Tropical and Subtropical Agroecosystems
E-ISSN: 1870-0462
ccastro@uady.mx
Universidad Autónoma de Yucatán
México

Makinde, O.J.; Inuwa, M.
THE USE OF AGRO INDUSTRIAL BY-PRODUCTS IN THE DIET OF GROWER TURKEYS
Tropical and Subtropical Agroecosystems, vol. 18, núm. 3, 2015, pp. 371-378
Universidad Autónoma de Yucatán
Mérida, Yucatán, México

Tropical and Subtropical Agroecosystems, 18 (2015): 371 - 378

THE USE OF AGRO INDUSTRIAL BY-PRODUCTS IN THE DIET OF GROWER TURKEYS

[USO DE SUBPRODUCTOS AGROINDUSTRIALES EN LA DIETA DE PAVOS EN CRECIMIENTO]

O.J. Makinde [1*] and M. Inuwa[2]

[1]Department of Animal Science, Federal University, Gashua, Nigeria.
Email: johyinmak@yahoo.com
[2]Department of Animal Production Technology, Federal College of Wildlife Management, PMB 268, New Bussa, Niger State, Nigeria.
Corresponding author

SUMMARY

An experiment was conducted to evaluate the response of grower turkeys to diets containing different agro industrial by-products. A total of 120grower turkeys were used for this study. Four experimental diets were formulated and designated as T1, T2, T3, and T4. T1 (control diet) contained none of the agro industrial by products used while T2, T3 and T4 contained15% each of Wheat offal, Maize offal, Rice offal respectively. The turkeys were randomly allocated to four experimental treatments of thirty birds per treatment while each treatment was replicated three times (3) with ten (10) birds per pen in a completely randomized design. The result of growth performance revealed that average feed intake, average weight gain and feed conversion ratio of turkeys fed the control and 15% Wheat Offal diets were not significantly different (P>0.05). The result of carcass characteristics and organ weights followed similar trend. Turkeys fed 15% Maize Offal and 15% Rice Offal diets recorded the lowest values (P<0.05). There were no significant differences (P>0.05) in all the haematological parameters and serum biochemical indices measured except PCV which decreased across the treatment groups. It was concluded that 15% wheat offal can be included in the diet of grower turkeys without adverse effect on growth performance, carcass yield and health status of birds.

Key words: grower turkeys; wheat offal; maize offal; rice offal; growth performance.

RESUMEN

Se evaluó el desempeño de pavos en crecimiento con dietas con diferentes subproductos agroindustriales. Se empleó un total de 120 animales en cuatro dietas experimentales dónde la dietaT1- control no contenía subproductos y las dietas T2, T3 y T4 contenían 15% de residuos de trigo, maíz o arroz respectivamente. Se distribuyeron los pavos aleatoriamente, 30 animales por tratamiento en 3 réplicas de 10 pavos, en un diseño completamente aleatorizado. Los resultados mostraron que el consumo, ganancia de peso y conversión alimenticia de los animales con residuo de trigo no fueron diferentes a los obtenidos con la dieta control (P>0.05). Las características de la canal y peso de los órganos siguieron una tendencia similar. Los pavos con residuo de maíz y arroz tuvieron el menor desempeño (P<0.05). No se encontró diferencias (P>0.05) en las variables hematológicas y séricas evaluadas excepto para volumen de paquete celular que fue menor en las dietas con subproductos. Se concluyó que un 15% de residuo de trigo puede ser empleado en dietas de pavos en crecimiento sin afectar su desempeño productivo, rendimiento de canal e indicadores de salud de las aves.

Palabras clave: Pavos en crecimiento; residuo de trigo; residuo de maíz; residuo de arroz; crecimiento.

INTRODUCTION

Turkey (*Meleagris gallopavo*) is an integral part of poultry. It is a very important bird usually raised for economic benefit (Adene and Oguntade, 2006). The population of turkey in Nigeria had grown from 1.5 to 2.0 million (Morgan, 1991). In poultry farming, feeding accounts for 65 – 80 % of the production cost

and the poultry industry has suffered more than any other livestock industry as a result of the problem arising from inadequate supply of feed (Lepaideur, 2004). Energy and protein feedstuff, which constitute about 80% of poultry feedstuff have been the major hindrances to effective poultry production in Nigeria (Uchegbu *et al*., 2004). Cereal grains constitute the major source of energy in poultry diet in the tropics (Oluyemi and Roberts, 2000). Maize has remained the chief source of energy in compounded diet and it constitutes about 50% of poultry ration (Ajaja *et al*., 2002). Pressure on maize and recently cassava has been on the increase worldwide with emphasis being placed on export in Nigeria, since recent trends have seen massive exploitation of corn in ethanol production as an alternative source of fuel (Doki, 2007). This trend has necessitated the use of agro industrial byproducts such as wheat offal, maize offal, rice offal, palm kernel meal, brewers dried grains etc. in formulating feed for the livestock. Maize offal is a by-product of maize milling processes, second to wheat offal as the most preferred and utilized conventionally in livestock feeds in Nigeria (Babatunde and Oluyemi, 2002). Maize offal contains about 110 to 120 g/kg crude protein and 80 to 90 g/kg crude fibre (Onifade and Babatunde, 1998). The relatively low crude fibre content compared to other agro industrial by-products could be an advantage in fibre nutrition whereas the low protein content appears to be a limitation. Rice offal has high lysine and methionine content and it is available in large quantities all year round in many towns in the rice growing areas of Nigeria (Makinde *et al*., 2014). However, its phytate content, enzyme inhibitor, high fibre content and oxidative rancidity may have deleterious effects on poultry. Rice offal may become rancid and decrease poultry growth performance and lipid stability of meat (Chae *et al*., 2002). It is suggested to include it at relatively low levels (up to 15% only) in poultry diets (Makinde *et al*., 2014) as higher levels may result in low calcification, decreased feed intake and even mortality above 80% inclusion (ArunaTomar and Singh, 1999). More recently, Aduku (1993) in Nigeria reported that wheat offal contains 1256 and 2320 Kcal of metabolizable energy per kg for poultry and swine respectively, 15.6% crude protein and mineral elements such as calcium and phosphorus. These reports have portrayed wheat offal somewhat, as a product with a fair potential for use in the diet, even if it is to replace a portion of maize, which is used conventionally in the diet of chicken. Nuhu *et al*. (2008) reported that the FCR of birds fed on wheat offal diets were efficiently more utilized than those birds fed on maize offal-based diets. These workers concluded that 20% wheat offal inclusion in broiler diets is recommended to farmers. Despite the availability of various nutrients in these agro industrial byproducts, information on their utilization in the turkey diets is scanty, therefore, this study aimed at assessing the use of agro industrial byproducts in the diet of grower turkeys.

MATERIALS AND METHOD

Experimental site

This study was conducted at the Poultry Unit of the Teaching and Research Farm, Federal College of Wildlife Management (FCWM), New Bussa, Niger State, Nigeria. The poultry building is an open sided type that permits adequate ventilation in the house, with a concrete floor and zinc-roofing sheet. New Bussa sits at 9°53′N 4°31′E, and the original town of Bussa is located about 40 km North of New Bussa at 10°13′51″N 4°28′31″E (altitude 170 m.a.s.l.). The climate of the area is tropical with monthly average temperature of 34°C and mean annual relative humidity of 60%.

Sources of Experimental Materials

The agro industrial by-products used in this study were wheat offal, rice offal and maize offal which were purchased around Neighbouring market within New- Bussa and its catchment areas.

Experimental Design and Management of Birds

One hundred and twenty day old unsexed turkeys (Narraganset and bronze breed) were purchased from a reputable hatchery in Ibadan, Nigeria. The birds were raised on deep litter pen with wood shaving as litter material. They were fed on a common diet for the first four (4) weeks of life. Feed and water was supplied *ad-libitum.* Management practices and vaccination programme was followed strictly. At the end of the four (4) weeks, the grower turkeys (initial average weight = 330g) were randomly allocated to four experimental treatments of thirty birds per treatment, while each treatment was replicated three times (10birds per replicate) in a completely randomized design (CRD).

Experimental diets

Four experimental diets were formulated and designated as T1, T2, T3, and T4. T1(control diet) contained none of the agro industrial by products used while T2, T3 and T4 contained 15% each of Wheat offal (WO), Maize offal (MO), Rice offal (RO) respectively. The gross composition and proximate composition of the experimental diets arepresented on Table 1 and 2 respectively.

Table1. Gross Composition of Experimental Diets

Ingredients	T1 (control)	T2 (15% W.O)	T3 (15% M.O)	T4 (15% R.O)
Maize	52.00	46.00	46.00	46.00
Wheat offal	-	15.00	-	-
Maize offal	-	-	15.00	-
Rice offal	-	-	-	15.00
GNC	24.00	10.00	10.00	10.00
Fish meal	13.45	18.45	18.45	18.45
Palm oil	2.00	2.00	2.00	2.00
*Premix	0.40	0.40	0.40	0.40
Limestone	3.00	3.00	3.00	3.00
Bone meal	4.50	4.50	4.50	4.50
Salt	0.25	0.25	0.25	0.25
Methionine	0.30	0.30	0.30	0.30
Lysine	0.10	0.10	0.10	0.10
TOTAL	**100**	**100**	**100**	**100**
Calculated Nutrients				
Metabolizable energy (Kcal/Kg DM)	2999	2876	2784	2691
Crude Protein (%)	25.34	25.01	24.42	24.09
Crude fibre (%)	2.50	3.89	4.08	4.59
Ether Extract (%)	3.80	3.80	3.80	3.80
Calcium (%)	1.20	1.20	1.20	1.20
Methionine (%)	0.80	0.80	0.80	0.80
Lysine (%)	1.60	1.60	1.60	1.60

Wheat offal (WO), Maize offal (MO), Rice offal (RO)

*Composition of vitamin premix per kg is as follows: Vitamin A, 8000 iu; Vitamin D_3, 1600 iu; Vitamin E 5 iu, Vitamin K 0.200 mg; Vitamins B, Thiamine B_1 0.5mg; Riboflavin B_2 4mg; Pyridoxine B_6 0.015 mg; Niacin 0.015mg; B_{12} 0.01mg; Pantothenic acid 0.5mg; folic acid 0.5mg and Biotin 0.020 mg; Chlorine chloride 0.02 mg; Anti-oxidant 0.125g and Minerals (Mn, Zn, Fe, Cu, I, Si, Co) 0.156g.

Table 2. Proximate Composition of Experimental Diets

Nutrients %	Control	15% W.O	15% M.O	15% R.O
Dry Matter	92.93	93.48	94.51	93.68
Crude Protein	25.25	24.97	23.90	23.08
Crude fibre	3.78	4.01	4.56	5.02
Ash	5.68	6.71	6.98	7.28
Ether Extract	6.21	6.52	6.75	6.98
N F E	61.17	61.93	59.42	60.45

NFE-Nitrogen free extract

Performance data

The amount of feed given and left over was recorded on daily basis and it was used to calculate the feed intake. Before the commencement of the experiment, the initial weight of the birds were taken and the birds were weighed weekly thereafter to obtain weekly weight gain.Feed intake and weight recorded were used to calculate feed conversion ratio (FCR) using the formula below.

Feed conversion ratio (FCR) =feed intake/weight gain

Blood collection

At the end of the study period, 5ml of blood was collected from three birds per treatment through the wing vein and put into bottles containing Ethylene Diaminetetra- acetic Acid (EDTA) to determine the packed cell volume (PVC), red blood cell (RBC), haemoglobin (Hb), and white blood cell (WBC). Blood sample meant for serum biochemical studies were collected into plane bottles (without Anti-coagulant) to enhance serum separation. The blood serum obtained was used to determine total protein (TP), Albumin, Globulin,Glucose and Urea. All the analysis was done at the College Research Laboratory according to the methods described by Kohn and Allen (1995); Schalm *et al*. (1975) and Peters *et al.* (1982).

Carcass and Organs Weight determination

At the end of the study, two turkeys per replicate were selected at random and starved for about 12h to empty thecrops. They were then slaughtered, scalded, plucked and eviscerated. The carcass and internal organs (liver, heart, kidney, gizzard and intestines) were removed, weighed and expressed as a percentage of live weight.

Chemical analysis

Proximate composition of experimental diets was analysed using the methods described by AOAC (2000).

Statistical analysis

Data collected were subjected to analysis of Variance using SAS software (SAS 2008) while significant means were separated with Duncan multiple range test at 5% level of significance.

RESULTS

Table 3 shows the result of the growth performance of grower turkeys fed diets containing different agro industrial by-products. There were significant ($P<0.05$) differences in the daily weight gain, daily feed intake and feed conversion ratio of turkeys. Daily weight gain of turkeys fed 15% W.O was not different ($P>0.05$) from those fed the control diet. Turkeys fed 15% M.O and 15% R.O recorded the lowest daily weight gain ($P<0.05$). Average daily feed intake of turkeys fed control and 15% W.O diets were similar ($P>0.05$) and this was followed by birds fed 15% M.O diet.Birds fed 15% R.O diet recorded the lowest daily feed intake. Feed conversion ratio of turkeys fed control, 15% W.O and 15% M.O diets were not different ($P>0.05$). Turkeys fed 15% R.O recorded the highest value for feed conversion ratio. There were no differences ($P>0.05$) in feed cost per kg and feed cost per kg gain.

Table 4 shows the result of haematological parameters and serum biochemical indices of grower turkeys fed diets containing different agro industrial by-products. There were no differences ($P>0.05$) in the values obtained for haemoglobin, white blood cell and red blood cell across the treatment groups. Packed cell volume was however different ($P<0.05$). Birds fed control and 15% W.O diets recorded higher values for Packed Cell Volume than those fed 15% M.O and 15% R.O based diets. The results of serum biochemical indices show that there were no differences in all the parameters measured ($P>0.05$). The values obtained for Total Protein, Glucose, Albumin, Globulin and urea were not affected ($P>0.05$) by the dietary treatments.

Table 5 shows the results of carcass characteristics of grower turkeys fed diets containing different agro industrial by-products. There were differences ($P<0.05$) in all the parameters measured across the treatment groups. Turkeys fed 15% W.O diet were comparable with the turkeys fed the control diet in all the carcass parameters measured. Turkeys fed 15% M.O and 15% R.O diets performed poorly and were similar ($P>0.05$).

DISCUSSION

There have been wide variations in responses of Chickens to the use of Agro industrial byproducts in poultry diets. These were attributed to differences in quality, varieties, storage periods and climatic conditions to mention but a few. However, there are several literature reports on the inclusion levels of these unconventional, agro by-products in broiler diets without adverse effect on performance in Nigeria (Maikano, 2005; Duru, 2010).

Table 3. Growth Performance of grower Turkeys fed diets containing different agro industrial by-products

Parameters	Control	15% W.O	15% M.O	15% R.O	SEM
Initial weight, g/b	330.90	330.55	330.70	331.04	0.16
Final weight, g/b	1186.67[a]	1100.00[a]	786.67[b]	583.33[c]	22.29
Total weight gain, g/b	855.77[a]	769.45[a]	455.96[b]	252.30[c]	22.33
Average daily weight gain, g/b/d	20.38[a]	18.32[a]	10.86[b]	6.00[c]	4.79
Total feed intake, g/b	2990.00[a]	2750.70[a]	1555.50[b]	1084.0[c]	54.89
Average daily feed intake, g/b/d	71.19[a]	65.49[a]	37.04[b]	25.81[c]	10.13
Feed conversion ratio	3.53[a]	3.60[a]	3.49[a]	4.35[b]	0.27
Cost per kg feed, ₦/ kg	98.85	90.45	89.17	85.91	4.31
Cost per kg gain	178.52	182.41	185.34	188.12	3.20

SEM= Standard Error of Mean, abc means on the same row having different superscripts are significantly different ($p > 0.05$). WO=Wheat offal, MO=Maize offal, RO=Rice offal

Table 4. Haematological parameters and Serum biochemical indices grower Turkeys fed diets containing different agro industrial by-products

Parameters	Control	15% W.O	15% M.O	15% R.O	SEM
Packed cell volume, %	30.21[a]	31.66[a]	23.42[b]	24.30[b]	2.75
Haemoglobin, g/dl	8.97	10.55	8.81	8.77	0.93
White blood cell, X 10^6	44.60	48.25	49.24	50.68	3.86
Red blood cell, X 10^{12}	4.16	5.60	5.37	5.89	0.43
Glucose, g/dl	129.50	105.50	126.27	114.00	14.67
Albumin, g/dl	3.06	3.13	2.87	2.39	0.25
Globulin, g/dl	3.59	3.03	3.97	3.46	0.31
Urea, mg/dl	52.16	55.97	53.91	65.78	6.95
Total Protein, g/dl	6.64	6.33	6.84	6.85	0.12

abc = mean with different superscripts within the same row are significantly ($P<0.05$) different. SEM=standard error of mean. WO=Wheat offal, MO=Maize offal, RO=Rice offal

Table 5: Carcass Characteristics of grower Turkeys fed diets containing different agro industrial by-products

Parameters	Control	15% W.O	15% M.O	15% R.O	SEM
Liveweight, g	1376.67[a]	1450.00[a]	850.00[b]	826.67[b]	137.51
Dressedweight, g	1300.00[a]	1326.67[a]	750.00[b]	726.67[b]	150.56
Carcass weight, g	1167.47[a]	1116.02[a]	500.00[b]	470.47[b]	174.25
Dressingpercentage, %	69.10[a]	69.31[a]	51.05[b]	49.62[b]	4.87
Backweight, %	14.57[a]	14.12[a]	13.89[b]	11.88[b]	0.90
Thigh, %	12.17[a]	11.76[a]	9.22[b]	8.68[b]	1.16
Wing, %	13.05[a]	12.55[a]	9.04[b]	8.42[b]	1.15
Drumstick, %	10.44[a]	10.20[a]	8.29[b]	8.01[b]	0.61
Breast, %	18.20[a]	18.03[a]	16.64[b]	15.39[b]	0.94
Neck, %	9.46[a]	9.23[a]	7.06[b]	5.21[b]	1.06
Liver, %	27.15[a]	26.70[a]	18.67[b]	17.26[b]	2.47
Heart, %	7.05[a]	7.45[a]	4.55[b]	4.00[b]	0.86
Spleen, %	0.90[a]	1.10[a]	0.75[b]	0.67[b]	0.70
Gizzard, %	56.70[a]	54.66[a]	47.55[b]	34.40[b]	5.58
Intestine weight, %	11.10[a]	12.10[a]	5.88[b]	4.91[b]	1.55

abc = mean with different superscripts within the same row are significantly ($P<0.05$) different. SEM=standard error of mean. WO=Wheat offal, MO=Maize offal, RO=Rice offal

In this present study, the average daily weight gain, average daily feed intake and feed conversion ratio of turkeys fed the control and 15% W.O diets were similar indicating that grower turkeys at 5-12 weeks of age can utilize wheat offal up to 15% in their diets. Turkeys fed control and 15% W.O diets had higher feed intake than those fed 15% M.O and 15% R.O based diets. The improved weight gain and feed intake observed in 15% W.O based diet may be attributed to the low fiber content and other available nutrients in wheat offal compared with maize offal and rice offal based diets. Morrison (1975) had earlier reported that the protein content of wheat offal is of higher quality than that of maize and it has about 66.9% total digestible nutrients (TDN). The author reported that Wheat offal has 16.4% crude protein and 4.5% fat and usually does not contain more than 10% fibre (Morrison, 1975). Reduction in body weight of grower turkeys fed 15%M.O and 15% R.O diets may be attributed to depressed feed intake that led to low availability of nutrients needed for tissue, organ and body development (Ani and Okorie 2008). The depressed intake may be because of anti-nutrients present in maize offal and rice offal diets which cause irritation and burning of the throat (Sakai, 1979), thereby lowering the intake (Okon *et al*., 2007). Anti-nutritional factors such as trypsin inhibitors and tannins can cause decrease in voluntary feed intake, digestibility of protein and impair the absorption of nutrients in the ingesta thereby resulting in depressed weight gain (Esminger *et al*., 1996). Anti-nutrients interfere with nutrient utilization by forming complexes with the substrate at the site of digestion (Abeke *et al*., 2008). The high content of fibre present in the 15%M.O and 15% R.O diets could also be responsible for the poor performance of the turkeys fedthesediets. Kocher (2001) reported that rice offal is known to contain high level of fibre and low protein and energy and high dietary fibre depresses apparent digestibility of dry matter and nitrogen, decreases daily body weight and increase feed to gain ratio (Longe and Adekoya, 1988). The depressing effect on apparent digestibility has been found to be due to greater rate of passage. Abdelsamie *et al*.(1983) observed that growth and feed utilization decreased with increase in fibre contents in chickens' diet. The authors observed that feed utilization decreased with increasing dietary fibre content of the diet. The result of this study however contradicts the reports of Maikano (2005) who reported that broiler chickens can tolerate up to 20% dietarylevels of rice offal with no adverse effect on growthperformance.

The observation on haematological parameters and serum biochemical indices revealed that there were no differences ($P>0.05$) in the parameters measured except for PCV. The increase in the values of WBC across the treatment groups is an indication of health hazard. This could be due to infections, inflammatory conditions, stress condition or conditions induced by A.N.Fs content of the feed (Brij*et al*., 1977). Higher levels of White blood cell have been produced in farm animals in a bid to fight against the foreign bodies. Oduguwa (2006) reported that an elevated White blood cell showed that the birds were reacting to one or more dietary factors which in this study could be tannin, NSP and HCN residues present in the fibre sources used. White blood cell played protective roles and associated with the production of antibodies and recognition of foreign substance such as bacteria and viruses.

Turkeys fed 15% M.O and 15% R.O diets recorded lower values for PCV and Haemoglobin. Report had suggested that PCV is beneficial in assessing the protein status and possibly forecasting the degree of protein supplementation at different physiological states (Daramola *et al*., 2005). Keir *et al* (1982) reported that the reduced value of PCV is an indication of poor nutritional status and pointer to iron deficiency or nutritional anaemia. The poor nutritional value of maize offal and rice offal as compared to the control diet could be linked with the low PCV values obtained among turkeys fed 15% M.O and 15% R.O diets in this study. Also, reduced Haemoglobin values obtained among birds fed15% M.O and 15% R.O diets is a confirmation of the poor dietary protein quality. Udo (1987) reported that nutrition was the most important factor affecting haemoglobin levels of the blood. The range of 44.60 – 50.68 X 10^6 observed for WBC, 4.16 – 5.89 X 10^{12} for RBC, 23.42 – 31.66% for PCV and 8.07 – 10.55 g/dl for haemoglobin were within the ranges reported by Obadire *et al*. (2015) for grower turkeys fed diets containing malted sorghum sprouts supplemented with enzyme.All the parameters measured for serum biochemical indices were within the normal range reported by Elizabeth *et al*. (2010) and Obadire *et al*. (2015) for healthy domestic turkeys.

The similarity in the carcass parameters measured between the control and 15% W.O diets is a true reflection of the body weight performance indices and that of tissue development.This indicates that the nutrients supplied by these diets were adequate and produced comparable carcass parameters that were similar. The cut-up parts such as drumstick, thigh and wing weight (expressed as percentage of live weight) of the grower turkeys fed 15% W.O diet followed the performance pattern of the body weight development.The weight of different organs measured were ($P<0.05$) different across the treatment groups. The values of these organs indicate that there were metabolic differences in turkeys fed 15% M.O and 15% R.O diets. The lower weight of organs observed among turkeys fed15% M.O and

15% R.O diets could also be attributed to the pathological effect of residual of ANFs (tannin, phytin e.t.c) present in the maize offal and rice offal based diets. The lack of effect (P>0.05) in the values of spleen and other organs of grower turkeys fed the control and 15% W.O diets implies that wheat offal can be included in the diet of grower turkeys and the immunity of the birds against disease would not be compromised since spleen is the major source of lymphocytes and the storage site for white and red blood cells (Hetland and Svihus, 2001).

CONCLUSION

Based on the result of this study, it can be concluded that 15% wheat offal can be included in the diet of grower turkeys without adverse effect on growth performance, carcass yield and health status of birds.

Acknowledgement

The authors gratefully acknowledge Ogunwale Segun, Abdulahi Jimoh and Omotayo Oluwadamilola for their assistance in the collection of data pertaining to this study.

REFERENCES

A.O.A.C. 1990. Official Methods of Analysis.13th Ed. Association of Analytical Chemists, Washington DC.

Abeke, F.O., Ogundipe, S.O., Sekoni, A.A., Dafwang, I.I. and Adeyinka, I.A. 2008.Effect of dietary levels of cooked *Lablab purpureus* beans on the performance of broiler chickens. American Journal of Food Technology 3(1):42-49.

Abdelsamie, R.E., Ranawere, K.N.P. and Nano, W.E. 1983. The influence of fibre content and physical texture of the diet on the performance of broilers in the tropics. British Poultry Science 24:383-39.

Adene, D.F. and Oguntade, A.E. 2006. The Structure and Importance of the Commercial and Village based Poultry industry in Nigeria. FAO (Rome) Italy, pp 22 – 28.

Aduku, A.O. 1993. Tropical Feedstuffs Analysis Table. Department of Animal Science. Faculty of Agriculture, Ahmadu Bello University, Zaria. Pp. 196.

Ajaja, K., Agbede, J.O. and Aletor, V.A. 2002. Replacement Value of Sorghum Dust for Maize in Diets for Broiler Chicks.Proc., 27th Annual Conference of the Nigeria Society for Animal Production. March 17 – 21, Federal University of Technology, Akure, pp: 109 – 112.

Ani, A.O. and Okorie, A.U. 2008. Carcass and organ characteristics of Broiler finisher fed diets containing graded levels of processed castor oil bean (*Ricinus communis L*) meal and supplementary DL-methionine. Proceedings 33rd Annual Conference Nigerian Society Animal Production. Ayetoro, March pp:378-381.

ArunaTomar, S. and Singh, K.S. 1999. Femur bone mineralization of chicken fed rice offal based diets. Indian Journal Poultry Science, 34 (3): 332- 336.

Babatunde, B.B. and Oluyemi, A. 2002. Comparative digestibility of three commonly used in fibrous ingredient in maize - soya bean meal – fish meal diet by broiler chicks. Tropical Journal Animal Science, 3 (1): 33- 43.

Brij, M.A., Howard, M.R. and Bhuran, V.V. 1977. Clinical, biochemical and haematological values in normal experimental animals. Massan publishing co. U.S.A. Fr Gef. lugelkunde 54:34-37.

Chae, B.J., Lee, K.H., Lee, S.K. 2002. Effect of feeding rancid rice offal on growth performance and chicken meat quality on broiler chicks. Asian-Australasian Journal Animal Science, 15 (2): 266 – 273.

Daramola, J.O., Adeloye, A.A., Fatoba, T.A. and Soladoye, A.O. 2005. Haematological and biochemical parameters of West African Dwarf goats. Livestock Research for Rural Development, *17*(8): 95. Retrieved January 22, 2014, from http://www.lrrd.org/lrrd17/8/dara17095.htm.

Doki, T. 2007. Benue Gives Land to NNPC. In: Saturday Independent, January 27, Tunde Abatan (ed). 1(86): 44.

Duru. S. 2010. Evaluation of three types of rice offal in broiler diets Ph.D Thesis. Department of Animal Science, Ahmadu Bello University, Zaria. Nigeria.

Elizabeth, M.S., Antonio, C.P., Ivan, M.L., Gislaine, R.V.M., Leonildo, N.J. and Alan, P.T. 2010. Serum biochemical parameters of female bronze turkeys (*Meleagris gallopavo*) during Egg-laying season. Int'l Journal of Poultry Science 9(2): 177-179.

Ensminger, M.E., Oldfield, J.E. and Heinemam, W.N. 1996. Feed and Nutrition. The Ensminger publishing Coy, Clovis, USA.

Hetland, H. and Svihus, B. 2001. Effect of oat hulls on the performance, gut capacity and feed passage time in broiler chickens. British Poultry Science Journal 60: 63-69.

Keir,G.R., Lar, M.K., Horium, R.J. and Ranola, E.E. 1982. Relationship between dietary and biochemical measures of nutritional status. American Journal of Clinical Nutrition. 35: 294-308.

Kohn, R. A. and Allen, M. S. 1995. Enrichment of proteolytic activity relative to nitrogen in

preparations from the rumen for in vitro studies. Animal Feed Science Technology, 52:1-14.

Kocher, A. 2001. Enzymatic degradation of non-starch polysaccharides in vegetable proteins in poultry diets. Recent Advances in Animal Nutrition in Australia, 13:163-168.

Leplaideur, M. 2004. Poultry farming – A disease called competition. In: SPORE Magazine, 114: 4 – 5.

Maikano, A. 2005. Effects of graded levels of rice offal in broiler diets M.Sc. Thesis, Department Animal Science, Ahmadu Bello University, Zaria. Nigeria.

Makinde, O.J., Enyigwe, P.C., Babajide, S.E., Atsumbe, J.A., Ibe, E.A. and Samuel, I. 2014. Growth performance and carcass characteristics of finisher broilers fed rice offal based diets supplemented with exogenous enzyme. Greener Journal of Agricultural Sciences 4 (4): 144-149.

Morgan, D.1991. African Farming and Food Processing, March/April, 1991.

Morrison, F.B. 1975. Feeds and feeding.9th (ed.) Morrison publishing company.Vail-Ballou press.Inc. Binghamton, New York, USA. Pp: 290-293.

Nuhu, B., Abba, A. and Amina, L. 2008. The profitability of broiler chickens raised on graded levels of maize offal and wheat offal-based diets. Proceedings of the 13th Annual Conference of the Annual Science Association of Nigeria (ASAN), 15th-19th Sept., 2008, ABU, Zaria, Nigeria Pp: 298-302.

Obadire, F.O., Oso, A.O., Osofowora, A.O., Oduguwa, O.O., Adeyemi, A.O., Jegede, A.V. and Olurunsola, R.A. 2015. Blood chemistry and carcass characteristics of growing turkeys fed diets containing malted gorghum sprouts supplemented enzyme and yeast. Nigeria Poultry Science Journal. 11:88-98.

Oduguwa, O.O. 2006. Utilization of whole pods of *Albiziasaman* in diets of growing rabbits. Nigerian Journal of Animal Production. 33(2): 197-202.

Okon, B.I., Obi, M.B. and Ayuk, A.A. 2007. Performance of quails (*Coturnix coturnix japonica*) fed graded levels of broiled sun-dried taro cocoyam (*Colocasia esculenta*) as a replacement to maize. Agricultural Journal 2(6) 654-657.

Oluyemi, J.A. and Roberts. R.A. 2000. Poultry Production in Warm Wet Climates. Macmillian Press, London. 2nd Edition, p. 692.

Onifade, A.A. and Babatunde, G.M. 1998. Comparison of the utilization of palm kernel meal, brewers dried grains and maize offal by broiler chicks. British Poultry Science. 39:245-250.

Peters, T., Biomont, C. T. and Doumas, B. T. 1982. Protein in serum, urine and cerebrospinal fluid, albumin in serum: In selected methods of clinical chemistry, W.R. Faulkner and S. Meites (eds.) Washington D.C. American Association of Clinical Chemist, Vol 9.

SAS.2008. User's guide: Statistics. Version 12.0. SAS Institute, Inc. Cary. NC, USA. 2008.

Sakai, W.S. 1979. Arid Root Crops, Acridity and Raphids. In: Inglett, G.E. and charalampous, G. (Eds) Trop. Foods chain and Nutrition, New York, Academic Press 1:265.278.

Schalm, O.W., Jain, N.C. and Carrol, E.J. 1975. Veterinary haematology 3rd Edn. Lea and Fabinger, Philadelphia.

Uchegbu, M.C., Etuk, E.B., Okpala, C.P., Okoli, I.C. and Opara, M.N. 2004. Effect of Replacing Maize with Cassava Root Meal and Maize/Sorghum Brewers Dried Grains on the Performance of Starter Broilers. Proceedings of the 9th Annual Conference of Animal Science Association of Nigeria. Sept. 13–16, 2004, Ebonyi State University, Abakiliki, pp. 49 – 51.

Udo, H. 1987. Effect of Cassava peel supplementation in swine ration on performance, haematology and serum metabolites in growing pigs. M.Sc. Thesis submitted to the Department of Animal Sci., University of Ibadan. Pp.112.

Submitted July 13, 2015 - Accepted November 26, 2015