FEED COST OF BROILER CHICKENS FED TIGERNUT (*CYPERUS ESCULENTUS*) MEAL AS A SUBSTITUTE FOR MAIZE IN SEMI – ARID ZONE OF NIGERIA

Titima, S. I.[1], Bawu, A. S.[2], Sabo, M. N.[3], H. Shuaibu.[4] and Umar, A. M.[5]
[1]Department of General Agric, Federal Polytechnic Monguno, Borno, Nigeria.
[2] Department of Business Administration and Management, Federal Polytechnic Monguno, Borno State.
[3]Department of Animal Science, Federal University Dutsin - Ma, Katsina, Nigeria.
[4]Department of Animal Health and Production, Federal Polytechnic Bali, Taraba, Nigeria
[5]Department of Animal Science, Federal University Dutse, Jigawa, Nigeria
Corresponding author: Titima, S.I., Mobile:+234 8022696835,E-mail: titimasabi@gmail.com

Abstract
A feeding trial of 6-weeks was conducted to evaluate the effect of substituting Tigernut (Cyperus esculentus) TNM with maize on the cost of feed 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 Total feed cost (₦), Total feed intake (Kg/bird), cost/kg feed (₦) and cost/kg gain (₦/kg) was analyzed. The result of the study revealed significant (< 0.05) differences in Total weight gain (Kg/bird), cost/Kg feed (₦), Total feed cost (₦) and cost per Kg gain (₦/Kg). The general trend revealed that feed cost per kilogram decreased with increasing level of Tigernut meal in the diets. The highest substituting value (25% Tigernut meal) recorded the lowest (₦123.60K) feed cost per kilogram, while the control (0% Tigernut meal) recorded the highest (₦131.33K) feed cost per kilogram. This revealed that substitution level at 25% Tigernut meal is more cost effective than other treatments. Therefore, this indicated that the use of Tigernut meal is cost effective when used as a substitute for maize at 25% substitution levels.
Keywords: Broiler Chickens, Tigernut meal (TNM), Maize, Feed Cost.

Introduction

The shortage and high cost of major cereals like maize, sorghum and millet due to their consumption by humans and livestock has hindered significant development in the production of poultry. 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. 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). 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. Tigernut is cultivated for its nutritive value, edible nut and has high content of soluble glucose of about 21% (Bamishaiyi et al 2010). **Tigernut has been reported to have alot of medicinal benefits (Omode *et. al.*, 1995). FAO (2002) reported that Tigernut is rich in minerals such as Potassium 261.18mg, Phosphorus 158.86mg, magnesium 118.14mg, sodium 17.02mg, copper 0.54mg, iron 2.82mg and zinc 1.39mg.** The objective of this study was to analyze the feed cost of broiler chickens fed Tigernut meal (TNM) 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 defected 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. The diets 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.

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.

Feed Cost

Total feed cost in Naira was calculated based on the prevailing cost of ingredient per kilogram as at time the experiment was conducted by summing the price per kilogram of feed ingredient multiplied by their proportion in the feed formular then divided by 100. Total feed cost in Naira was obtained by multiplying cost per kilogram feed in Naira by Total feed intake in kilogram per bird. Total feed intake in kilogram per bird was gotten by dividing Total feed cost in Naira by cost per kilogram feed in Naira. Cost per kilogram feed in Naira was gotten by dividing Total feed cost in Naira by Total feed intake in kilogram per bird. The cost per kilogram gain in Naira per kilogram was gotten by dividing Total feed cost in Naira by Total weight gain in kilogram per bird. The parameters analyzed can be mathematically represented as follows.

i. **TFC** = $CF\ X\ TFI$
ii. **CG** = TFC/TWG

Where; TFC = Total feed cost (₦),CG = Cost / Kg gain (₦/Kg), TFI = Total feed intake (Kg/bird), CF = Cost / Kg feed (₦)

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

Feed cost of substituting Tigernut with maize in the diets of broiler chickens are presented in Table 3. The economic value of including Tigernut meal in the diets of broiler chickens was depicted with decreased cost of feed per kilogram. The result of the study revealed significant ($P<0.05$) differences in Total weight gain (Kg/bird), cost/Kg feed (₦), Total feed cost (₦) and cost per Kg gain (₦/Kg). The general trend revealed that feed cost per kilogram decreased with increasing level of Tigernut meal in the diets. The highest substituting value (25% Tigernut meal) recorded the lowest (₦123.60K) feed cost per kilogram, while the control (0% Tigernut meal) recorded the highest (₦131.33K) feed cost per kilogram. The reduction in feed cost per kilogram was due to lower cost of Tigernut meal compared to cost of maize as of the experiment period. This is in line with the findings of (Bamgbose *et al*. 2008; Agbabiaka *et al*. 2012 and Agbabiaka *et al*., 2013) who analyzed feed cost of similar diets. The total feed cost was higher (₦539.77K) in birds fed T_1 (0% Tigernut meal) and T_5 (25% Tigernut meal) recorded the lowest (₦504.29K) total feed cost. This could be as a result of the increased levels of Tigernut in the diets. The highest cost per kilogram weight gain (₦319.39K) was recorded in T_1 (0% Tigernut meal) while, the lowest cost per kilogram weight gain (₦278.61K) recorded in T_5 (25% Tigernut meal). This revealed that substitution level at 25% Tigernut meal is more cost effective than other treatments. Therefore, this indicated that the use of Tigernut meal is cost effective when used as a substitute for maize at 25% substitution levels.

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: Feed Cost of Substituting Maize with Tigernut in the Diet of Broiler Chickens

	Tigernut levels substituting Maize (%)					SEM
Parameters	**T_1(0)**	**T_2(10)**	**T_3(15)**	**T_4(20)**	**T_5(25)**	
Total feed intake (g/bird)	4106.20	4166.36	4020.00	4109.28	4081.9^{0}	0.04^{NS}
Total feed intake (kg/bird)	4.12	4.16	4.02	4.11	4.0^{8}	0.32^{NS}
Total weight gain (kg/bird)	1.69^{b}	1.78^{a}	1.70^{b}	1.79^{a}	1.81^{a}	5.31^{*}
Cost/kg Feed (₦)	131.33^{a}	128.33^{ab}	126.63^{ab}	125.14^{b}	123.60^{b}	0.68*
Total Feed Cost (₦)	539.77^{a}	533.85^{a}	509.29^{ab}	$514.33a^{b}$	504.29^{b}	27.56^{*}
Cost/kg gain (₦/kg)	319.39^{a}	299.92^{ab}	299.58^{ab}	287.34^{b}	278.61^{b}	1.27^{*}

**Cost per kilogram of the various ingredients used in compounding the experimental diets: Maize grain ₦110.00, Tigernut meal ₦60.00k, Wheat offal ₦60.00, SBMN198.00K, GNC ₦100.00, Fish meal₦150.00, Bone Meal ₦50.00k, Salt ₦50.00, Lysine ₦1000.00, Methionine ₦1000.00 and Vitamin and Mineral Premix ₦ 1500.00. NB: Based on Prevailing Market Price in Maiduguri market and Gujungu market Jigawa State.*

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

Conclusion

It can be conclude based on the findings of the study that **Tigernut could conveniently substituting maize in broilers diet up to 25% level of inclusion. Also, feeding broilers with diet containing 25% Tigernut meal could reduce the cost of feeding broilers.**

Recommendation

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

References

Abeke, F.O., Bawa, G.S. and Bot, M.H. (2013). Response of broiler chickens fed graded levels of locust beans *(Parkia biglobosa)* pulp meal. Nigerian *Journal of Animal Production.* 40(1): 57-66.

Abioye, J., Amos, O.F., Adeyemi, M., Bamgbose, M.A. and Dipeolu, O. (2006). Nutrient Utilization, growth and Carcass Performance of broiler chickens fed graded levels Kola nut husk. *Journal of Poultry Science*. 43(4): 365 -370.

Adel, A.A., Awad, A.M., Mohammed, H.H. and Iryna, S. (2015). Chemical composition physicochemical properties and fatty acid profile of Tigernut *(Cypernus esculentus)* seed oil as affected by different preparation method. *International Food Research Journal* 22(5): 1931-1938.

Agbabaika, L.A., Madubuike, F.N. and Esonu, B.O. (2012). Performance carcass and organ weights characteristic of broiler finisher fed varying levels of Tigernut (*Cyperus esculentus* L.) meal as dietary supplement. *British Journal of Poultry Science*. 1 (2): 11 – 17.

Agbabaika, L.A., Madubuike, F. N., Ekanyem, B.U. and Esonu, B.O. (2013). Effect of Tigernut based diets no hematology and serum biochemistry of broiler finisher. *Agriculture and Biology Journal of North American.* 2(1):51 – 57.

Apel, D., Nwogu, N.A., Uwakwe, E. and Chinelo, I. (2016). Comparative proximate analysis of maize and sorghum bought from Ogbete Main Market of Enugu State, Nigeria. *Greener Journal of Agricultural Science*. 6(9): 272-275.

Bamgbose, A.M., Awosanya, O., Ojo, O.T. and Oso, A.O. (2005). Performance of Broilers fed enzyme – supplemented Tigernut (*Cyperus rotunda* (*L*.)) meal diets. *Ghana Journal of Agricultural Science*. 38:89 – 93.

Bamishaiye, E. Muhammad, N. O. and Bamishaiye, O.M. (2010). Haematological parameters of albino rats fed on tigernut (cyperus esculentus) tuber oil meal-based diet. International Journal of Nutrition and Wellness. (1). Doi:10.5580/187b

Biu, A. A., Abdulkarim, M. A. and Isade, O. (2012). Effect of temperature and relative humidity on egg laying pattern of *Rhicephelus sangismusis*.(Koch, 1884) infesting sheep in semi-arid region of Nigeria. *Sokoto Journal of Veterinary Science*, 10(2): 18-

FAO/WHO/UNU. (2002). Human, Vitamin and Mineral requirements (recommended Dietary Intakes): Report of a Joint Food and Agricultural Organization, World Health Organization and United Nations University. www.net.int

Khempaka, S., Molee, W. and Guillaume, M. (2009). Dried Cassava pulp as an Alternative Feedstuff for Broilers: Effect on growth performance, carcass traits, digestive organs and Nutrient digestibility. *Journal of Applied Poultry Research*. 18(3):487 – 493.

Oderinde, R. A. & Tahir, O. A. (1988). Chemical investigation of Nigerian *Cyperus esculentus* (L) tuber for possible industrial applications. *Nigerian Journal of Science*. 22:70 – 73.

Omode, A.A., Fatoki, O.S. and Olaogun, K.A. (1995). Physiochemical properties of some underexploited and non-conventional oil seeds. *Journal of Agriculture Food and Chemistry*. 43: 2850-2853.

Pauzenga, U. (1985). Feeding parent stock. *Zootecnia International*. *Pp.* 22-24.

Steel, R. G. and Torrie, J. H. (1980). *Principles and Procedure of Statistics. A Biometrical Approach* 2nd edition Mc Graw Hill Book. Co. New York, U.S.A.479-489.

Udedibe, A.B.I., Anyaegbu, B.C., Onyechekwu, G.C. and Egbuokporo, O.C. (2004). Effect of feeding different levels of fermented and unfermented Cassava tuber meal on the performance of Broilers. *Journal of Animal Production*. 31:211 – 217.

Umar, H.A., Adamu, R., Dahiru, D. and Nadro, M.S. (2007). Levels of anti-nutritional factors in some wild edible fruits of Northern Nigeria. *African Journal of Biotechnology,* 6(16):1935-1938.