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Effect of Feeding Different Levels of Tigernut (*Cyperus esculentus* L) Meal on Growth of Broiler Chicks

L. A. Agbabiaka[1*], F. N. Madubuike[1], B. U. Ekenyem[1] and B. O. Esonu[2]

[1]Department of Animal Science and Fisheries, Imo State University, Owerri, Nigeria.
[2]Department of Animal Science, Federal University of Technology, Owerri, Nigeria.

Authors' contributions

This work was executed through the collaborations of all the authors. Author LAA designed the experiment, wrote the first draft and carried out the feeding trial. Author FNM carried out the laboratory analysis while authors BUE and BOE were responsible for literature and statistical analysis respectively. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

An investigation into the replacement value of tigernut meal as substitute for maize in diets of broiler starter was studied. Tigernut tubers were sundried for 5 days and milled to produce tigernut meal. This was used to replace maize at dietary levels of 0%, 25%, 50%, 75% and 100% represented by T_1, T_2, T_3, T_4 and T_5 respectively in five isonitrogenous diets containing 22% crude protein; the diet containing no tigernut meal was used as control (T_1). Three hundred day-old (Anak strain) chicks were randomly assigned to the five dietary treatments in a completely randomized design to determine the effect of the test ingredient on feed intake, body weight changes and feed conversation ratio. Result indicated that feed intake reduced as dietary level of tigernut increased in the diets ($p<0.05$), similar trend was observed for body weight changes. There was no significant difference among treatment groups for feed conversion ratio ($p>0.05$).The findings from this experiment suggested that tiger nut meal can replace maize up to 75% dietary level in diets of broiler starter chicks without compromising growth.

**Corresponding author: Email: adegokson2@yahoo.com;*

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1. INTRODUCTION

Poultry industry occupies a unique position in livestock sector of Nigeria because poultry species are highly prolific and are good converter of feeds. Udedibie et al. [1] suggested that, the best solution to Nigerian's protein intake particularly from animal origin is increased poultry production.

It has been reported that the major factor militating against increased poultry production and/or sustainable animal agriculture especially monogastrics such as poultry, rabbits and fishes is the non-availability of feed at economic price [2,3]. Most of the cereal concentrates are very costly being multi-purpose farm products and staple food for the ever-increasing human population, component of livestock feed and major raw-material in beer-brewing industry [4]. Consequently, the price has continued to rise because the demand far out-weighed supply.

In view of this problem, many attempts have been made at sourcing alternatives to maize as energy source in monogastric nutrition; for instance, cassava meal [5], *Napoleon imperialis* [6], cocoyam [7], wild variegated cocoyam [8], Maize cob [9] with varying degrees of success. Nevertheless, nutritional studies being a dynamic field therefore, necessitates the need to explore and harness the potentials of other energy feedstuffs that are environment friendly, cheap and readily available with less competition with humans. One of such plant is tigernut, a tuber crop primarily grown in Nigeria for its vegetable milk. It is rich in Omega 3 fatty acids with crude protein of about 9% reported by Belewu and Belewu [10]. There is paucity of information on its potential as feedstuff for broiler starter in tropical environment such as Nigeria.

This experiment was aimed at investigating the growth response of broiler starter chicks fed with different levels of tigernut meal diets as substitute for maize.

2. MATERIALS AND METHODS

2.1 Location of the Experiment

This study was carried out at the Teaching and Research Farm, Federal University of Technology, Owerri, Imo State of Nigeria. Owerri lies between latitudes 5º. 35'N and 6º.10'N and longitudes 6.40'E and 7º.11'E, 90m above sea level and has annual mean temperature of 32.18ºC, annual rainfall of 192-194cm and relative humidity of 77-78.42% annually [11].

2.2 Source and Processing of Experimental Materials

The tigernuts used for the study was purchased from the open market at "AMA-HAUSA" in Owerri. The tigernut seed were sundried for 4-5 days and passed through a hammer mill, to produce tigernut meal. The drying process was to reduce excess moisture so as to prevent rancidity of the material and growth of moulds.

Other conventional feed ingredients such as maize, fish meal, soya bean meal, wheat offal, bone meal, palm kernel meal, vitamin-premix, and salt were procured from Zion Farm Feed Mills, Egbu, Owerri, Imo State. A sample of tigernut meal and experimental diets were

subjected to proximate analyses (Tables 1 and 3) using standard procedures according to AOAC [12]. The tigernut meal was further subjected to phytochemical analysis for anti-nutritional substances using standard methods of Enujiugha and Olubunmi [13] presented in Table 4.

2.3 Experimental Diets

Five broiler starter experimental diets were formulated such that tigernut meal replaced maize at 0%, 25%, 50%, 75% and 100% dietary levels respectively. Other ingredients were similar in all the diets. Table 2 shows the ingredients composition of the experimental diets.

2.4 Experimental Birds and Design

Three hundred day – old Anak broiler chicks were procured from Obasanjo Farms Limited (Ogun State, Nigeria) and reared for two weeks; feeding them with commercial broiler starter diet before the commencement of the trial. The birds were divided into five groups of sixty chicks each and randomly assigned to the five diets in a completely randomized design (CRD). Each group was further sub-divided into three replicates of twenty chicks each and housed in a deep litter compartment measuring 6.0 x 4.0m^2. Feed and water were provided *ad-libitum* and other routine poultry management practices maintained.

2.5 Data Collection

Birds were weighed at the beginning of the experiment and thereafter on weekly basis. Feed intake was determined by obtaining the difference between the quantity of feed given and the quantity leftover the next morning, and feed conversion ratio computed accordingly. Economic analysis was calculated and the trial lasted for 21days.

2.6 Statistical Analysis

Data collected were subjected to analysis of variance procedures [14]. When significant differences were observed between treatments, means were compared using Duncan's new multiple range test as outlined by Obi [15].

Table 1. Proximate composition of tigernut meal (%DM)

Parameters	Chemical composition (%)
Moisture content	7.62 ± 1.03
Crude protein	8.44± 1.63
Ether extracts	27.71± 0.05
Crude fiber	11.69± 3.11
Ash	3.51± 1.03
Nitrogen free extract	41.03± 2.03

Table 2. Composition of experimental diets utilised in the feeding assay with broiler chicks

Ingredients	Dietary levels				
	0%	25%	50%	75%	100%
Maize	50.00	37.50	25.00	12.50	0.00
Tigernut meal	0.00	12.50	25.0	37.50	50.00
Soybean meal	25.00	25.0	25.0	25.0	25.0
Wheat offal	8.00	8.00	8.00	8.00	8.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Blood meal	2.00	2.00	2.00	2.00	2.00
Palm kernel meal	8.00	8.00	8.00	8.00	8.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vitamin/min. Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100.0	100.0	100.0	100.0	100.0
Cost/25kg feed(N)	2281.25	2240.50	2203.00	2185.50	2128.00

To provide the following per kg of diet:
Vit A; 1000 IU; Vit D;2000 IU, Vit E; 5 IU, Vitk, 2,250mg, Ribofiavin, 5,500mg, vitamin B 12, 15mcg, vitamin z, 100mg panthothenic acid; 7500mg, Nican,2,750mg, choline 300mg, folic, 4mg; mn,80mg; zn 50mg, iodine, 1.0mg; Cu, 10mg, Fe; 20mg.

Table 3. Proximate analysis of the treatment diets used in feeding assay with broiler chicks

Parameters	Dietary levels of Tigernut				
	0%	25%	50%	75%	100%
*Crude protein	22.91[a]	22.15[a]	22.20[a]	21.98[a]	20.73[a]
Crude Fat	4.33	4.52	4.77	4.60	5.07
Ash	5.30	5.43	5.60	6.68	6.51
Crude fiber	4.45	4.94	5.05	5.15	5.20
NFE	42.09	42.52	42.13	36.79	35.09
*ME (Kcal/kg)	2781	2863	2945	3027	3069

** ME = Metabolisable energy calculated, NFE= Nitrogen Free Extract. Means with same superscript on row not significantly different (p> 0.05)*

Table 4.Anti- nutrients of raw tigernut

Parameters	Chemical composition
Tannin (%)	1.59 ± 1.11
Saponin (%)	1.23± 0.03
Phytate (mg/g)	18.12± 3.02
PhytinPhytate (mg/g)	6.11± 1.02
Phenols (%)	1.31± 0.04

3. RESULTS

The proximate composition of tigernut is shown in Table 1, while the chemical analysis of the experimental diet is presented on Table 3. The performance of the experimental birds is summarized on Table 5.

3.1 Proximate Composition of the Test Ingredient

The crude protein content (CP) of tigernut meal is 8.44%, while values of 27.71, 11.69, 3.51 and 41.03% were obtained for crude lipid, crude fibre, Ash and soluble carbohydrate (NFE) respectively.

3.2 Proximate Analysis of Trial Diets

Control diet (T_1) had the highest crude protein value of 22.91%, while (T_2), (T_3), (T_4), and (T_5) have values of 22.15%, 22.20%, 21.98% and 20.73% respectively. The crude fat was lowest in the control diet (T_1) and highest in (T_5) with the value of 4.33%, and 5.07 respectively, crude fiber content of the trial feeds followed same trend as ether extract with the highest in T_5 (5.20%) and lowest in T_1 (4.45%).

3.3 Feed Intake

There was a significant ($P<0.05$) difference in feed intake among the treatment groups. The feed intake values of the groups were 90.00g, 90.00g, 76.67g, 83.33g and 70.00g for 0%, 25%, 50%, 75% and 100% respectively. The groups on the 0% and 25% replacement levels recorded the highest feed intake values of 90.0g each while the group on 100% replacement level recorded the lowest feed intake value of 70.0g.

3.4 Body Weight Gain

There was significantly difference ($P<0.05$) in body weight gain among the treatment groups. The daily body weight gain of the groups were 34.76g, 36.67g, 34.29g, 32.39g and 27.14g for 0%, 25%, 50%, 75% and 100% respectively. The group on 25% recorded the highest average daily weight gain of 36.67g while the group on 100% replacement level recorded the least body weight gain of 27.14g.

3.5 Feed Conversion Ratio

The feed conversion ratios of the birds were 2.59, 2.45, 2.24, 2.57 and 2.58 for 0%, 25%, 50%, 75% and 100% respectively. There was no significant different ($P>0.05$) among the treatment groups. The group on 50% replacement level recorded the best feed conversion ratio of (2.24) while the group on 0% replacement level recorded the poorest feed conversion ratio (2.59).

4. DISCUSSION

The feed intake of the experimental birds was influenced by dietary levels of protein, energy and fibre. The control diet (T_1) recorded the highest daily feed intake 90.0g while the least value of 70.0g was recorded from birds on 100% tigernut based diet T_5. The feed intake of

the broiler chicks decreased with increased dietary level of tigernut as replacement for maize in the diets (Table 5). This agrees with the reports that voluntary feed intake of chickens or monogastrics have been established to be a function of dietary fibre characteristics [16,17]. Replacing maize with wheat offal beyond 50% in broilers has also been reported to reduce chicken feed intake [18]. Feeding of high fibre feedstuff such as Tigernut might have resulted in gut filling in birds, hence, the observed decline in feed intake as observed by Dairo et al. [19].

Table 5. Performance of Broiler Starter fed graded levels of tigernut based diets

Parameters	Replacement levels					
	0%	25%	50%	75%	100%	SEM
Initial body weight (g)	220.00[a]	230.00[a]	230.00[a]	230.00[a]	230.00[a]	1.44
Final body weight (g)	950.00[a]	1000.00[a]	950.00[a]	910.00[a]	800.00[b]	6.32
Body weight gain (g)	730.00[a]	770.00[a]	720.00[a]	680.00[a]	570.00[b]	8.20
Daily weight gain (g)	34.76[a]	36.67[a]	34.29[a]	32.39[a]	27.14[b]	1.38
Daily feed intake (g)	90.00[a]	90.00[a]	76.67[b]	83.33[a]	70.10[b]	2.0
Feed conversion ratio	2.59[a]	2.45[a]	2.24[a]	2.57[a]	2.50[a]	0.30[a]

[ab]Means rows with different superscripts are significantly different (P<0.05)

Nevertheless, control diet, (T_1) contained relatively low metabolisable energy (ME) value of 2781 kcal/kg, while T_2, T_3, T_4 and T_5 have ME values of 2863, 2945, 3027 and 3069 kcal/kg respectively. This may also be responsible for the variations in feed intake as birds will continue to eat until the energy requirement is met [20]. There was a significant difference ($p< 0.05$) in feed intake between birds fed control diet and those fed tigernut based diet beyond 75% dietary level. The body weight gain of the birds showed similar pattern as the feed intake. There was a significant difference ($p< 0.05$) between the birds fed control diet and those fed 100% tigernut based diet. It was observed that T_5 (100% tigernut) diet has crude protein value (20.73%) slightly below the recommended range of 23 ± 1.0% crude protein by Olomu and Effiong [21], Onwudike [22] and Fetuga [23].

The reduction in crude protein content of the trial feeds might be due to the inferior crude protein content of tigernut (8.44%) as compared to maize (10%CP) according to Aduku [24] thereby reducing the dietary crude protein level as tigernut inclusion was increased in the experimental feeds especially in T_5 with 100% dietary inclusion of tigernut. Consequently, the poor performance of the birds in T_5 may have been due to inadequate dietary protein content of the feed coupled with high calorie level beyond the 3000 kcal/kg metabolisable energy recommended for broiler chicks in tropics [22,23]. The relatively high calorie feed increases heat increment of birds hence, reduces fed intake.

The relatively high metabolisable energy of tigernut based diets is attributed to high carbohydrate and crude fat content of the tigernut (Table 3.) with value of 4087 kcal/kg compared to 3432 kcal/kg ME of maize [24]. The poor performance of birds on 100% tigernut diet (T_5) may also be traced to the dilution of available nutrients by high fibre feedstuffs such as tigernut, which impair digestion and consequently unavailability of nutrients to the animals (monogastrics) fed such diets. The inherent anti-nutrients in tigernut such as tannins and phytate [25,26] may also contribute to the poor performance of broilers fed high dietary level of tigernut in their diets.

In order to determine the effect of feed intake and feed conversion ratio on body weight gain of broiler starter, a multiple regression analysis was applied. The coefficient of multiple

determination was 0.881 (88.1%) implying that the explanatory variables (feed intake and feed conversion ratio) jointly explained 88.1% of the variation in the dependent variable (body weight gain). The F-ratio (7.423) which determines the overall significance of a regression is not significant (P = 0.119). Consequently, the interpretation of the regression indicates that feed intake had a positive and significant effect on body weight gain of broiler starter chicks. This implies that as the feed consumed increased, the body weight gain of broiler starter birds increased too; and vice versa. Also, feed conversion ratio had a negative and insignificant effect on body weight gain of broiler starter chicks. This implies that as the feed conversion ratio increased the body weight gain of broiler starter decreased; and vice versa.

5. CONCLUSION

The findings from this experiment suggested that tiger nut meal can replace maize up to 75% dietary level in diets of broiler starter chicks without compromising growth.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Udedibie ABI, Alozie IL, Duru IH. Effects of 12 hour wetting of sun-dried cassava tuber meal on its HCN content, performance and haematological indices of broiler chicks. Animal Production Research Advances. 2007;3:1-5.
2. Esonu BO, Ogbonna UD, Anyanwu GA, Emenalom OO, Uchegbu, Etuk EB, Udedibie ABI. Evaluation of performance, organ characteristics and economic analysis of broiler fed dried rumen digester. International Journal of Poultry Science. 2006;5(2):1116-111
3. Agbabiaka LA, Madubuko CU, Anyanwu CN. Replacement value of tigernut meal (*Cyperus esculentus*) with maize in catfish (*Clarias gariepinus*) diets. Journal ofScience Research Reporter. 2012;2(2):160-164
4. Agbabiaka LA. Evaluation of tigernut meal (*Cyperus esculentus* L) as replacement for maize in diets of broiler chicks and African catfish *(Clarias gariepinus* Burchell, 1822) . Ph.D Thesis, Department of Animal Science and Fisheries. Imo State University, Owerri. Nigeria. 2012;174p
5. Udedibie ABI, Anyaegbu BC, Onyechekwa GC, Egbuokporo OC. Effect of feeding different levels of fermented and unfermented cassava tuber meals on performance of broilers. Nigerian Journal of Animal Production. 2004;31:211-219.
6. Uchegbu MC, OkoliIC, Etuk EB, Anyanwu GA, Esonu BO, Udedibi ABI. Performance, carcass and organ characteristics of finisher broilers fed graded levels of raw *Napoleona imperialis* seed meal. Livestock Research for Rural Development. 2004;16(6):24-30
7. Obikaonu HO, Udedibie ABI. Comparative performance of sun-dried and ensiled cassava peel meals as substitute for maize in broiler starter diets. International Journal of Agric and Rural Development. 2006;7(2):52-55.

8. Agbabiaka LA, Odoemenam SA and Esonu BO. Preliminary investigation on the potentials of wild variegated cocoyam (*Caladium hortulanum*) as replacement for maize in diets of catfish (*H. bidorsalis*) fingerlings. International Journal of Agric and Rural Development. 2006;7(1):138-142.
9. Anyaehie AA. Studies on exogenous enzyme supplementation on high fibre (maize-cob) soyabean based poultry diets. Ph. D Thesis. Imo State University, Nigeria. 2006;234p
10. Belewu MA, Belewu KY. Comparative physico-chemical evaluation of Tigernut, soybean and coconut milk sources. International Journal of Agriculture and Biology. 2007;9(5):785-787
11. Federal Ministry of Aviation. Department of Meteorology Services, Abuja, Nigeria. 2001.
12. AOAC, Official methods of Analysis. Association of Official Analytical Chemists (ed. K. Herrick) 16th ed. Washington DC. U.S.A; 1995.
13. Enujiugha VN, Olubunmi AO, Evaluation of nutrients and some anti- nutrients in lesser-known under-utilized oil seeds. International Journal of Food Science and Technology. 2003;38:1-4.
14. Snedecor GW, Cochran WG. Statistical Methods. 6th edition. Iowa State University Press, Ames, Iowa, USA.1978
15. Obi IU. Statistical methods of detecting djfference between treatment means. 2nd edition. Snaap Press, Enugu, Nigeria; 1990.
16. Sundu B, Kumar A, Dingle J. Response of birds fed increasing levels of palm kernel meal supplemented with enzymes. Australian Poultry Science Symposium. 2005;17:228-278
17. Fetufe AA, Akanbi IO, Saba GA, Olowofeso O, Tewe OO. Growth performance and nutrient digestibility of growing pigs fed a mixture of palm kernel meal and cassava peel meal. Livestock Research for Rural Development. 2007;19:180
18. NAPRI. National Animal Production Research Institute: Highlights of research achievements on animal feeds. Fed. Min. Sci. Tech., briefing , Lagos February. 1985;Pp18
19. Dairo FAS, Adesehinwa AOK, Oluwasola TA, Oluyemi JA. High and low dietary energy and protein levels for broiler chickens. African Journal of Agric. Research. 2010;5(15):2030-2038
20. Esonu BO. Effect of dietary cooked wild variegated cocoyam (*C. hortulanum*) on the performance of broiler chicken. Tropical Agriculture (Trinidad). 2001;77(4):269-272
21. Olomu JM, Effiong SA. The effect of different protein and energy levels and time of change from starter to finisher ration on the performance of broiler chicken in the tropics. Poultry Science. 1980;59:828-835
22. Onwudike OC. Energy and protein requirements of broiler chicks in humid tropics. Tropical Animal Production. 1983;8:39-44
23. Fetuga BL. Techniques in feed formulation. Paper presented at feedmill management Training workshop. Dept of Agric. Economics, University of Ibadan, Nigeria; 1984.
24. Aduku AO. Tropical feedstuffs analysis table. Department of Animal Science, ABU, Samaru, Zaria, Nigeria; 1993.

25. Eteshola E, Oraedu ACI. Fatty acid composition of tigernut tubers (*Cyperus esculentus* L), Baobab seeds (*Adasonia digitata* L) and their mixture. Journal America Oil Chem. Soc. 1996:73(2):255-257

26. Oladele AK, Oshundahunsi FO, Adebowale AY. Influence of processing techniques on the nutrients and anti-nutrients of tiger nut (*Cyperus esculentus*). World Journal of Dairy and Food Sciences. 2009;4(2):88-93.

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