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Effect of Supplementing Tigernut (*Cyperus Esculenta Var Sativus*) Meal on Proximate, Performance and Nutrient Digestibility of Female Weaner Rabbits.

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ABSTRACT

This experiment was conducted to find the effect of feeding varying levels of tiger nut meal on weaner performance and nutrient digestibility of female rabbits at graded levels of inclusion (0% $=T_1$, 10%$=T_2$, 20%$=T_3$ and 30%$=T_4$). Four (4) treatment diets were formulated to contain tigernut inclusion levels of 0% (control), 10%, 20% and 30%. Twenty-four (24) clinically healthy female weaner rabbits were used in the experiment to evaluate the effect of feeding varying levels of tigernut meal diet. They were randomly divided into 4 groups of 6 animals per treatment with 2 animals per replicate given 3 replicate per treatment, in a Completely Randomized Design (CRD). Water and feed were given ad libitum. The experiment lasted for 120 days. Simple descriptive statistics and analysis of variance (ANOVA) were used to analyze the data while the New Duncan's Multiple Range Test was employed to compare treatment means. The dry matter (DM) and crude protein (CP) digestibility values were affected ($P<0.05$) by dietary treatments. The final body weight and average daily weight gain did not differ ($P>0.05$) between dietary T_1 (0%) and T_2, while they differed significantly ($P<0.05$) between dietary T_3 and T_4 respectively, but average daily weight gain highest in T_4 (9.61g). The result showed that the values of rabbits fed 0% (77.21%) and that of 10% (72.15%) diet were same statistically. They also indicated that rabbits fed 10% diet had no problem in digesting the dry matter in the diets contrary to those fed 30% diets. It therefore showed that rabbits fed 10% tigernut meal had better and superior dry matter digestibility than treatments 3 and 4. Crude protein digestibility showed no significant difference ($P>0.05$) between rabbits fed 0% and 10% tigernut meal diets but differed significantly ($P<0.05$) from rabbits fed 20%(52) and 30% (51.06) diets which were statistically similar ($P>0.05$). In this study it was observed that rabbits fed tigernut meal were able to digest crude protein at a decreasing rate as the level of inclusion increased. The reason for the poor digestibility at 30% maybe attributed to higher concentrations of tannins, phytate, etc. These observations agreed with the findings of Sathe and Salunke, (1981). Ether extract digestibility was highest in rabbits under treatment 1 (63.45%) followed by T_2 (61.31%), T_3 (53.35%) and T_4 (48.35%) respectively. Nitrogen free extract digestibility had significant difference ($P<0.05$) between treatments 3 and 4, but had higher non-significant difference between treatments 1 and 2. Crude fibre digestibility was significantly different among the treatments. The values were 53.25, 55.45, 61.18 and 62.33% for T_1, T_2, T_3 and T_4 respectively. The difference in digestibility between rabbits on T_1 and T_2 was not significant ($P>0.05$) but they differed significantly ($P<0.05$) from rabbits on T_3 and T_4 which were statistically similar ($P<0.05$). The observed trend in nutrient digestibility was that the digestibility of DM, CP, EE and

NFE declined as the level of tigernut meal increased in the diet. However, CF digestibility increased as the level of tigernut meal in the diet increased. This may be due to the fact that tigernut meal contains about 12.4% CF (Ladeji *et al.*, 2003).

INTRODUCTION

The high cost of maize as the main energy source for livestock and rabbit feeds and a staple food for Nigerians and Agro-allied companies including brewing industries cannot be over- emphasized. The resultant effect is high cost of animal protein hence inability of the populace to meet the minimum dietary protein intake of 56g per person per day as recommended by the. Food and Agricultural Organization of the United Nation (Fasuyi, 2005). Many attempts have been made to solve this problem through the use of some non-conventional energy sources in poultry such as maize offal (Vantsawa *et al.,* 2008), palm oil sludge (Esonu *et al.,* 2006), cassava (Udedibie *et al.,* 2009) and in rabbit nutrition, wild variegated cocoyam (Agbabiaka *et al.,* 2006), cocoyam corm (Omorege *et al.,* 2009, Aderolu and Sogbesan, 2010). These tuber crops have been found to be of good potential but with limited crude protein content which is often below 3%. Tigernut (*Cyperus esculentus* L.) has been reported to be rich in energy while its oil content (about 25%) is resistant to peroxidation (Belewu and Belewu, 2007). Tigernut has been reported to be eaten raw, fermented and processed as beverages. It has the medicinal quality of preventing colon cancer, heart attack and diabetics (Belewu *et al.,* 2007). Tiger nut is a tuber rich in energy content (starch, fat, sugar), minerals (mainly phosphorus and potassium), and vitamins E and C thus making the tuber also suitable for diabetic patients to take (Ekeanyanwu and Ononogbu, 2010). Tiger nut tubers contain almost twice the quantity of starch as potato or sweet potato tubers. The oil of the tuber was found to contain 18.0% saturated (palmitic acid and stearic acid) and 82.0% unsaturated (oleic acid and linoleic acid) fatty acids (Ezeh *et al.,* 2014). The moderately high content of phytosterols further enriches the quality and value of tiger nut oil as a food source, according to Consejo Regulador de Chufa de Valencia (Regulating Council for Valencia's Tigernuts, 2002). Milling of the dry tiger nuts is a common and practicable processing technique among the livestock farmers and feed millers. Hence, it attracts attention in this study. Of importance to farmers and animal scientists are the following information; growth performance, particularly how a test feedstuff affects the feed intake, weight gain, final live weight and the proportion of the live weights that are edible and inedible (Chineke *et al.*, 2002). Blood is very vital to life and for meaningful work to be done on the biology of rabbits, the blood must be studied (Oke *et al.*, 2001; Chineke *et al.*, 2002). Hence information on the effect of tested feedstuff on the blood constitutuents is equally important. There is paucity of information on its potential as rabbit feedstuff in Nigeria, this study is therefore designed to evaluate its suitability as replacement for maize in rabbit production and the increase rearing of rabbit will improve and complement the quantity and quality of meat supply in the country.

MATERIALS AND METHODS

The experiments were carried out at the Rabbitary Unit of the Teaching and Research Farm of Abia State University, Umuahia Location. The Campus is located within the Southeastern Nigeria and lies between Longitude 07^0 33^I E and Latitude 05^0 29^I N at about 8km East of the Umuahia-Ikot Ekpene road. It is 140 km North of Port Harcourt International Airport, 135 km South of Enugu Airport and 80 km East of Owerri Airport. The experiment lasted for 120 days. The tiger nut seeds were purchased from "Ama Hausa" in Umuahia in Abia State, Nigeria. The milling was done at Feed Mill Unit of National Root Crops Research Institute, Umudike. Twenty-four (24) female weaner rabbits were used for the experiment and were assigned to the four treatment diets following the Completely Randomized Design (CRD). where each treatment had six rabbits which was further replicated 3times with 2 rabbits per replicate and the breed used for the studies was New Zealand White with an average weight of 980g and 6-8 weeks of age. The rabbits were purchased from the rabbit unit of National Root Crops Research Institute, Umudike.

The rabbits were housed in galvanized metal hutches measuring $100\times60\times80cm^3$. The hutches were placed in an open sided house with corrugated roofing sheets, the side walls built up to 1meter high and the remaining part of the sides covered with wire mesh. Four treatment diets containing 0%, 10%, 20% and 30% tigernut meal were compounded.

RESULTS AND DISSCUSSION

Table 1. Proximate Composition of Tigernut meal (%DM)

Parameters	Concentration (%)
Moisture Content	7.62
Crude Protein	8.44
Ether Extracts	27.71
Crude Fiber	11.69
Total Ash	3.51
Nitrogen Free Extract (NFE)	41.03

The analysis in the Table1 of this study has established that tubers of *C. esculentus* which is the only edible member of the sedge (Cyperaceae) family and widely consumed in Nigeria as very nutritious. The proximate composition of food is a major index of nutritious potentials of crops. The raw tubers gave proximate values (%) of 8.44, 11.69, 3.51, 7.62 and 41.03 for protein, fiber, ash, moisture and nitrogen free extract, respectively. These were compared with the proximate values of some widely consumed nuts already reported in literature (Table 2.2). The protein level of C. esculentus is quite low and within range for other nuts like the hickory nut (3.60%), chest nut (4.53%), coconut (2.06%) and pine nut (6.81%). Cyperus esculentus has a fat content of 24.3 and 25.2% for both raw and roasted tuber which is comparable to values for some widely consumed nuts already reported in literature (Table 2.2). Fat is important in diets because it promotes fat soluble vitamin absorption (*Chang et al.,* 2009).

Table 2. Proximate Composition of the Exprimental Diet (%DM)

	Concentration (%)			
Parameters	T_1 (0%)	T_2 (10%)	T_3 (20%)	T_4 (30%)
Dry matter (DM)	86.00	88.20	87.00	90.00
Crude protein (CP)	14.94^b	15.75^a	16.19^a	16.50^a
Crude fibre (CF)	3.10	3.00	3.13	3.20
Ash	18.80^c	26.00^a	20.00^b	25.00^a
Ether extract (EE)	6.60^c	6.00^c	7.70^a	7.10^b
Nitrogen free extract (NFE)	43.56^a	41.04^a	33.21^b	31.30^b
Metabolisable energy (Kcal/kg)	2311^a	2242.7^a	1899.1^b	1945^b

Atwater 1978.

The results in the Table2 of this study established that tubers of *C. esculentus* diet compared favourably with the control that had no tigernut. The results showed that the proximate composition of the diet in dry matter and crude fibre indicated no significant ($P>0.05$) differences among 0%, 10%,20% and 30% levels of inclusion of tigernut meal. In crude protein there were no significant significant difference ($P>0.05$) between T_2, T_3 and T_4 respectively but differed ($P<0.05$) slightly from T_1. In Ash there were significant difference ($P<0.05$) between T_1, T_2, T_3 and T_4 respectively while T_2 and T_4 had no significant difference ($P>0.05$). In ether extract there were no significant between ($P>0.05$) T_1 and T_2 but differed significantly ($P<0.05$) from T_3 and T_4. Nitrogen free extract showed no difference ($P>0.05$) between T_1 and T_2 but differed significantly ($P<0.05$) with T_3 and T_4 as T_3 and T_4 had no significant difference ($P>0.05$) between them. In metabolisable energy the result showed no difference ($P>0.05$) between T_1 and T_2 but differed significantly ($P<0.05$) with T_3 and T_4 as T_3 and T_4 had no significant difference ($P>0.05$) between them. The proximate composition of the experimental diet offered the normal nutrition required for maximum performance.

The performance of weaner rabbits fed tigernut meal diet at different levels of inclusion is presented in Table.3.

Table 3. Performance of female weaner rabbits fed tigernut meal-based diet.

Treatments of dietary levels of tigernut meal (%)

Paramet	**T_1 (0%)**	**T_2 (10%)**	**T_3 (20%)**	**T_4 (30%)**	**SEM**
Initial body weight(g)	980	960	990	975	8.50
Final body weight (g)	1370^c	1355^c	1400^b	1538^a	41.81
Av. Daily weight gain (g)	6.96^c	7.05^c	7.32^b	9.61^a	0.63
Av. Daily feed intake (g)	21.34^b	22.34^a	20.39^c	20.75^c	0.47
Total feed intake (g)	1195^b	1251^a	1142^c	1162^c	23.82
Total body weight gain (g)	390^c	395^c	410^b	538^a	35.17
Feed conversion ratio	3.06^a	3.17^a	2.79^b	2.16^c	0.23
Mortality	0.0	.00	0.0	0.0	0.0

A, B, C: Mean within row with different superscript are significantly different ($P<0.05$).

Final body weights indicated no significant ($P>0.05$) differences between 0% and 10% levels of inclusion of tigernut meal. But they differed ($P<0.05$) from T_4 (30%). The crude protein of all the diets fall within the recommended range of 12%–18.5% for weaner rabbit (Agbabiaka, 2010). The general increase in the body weight of the experimental rabbits in all the treatments is an indication that all the treatment diets were adequate in dietary protein and other nutrients required by weaner rabbits. Av. daily weight gain ranged from 6.96g (T_1) to 9.61g (T_4). There was no significant ($P>0.05$) different between 0% inclusion and 10% inclusion of tigernut meal, but they differed significantly ($P<0.05$) from 20 and 30% inclusion levels. The difference between 20 and 30% levels of inclusion was significant ($P<0.05$). The greatest body weight gain of weaner (1538 g) recorded at 30% dietary inclusion of tigernut may be due to synergetic effect between the utilization of polysaccharides in maize and tigernut tubers by the rabbit, and was able to convert it into muscle for growth. Similar reports were obtained when cassava leaves were fed to weaner rabbit at 40% (Bichi and Ahmad 2010). The best utilization of wild variegated cocoyam in rabbit diet was also recorded at 42% dietary level (Agbabiaka, *et al.,* 2010). Av. daily feed intake ranged between 20.39g to 22.34g with treatment2 (10%) having the highest value followed by treatment 1 (0, control) 21.34g and treatment 4 (30%) 20.75g while treatment 3 (20%) had the lowest daily feed intake with 20.39g. This finding agrees with Agbabiaka *et al.,* (2013) who reported that the higher the inclusion levels of tiger nut meal in rabbit diet, the lower the feed intake.

Total feed intake ranged from 1142g to 1251g with treatment 2 having the highest value (1251g), while treatment 3 had the least value of 1142g which did not differ significantly ($P>0.05$) from treatment 4 (1162g). Treatments 3 and 4 differed significantly ($P<0.05$) from treatment 1 (1195g). The feed intake of the weaner rabbit decreased with increased dietary level of tigernut as inclusion for maize in the diets (Table 4.2). This agrees with the reports that voluntary feed intake of rabbits or monogastrics have been established to be a function of dietary fibre characteristics (Sundu *et al,* 2005; Fetufe *et al,* 2007). Replacing maize with wheat offal beyond 50% in rabbits has also been reported to reduce rabbits feed intake (NAPRI, 1985).

Total body weight gain ranged between 390g to 538g with treatment 4 (30%) having the highest value (5.38g) while treatment 1 (0%) had the least value (390g) but with no significant (P>0.05) difference from treatment 2 (395g). The increase in the total body weight gain can be attributed to the increase of the test ingredient percentage as reported by Adejumo (2002), for rabbit on Gliricidia leaf meal, Iheukwumere *et al.,* (2002) on rice milling waste while, Adegbola and Okonkwo (2002) on cassava leaf meal. This shows that the test ingredient tigernut meal compared favourably with other non-conventional ingredients such as cassava leaf meal, gliricidia leaf meal, etc as feedstuff for rabbits. Feed conversion ratio ranged from 2.16 to 3.17 with treatment 2 (10%) having the highest value (3.17) while treatment 4 (30%) had the least value of 2.16. Treatments 1 (0%) and 2 (10%) had no significant (P>0.05) difference between them, but they differed significantly (P<0.05) from treatments 3and 4. The best feed conversion ratio with tigernut meal was treatment 4 (30%) with 2.16. These observations maybe attributed to some factors. It appears that the common processing technique for tigernut such as washing, discarding the bad ones, drying and grinding treatments employed in this study have the ability to modify the nutritive value of the tigernut meal, which increased the nutrient availability to the rabbits. This view agrees with the report of Onyimonyi and Okeke (2002) that the enhanced performance of pigs on the 30% diet may also be as a result of their better digestive ability. Table 4.3, also showed that there was no mortality recorded in any of the rabbit groups during the study indicating good and efficient management. Moreover, it is an indication that tigernut meal is a safe ingredient to be used for rabbit production which was in line with what Okiyi and Iheukwumere (2013) reported using toasted bambara-groundnut sievate.

Nutrient Digestibility

Table 4. Effect of Tigernut meal on Nutrient Digestibility of various diets in female rabbits

Treatments of dietary levels of tigernut meal (%)

Parameters	T_1 (0%)	T_2 (10%)	T_3 (20%)	T_4 (30%)	SEM
Dry matter (%)	77.21^a	72.15^a	56.00^b	53.00^b	5.95
Crude protein(%)	70.25^a	63.50^a	52.00^b	51.06^b	4.64
Ether extract(%)	63.45^a	61.31^a	55.34^b	52.30^b	2.58
Nitrogen free extract(%)	84.21^a	77.30^a	53.35^b	48.35^c	8.81
Crude fibre (%)	53.25^a	55.45^b	61.18^a	62.33^a	2.20

a, b, c: Means with different superscript on the same row differ significantly ($P<0.05$).

The digestibility result is presented in Table 4.4. The result showed that the values of rabbits fed 0% (77.21%) and that of 10% (72.15%) diet were same statistically. They also indicated that rabbits fed 10% diet had no problem in digesting the dry matter in the diets contrary to those fed 30% diets. It therefore showed that rabbits fed 10% tigernut meal had better and superior dry matter digestibility than treatments 3 and 4.

Crude protein digestibility showed no significant difference ($P>0.05$) between rabbits fed 0 and 10% tigernut meal diets but differed significantly ($P<0.05$) from rabbits fed 20%(52) and 30% (51.06) diets which were statistically similar ($P>0.05$). In this study it was observed that rabbits fed tigernut meal were able to digest crude protein at a decreasing rate as the level of inclusion increased. The reason for the poor digestibility at 30% maybe attributed to higher concentrations of tannins, phytate, etc. These observations agreed with the findings of Sathe and Salunke, (1981). Ether extract digestibility was highest in rabbits under treatment 1 (63.45%) followed by T_2 (61.31%), T_3 (53.35%) and T_4 (48.35%) respectively. Rabbits on T_1 and T_2 had similar ($P>0.05$) digestibility but they differed significantly from rabbits on 20 and 30% levels of inclusion. Rabbits on 20% level of inclusion differed significantly ($P<0.05$) from those on 30% (T_4) level of inclusion. Nitrogen free extract digestibility had significant difference ($P<0.05$) between treatments 4 and 3, but had higher non-significant difference between treatments 2 and 1. Crude fibre digestibility was significantly different among the treatments. The values were 53.25, 55.45, 61.18 and 62.33% for T_1, T_2, T_3 and T_4 respectively. The difference in digestibility between rabbits on T_1 and T_2 was not significant ($P>0.05$) but they differed significantly ($P<0.05$) from rabbits on T_3 and T_4 which were statistically similar ($P<0.05$). The observed trend in nutrient digestibility was that the digestibility of DM, CP, EE and NFE declined as the level of tigernut meal increased in the diet. However, CF digestibility increased as the level of tigernut meal in the diet increased. This may be due to the fact that tigernut meal contains about 12.4% CF (Ladeji *et al.*, 2003).

CONCLUSION

The result of this study indicated that the tigernut inclusion up to 30% had positive reliable effect on the growth performance with no adverse effect on the nutrient digestibility on the female weaner rabbits.

REFERENCE

Adegbola, T.A. and Okonkwo, J.C. (2002). Nutrient intake, digestibility and growth rate of rabbits fed varying levels of cassava leaf meal. Nig. J. Anim. Prod., 29:21-26.

Adejumo, J.O. (2002). Utilization of different levels of gliricidia leaf meal by growing rabbits. Proceedings of the 7th Annual Conference on Austistic Self Advocacy Network (ASAN'20), September 16-19,2002, Abeokuta, Nigeria, pp: 98-100.

Aderolu, A.Z and Sogbesan, O.A (2010). Evaluation and potential of Cocoyam as carbohydrate source in catfish (*C. gariepinus* ; Burchell, 1822) juvenile diets. *African Journal of Agric. Research,* **5**(6):453 – 457.

Agbabiaka, L.A., Odoemenam, S.A and Esonu, B.O (2006). Preliminary investigation on the potentials of wild variegated

Cocoyam (*Caladium hortulanum*) replacement for maize in diets of catfish (*Heterobranchus bidorsalis*) fingerlings. Int. J. Agric and Rural development, 7(1): 138 – 142.

Agbabiaka, L.A., Madubuike, F.N., Ekenyem, B.U and Esonu, B.O (2010). Effect of tiger nut ased diets on haematology and serum biochemistry of broiler finisher. Agr. Biol.

J. N. Anim., 4(3): 186-191.Atwater, W.O. and Bryant, A.P. (1978). The availability and fuel value of food materials. Washington, DC. US Government Printing Office, 1978 (Agriculture Experiment Station 12th Annual Report). Pp:78-110.

Belewu, M.A and Belewu, K.Y, (2007). Comparative physico-chemical evaluation of Tigernut, soybean and coconut milk sources. *Int. J. Agric and Biology,* 9(5): 785-787

Belewu, M.A., Orisameyiti, B.R., and Ajibola, K.A, (2007). Effect of feeding graded levels of Tigernut (*C. esculentus*). Seeds meal on the performance characteristics of west AfricanDwarf Goat. *Pakistan Journal of Nutrition.* 6(6): 526-529.

Chineke, C.A., Adenrin, F.A., Ologun, A.G., Ikeobi, C.O.N. and Oseni, O.A. (2002). Analysis Of Serum biochemical parameters in New Zealand White rabbit and their crosses. NSAP. Proced. of the 27th Annual Conf. March 17-121, 2002. Akure, pp: 5-7.

Ekeanyanwu, R.C. and Ononogbu, C.L. (2010). Nutritive value of Nigerian tigernut (*Cyperusesculentus L*). Agric.J. 5(5):297-302.

Esonu, B.O., Ogbonna, U.D., Anyanwu, G.A., Emenalom, O.O., Uchegbu Etuk, E.B and Udedibie, A.B.I. (2006). Evaluation of performance, organ characteristics and economic analysis of broiler fed dried rumen digester, *Int. J. Poultry Sci.* 5(2): 1116-1118.

Ezeh, O., Gordon, M.H, and Niranjan, K, (2014). Tigernut oil (*Cyperus esculentus L.*): A reviewof its composition and physio-chemical properties. Eur.J. Lipid Sci. Technol. 166: 783-794.

Fasuyi, A.O, (2005). Nutritional evaluation of cassava (*Manihot esculenta;* Crants) leaf protein Fielding, concentrate as alternative protein sources in rat assay. *Parkistan Journal of Nutrition* 4: 50-56.

Fetufe, A.A; Akanbi, I.O., Saba, G.A., Olowofeso. O and Tewe.O.O (2007).Growth performance and nutrient digestibility of growing pigs fed a mixture of palm kernel meal and cassava peelmeal. *Livestock Research for Rural Development*. 19: 180

Iheukwumere, F.C., Onyekwere, M., Nwoche, G. and Saulawa, L.A. (2002). Evaluation of growth Performance, blood mineral profile and carcass characteristics of weaner rabbits Fed rice milling waste. J. Sustain. Trop. Agric. Res., 4:61-66.

Ladeji, O., Solomon,M. and Maduka, H. (2003). Proximate chemical analysis of *Zonocenus variegatus* (Giant Grasshopper). Nigerian J Biochem, 14(17): 42–45.NAPRI (1985). National Animal Production Research Institute: Highlights of research achievements on animal feeds. Fed. Min. Sci. Tech., briefing , Lagos February. Pp18.

Oke, U.I., Joseph, K. and Udo. H. (2001). Haematological values of the Indigenous female Guinea Fowl Numida Meleagris galeata (palla). As influenced by photo induction, proceed of 6th Ann. Conf. Maiduguri, Sept. 17-19, 2001.

Okiyi, P.C. and Iheukwumere, F.C. (2013). Effect of toasted bambara groundnut sievate on the growth and reproductive performance of rabbit does. Journal of Agriculture Biology and Food Research 3(2): 120-128.

Omorege, E., Igoche, L., Ojobe, T.O., Absalom, K.V and Onusiriuka, B.C., (2009). Effect of varying level of sweet potato (*Ipomea batatas*) peels on growth, feed utilization and someio chemical responses of the Cichlid (*Oreochromis niloticus*). *African Journal of Food, Agric., Nutrition and Development.* 9(2): 701-712.

Onyimonyi, A.E. and Okeke, G.C. (2002). Performance of weaner pigs fed varying dietary levels Of bambara (*Voandzeia subterranean Thouars*) waste. Proc. 7th Ann. Conf. Anim. Sci. Ass. Of Nig.

(ASAN). Univ. of Agric. Abeokuta, Nigeria. Sathe, S.K and Salunkhe, D.K. (1981). Functional properties of great Northern bean (Phaseolusulgaris) protein: Emulsion, foamimg, viscosity and gelation properties. J. Food Sci. 46: 71-75.

Sundu, B; Kumar.A and Dingle. J (2005). Response of birds fed increasing levels of palm kernelmeal supplemented with enzymes. *Australian Poultry Science Symposium,* 17: 228-278.

Udedibie, A.B.I., Alozie, I.L and Duru, I.H, (2009). Effects of 12 hour wetting of sun-dried cassava tuber meal on its HCN content, performance and haematological indices of broiler chicks. *Anim. Prod. Res. Adv.,* 3: 1-5.

Vantsawa, P.A., Ogundipe, O.S., Dafwang, L.L and Omage, J.J., (2008). Replacement value of Dusa (Locally Processed Maize Offal) for Maize in the diets of pullets and subsequent early laying characteristics. *Pakistan Journal of Nutrition,* 7(4): 574-57.