GROWTH PERFORMANCE OF BROILER CHICKENS FED TIGERNUT (*CYPERUS ESCULENTUS*) MEAL AS A SUBSTITUTE FOR MAIZE

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ABSTRACT
A 6-week feeding trial was conducted to assess the effect of substituting maize with Tigernut (Cyperus esculentus) TNM on the performance of 150 day-old Abor acre broiler chicks. Five experimental broiler starter and finisher diets were formulated with diet T_1 formulated to contain 0 % Tigernut while diet T_2, T_3, T_4 and T_5 were formulated to contain Tigernut meal at 10, 15, and 20 and 25% substituting for maize, respectively. Thirty (30) chicks were randomly assigned to the five dietary treatments in a completely randomized designed (CRD). Each treatment consisted of three replicates of ten (10) chicks. The results of final live weight and daily feed intake shows significant ($P<0.05$), daily weight gain, protein and feed conversion ratio efficiency ratio shows significant did not differ significantly ($P>0.05$) among the treatment groups. The highest final live weight, daily feed intake and daily weight gain of 2025.69g/bird, 101.95g/day and 43.10g/bird, respectively were obtained in T_5. Therefore, substitution level of Tigernut meal for maize at 25% gives a final live weight of 2025.67 g. It can be concluded that Tigernut meal can substitute maize up to 25% in broiler diets without adverse effects on performance.
Keywords: Broiler Chickens, Tigernut meal (TNM), Maize, Growth, Performance.

INTRODUCTION
A major challenge facing most developing countries like Nigeria in Africa is food insecurity. Due to the high population growth in Africa and growing income, the demand for eggs and poultry meat has significantly increased in recent years across large parts of the continent (Abeke *et al*., 2013). Maize is one of the premium energy feed in poultry diets and it is responsible for between 50 and 60 % of the total cost of production (Abeke *et al*., 2013). Maize as a major component of livestock feed in Nigeria is expensive and inadequate due to its use for human food, livestock feed and industrial purposes. The scarcity and high cost of maize has forced many farmers to explore alternative sources of energy feedstuffs for poultry feeding, Tigernut is an example of such alternatives. Tigernut (*Cyperus esculentus*) is a perennial grass-like plant (Adel *et al*., 2015). The metabolizable energy value of Tigernut is 3654.59 Kcal/kg which is higher than that of Maize (3526.42 Kcal/Kg) as reported by (Apel *et al*., 2016). Crude protein content of Tigernut is 4.33 % (Adel *et al*., 2015) which is lower than 8.75 % for maize but Oderinde and Tahir (1988) reported a value of 7.00 % which is close to maize. However, Tigernut has high fibre content. The objective of this study was to investigate the productive performance of broiler chickens fed Tigernut meal as a substitute for maize.

MATERIALS AND METHODS
Study Area
The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Department of Animal Science, University of Maiduguri, Maiduguri, Borno State for a period of six (6) weeks. Maiduguri lies between latitude 11^0 5' and 12^0 North and between longitude 13^005' and 14^0 East and an altitude of 354 m above the sea level. The area is characterized by a short rainy season (June to September) with a long dry period of seven (7) to eight (8) months. The hottest month are April and May with a temperature range of 39.4^0c to 41.1^0c under shade. Mean relative humidity ranges from 51.3 to 72% in August but usually low (5%) in December and January (Biu *et al*., 2012).
Source of Test Materials and Feed Sample Preparation
Tigernut *(Cyperus esculentus)* was purchased from a Market in Gujungu Local Government Area Jigawa State, Nigeria. The Tigernut was visually inspected and bad ones were manually removed and discarded. Tigernut was thoroughly washed with clean water, drained and dried for seven (7) days before grinding

and diet formulation. The drying process was to reduce excess moisture so as to prevent rancidity of the Tigernut. The nut was ground to produce Tigernut meal with size of 2.00mm. All processing was done by the method described by Umar *et al*., (2007).The Tigernut contained 6.91% crude protein, 14.65% crude fibre and 3916.56kcal/kg metabolizable energy.

Experimental diets, design and Dietary Treatments

The experimental diet contained Tigernut which was dried and ground into meal. The Tigernut meals (TNM) were used to substitute maize at 0, 10, 15, 20 and 25% levels in the diets. Complete randomized design (CRD) was used. Different diets with Tigernut at 0% (control), 10, 15, 20 and 25% were designated as T_1, T_2, T_3, T_4 and T_5, respectively. They were formulated to contain 21.43 to 23.37% and 19.88 to 20.88% crude protein and metabolizable energy of 2869.16 to 2979.01 Kcal/Kg and 3039.47 to 3108.46 Kcal/Kg for both broiler starter and finisher diets, respectively. The ingredients composition and calculated analysis of the experimental diets (Starter and Finisher) are presented in (Tables 1 and 2). The diets and clean drinking water were provided *ad-libitum* throughout the six (6) weeks of the experiment. The data measured were initial weight, final weight, weight gain and feed intake while the feed conversion ratio and protein efficiency ratio were calculated accordingly.

Experimental Stocks and Management

One hundred and fifty (150) day old *Abor acre* strain were bought from Amor hatchery Jos, Plateau State and used for the study. The chicks were brooded for fourteen days and allotted to commercial broiler starter mash during the period. Later, the chicks were divided into five (5) groups of thirty (30) chicks containing three (3) replicates of ten (10) chicks each, fed the experimental starter diet for two weeks and switched to experimental finisher diets throughout the finishing phase of four weeks. The chickens were housed in cemented floor pens with wood shavings as litter material. The birds were vaccinated against Gumboro at 2^{nd} and 4^{th} weeks and Newcastle at 3 weeks of age.

Statistical analysis

All data obtained were subjected to Analysis of Variance (ANOVA) appropriate to Completely Randomized Design (CRD) (Steel and Torrie 1980). Differences between treatment means were determined using the least significant difference (LSD), using statistical package (Statistix 9.0 version).

RESULTS AND DISCUSSION

Productive Performance of Broiler Chickens Fed Different Levels of Tigernut Meal in their Diets

The productive performances of broiler chickens fed different levels of Tigernut meal (TNM) as a substitute for maize are presented in Table 3. The parameters are final live weight, daily weight gain, feed conversion ratio and protein efficiency ratio. The result showed significant ($P<0.05$) difference in the final live weight and daily feed intake. Daily weight gains, protein efficiency ratio and feed conversion ratio did not differ significantly ($P>0.05$) among the treatment. Broiler chickens fed T_5 (25% TNM) recorded the highest final live weight but were similar to those fed T_4 (20% TNM) but superior to those fed T_1 (control) and T_3 (15% TNM) which recorded the least values. The final live weight (1889.87 to 2025.67 g) obtained in this study were higher than the values (1350 to 1720 g) reported by Agbabiaka *et al*. (2012) for broiler chickens fed similar diets. These differences may be attributed to environmental difference, variety of test material or the substitution levels of the test material. The broiler chickens fed T_1, T_2, T_4 and T_5 consumed more feed than those fed T_3. However, the daily feed intake obtained in this study (95.81 to 101.95 g/day) were higher than the values (67 to 95 g/day) reported by Agbabiaka *et al*. (2012) for broiler chickens fed Tigernut meal at varying inclusion levels. Higher feed intake observed in this study may be attributed to the fibre fraction of the TNM which bind nutrients in the feed. Hence, the chickens will eat more to meet their nutrient requirement which is in line with the findings of Chen *et al*. (1992) who reported that an increase in fibre content of the diets could probably stimulate higher feed intake due to the lower energy level of such diets, hence increased feed intake of the birds. The broiler chickens fed T_2, T_4 and T_5 gained more weight compare to those fed T_1 and T_3, the differences in weight gain may be attributed to feed intake. Feed conversion ratios of 2.30 to 2.40 obtained in this study were similar to the values (1.90 to 2.30) reported by Aduku *et al*. (1994) who fed brewers' dried grain to broiler chickens. The protein efficiency ratio obtained in this study revealed that utilization of protein was better

in T_2, T_4 and T_5 than those fed T_1 and T_3. This is confirmed by the superior weight gains of chickens on the diets (T_2, T_4 and T_5). The values (1.98 to 2.17) were higher than the values (1.26 to 1.99) reported by Agbabiaka *et al*. (2012). Generally, the results obtained in this study agreed with the findings of Agbabiaka *et al*. (2012) who fed similar diets to broiler chickens, thus indicating that TNM is a good source of energy in broiler diets and can replace maize. The study shows no negative effect on performance which is in line with the findings of Agbabiaka *et al*. (2013). Jimenez *et al*. (2009) reported that if the diets are carefully balanced, fibre components of diets may not affect performance. Therefore, substituting maize with dietary levels of TNM in the diets of broiler chickens had no adverse effects on the productive performance of the birds.

Table 1: Ingredient composition and calculated analysis of experimental broiler starter diets (%)

	Tigernut levels substituting maize (%)				
Ingredients	**0**	**10**	**15**	**20**	**25**
Maize	51.50	46.35	43.76	41.20	38.62
Tigernut meal	-	05.15	07.74	10.30	12.88
Wheat offal	08.00	08.00	08.00	08.00	08.00
Soya bean meal	22.30	22.30	22.30	22.30	22.30
Groundnut cake	10.00	10.00	10.00	10.00	10.00
Fish meal	5.00	7.00	7.00	7.00	7.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Premix*	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Salt (NaCl)	0.30	0.30	0.30	0.30	0.30
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis (%)					
Crude protein	23.43	22.79	22.23	21.68	21.22
Crude fibre	3.09	3.73	4.07	4.39	4.67
Ash	3.13	3.30	3.48	3.65	3.65
Ether extract	4.55	6.89	9.22	11.56	13.89
NFE	68.46	67.81	66.37	65.32	64.43
ME (Kcal/Kg)**	2810.06	2852.00	2856.00	2910.00	3005.00

NFE =Nitrogen free extract ME =Metabolizable energy, *****Composition of broiler premix supplying the following per kg of feed: *Vitamin A = 3,400IU, Vitamin D_3= 600IU, Vitamin E = 4,000IU, Vitamin K_3 600mg, Vitamin B_1 = 640mg, Vitamin B_2 = 1,600mg, Niacin = 8,000mg, Vitamin B_6 = 600, VitaminB_{12} = 4mg, Choline + Chloride = 7,0000mg, Cobalt = 80mg, Copper = 1,200mg, Iodine = 400mg, Iron = 8000mg, Manganese = 1,6000mg, Selenium = 80mg, Zinc = 1,2000mg and Antioxidant = 500mg* ****Calculated according to Pauzenga (1985)**

Table 2: Ingredient composition and calculated analysis of experimental broiler finisher diets (%)

	Tigernut levels substituting maize (%)				
Ingredients	**0**	**10**	**15**	**20**	**25**
Maize	61.80	55.62	52.53	49.44	46.35
Tigernut meal	-	06.18	09.27	12.36	15.45
Wheat offal	06.00	06.00	06.00	06.00	06.00
Soya bean meal	21.70	21.70	21.70	21.70	21.70
Groundnut cake	02.00	02.00	02.00	02.00	02.00
Fish meal	05.00	05.00	05.00	05.00	05.00
Bone meal	02.50	02.50	02.50	02.50	02.50
Premix*	0.50	0.50	0.50	0.50	0.50
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20	0.20
Salt (NaCl)	0.20	0.20	0.20	0.20	0.20
Total	**100**	**100**	**100**	**100**	**100**
Calculated Analysis (%)					
Crude protein	20.68	20.43	20.22	19.84	19.53
Crude protein	3.80	4.01	4.52	5.42	7.17
Crude fibre	3.58	4.07	4.25	4.42	5.02
Ash	3.08	3.97	4.15	4.32	4.63
Ether extract	3.76	5.58	6.24	7.66	9.37
NFE	68.68	66.01	64.87	62.76	59.30
ME (Kcal/Kg)**	2916.18	2950.56	2984.96	3019.34	3053.74

*** Same as in Table 1, ** Same as in Table 1**

Table 3: Growth Performance of Broiler Chickens fed Different Levels of Tigernut Meal in their Diets

	Tigernut levels substituting Maize (%)					
Parameters	**T_1 (0)**	**T_2 (10)**	**T_3 (15)**	**T_4 (20)**	**T_5 (25)**	**SEM**
Initial weight (g)	220.76	214.60	206.86	210.00	215.50	0.04^{NS}
Final live weight (g)	1908.00^{b}	1992.46^{b}	1889.87^{c}	1998.43^{ab}	2025.67^{a}	49.45*
Daily feed intake (g/bird)	98.72^{a}	101.58^{a}	95.81^{b}	97.84^{a}	101.95^{a}	1.00*
Daily weight gain (g/bird)	40.17^{b}	42.33^{a}	40.07^{b}	42.58^{a}	43.10^{a}	10.62^{NS}
Feed Conversion ratio	2.40	2.40	2.39	2.30	2.37	0.03^{NS}
Protein efficiency ratio	1.97^{b}	2.06^{a}	1.98^{b}	2.11^{a}	2.17^{a}	5.20^{NS}
Initial Number of Bird	30.00	30.00	30.00	30.00	30.00	NTS
Mortality (Number)	2.00	1.00	2.00	0.00	0.00	NTS

a, b, and c = Means in the same row bearing different superscripts differ significantly * = Significant (P<0.05)
NS = Not significant (P>0.05),
NTS = Not Tested Statistically, SEM = Standard error of means (P<0.05)

CONCLUSION

The result of this study revealed that Tigernut meal at 25% substitution level for maize it gives final live weight of 2025.67 g and improved the productive performance of broiler chickens without any adverse effects.

RECOMMENDATION

Tigernut (*Cyperus esculentus*) is recommended as good substitute for maize to enhance optimum growth performance of broiler chickens especially in areas where it is cheaper than maize, and should be exploited in other species of poultry and monogastric animals.

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