Nigerian J. Anim. Sci. 2016 (2):

Combinations of palm kernel cake, yam peels and plantain peels as alternative energy source in finisher broiler diets.

***Etuk, E. B., Anosike, C. A., Ifeduba, A. V., Etuk, I. F., [1]Ekpo, J. S., Emenalom, O. O. and E.U. Ahiwe.**

Department of Animal Science and Technology, Federal University of Technology, PMB 1526, Owerri, Nigeria.
[1]Department of Animal Science,Akwa Ibom State University, Obio Akpa Campus, Oruk Anam, Nigeria
* corresponding author**:**edeheetuk@gmail.com

Target audience: Farmer,Animal scientists, feed producers.

Abstract

Combinations of palm kernel cake (PKC), yam peels (YP) and plantain peels (PP) were evaluated as alternative energy source in finisher broiler diets. Four experimental finisher broiler diets were formulated such that diet T1 (control) contained no PKC, YP and PP. Diets T2, T3 and T4 contained PKC, YP and PP combined in the ratios 1:2:1, 1:1:2 and 2:1:1, respectively, replacing 50% of the maize in the respective finisher broiler diets. These diets were randomly assigned to eighty four, four week old unsexed Marshall Broilers in four groups of 21 birds each and 3 replicates of 7 birds respectively, for 28 days. Results obtained indicated that PKC contained higher crude protein and crude fibre (17.05 and 15.09%) and lower nitrogen free extract (54.20%) than YP and PP. PP however, recorded the highest value of nitrogen free extract (70.30%), and lowest ether extract value (2.06%). Broilers fed diets T3 produced numerically higher but comparable ($p>0.05$) body weight gain (1341.50 vs 1551.40g) and feed conversion ratio (2.40 vs 2.41) to those on diet T1. Values for dressed carcass weights, thigh and back cuts produced by diet T3 were also comparable ($p>0.05$) to that of diet T1. Breast and wing yield of birds on diet T3 was nevertheless significantly ($p<0.05$) heavier than other groups. Diets T1 produced significantly heavier gizzard and liver than other groups while abdominal fat, heart and spleen weights produced by birds on diet T1 were comparable ($p>0.05$) to those on diet T3.Diet T2 produced the poorest performance in most of the parameters measured. Replacement of 50% maize in finisher broiler diets with 1:1:2 combinations of PKC, YP and PP produced a 25.10% savings on feed cost per kg and 24.79% savings on feed cost per kg body weight gain.

Keywords: Pperformance; broiler finisher; alternative energy

Description of problem

The high cost of formulated ration and its availability all year round is one of the major constraints to optimal poultry production especially in Nigeria. Energy and protein feedstuff which constitute about 80% of poultry feed have been the major contributors to the high feed cost

(1, 2, 3, 4). Maize constitutes about 45 – 60% of compounded feed and it is the main cause of the high price of finished feed (5). The obvious cause of the high price of maize is the several use of the commodity as human food and industrial raw material (6, 7, 8).In order reduce the pressure on maize as energy source for poultry and possibly reduce the cost of finished poultry feed, there is the need to find alternatives that can wholly or partially contribute to energy supply in compounded poultry feed. Among the relatively less expensive potential feedstuff, agro by-products appear to have offered a lot of promise(9, 10).Palm kernel cake (PKC), yam peels (YP) and plantain peels (PP) are agro by-products that have been investigated as potential feedstuff in poultry ration (11, 8, 12, 13). PKC contain 14 – 21% crude protein, 11.00% crude fibre and 2700 Kcal/kg metabolizable energy. YP contain 88.90% - 91.66% dry matter, 11.73% crude protein, 5.09 – 9.50% crude fibre and 2988 Kcal/kg metabolizeable energy. PP on the other hand contains 90.90% dry matter, 6.43% crude fibre and 2993 Kcal/kg metabolizeable energy (14, 15, 8).

PKC, YP and PP have been studied individually or in combination with other feed ingredients as replacement for maize in livestock diets (16,17, 18). PKC however, is currently in extensive use in poultry ration though not in combination with YP and PP (19). PKC, YP and PP are relatively less expensive than maize and if utilized in poultry diet could reduce cost of production and improve the livelihoods of rural and urban poor. Also, the use of these agro by products will most likely reduce the waste disposal problem associated with the production and processing of yam and plantain especially, promote clean, healthy and safe environment. Wealth creation from waste will be ensured if YP and PP are utilized in poultry diets.

This study therefore, aimed at determining the optimum combination ratio of PKC, YP and PP to partially replace maize in finisher broiler diets.

Materials and Methods

Experimental site

This study was carried out in the School of Agricultural and Agricultural Technology Teaching and Research Farm, Federal University of Technology, Owerri, Imo State, Southeast Nigeria. Imo State lies between latitude 5°29' North and longitude 7°20' East. Owerri, the capital of Imo State, is located in the South – eastern agro-ecological zone of Nigeria. It is about 91m above sea level with annual rainfall, temperature and humidity ranging from1,500mm to 2,200mm, 20.0 – 27.5°C and 75– 90%, respectively (20).

Procurement and processing and analysis of test materials

Plantain peels and yam peels were collected from eateries and processors within the Federal University of Technology, Owerri, Nigeria and environs. The peels were sundried (around March-April when the temperature was 27 ° C) for 2 – 3 days until they became crispy to touch. Hydraulic pressed palm kernel cake was obtained from a reputable supplier in Owerri. Proximate and gross energy composition of PKC, YP and PP were

determined according to (21) (Table 2).

Experimental diets

Four experimental finisher broiler diets were formulated such that diets (0:0:0) contained only maize as the major source of energy. Diets T2,T3 and T4 contained PKC, YP and PP combined weight for weight in the ratio 1:2:1, 1:1: and 2:1:1 replacing 50% of the maize in the respective diets (Table 1)

Table 1: Gross Composition of Experimental Finisher Broilers

	Combinations of PKC, YP and PP			
Ingredients	**T1 (0:0:0)**	**T2 (1:2:1)**	**T3 (1:1:2)**	**T4 (2:1:1)**
Maize	64.00	32.00	32.00	32.00
Soy bean meal	20.00	20.00	20.00	20.00
Palm kernel cake (PKC)	0.00	8.00	8.00	16.00
Yam peel (YP)	0.00	16.00	8.00	8.00
Plantain peel (PP)	0.00	8.00	16.00	8.00
Wheat offal	6.00	6.00	6.00	6.00
Fish meal	3.50	3.50	3.50	3.50
Blood meal	3.00	3.00	3.00	3.00
Bone meal	2.50	2.50	2.50	2.50
Vit/min premix*	0.25	0.25	0.25	0.25
L-Methionine	0.25	0.25	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrient composition ofexperimental diets				
ME (kcal/kg)	2942.06	2651.02	2702.22	2687.02
Crude protein	19.97	21.25	21.21	21.87
Ether extract	3.86	4.07	4.75	4.55
Ash	3.14	6.23	5.98	5.02
Crude fibre	3.72	5.72	6.02	5.84
Calcium	1.08	1.10	1.10	1.07
Phosphorous	0.88	0.84	0.84	0.90
Methionine	0.36	0.34	0.34	0.38
Lysine	1.06	1.02	1.02	1.07

*Broiler finisher premix® to provide the following per kg: vit A, 3,200,000 iμ; vit D_3, 640,000 iμ; vit E, 8,000 iμ; vit K, 800mg; vit B_1, 600 mg; vit B_2, 1600 mg; vit B_6, 800 mg; vit B_{12}, 4 mg; niacin, 1600 mg; panthotenic acid, 2,000 mg; folic acid, 5,000 mg; biotin, 8 mg; choline chloride, 8,000 mg; manganese, 20,000 mg; zinc, 8,000 mg; copper, 2,000 mg; iodine, 400 mg; selenium,, 80 mg; cobalt, 200 mg; antioxidant 48,000 mg.

Experimental design and management of birds

Eighty four, four week old unsexed Marshall broiler chicks fed with commercial feed before the experiment commenced were divided into 4 groups of 21 birds each. Each group was replicated thrice on weight equalization basis. Each replicate was housed in a compartment measuring 3.3m x 1.7m in a dwarf walled poultry house. The four experimental diets were then randomly assigned to the four groups of broilers in a completely randomized design (CRD) experiment. Feed and water were offered *ad libitum*. Routine

management practices, recommended vaccination and medication schedules were strictly applied to all the groups. Each dietary group received the same management treatment throughout the feeding trial. The feeding trial lasted 28 days.

Carcass and organ weight determination

Two broilers whose weights were closest to the average were selected from each dietary group at the end of the feeding trial. The birds were starved of feed for 12 hours, weighed individually, slaughtered by cutting the jugular veins, defeathered by dipping in boiling water of about 100°C and then eviscerated. Carcass was cut into parts and weighed using a 5kg weighing balance (Camry®).Internal organs were separated and weighed using the Satorius® electronic scale.

Data collection and analysis

Chicks were weighed at the commencement of the study and thereafter on weekly basis. Feed intake was determined by offering weighed quantity of feed daily and weighing the leftover the next morning. Feed cost was calculated from the cost of the ingredients and mixing. Feed conversion ratios, feed cost per kg body weight gain were obtained by calculation. Weights of the carcass cut and internal organs were expressed as percentage of dressed weight and live weights, respectively. Means of all data obtained were analysed and compared using the General Linear Model (GLM) procedure of (22) and the Student Newman Keul's Test, respectively.

Results and Discussion

The proximate composition of the test materials, PKC, YP and PP are presented in Table 2. PKC recorded the highest crude protein value (17.05%) while YP and PP recorded much lower crude protein values (5.09 and 5.73). Similarly, the crude fibre content of PKC was highest (15.09%) compared to values obtained for YP (5.01%) and PP (5.06%). (23) reported a slightly higher crude fibre value (6.04%) for YP. The crude protein value of PKC obtained in this study was within the range reported by (14) and (24). However, the crude protein values recorded for YP and PP were much lower than the values reported earlier (11). The highest nitrogen free extract (NFE) value was obtained from PP with PKC recording the least value. The NFE obtained for YP was lower than the value (62.78 vs 78.49%) reported by (23). It is probable that varietal differences and deepness of peeling might have resulted in the disparity in the proximate value of YP(15).

Table 2: Proximate and gross energy composition of palm kernel cake (PKC), yam peel (YP) and plantain peel (PP).

Parameter	PKC	YP	PP
Dry matter	91.02	88.90	87.58
Crude protein	17.05	5.09	5.73
Crude fibre	15.09	5.01	5.06
Ether extract	6.90	4.89	2.06
Ash	8.40	3.21	0.10
Nitrogen fee extract	54.20	62.78	70.30
Gross energy(Kcal/kg)	2440.00	2455.10	2239.51

There were significant ($p<0.05$) differences among the treatment groups in the body weight gain, total feed intake, feed conversion ratio and feed cost per kg body weight gain (Table 3). Birds fed diets T3 recorded the highest body weight gain which was nevertheless similar ($p>0.05$) to the values recorded by those on the control (T1) diet. Diets T1, T3 and T4 produced final body weight values that were not significantly ($p>0.05$) different from each other.

Table 3: Performance of finisher broilers fed differentcombinations of PKC, YP and PP

	Combinations of PKC, YP and PP				
Parameters	**T1 (0:0:0)**	**T2 (1:2:1)**	**T3 (1:1:2)**	**T4 (2:1:1)**	**SEM**
Av. body wt. (g)	831.30	826.20	831.00	828.60	21.60
Av. final body wt. (g)	2172.88^{a}	1835.20^{b}	2382.40^{a}	2026.20^{ab}	123.10
Av. body wt. gain (g)	1341.50^{ab}	1009.00^{b}	1551.40^{a}	1197.60^{b}	117.50
Av. total feed intake (g)	5150.00^{a}	6348.00^{b}	5736.00^{ab}	5694.00^{ab}	256.00
Feed conversion ratio (FCR)	2.40^{a}	3.45^{b}	2.41^{a}	2.81^{ab}	0.25
Feed cost (₦ /kg)	87.48^{a}	65.52^{b}	65.52^{b}	66.15^{b}	4.39
Feed cost per kg body weight. gain (₦)	209.95^{a}	226.04^{a}	157.90^{b}	185.88^{b}	6.06
Mortality(%)	0.00	9.50	0.00	0.00	

^{ab}Means with different superscript within a row are significantly ($p<0.05$) different

This result is at variance with the reports of (15) and (25) showing consistent decline in body weight gain with increasing dietary fibre. The relatively higher body weight gain recorded by birds fed diet T3 despite the higher crude fibre in the diet might be as a result of the higher ratio of PP in the diet which resulted in a slightly higher energy value. The poor performance of birds on diet T2 might have resulted from some antinutritional factors in YP (8). YP is reported to contain tannin, saponin, oxalate and phytate (8) and it made up 16% of diet T2. It has also been reported that high content of unconventional feedstuff may alter the texture, colour, taste and odour of diets. Feed consumption and ultimately utilization might be affected by each of these parameters independently or in combination (26, 27, 9).

Values for feed conversion ratio (FCR) indicated that diet T1 produced the best (2.40) while T2 produced the poorest (3.45). There were no significant ($p>0.05$) differences between the values recorded for diets T1, T3 and T4. The total feed intake values indicated that birds on diet T1 produced the lowest value which was however, similar ($p>0.05$) to the feed intake of birds on diets T3 and T4. Diet T2 produced the highest feed intake which could probably be due to the slightly lower energy value of the diet and hence increased feed intake to meet the energy requirements of the birds (4, 28). Similarly, the lower feed intake of birds on diet T1 might have resulted from the higher metabolizable energy (ME) value and low crude fibre in the diet (14, 29).

Feed cost per kg body weight gain of birds on diets T3 and T4 were similar ($p>0.05$) and significantly ($p<0.05$) lower than values obtained for those on

diets T1 and T2. This might be due to the lower feed cost and comparatively higher body weight gain of birds on diets T3 and T4 (30). Diets T2 and T3 produced 25.10% while T4 produced 24.38% savings on feed cost (Fig.1). Similarly, feed cost savings per kg body weight gain was highest among birds on diet T3 (24.79%) while those on diet T2 produced a negative feed cost savings per body weight gain (Fig. 2).This result partly agrees with the report of (8) that reduction in production cost followed inclusion of YP meal in broiler diet.

Figure 1: Feed cost savings.

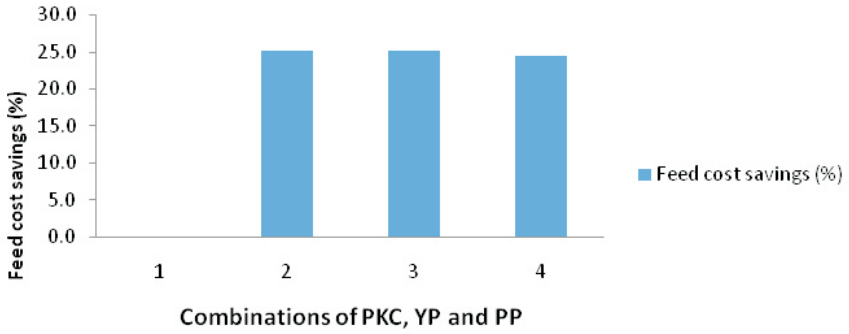

Figure 2: Feed cost savings per kg body weight

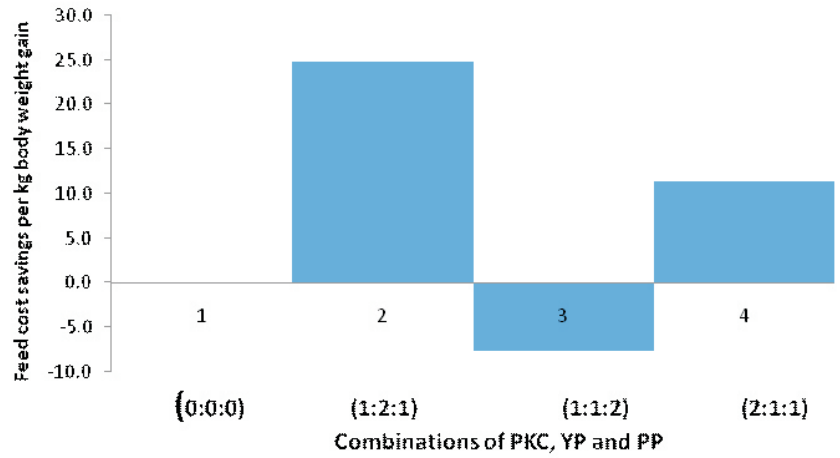

Table 4 shows the weights of cut parts expressed as percentage of dressed weight of broilers. The values obtained for the cut parts followed the same trend as the live weight and dressed weight of broilers though those on control diets showed higher value for dressed weight and back cut. There were significant ($p>0.05$) differences among the dietary groups in all the parameters measured except the thigh. Birds on diet T3 recorded the heaviest breast, thigh and

wing weights while those on diet T1 produced the heaviest back weight. The heavy breast weight recorded among birds on T3 agrees with the live weight of birds on the same diet. Breast meat according to (31) increases with increasing body weight. Birds on diet T2 recorded the lowest back cut value which was significantly ($p<0.05$) lower than values obtained for birds in other groups. There were no significant ($p>0.05$) differences in values of the back obtained for birds on diets T1, T3 and T4. Values for wings showed that diet T3 produced the heaviest weight followed by T1 and T4 while diet T2 again produced the lightest wing. It is possible that low weight of carcass and cut parts of birds on diet T2 was as a result of the lower dietary metabolisable energy. According to (32) reduced ME content of feed tends to have the effect of reducing the weight of carcass of birds.

Table 4: Carcass of broilers fed different combinations of palm kernel cake (PKC), yam peel (YP) and plantain peel (PP) in their diets.

	Combinations of PKC, YP and PP				
Parameters (% live weight)	**T1 (0:0:0)**	**T2 (1:2:1)**	**T3 (1:1:2)**	**T4 (2:1:1)**	**SEM**
Live weight (g)	2100.00^{a}	1900.00^{c}	2320.00^{b}	2000.00^{ac}	51.58
Dressed weight (% live weight)	63.40^{a}	54.25^{b}	62.02^{a}	57.81^{ab}	2.18
Thigh	19.90	18.87	21.80	18.37	3.35
Breast	16.39^{a}	11.23^{c}	18.15^{d}	14.83^{b}	0.08
Back	14.01^{a}	9.60^{b}	13.88^{a}	13.31^{a}	0.27
Wing	8.19^{a}	5.76^{c}	10.27^{d}	7.79^{b}	0.07

^{a,b,c,d}: means within a row with different superscript are significantly different ($p<0.05$)

The mean weight of organs expressed as percentage live weight of broilers is presented on Table 5. The liver, full and empty gizzard of broilers fed diet T1 were significantly ($p<0.05$) heavier than those fed diets T2, T3 and T4. This result agrees with the report of (33) for all groups except T2. Spleen weight followed the same trend with heart weight of birds on diet T2 recording the least value. According to (34)factors like age, diet and body weight influences affect organ weight of birds. Abdominal fat of birds on diet T3 was the heaviest while those on diet T2 recorded significantly ($p>0.05$) lower value than those on other diets. (29) reported that dietary fibre is observed to reduce carcass and abdominal fat in broilers, this is because broilers being a monogastric animal cannot digest fibre easily, so adequate nutrient absorption that will lead to deposition of fat as energy reserve is reduced when the diet is high in fibre (29).

Table 5: Organ weights of broilers fed different combinations of palm kernel cake (PKC), yam peel (YP) and plantain peel (PP) in their diets .

Parameters (% live weight)	Combinations of PKC, YP and PP T1 (0:0:0)	T2 (1:2:1)	T3 (1:1:2)	T4 (2:1:1)	SEM
Gizzard (full)	3.63[a]	2.74[c]	3.20[d]	3.02[b]	0.04
Gizzard (empty)	2.67[a]	2.19[c]	2.35[b]	2.52[b]	0.06
Liver	3.15[a]	1.92[c]	2.14[d]	2.52[b]	0.02
Spleen	0.33[a]	0.20[c]	0.31[a]	0.24[b]	0.02
Heart	0.46[a]	0.19[b]	0.40[a]	0.54[a]	0.09
Abdominal fat	1.03[ab]	0.55[c]	1.19[a]	0.93[b]	0.07

[a,b,c,d]: Means within a row with different superscripts are significantly different ($p<0.05$).

This does not totally agree with the results obtained in this study since diet T2 which produced the lowest abdominal fat did not contain the highest quantity of crude fibre. However, (10, 34) reported a significant depression in abdominal fat with decreasing energy value of feed.

Conclusions and applications

1. Considering the performance of broilers in terms of body weight gain, feed cost savings and carcass weight, diet T3 compared favorably with the standard diet, T1.
2. It is therefore, concluded that palm, kernel cake, yam peel and plantain peels combined in the ratio 1:1: 2 could be used to replace 50% of maize in finisher broiler diet.

References

1. Etuk, E.B., Udedibie, A.B.I. and Obikaonu, H.O. (2002).Replacement value of cooked pigeon pea (*Cajanus cajan*) Seed meal for soybean meal and maize in broiler finisher diet. In: P*roceedings of the 7th Annual Conference, Animal Science Association of Nigeria.* (ASAN). 16th – 19th September, 2002. University of Agriculture, Abeokuta, Nigeria. Pp.157-160.
2. Durunna, C.S., Udedidie, A.B.I. and Etuk, E.B. (2006). Performance and organ characteristics of broiler chickens fed graded levels of *Anthonata macrophylla* seed meal as replacement of *Arachis hypogea* meal. *Nigerian Journal of Agriculture Food and Environment*. 3(1 and 2):1-4.
3. Emenalom, O. O, Etuk, E. B., Esonu, B. O., Udedibie, A.B.I., Nwaiwu , C.C. and Obiora, B.A. (2008). Evaluation of raw and fermented *Alchornea cordifolia* seeds as feed ingredients for broilers. In: *Proceedings of the32nd Annual Conference, Nigerian Society for Animal Production (NSAP.)* March 16 – 20, 2008. Olabisi Onabanjo University, Yewa Campus, Ayetoro. Pp. 479-481.
4. Emenalom, O. O. and Udedibie, A. B. I. (1998). Effects of dietary raw, cooked and toasted *Mucuna pruriens* seed (Velvet beans) on the performance of finisher broilers.

Nigerian Journal of Animal Production, 25:115 – 119.

5. Anyanwu,G. A., Esonu,B.O., Iwuala, F.,Okerie, K. and Etuk, E.B. (2003).Bambara groundnut (*Voandzeasubterrranga (L) thours)* offal as partial substitute for maize in broiler diets. *Tropical Animal Production* 6:55-61.
6. Nworgu, F.C. and Ogbusuka, G.E. (2003).Ripe plantain(*Musa paradisiaca*) peels meal as an alternative energy source for weaned rabbits. In: *Proceeding of the28th AnnualConference,Nigeria n Society for Animal Production*. March 16- 20th,IAR/Ibadan.Pp. 348-351.
7. Ezieshi, E.V., Okhuerbie, I.F., Ezennabike, C.C. and Olomu, J.M. (2002). Comparative performance of broiler chicks fed graded levels of palm kernel cake and maize offal. In: *Proceeding of the 29th Annual Conference Nigeria Society Animal for Production* .March 21st – 25th .Usman Danfodio University, Sokoto.
8. Akinmutimi, A. H. and Onen, G. E. (2008). The response of broiler finisher birds fed graded levels of yam peel in place of maize – based diets. *International Journal Poultry Science,* 7(5): 474 – 479.
9. Uchegbu,M.C., Dikeocha, R.C., Etuk, E.B. and Opara, M.N. (2004).Replacement value of cassava root meal and maize/sorghum brewers' dried grain for maize in finisher broiler diet. *Journal of Sustainable Tropical Agricultural Research* 9 : 89-91.
10. Uchegbu, M. C. (2005). Combinations of brewers' grain, jack bean and cassava root meals as major energy sources for poultry. PhD Thesis. Federal University of Technology, Owerri, Nigeria. Pp. 27 – 140.
11. Akinmutimi, A. H., Odoemelam, V. U. and Abasiekong, S. F. (2006). Effect of replacing maize with ripe plantain and yam peels in the diet of weaner rabbits. *Journal of Animal and Veterinary Advances,* 5(9): 737 – 740.
12. Afolabi, K. D., Akinsoyinu, A. O., Abdullah, A. R., Olajide, R. and Alabi, O. M. (2010). Performance characteristics and nutrient digestibility of the Nigerian locally grown chicken fed varying dietary levels of Palm kernel cake. In; *Proceedings of the of the 15th Annual Conference Animal Science Association of Nigeria* 13 – 15 September, 2010. University of Uyo. Pp:413 – 416.
13. Lalabe, B. C., Awah, A. A., Defwang, I. I. and Ginoh, D. Y. (2010). Performance of broilers fed rubber seed cake and Palm kernel cake in place of maize. In: *Proceedings of the 15thConference of Animal Science Association of Nigeria.(*ASAN) *13 – 15th*September, 2010. University of Uyo. Pp. 526 – 528.
14. Aduku, A. O., Dim, A. I. and Ogundipe, S. O. (1991). Evaluation of sun/dried cassava peels as energy/source in broiler diets. In: *Proceedings, 16th Annual*

Conference of the. Nigerian Society for Animal Production March. Usman Dan Fodio University, Sokoto, Nigeria. Pp. 1 -4.

15. Akinmutimi, A. H. (2004). Evaluation of sword bean (*Canavalia gladiata*) as an alternative feed resource for broiler chickens. PhD Thesis. Michael Okpara University of Agriculture, Umudike. Pp. 4 – 28.
16. Ijaiya, A. T. and Awonusi, E. A. (2002). Effect of replacing maize with yam peels on growth performance of weaner rabbits. In: *Proceeding of the 7th Annual Conference, Animal Science Association of Nigeria (ASAN*). September 16th – 19th, University of Agriculture, Abeokuta, Nigeria. Pp. 161 – 163.
17. Odunsi, A. A., Akande, A. S., Yusuf and Salami, R.J. (2002). Comparative utilization of high inclusion of four agro-industrial by-products in the diets of egg type chicken. *Zootech.* 51:465 – 468.
18. Okeudo, N.J., Ebo, k.Vv., Izugboekwe, N.V. and Akanno E.C. (2005).Growth rate, carcass characteristics and organoleptic quality of broilers fed different levels of palm kernel cake. *International Journal of Poultry Science*. 4 (5): 330-333, 2005
19. Adejinmi, N.I. (1998). Effects of varying levels of dietary fibre on mineral and amino acid availability in poultry. *Journal of Animal Science*22: 81 – 85.
20Accuweather(2015). Weather for Owerri,Nigeria.www.accuweather.com/en/ng/owerri/253317/weather-forecast/253317. Retrieved on November 15, 2015.
21. Association of Official Analytical Chemists (AOAC) (1990). Official Methods of Analysis. 15th Edition, Washington DC., USA.
22. SAS, Inc. (1999). Statistical Analysis System/Stat: Guide for Personal Computer Version of Statistical Analysis System Institute Inc. Cary NC., USA. (1999).
23. Inaku, E. N., Bawa, G. S., Olugbemi, T. S. and Buba, W. (2011). Nutritive value of yam peel meal (YPM) in broiler diets. *In Proc. of the 36th Annual Conference of Nigerian Society for Animal Production.* 13th – 16th March. Merit House/Raw Materials Research and Development Council, Abuja, Nigeria. Pp. 414-416.
24. Olomu, J.M, (1995).*Monogastric Animal Nutrition-Principles and practice*. Jachem Publications Benin-city, Nigeria.
25. Pesti, G. M. (2009). Impact of dietary amino scid and crude protein levels in broiler feeds on biological performance. *Journal of Applied Poultry Research.* 18: 471 – 486.
26. Ande, K. O. (1992). Some physical characteristics of diets containing graded levels of palm kernel corn offal and dressing characteristics of broilers fed these diets. MSc., Thesis., Department of Animal Science, University of Ibadan.

27. Odunsi, A. A., Farinu, G. O. and Akinola, J. O. (1996). Influence of dietary wild sunflower (*Tithonia diversifolia* Hels A Gray) leaf meal on layers performance and egg quality. *Nigerian Journal Production*. 23:28 – 32.
28. Esonu, B. O., Azubuike, J. C., Emenalom, O. O., Etuk, E. B., Okoli, I. C. and Nneji, C. S. (2004). Effect of enzyme supplementation on the performance of broiler finishers fed *Microdemis puberula* leaf meal. *International Journal of Poultry Science,* 3(2): 112 – 114.
29. Iyayi, E. A., Ogunsola, O. and Jaji, I. R. (2005). Effect of sources of fibre and period of feeding on the performance of broilers carcass. *Poultry Science*. 3:335 – 340.
30. Oladunjoye, I. O., Ologbobo, A. O., Emiola, I. A. and Amao, O. A. (2004). Growth performance, carcass analysis and organ weights of broilers fed varying breadfruit (*Artocarpus altilis*) meal base diets. *Tropical Journal of Animal Science* 7:133 – 140.
31. Rose, S.P. (1997).*Principle of Poultry Science*.CAB International, Wallingford, UK.Pp.9-14.
32. Iyayi, E. A. and Yahaya, B. (1999). Performance of broilers maintained on diets supplemented with a commercial polysaccharide enzyme in the humid tropics. *Tropical Animal Production Investigation* 2:125 – 130.
33. Anugwa, F. O. I., Adesua, M. and Ikuior, S. A. (1998). Effects of dietary crude fibre levels on performance, nutrient digestibility and carcass characteristics of weaning – growing rabbits. In:*Proceedings of the Inaugural Conference*,*West African Society for Animal Production*.Pp. 610 – 6110.
34. Uchegbu, M. C., Okoli, I. C., Anyanwu, C. E., Etuk, E. B., Esonu, B. O. and Udedibie, A. B. I. (2004). Performance, carcass and organ characteristics of finisher broilers fed graded levels or raw *Napoleona imperialis* seed meal. *Livestock Research for Rural. Development* 16(6): http:www.cipav.org.co/lrrd16/6/uche1604/htm.