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Evaluation of tiger nut (*Cyperus Esculentus*) waste as feed ingredient in broiler chicken diet

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***Target Audience**: Rural Small-scale poultry farmers, Nutritionist, Researchers*

Abstract

The poultry industry has been making valuable contributions to lessen the problem of malnutrition, particularly in the developing countries by providing consumers around the world with a cheap but high quality source of protein. This study was conducted to evaluate the effect of tiger nut (Cyperus esculentus) waste (TNW) as feed ingredient on the growth performance and carcass characteristics of broiler chicken. One hundred and twenty day-old Arbor acre strains of broiler chicken were assigned to four treatments with thirty birds per treatment, each treatment had 3 replicates of 10 birds each in a Completely Randomized Design. Dietary treatment included: basal diet + 0.0% TNW (T1), basal diet + 5% TNW (T2) basal diet + 10% TNW (T3) and basal diet + 15% TNW (T4). The study lasted for 7 weeks. Data were collected on growth performance and carcass quality using standard method. Significant means were separated using Duncan multiple range test at p≤0.05 level of significance. The final weight, feed intake and feed conversion ratio varied significantly (P<0.05) among treatments. Highest feed intake was obtained in T1 (3913.87g) and lowest value in T4 (3720.94g). However, highest weight was obtained in T2 (1825.33g), while the lowest value was obtained in T4 (1600.00g). No Significant (p> 0.05) difference was observed in primal cut part. Highest drumstick value of 10.36% was obtained in T2 and lowest value of 9.00% was obtained in T3. Highest breast weight of 26.73% was obtained in T2 and lowest value of 23.88% in T4. However, there was no significant differences (p>0.05) in organ weight. In conclusion TNW at 5% inclusion level in the diets of broiler chicken had no detrimental effect on performance and carcass quality.

***Keywords:** Broiler, tigernut waste, performance characteristics, carcass characteristics.*

Description of Problem

Poultry is highly dependent on grains and other feed ingredients normally utilized by man, they therefore competes directly with man for feed. Poultry farmers in developing countries are faced with various problems of feed shortage, high demand for grains and increase in prices of other feed ingredients in the poultry industry (1). The effects of these challenges have reflections on the quality and quantity of animal protein available for consumption. However, the cost of poultry production keeps on rising due to the high cost of feedstuffs, and this observable fact has led researchers to direct increased attention to non-conventional feeds (2). Although most of these non-conventional feedstuffs are good sources of protein and carbohydrate, their use by poultry is limited by the high fiber content and in some cases, the presence of toxic or anti-nutritional factors. According to (2), the search for lesser known and underutilized crops, many of which are potentially valuable animal feed has been intensified to maintain a balance between population growth and agricultural productivity, particularly in the tropical and sub-tropical areas of the world. The bulk of energy in broiler diet (3) is supplied by either

maize, sorghum or millet, and are in high demand as staple human food in most developing and developed countries; thus leading to high cost of grains for use in poultry feed. Agro-industrial by-products and crop residues, which represent a vast animal feed resource, have now been targeted by animal nutritionists because of their cost effectiveness. Considerable research has been, and still being carried out on the potential use of these by-products and crop residues but to date, very little effective practical application has been achieved.

Tiger nut *(Cyperus esculentus*) is one of the underutilized crops. According to (4), it is often cultivated for its nutritive edible nuts and has high content of soluble glucose of 21 % (4). Tiger nut is a grass-like plant of the family Cyperaceae (sedge), order Cyperales or Graminales (5). Like other sedges, the plant is most frequently found inhabiting wet marshes and edges of streams and ponds where it grows in coarse turfs (6). In Nigeria, tiger nut is well grown in the middle belt and northern region (7), where it is sold locally and consumed uncooked. According to (8), three varieties are cultivated i.e. yellow, brown and black. Among these, only two varieties; yellow and brown are readily available in Nigeria market (9). The medicinal benefits of tiger nuts are ascribed to a large number of nutritional components or constituents it contains. Sugar free tiger nut milk is suitable for diabetic patients (10). They are thought to be beneficial to those seeking to reduce cholesterol or lose weight (11). It is good for arteriosclerosis (12). Tiger nut milk is used in making soap and bath milk due to its high content of vitamin E, (13). It contains potassium (K) 267.18mg, phosphorus (P) 158.86 mg, calcium (Ca) 43.36 mg, magnesium (Mg) 118.14 mg, sodium (Na) 17.02 mg, copper (Cu) 0.54 mg, iron (Fe) 2.82 mg and zinc (Zn) 1.39 mg. It also contains vitamin A 0.87 mg and vitamin C 30.70 mg per 100g of sample (14).The oil of tiger nut (*C. esculentus*) is used for the production of biodiesel.

The research for lesser known and underutilized crops, which include tiger nuts, many of which are potentially valuable as human and animal food has been intensified to maintain a balance between population growth and agricultural productivity particularly in tropical and sub-tropical areas of the world (15). In spite of the numerous health benefits of tiger nut as human diet, its prospect as energy source for poultry and livestock production has not been delve into extensively (7). In view of this problem, many attempts have been made at sourcing alternatives to maize as energy source in monogastric nutrition. 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. There is paucity of information on the potential of its waste as feedstuff for broiler chicken in tropical environment such as Nigeria. The aim of this study therefore is to evaluate tiger nut waste (TNW) as feed ingredient in broiler chickens diets.

Materials and Methods

Location of study: The experiment was conducted at the Teaching and Research Farm of Department of Agriculture and Industrial Technology, Babcock University, Ilishan-Remo, Ogun State. Ilishan-Remo is in the rain forest of South Western Nigeria with mean rainfall of 2400 mm. It falls on latitude of 6E54'N from the equator and longitude 3E42'E from the Greenwich Meridian and the mean annual temperature is about 27^{o}C.

Sourcing of Experimental Material: The tiger nut waste (TNW) was obtained from a reputable tiger nut milk processor in Lagos

State. The TNW was air dried at room temperature for about 5-7 days and incorporated into broiler starter and finisher diet. Maize was replaced at 0%, 5%, 10% and 15% inclusion levels.

Experimental design, birds and housing: One hundred twenty day-old Arbor acre broiler chicks were procured from a reputable hatchery. They were brooded together for one week and randomly assigned into four (4) treatments adjusting for weight in a completely randomized design. Birds on each treatment were further divided into 3 groups (replicates) of 10 chicks each. The feed and water were supplied *ad libitum* for an experimental period of 49 days. Moveable wooden cages were washed, disinfected and left for two weeks prior to the arrival of the chicks. The experimental birds were vaccinated but not medicated.

Chemical analysis: Tiger nut waste was analyzed for moisture, crude fiber, crude protein, ether extract, nitrogen free extract and ash according to the methods of the (16).

Experimental Diets: Four experimental diets of broiler starter and finisher were formulated at the following inclusion levels of tiger nut waste (*Cyperus Esculentus*) T1 (control) -0%, T2-5%, T3-10%, T4-15%. The TNW was used for partial replacement of maize in the diet formulation (Table 1 and 2)

Table 1: Composition of broiler starter diet with graded levels of tiger nut waste

Ingredients	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)
Maize	54.50	51.77	49.04	46.31
Tiger nut waste	0.00	2.73	5.46	8.19
Fish meal (72%)	5.00	5.00	5.00	5.00
Wheat offal	3.00	3.00	3.00	3.00
Soya bean meal	30.00	30.00	30.00	30.00
Dicalcium phosphate	3.75	3.75	3.75	3.75
Soya oil	3.00	3.00	3.00	3.00
Salt	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Broiler premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
Crude Protein (%)	21.51	21.48	21.28	21.16
Crude Fiber (%)	2.88	3.40	3.90	4.42
Metabolisable Energy Kcal/Kg	3083.47	3030.32	3062.53	3052.06

Data collection

Data were collected on the performance parameters (Feed intake, Body weight gain, and Feed conversion ratio (FCR) and Live ability) and carcass characteristics of broiler chicken.

Liveability: This was calculated with the formula

Percentage liveability (%)

$$= \frac{\text{Number of live birds} \times 100}{\text{Number of birds per treatment}}$$

Carcass characteristics: At the end of seven weeks experimental period, six birds were randomly selected from each treatment, two (2) per replicate for the carcass characteristics. The selected birds were starved overnight and their live weights were recorded. Birds were slaughtered by bleeding the jugular vein

according to (17). Afterwards, they were defeathered, eviscerated and their respective weights were taken. The following parameters were recorded: thigh, wing, breast, drumstick and the organs (gizzard, liver and heart).

Statistical analysis: Data collected were subjected to analysis of variance (ANOVA) procedure using (18). Significant means were separated using (19) at $p \leq 0.05$.

Results and Discussions

Results of chemical analysis of tiger nut waste is as shown in table 3, it revealed that it is rich in energy (2624.71Kcal/kg) and fat (8.70 %). It is also a good fiber source as revealed by the high mean value of 21.45 %. It also contains protein (4.40%) and ash (2.40 %).

Table 2: Composition of broiler finisher diets with graded levels of tiger nut waste

Ingredients	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)
Maize	53.35	50.69	48.03	45.37
Tiger nut waste	0.00	2.66	5.32	7.98
Bone meal	2.10	2.10	2.10	2.10
Wheat offal	10.00	10.00	10.00	10.00
Soya bean meal	29.00	29.00	29.00	29.00
Limestone	1.60	1.60	1.60	1.60
Soya oil	3.10	3.10	3.10	3.10
Salt	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Toxin binder	0.10	0.10	0.10	0.10
Broiler premix	0.25	0.25	0.25	0.25
Calculated Analysis				
Crude Protein (%)	19.15	19.03	18.90	18.78
Crude Fiber (%)	3.06	3.59	4.12	4.66
Metabolizable Energy Kcal/Kg	3138.45	3127.61	3116.56	3105.98

Table 3: Proximate Composition of tiger nut waste

Parameter	Values
Protein (%)	4.40
Fat (%)	8.70
Moisture (%)	5.90
Fiber (%)	21.45
Ash (%)	2.40
Metabolizable Energy kcal/kg	2824.71

The proximate composition of tiger nut waste showed that it contains relatively low protein of 4.40% which implies that the TNW cannot be used as good source of protein in poultry production. The value of protein obtained in this study was higher than the value of 1.5% obtained by (20). However, (21) obtained higher value of 8.44% which might be attributed to processing method or mophotype of tigernut used. This might be attributed to the observed reduction in crude protein content of the feed as tiger nut inclusion was increased in the experimental feeds, especially, in T3 and T4 with 10% and 15% TNW inclusion. This is similar to the findings of (22). Consequently, the poor performance of the birds in T3 and T4 may have been due to inadequate dietary protein content of the feed. The relatively high calorie feed of the feed could have increased

the heat increment of the bird's thereby reducing feed intake. The high metabolisable energy of TNW based diets is attributed to high carbohydrate and crude fat content of the tiger nut waste (Table 3). Lower crude fibre value of 21.45% obtained in this study was lower than 24.0 % and 23.3% obtained in raw and roasted tiger nut by (23). However, (21) obtained a value of 11.65% which is lower than the value obtained in this study. More so, the high crude fibre content will help in food digestion by animals thereby enhancing optimal growth. The value obtained for ash in this trial for TNW indicated that it contained appreciable level of minerals. TNW are good source of energy as reveled by the high level of energy contained. Considering the current state of global food security crises TNW could be used in feed formulation as energy source in order to increase animal production and consequently increase global food production.

The poor performance of birds on 10 and 15% TNW diet (T3 and T4) may also be traced to the dilution of available nutrients by high fibre tiger nut waste which impairs digestion and consequently availability of nutrients to the birds (monogastric) fed such diets. The inherent anti-nutrients in tiger nut such as tannins and phytate (24), (7), may have also contributed to the poor performance of broilers fed high dietary level of TNW in their diets.

The growth performance of broilers are shown in Table 4.There was significant difference in the average feed intake of the birds fed experimental diet ($P<0.05$).The highest average feed intake of the birds was obtained from the control diet (3913.87g) while the least average feed intake was obtained from birds on T4 (3720.94g). This finding agreed with (21) who reported that the higher the inclusion levels of tiger nut meal in broiler diet, the lower the feed intake, although tiger nut waste was used in this trial. Significant differences were observed between the final weight of the birds fed experimental diet ($P<0.05$), T2 had the highest value (1825.33g) while T3 had the lowest weight (1600g). The feed conversion ratios of the birds were 2.27, 2.13, 2.34 and 2.30 for 0%, 5%, 10% and 15% respectively. The group on 5% replacement level recorded the best feed conversion ratio of (2.13) while the group on 10% replacement level recorded the poorest feed conversion ratio (2.34).

Table 4: Growth performance of broiler birds fed graded levels of tiger nut waste diets

Parameters	T1	T2	T3	T4	SEM
Final Weight (g)	1716.67^{b}	1825.33^{a}	1600.00^{c}	1616.67^{c}	52.04
Average feed intake (g/bird)	3913.87^{a}	3896.64^{b}	3751.37^{c}	3720.94^{c}	19.32
Initial weight at 1 week (g)	126.50	127.00	127.25	126.40	1.00
Feed conversion ratio	2.27^{a}	2.13^{b}	2.34^{a}	2.30^{a}	0.04
Mortality %	0.00	0.00	0.00	0.00	0.00

a, b, c means on the same row with different superscripts are significantly different ($P<0.05$).
SEM: Standard Error of Means.

The result on carcass characteristics (Table 5) showed that there were significant differences ($P<0.05$) in the live weight, defeathered weight, eviscerated percentages and dressing out percentages. However, values obtained for primal cuts showed no significant ($p>0.05$) differences for the thigh, drumsticks, wings and the breast percentages. The liver, heart and gizzard also did not exhibit any significant variations among the dietary treatments. The result indicated that the test ingredient had no negative effects on the carcass characteristics of the birds. Therefore, this findings agreed to the report of (24) who observed no significant

difference (p>0.05) in carcass evaluation, except the neck weight when the birds were fed graded levels of alkaline treated tiger nut residue.

Table 5: Carcass characteristics of broiler chickens fed graded levels of tiger nut waste

Parameters	T1	T2	T3	T4	SEM
Live weight (g)	1750.00[b]	1900.00[a]	1700.00[b]	1750.00[b]	43.30
De-feathered weight (g)	1620.00[c]	1790.00[a]	1609.00[c]	1670.00[b]	65.07
Eviscerated %	82.28[b]	83.16[a]	82.05[b]	82.06[b]	3.44
Dressed %	76.06[a]	75.78[a]	73.70[b]	64.62[c]	5.90
Primal cuts (%)					
Thigh	15.50	17.00	15.00	15.0	1.59
Drumstick	9.50	10.36	9.00	9.10	0.18
Wings	7.00	7.84	7.00	6.90	0.13
Breast	25.40	26.73	25.29	23.88	1.02
Organs					
Liver	1.37	1.64	1.35	1.20	0.26
Gizzard	1.97	2.10	1.94	1.93	0.26
Heart	0.50	0.60	0.58	0.46	0.08

a, b, c means on the same row with different superscripts are non-significantly different (P<0.05).SEM: Standard Error of Means.

Conclusion and Applications

1. The results obtained from this study amply demonstrated that tiger nut waste has relatively good nutritional composition, thus making it fitting for animal consumption at 5% inclusion level. This research has established from proximate analysis presented that tiger nut residue which are often regarded as waste materials has relatively good nutritional composition; fat, fiber, ash and energy which can be harnessed for use in monogastric nutrition, although at lower level of inclusion.
2. This will provide means of converting waste into wealth and cleaning up the environment of this solid waste especially considering the current increase in environmental pollution.

   Therefore, tiger nut waste could be incorporated in the diet of broilers at 5% inclusion level to reduce its effect as pollutant on our environment

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