GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY OF GROWING RABBITS (*ORYCTOLAGUS CUNICULUS*) FED WITH MIXTURES OF BREWERS DRIED GRAINS AND SORGHUM BREWERS DRIED GRAINS DIETS

Hadiza, Ibrahim[1]

[1]Department of Animal Production, Faculty of Agriculture, Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria
ihadiza080@gmail.com

ABSTRACT
Seventy five weaned rabbits aged between 5 and 6 weeks and of mixed breeds and sexes, with average initial weights of 450 g were used to investigate the growth performance and nutrient digestibility of rabbits. Oryctolagus cuniculus fed diets containing mixtures of brewers dried grains and sorghum brewers dried grains. The rabbits were allotted into five dietary treatments; T_1 (0 % as the control diet), T_2, T_3, T_4 and T_5 (containing 10, 20, 30 and 40% brewers dried grains) of three (3) replicates with five (5) rabbits per replicate in a completely randomized design. Data were collected on body weight gain, feed intake, feed conversion ratio (growth performance parameters) and nutrient digestibility, the trial lasted twenty weeks. Data generated from the study were subjected to analysis of variance (ANOVA). The variations in means were separated using the Duncan Multiple Range. (Duncan, 1955). The initial weight, final weight, total weight, feed conversion ratio and daily weight gain were not significantly ($P>0.05$) affected by the dietary treatments except initial weight and total forage intake that were significantly affected, also the result nutrient digestibility showed that there were significant ($P<0.05$) differences in all the treatment groups. Despite the non significant differences observed on the growth performance parameters, mixtures of brewers dried grains and locally produced brewers dried grains inclusion at 40 % (T5) gave the highest and best values of (1079.92 g and 7.73g) final weight gain and feed conversion ratio and could be recommended as the best inclusion level for growing rabbits.
Key words: *brewers dried grain, growing rabbit, growth, nutrient digestibility*

Received: 22.11.2018 Reviewed: 18.03.2019 Accepted: 19.03.2019

INTRODUCTION

The rapid increase in the population of the world has resulted in a huge increase in the demand for animal protein which is essentially higher in quality than that of plant protein. The average protein intake in Nigeria is about 5.5g of animal protein per day which is low and far below Food and Agriculture Organization of the United Nations (FAO) recommendation of 77 g of animal protein per day (FAO, 2006). The nutritional requirement is particularly crucial in a developing country such as Nigeria where malnutrition and starvation are the major problems faced by millions of rural dwellers. The low protein intake is an indication of shortage of high quality protein food in the diet of Nigerians per day. Meat consumption has been estimated to be 1.6 metric tonnes (Tabor, 1990). Odunsi (2003) reported that the rapid growth of human and livestock population is creating an increase in the needs for food and feed in less developed countries. The author suggested that alternative feed resources must be identified and evaluated in order to meet this need.

In recent times, nutritionists have highlighted the important role of animal protein in human health, particularly during pregnancy and early life and subsequent development of children. Maternal protein intake throughout pregnancy is related to birth size, and therefore future viability of children. Where protein under-nutrition occurs, dietary protein from any source is important in human development; but increased intake of meat protein appears superior for future development (Waterlow, 1998). Sources of dietary protein, in particular have had a greater effect on prenatal development and size of the new-born child (Moore, 2002).

Rabbit is a good source of meat, which is of high quality with low cholesterol and therefore

suitable for special diets. It has the advantage of being able to consume fibrous feedstuffs that are not utilized by humans because of the presence of their large caecum (Aduku and Olukosi, 1990). Meat from rabbit of any age has been reported to be highly appreciated for human consumption, tender, of high culinary (cooking) yield and above all a source of healthy food as it is good in coronary heart patients (Nodu *et al.*, 2003; Hernandez, 2004). Rabbit is required in a large number for medical and cosmetic industries (Dalle Zotte, 2002). Additional income on a sustainable basis can be generated from rabbits (Taiwo *et al*., 2005) It is also ideal in meeting the protein need of the developing countries because according to International Federation for Science –IFS (1978), rabbits are prolific and have relatively low incidence of epidemic diseases when careful management is practised with standard hygiene. Increased rabbit production is one way of meeting the animal protein requirement of the Nigeria populace (Iyeghe- Erakpotobor *et al.*, 2002).

Industrialization has left us with lots of waste materials in both urban and rural areas among which are grain wastes such as Brewers Dried Grain and locally produced Brewers Dried Grain. These wastes result after the removal of the grains or seeds; which are either thrown away, burnt in air, or left to litter our environment, causing pollution.

In this research work, mixtures of Brewers dried grains (BDG) industrially sourced from barley, and Sorghum brewers dried grains (SBDG) locally sourced from red sorghum at 50:50 were used to evaluate the performance of rabbits in the humid tropics of Nigeria with the of aim of educating the farmers, individual organizations and government agents concern with the animal feed formulation.

MATERIALS AND METHODS

Location of experimental site

The research was conducted at the Teaching and Research Farm of the Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State, Nigeria. Minna is situated between latitude 9^{o} 31 and longitude 9^{0} 45North, and Longitude 6^{0}31 and 6^{0}45 East of the equator. The area falls within the Southern guinea savannah vegetation zone of Nigeria with mean annual rainfall of between 1100 and 1600 mm and a mean temperature of 30^{0}C. The relative humidity is between 21 to 73 %. Minna experiences two distinct seasons (dry from November to March and wet or rainy season, from April to October). The soil is full of ferruginous substances and gneiss and magnetic rocks. The town is situated on a large gentle depression with undulating hill and uplands flanking the north east side of the town.

Sources of test ingredients, experimental animals and their management

The rabbits were obtained at Ministry of Livestock and Fisheries Minna, Niger state. Brewers Dried Grains from brewery industry at Aba and locally produced brewers dried grains at Anguwan Kaje , Minna, Niger State. while maize grain, groundnut cake, vitamin/ mineral premix, salt and bone meal were bought from Kure ultra modern market Minna, Niger state.

Seventy five (75) weaned rabbits of mixed breeds and sexes (forty-five females and thirty males), age between five and six weeks were randomly allotted to five treatments groups. Each treatment had three replicates with five rabbits each (two males and three females) The rabbits were housed intensively in a well constructed hutches that were made of wire and woods with trays to collect the faeces as well as for easy cleaning of the hutches. The hutches were equipped with feeders and drinkers. The hutches were cleaned twice daily throughout the study period of 20 weeks. After one week of adjustment period the rabbits on all the treatments were kept under closed observations for proper monitoring indication of ill-health. They were dewormed against endoparasite using ivermecin and Coccidiosis was treated once using sulphadimidine and multivitamin soluble powder (Vitalyte) were given as an anti-stress and these were bought from step by step animal feeds and veterinary drugs store Minna, Niger state.

Experimental Diets

The diets formulated were designated as T1 – T5 and had the test ingredients , mixtures of brewers dried grain and locally produced brewers dried grain were incorporated into the diets at the level of 0, 10, 20, 30 and 40 % inclusion for the experiments. The feed ingredients in the formulated diets consisted of maize, groundnut cake, bone meal, salt and vitamin/mineral (premix). All the feed ingredients were grounded in an Hammer mill, mixed and pelleted before being fed to the rabbits. The diets were supplemented with 100 g of *Amaranthus hybridus* as a source of forage in the evenings. The diets were formulated to give 20 % crude protein needed for rabbits growth. Prior to the start of the experiment, the animals were fed normal diet and allowed an adjustment period of one week to enable the animals get acclimatized to their cages and diets. The diets and fresh water were provided *ad-libitum* throughout the duration.

Proximate Analysis

Chemical composition of the BDG and SBDG and the compounded experimental diets were determined using the AOAC (2002) method. The parameters determined were dry matter, crude protein, crude fibre, ash content and nitrogen free extract.

Data Collection

Data on growth (initial growth, final weight, daily weight gain, total concentrate intake, total feed intake, feed conversion ratio) were collected over a period of twenty (20) weeks using a Camry weighing scale for weekly weighing of the animals. Feed intake was determined on daily basis by weighing the feed offered to the animals and the quantity of feed left unconsumed by the following morning. The difference in weight between the two gave the quantity of feed consumed per day. Mean daily weight gain and feed conversion ratio were determined as:

Total feed intake (g) = Total quantity of feed served (g) – Total quantity of left over (g)

Weight gain (g) = Final body weight at twenty weeks (g) – Initial body weight at first week (g)

$$\text{Feed conversion ratio} = \frac{\text{Total feed intake (g)}}{\text{Total weight gain (g)}}$$

TABLE 1: Composition of the experimental diets containing mixture of BDG and SBDG (%) (50:50)

Ingredients (%)	**T1**	**T2**	**T3**	**T4**	**T5**
	0	**10**	**20**	**30**	**40**
Maize	57.00	51.00	45.00	38.00	32.00
Brewers dried grains	0.00	5.00	10.00	15.00	20.00
Sorghum BDG	0.00	5.00	10.00	15.00	20.00
Groundnut cake	38.00	34.00	30.00	27.00	23.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Salt	0.50	0.50	0.50	0.50	0.50
Premix*	2.00	2.00	2.00	2.00	2.00
Total	100	100	100	100	100
Calculated values					
ME Kcal/kg	2618.78	2562.84	2586.90	2541.22	2485.98
Crude Protein (%)	20.20	20.68	21.13	21.36	21.59
Crude fiber (%)	12.95	13.84	14.77	15.17	15.42
Ether extract (%)	5.76	5.89	6.03	6.21	6.35
Ash (%)	2.83	3.01	3.20	3.42	3.61
Calcium (%)	0.09	0.11	0.13	0.15	0.18
Phosphorus (%)	0.40	0.44	0.49	0.53	0.58
Lysine (%)	0.81	0.81	0.82	0.83	0.84
Methioniine (%)	0.30	0.32	0.34	0.38	0.41

*Provided per kilogram of diet: vitamin A, 10000IU (retinyl acetate); cholecalciferol, 3000IU; vitamin E, 8.0IU (DL-a-tocopheryl acetate); K, 2.0mg; thiamine, 2.0mg; pyridoxine, 1.2mg; cyanocobalamin, 0.12mg; niacin, 1.0mg; pantothenic acid, 7.0mg; folic acid, 0.6mg; choline chloride, 500mg; Fe, 60mg; Cu, 8.0mg; Zn, 50mg; Co 0.45mg; I, zzz2.0mg; Se, 0.1mg. 0.00 % = TRT1 (control); 10.00 % = TRT; 20.00 % = TRT; 30.00 % = TRT; 40.00 % = TRT5 BDG. ME= Metabolisable energy BDG =Brewers dried grains; SBDG = Sorghum brewers dried grains

Nutrient Digestibility Trial

Two rabbits (one buck and one doe) were selected from each replicate group between 19th and 20th weeks of the feeding trial for digestibility studies. Total collection method was used, following the procedures of Lamidi *et al.*, (2008). Daily faeces were collected for each replicate separately for a duration of seven (7) days. This was possible with the aid of a collector constructed with a net and planks attached to the bottom of each cage. Total collections for each replicate were bulked, oven dried overnight at 80^0 C, grounded and kept in air tight sample bottles. About 2 g of sub samples were used for carried proximate analysis as recommended by (AOAC, 2002). The outcomes were used in determining the apparent digestibility coefficient of the feed by the rabbits. This was calculated using the following formula:

$$\text{Apparent Digestible Nutrient} = \frac{\text{Nutrient in feed consumed - Nutrient in droppings voided}}{\text{Nutrient in feed consumed}} \text{ X } 100$$

Source**:** Iyeghe – Erakpotobor *et al.* (2005)

Total digestible nutrient (TDN) is a measure of energy, roughly comparable to digestible energy (DE), but expressed in units of weight or percent. This was also calculated using the formula given by Church and Pond (1988) as expressed below

TDN = Digestible crude protein + Digestible NFE +2.25 x Digestible either extract.

According to them, when converting TDN to DE, the formula normally used is:

DE (in Kcal /kg) =44.0 x TDN.

Data Analysis

Data generated from the study were subjected to analysis of variance (ANOVA) using statistical package (SAS, 2002). The variations in means were separated using the Duncans Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The results of proximate composition of BDG and SBDG mixture diets are presented in Table 1. Crude protein determined ranged between 19.21 and 22.75 % in (T1 and T5). Crude fibre content was highest in T5 (18.10 %), followed by T2 and T4 with 17.8% each, T1 (17.60 %) and the least value was recorded in T3 (17.40 %). Ether extract increased with increasing levels of the mixture based diet with a range of 7.02 % (T2) to 7.90 % (T5). Highest value of 13.94 % was recorded in T5, followed by T4 (10.26 %), T2 (9.87 %), T3 (8.37 %) and the lowest was in T1 (5.19 %) in ash content of the sample. metabolisable energy content of the samples ranged between 2621.00 to 2518.00 kcal/kg in T1 and T5 respectively.

The proximate composition of the experimental diets showed their sufficiency to meet the nutrient needed for growing rabbits. (Table 1) This agrees with the recommended values of (Nworgu *et al.*, 2000). The Crude Protein level in the diets was in the range of 19.21- 22 75 %. However, Fasanya and Ijaiya (1997) recommended range of between 16-20 % of CP levels for better performance of growing rabbits and Ugwubuike *et al.* (2013) recorded lower value of 19.77 % when growing rabbits were fed two varieties of sorghum as replacement for maize as energy source in tropical environment. The Crude fibre levels of the diets were between 17.40 – 18.10 %. The values increased with increase in the levels of inclusion of mixture in the diets. This was however; higher than the value of 10-16 % recommended John-Delaney (2006). The energy levels of the diet ranged between 2518.00 – 2621.00 (T1 - T5) respectively and were within the range of 2500 -2800 Kcal metabolisable energy level reported by Aduku and Olukosi (1990) and (Aduku 2004) for growing rabbits in tropical environment.

The results of growth performance of rabbits fed diet containing BDG and SBDG mixture meal are presented in Table 2. The result showed that most of the parameters determined (initial weight, final weight, total weight gain, daily weight gain, total concentrate intake, total feed intake, weekly feed intake and feed conversion ratio) were not significantly ($p>0.05$) affected by the test ingredients in all the treatment groups except the initial weight

Table 2: Proximate composition and energy contents of the mixture diets of BDG and SBDG meal

	Levels of the mixture meal (%)				
Composition	**T1**	**T2**	**T3**	**T4**	**T5**
	0	**10**	**20**	**30**	**40**
Dry matter	93.99	87.42	94.12	94.51	93.93
Crude Protein (%)	19.21	20.75	20.75	20.87	22.75
Crude fiber (%)	17.60	17.80	17.40	17.80	18.10
Ether extract (%)	7.37	7.02	7.48	7.69	7.90
Ash (%)	5.19	9.87	8.37	10.26	13.94
Nitrogen free extract	44.62	31.98	40.12	37.89	31.24
ME Kcal/kg	2621.00	2638.00	2572.00	2583.10	2518.00

and forage intake that were significantly different significantly ($p>0.05$).

The growth performance parameters revealed also that final body weight, total weight gain, daily weight gain, total concentrate intake, total forage intake, total feed intake, daily feed intake and feed conversion ratio were not significantly ($p>0.05$) affected by the test ingredient (mixture meal) (Table 2) final body weight gain (1819.67 - 1979.92 g) obtained in this trial were within the values (1805 – 2040 g) obtained by Abubakar *et al*. (2006) and higher than 1160.00 – 1470.70 g rec0rded by Ugwuibuike *et al.* (2013) when rabbits were fed two varieties of sorghum as replacement for maize as energy source in tropical environments. These differences could be probably be due to breeds, diets and duration of the research may be among other factors responsible for the differences in the inital weights. The daily weight gain (g) obtained in this study 9.78 - 10.93 g were also within 8.86-15.54 g recorded by (Uguibuike, 2013) and far lower than (22.37- 25.72 g) and (10 – 20 g) obtained by Abubakar *el al*. (2006) and Cheeke (1987) for rabbits reared in tropical countries. These variations could be attributed to effect of high ambient temperature about 34^0c on feed intake at the time of the study. Lower value of weight gain was recorded in control diet (1369.67g) and higher value in T5 (1369.67 and 1521.75 g). This result contradicts the finding of Abubakar *et al.* (2006) who recorded a significant higher weight gain when rabbits were fed diets containing malted sorghum than those fed unmalted sorghum diets. Despite the non significant difference observed, Olorunnismo *et al. (*2002) concluded that sorghum brewers dried grains stimulate better weight gain when the auth0rs fed weaner rabbit's sorghum brewers dried grains diets. Feed intake recorded a similar result from T1- T4 (11826.67 g) and lowest value in T5 (11758.00 g). This result does not agreed with the report of Adeniji and Ehiemere (2003) who fed rabbits with sorghum offal at 33. 66 and 100 % levels of inclusion and recorded a significant difference. The variation in fed intake might be due to tannin content in the diet that was high. Despite the non significant effects recorded, feed conversion ratio, values obtained were in all the treatment groups. Higher (poor) values were recorded in T1 (control) (8.64) and lowest (better) in T5 (7.73). The values were higher than 4.93 - 7.96 and 3.6 - 6.00 reported by Igwebuike (2004) and Mufwa *et al*. (2011). This could be an indication that mixture diets have better feed conversion ratio.

The results of the nutrient digestibility of rabbits fed diets containing varying levels of BDG and SBDG mixture meals are presented in Table 3. The parameters measured were all significantly affected in all the treatment groups. Crude protein was within the range of 54.94 % to 62.62 % (T1 to T2) digestibility. Crude fibre had a higher digestibility in T2 and lowest in T5 (74.07 % and (48.18 %).Ether extract had digestibility values ranged between 48.66 % to 61.44 % (T3 and T4). Also highest value for ash was recorded in T1 (28.29 %) and the lowest in T5 (12.12 %) and all significantly ($p<0.05$) different in all the treatment groups.

Table 3: Effects of different dietary inclusion of mixtures meal of industrially produced brewers dried grains and locally produced sorghum brewers dried grains on growth performance of rabbits (*Oryctolagus cuniculus)* 0-20 weeks

	Levels of the mixture meal (%)								
Parameters	**T1 0**	**T2 10**	**T3 20**	**T4 30**	**T5 40**	**SEM**	**CV**	**LS**	**P Value**
Initial weight (g)	450.00	445.80	451.70	453.11	458.17	0.06	2.81	*	0.00
Final weight (g)	1819.67	1851.67	1964.00	1919.60	1979.92	542.4	4.89	NS	0.38
Total weight gain (g)	1369.67	1405.87	1512.30	1469.49	1521.75	31.13	3.56	NS	0.49
Daily weight gain (g)	9.78	10.04	10.80	10.47	10.87	0.23	5.06	NS	0.37
Total conc. Intake (g)	10426.67	10427.33	10426.00	10426.67	10358.00	59.83	0.99	NS	0.89
Total forage intake (g)	1400.00	1400.00	1400.00	1400.00	1400.00	0.00	0.00	*	0.00
Total feed intake (g)	11826.67	11827.33	11826.00	11826.67	11758.00	59.83	0.88	NS	0.89
Daily feed intake (g)	84.48	84.48	84.47	84.48	83.99	0.52	1.06	NS	0.85
Feed conversion ratio	8.64	8.41	7.82	8.07	7.73	0.31	5.02	NS	0.29

SEM = Standard Error Mean CV = Coefficient of Variation LS = Level of Significance NS = Not Significant

Table 4: Effects of different dietary inclusion levels of the mixture meal of BDG and SBDG on nutrient digestibility of rabbits (*Oryctolagus cuniculus)*

	Levels of the mixture meal (%)								
Parameters	**T1 0**	**T2 10**	**T3 20**	**T4 30**	**T5 40**	**SEM**	**CV**	**LS**	**P Value**
Dry matter (%)	69.75^{a}	70.35^{a}	67.16^{ab}	64.77^{c}	68.34^{ab}	0.73	1.85	*	<.00
Crude Protein (%)	54.94^{c}	62.62^{a}	55.58^{c}	56.14^{c}	59.43^{b}	0.95	2.85	*	<.00
Crude fiber (%)	63.28^{b}	74.07^{a}	57.13^{c}	54.43^{c}	48.18^{d}	0.99	2.91	*	<.00
Ether extract (%)	54.46^{c}	50.36^{d}	48.66^{d}	61.44^{a}	57.69^{b}	0.95	3.03	*	<.00
Ash (%)	28.29^{a}	16.19^{b}	16.74^{b}	16.90^{b}	12.12^{b}	1.74	16.72	*	0.00
Nitrogen free extract	79.40^{b}	78.08^{b}	83.43^{a}	82.35^{a}	74.66^{c}	0.45	0.99	*	<.00
Total digestible nutrient (TDN)	55.60^{c}	64.27^{b}	64.82^{b}	67.74^{a}	67.73^{a}	1.21	15.50	*	0.00

^{abcd}Means with the same superscript (s) in the same row are not significantly (P>0.05) different
SEM = Standard Error Mean CV = Coefficient of Variation LS = Level of Significance
* = Significant

The nutrient digestibility values obtained were significantly different in all the treatment groups (Table 3). The range of Crude Protein digestibility in this study (54.94- 62.62 %) were lower than (69.28 – 84.47 %) and (64.88 – 65.35) recorded by Igwebuike *et a*l. (2013) Crude Protein digestibility result further showed that rabbit fed 10 % (T2) recorded higher value (62.62%). This may be linked to better feed conversion ratio in the diets. The result of Crude fiber obtained (48.18 % - 64.07%) from this study were within the range of 37.44 to 68.15 % reported by Igwebuike *et al.* (2013), Igwebuike *et al.* (1998) and Jegede (2008). Ether extract digestibility also showed significant difference among the treatment groups. Diet 5 (40 % inclusion level) produced a significant higher value 61.44 % than other treatments. The result fall within the range of 48.66 to 61.44 % and were below the value of 57.97 to 74.81 % and 65.63 to 85.41 % reported by Igwebuike *et al.* (1998) and Adama *et al.* (2007) when broilers were fed diets containing varying levels of sorghum brewers dried grains and (78.81 to 80.19 %) reported by Murin *et al.* (2002). Ash digestibility values recorded in this trial were in the range (16.19 – 18.29 %) lower than

(58.47 to 60.88 %) and 11.70 to 35.60 % reported by Igwebuike *et al.* (2013) and Uko *et al.* (1999) when rabbits were fed cereal by-products as energy source. The variation could probably be attributed to higher dry matter digestibility as reported by Murin *et al.* (2002) in their trial. Total digestible nutrient of the diet was in the range of 55.60 – 67.74 and treatment four and five recorded similar highest values of digestible nutrient of 70.17 % each.

CONCLUSION

The findings of this study revealed that

Feeding rabbits with mixtures of industrially produced brewers dried grains and locally produced sorghum brewers-dried at varying levels of inclusion (0, 10, 20, 30 and 40 %), the growth performance parameters were all not significantly affected. However, initial weight gain and forage intake were higher at 40 % inclusion level mixtures of BDG based diet and SBDG based diets were at treatment five (40%) inclusion level. Nutrient digestibility of mixture meal of BDG and SBDG inclusion in the diet were significantly ($P<0.05$) different in all the treatment groups. However, Total digestible nutrient was higher at treatments four and five with values of 67.73 % each.

RECOMMENDATIONS

i. Based on the conclusions drawn from this study, it is recommended that mixture meal can be included in the diet of weaner rabbits up to 40 % level of inclusion replacing maize and ground nut cake for optimum growth performance, nutrient digestibility and economy of feed production.

ii. It is my opinion and hope that livestock farmers should be avail of this result/information so as to reduce the cost production and maximize profit.

Animal Rights

I declare that the experiments on animals were conducted in accordance with in force laws and regulations as regards care and use of laboratory animals.

I declare that the principles of ethics in research on animals were fully fulfilled.

REFERENCES

[1]. Abubakar, M., Doma, U.D., Kalla, D. J. U, Ngele, M. B. & Augustine, C. L. D. (2006). Effects of dietary replacement of maize with malted and unmalted soghum on performance of weaned rabbits, *Livestock Resource Rural Development.* 18(5). Article 65 Retrieved November 28. http/www.cipav.org.co/irrd18/5/abub18065.htm.

[2]. Adama, T.Z., Ogunbajo, S.A. & Mambo, M. (2007). Feed Intake, Growth Performance and Nutrient Digestibility of Broiler Chicks Fed Diets Containing Varying Levels of Sorghum Dried Brewers' Grains. *International Journal of Poultry Science*, 6(8): 592-595

[3]. Adeniji, A. A. & Ehinmidu, O.M.(2003). Effect of feeding pullet chicks, cotton seed cake with or without fishmeal supplementation. *International Journal of Poultry Science* 6(11);818-827, 2007 ISSN 1682-8356. Asia Network for scientific info, 2007.

[4]. Aduku, A. O. & Olukosi, J.O. (1990). *Rabbit Management in the Tropics. Living Book Series.* First Edition. GV Publications. Abuja. FCT, Nigeria.

[5]. AOAC (2002). Association of Official Analytical Chemicals. Association of Analytical Chemist. Oxford methods of analysis, 13th edition, Washington Royal, UK: CAB Editors.

[6]. Cheeke, P. R. (1987). Rabbit feeding and nutrition. *Academic press*, Washington D.C., USA.

[7]. Church, J. F. C. W. Young, J. I. Kellsayo & Kin,W.W. (1988). Relationship among dietary constituents and specific serum clinical components of subject eating self selected diets. *Animal Journal of clinical Nutrition.* 40: 1338-1344

[8]. Dalle Zotte, A. (2002). Main factors influencing the rabbit carcass and meat quality. *In Proceeding of the 7th World Rabbit Congress* (pp. 1-32). Valencia, Spain.

[9]. Duncan, D. B. (1955). New Duncan Multiple Range and Multiple F- test. *Biometrics* 11:1-42.

[10]. Fasanya, O. O. A. & Ijaiya, A. A. (1997). Effect of graded levels of dietary protein on growth and carcass characteristics of rabbits. *Paper presented at the 33rd Conference of the Agricultural Society of Nigeria* (ASN). NCRI, Baddegi, Nigeria.

[11]. Food and Agricultural Organization (F.A.O), (2006). *Conference on protein from Animal Sources*, Rome Production Year Book. 1982.

[12]. IFS. (1978). International Federation for Science *Workshop on rabbit husbandry in Africa.* Monogor-Tanzania. December. 16-21, 20 pp.

[13]. Igwebuike, J. O, Alade N. K. & Anyi, H. D. (1998). Effects of feeding graded levels of sorghum waste on the performance and organ weight of

growing rabbits E. *African Journal of Agriculture* 60(40);193-200.

[14]. Igwebuike, J. U, Medugu, C. I, Kwari, I. D. & Dauda, A. (2013). Growth performance and nutrient digestiblilty of growing rabbits fed two varieties of sorghum as replacement for maize as energy source in tropical environment. *Global Journal of Bio-science and biotechnology,* Volume 2 (2) pp 167-172.

[15]. Iyeghe, Erakpotobor G.T, Ndolym Oyedipe, E. O. Eduvie L. O., & Ogwu, D. (2002). Effect of Protein Flushing on Reproduction Performance of Multifarious doe *Tropical Jounal Animal Science*, 5(1): 123-129.

[16]. Jegede, A. Y., Fafiolu, A. O., Faalaye., O. J. & Oduguwa, O. O, (2008) Utilisation of diet containing sorghum malted sprout by growing rabbits. *ASET Industrial Journal* 8 (2):110 – 117.

[17]. Johnson-Delaney, C.A. (2006). *Anatomy and physiology of Rabbit and Gastrointestinal System, 2006* proceedings of UK; *British small animal association*

[18]. Hernandez, P. (2004). Calidad nutrcional de la came de conejo, Cunicultura 1:17-21quality and major factors influencing the rabbit carcass and meat quality. *Livestock Production Science. 75:11-32.*

[19]. Lamidi, A. W., Fanimo, A. O., Eruvbetine, D. & Jobaku, W, O (2008) Effects of graded levels of pineapple (Ananas comsus L, Meer) crush waste on the performance, carcass yield and blood paramtersof broiler chiken. Nigerian Journal of Animal Production, 359(1), 40-47

[20]. Moore, K. J. & Jung, H. J. G. (2002). Lignin and fiber digestion. *Journal of Range Management*. 54, 420-430.

[21]. Mufwa, B. J. Kibon, A, Mafindi, M.1. & Yakubu B. (2011). Effect of Graded Levels of Brewers Dried Grain on the Performance of Growing Rabbits. *Journal of Sciences and Multidisciplinary Research Ceresin Publications* 3: 47-54.

[22]. Murin, P. A , Njoka, E. N., Tuitoek, J. K. & Nanua, J. N. (2002). Evaluation of sorghum as replacement for maize in the diet of growing rabbits, *Swidish Journal of Animal Science.* 15 (4): 565 – 569.

[23]. Nodu, M.B., Oguzor, N.S. & Onwunrah, F. (2003). Problem associated with rabbit farming in Ogba community of River State. *Proceedings of the 8th Annual Conference of Animal Science of Nigeria. (ASAN). September. 16-18, Federal University of Technology. Minna Niger State, Niger*ia.

[24]. Nworgu, F. C., Osayowu, S. O. & Yusuf A. A. (2000). Economic Importance of broiler fed varying levels of Protein. *Proceedings of 27th Annual Conference of NSAP. March 17-21st, Federal University Technology Akure, Ondo State. Nigeri*a. 235-238.

[25]. Odunsi, A. A. (2003). Assessment of Lablab (lablab purpureu) leaf meal as a feed ingredient and yolk colouring agent in the diet of layer. *International Journal of Poultry Science, 2(1): 71-*74

[26]. Olorumisoro, O. A., Adewumi, M. K. & Babayemi, O. S. (2002). Effect of Nitrogen level on the Utilization of maize offal and Sorghum brewers grain in sheep diets. *Livestock Research Development.* 18(1). Retrievedon May 16, 2007 from http://ww.cipav.org.cv/seed/rrd/six/soham.

[27]. Statistical Analysis System (SAS). (2002). Computer Software , *Version 9 Statistic SAS* institute Inc. cary, N.C. 27513, U.S.A.

[28]. Tabor, J .G. (1990). The Fishing Industry in Nigeria: Status and Potential for Self-sufficiency in Production. National Institute of Oceanography and Marine. *Research Technical Paper* 22: 1-8.

[29]. Taiwo, A. A., Adejuyigbe, A. D., Adebowale, E. A., Oshotan, J.S. & David, O .O. (2005). Performance and nutrient digestibility of weaned rabbits fed forages supplemented with concentrates. *Nigerian Journal of Animal Production, 32, 74-78.*

[30]. Ugweibuike, J. U, Medugu, C. I, Kwari, I. D. & Dauda, A. (2013). Growth performance and nutrient digestibility of growing rabbits fed two varieties of maize as energy source in tropical environment. *Global Journal of Bio-science and Biotechnology,* 2(2), 167-172.

[31]. Uko, O. J., Ataji, A. M. & Tanko, H. B. (1999). Response of rabbits to cereal by products as energy source in diets. *Archives de zoo technia.* 48, 285-294