J. Agric. Sci., 4: 148-153.
4. Okon, B.I. and A.A. Ayuk, 2007. Nutrient and mineral retention of broilers fed periwinkle flesh. Agric. J., 2: 646-650.
5. FAO., 2015. Help Eliminate Hunger, Food Insecurity and Malnutrition. Food and Agriculture Organization of the United Nations. http://www.fao.org/3/a-au829e.pdf
6. Awosanmi, V.O., 1999. Nigeria needs to recover from its present state of poultry production. Trop. J. Anim. Sci., 2: 21-26.
7. NBS, 2014. National Bureau of Statistics, Nigeria. Population report. https://www.brookings.edu/blog/africa-in-focus/2014/09/23/youth-unemployment-in-nigeria-a-situation-analysis/

8. Theodore, O.I., 2006. The effects of population growth in Nigeria. J. Applied Sci., 6: 1332-1337.
9. Vietmeyer, N.D., 1985. Potential of microlivestock in developing countries. J. Applied Rabbit Res., 8: 1581-1586.
10. Onifade, A.A., O.A. Abu, R.I. Obiyan and O.T.F. Abanikannda, 1999. Rabbit production in Nigeria: some aspects of current status and promotional strategies. World Rabbit Sci., 7: 51-58.
11. Ozung, P.O., O.O.O. Kennedy, J.A. Ubua and E.A. Agiang, 2019. Dietary cocoa pod husk meal could influence the reproductive tract morphometry of rabbits. East Afr. Scholars J. Agric. Life Sci., 2: 26-30.
12. Okon, B.I., M.B. Obi and A.A. Ayuk, 2007. Performance of quails (*Coturnix coturnix* Japonica) fed graded levels of boiled sun-dried taro cocoyam (*Colocasia esculenta*) as a replacement for maize. Agric. J., 2: 654-657.
13. Bistanji, G., S. Hamadeh, H. Hassan, F. Tami and R. Tannous, 2000. The potential of agro-industrial byproducts as feeds for livestock in Lebanon. Livestock Res. Rural Dev., Vol. 12,
14. Ayuk, A., G. Kalio, L. Agwunobi and B. Okon, 2007. Agro by-product feedstuffs and livestock management systems for rural livelihoods in cross river state. J. Agric. Sci., 3: 191-197.
15. Kalio, G.A., A.A. Ayuk and L.N. Agwunobi, 2013. Performance and economics of production of West African Dwarf (WAD) bucks fed crop by-products as sole feed in Cross River State, Nigeria. World Sci. Res. J., 1: 81-87.
16. Agbabiaka, L.A., K.C. Okorie and C.F. Ezeafulukwe, 2013. Plantain peels as dietary supplement in practical diets for African catfish (*Clarias gariepinus* Burchell 1822) fingerlings. Agric. Biol. J. North Am., 4: 155-159.
17. NMA, 2019. Nigerian Meteorological Agency, Daily weather report, Margaret Ekpo International Airport, Calabar, Nigeria. https://en.allmetsat.com/metar-taf/nigeria.php?icao=DNCA
18. Iyayi, E.A., O. Olubamiwa, A. Ayuk, S. Orowvegodo and E.F. Ogunaike, 2001. Utilization of urea treated and untreated cocoa pod husk based diets by growing pigs: An on-farm study. Tropicultura, 19: 101-104.
19. AOAC., 1990. Association of Official Analytical Chemists, Official Methods of Analysis. 15th Edn., Washington, D.C. America, Pages: 684.
20. Onyenuga, V.A., 1968. Nigerias Food and Feeding-Stuffs: Their Chemistry and Nutritive Value. 3rd Edn. (Revised Edition), Ibadan University Press, Ibadan, Nigeria, pp: 99.
21. Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics: A Biometrical Approach. 2nd Edn., McGraw Hill Book Co., New York, USA., ISBN-13: 9780070609266, Pages: 633.
22. Uwalaka, R.E., J.P. Ihezuo and E. O. Ahaotu, 2013. Effects of inclusion of unripe plantain peel meal (*Musa paradisca*) on carcass quality, performance and internal organ weights in finisher broiler birds. Int. J. Agric. Biosci., 2: 136-140.
23. Akinmutimi, A.H., V,U. Odoemelam and S.F. Obasienkong, 2006. Effect of replacing maize with ripe plantain and yam peels in the diet of weaner rabbits. J. Anim. Vet. Adv., 5: 737-740.
24. Omole, A.J., I.O. Ayodeji and M.A. Raji, 2004. The potential of peels of mango, plantain, cocoyam and pawpaw as diets for growing snails (*Archachatina marginata*). Livestock Res. Rural Dev., Vol. 16, No. 12.
25. Ogunsipe, M.H., J.O. Agbede and O.A. Adedeji, 2014. Performance response, carcass evaluation and economic benefit of rabbits fed sorghum offal-based diets. Afr. J. Food Agric. Nutr. Dev., 14: 8585-8601.
26. Ighodaro, O.M., 2012. Evaluation study on Nigerian species of *Musa paradisiaca* peels: Phytochemical screening, proximate analysis, mineral composition and antimicrobial activities. Reseacher, 4: 17-20.
27. Lebas, F., P. Coudert, R. Rouvier and H.D. Rochambeau, 1986. The Rabbit Husbandry, Health and Production. 1st Edn., F.A.O., Rome, Italy.
28. Attah, S., D.D. Ortserga and F.O.I. Anugwa, 2011. Effect of replacement of rice offal with graded levels of melon (Citrullus Vulgaris) seed offal on performance of growing rabbits. Niger. J. Anim. Prod., 38: 67-73.
29. Ogunsipe, M.H. and J.O. Agbede, 2010. The replacement value of unripe plantain peels on the growth performance, carcass characteristics and cost implications of rabbit production in the tropical region. Researcher, 2: 24-29.
30. Arnold, G.W., E.S.d. Boer and C.A.P. Boundy 1980. The influence of odour and taste on the food preferences and food intake of sheep. Aust. J. Agric. Res., 31: 571-587.
31. Olabanji, R.O., G.O. Farinu, J.A. Akinlade and O.O. Ojebiyi, 2007. Growth performance, organ characteristics and carcass quality of weaner rabbits fed different levels of wild sunflower (*Tithonia diversifolia* Hemsl A. Gray) leaf-blood meal mixture. Int. J. Agric. Res., 2: 1014-1021.
32. Duwa, H., A.Y. Girgiri, A. Dauda and J.U. Igwebuike, 2014. The effect of feeding graded levels of roasted sunflower (*Helianthus annus* L.) seed meal on weaner rabbits. J. Anim. Feed Res., 4: 107-112.
33. Ramchurn, R., J. Raggoo and A. Ruggoo, 2000. Digestibility and growth in the domestic rabbit using multi-nutrient blocks as a feed supplement. Livestock Res. Rural Dev.,
34. Ajayi, A.F., G.O. Farinu, O.O. Oyebiyi and T.B. Olayemi, 2007. Performance evaluation of male weaner rabbits fed diets containing graded levels of Blood-wild sunflower leaf meal mixture. World J. Agric. Sci., 3: 250-255.
35. Iyayi, E.A., H. Kluth and M. Rodehutscord, 2006. Chemical composition, antinutritional constituents, precaecal crude protein and amino acid digestibility in three unconventional tropical legumes in broilers. J. Sci. Food Agric., 86: 2166-2171.
36. Iyeghe-Erakpotobor, G., I.K. Tudunwada, T. Adam, I.R. Muhammad and N. Bello, 2012. Influence of level of groundnut haulms and feeding system on performance of growing rabbits. Niger. J. Anim. Prod., 39: 63-73.
37. Akinmutimi, A.H. and C.C. Osuagwu, 2008. Response of weaner rabbits fed graded levels of sweet potato meal in place of maize-based diet. Pak. J. Nutr., 7: 705-709.