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Feeding Replacement Levels of Maize With Tigernut *(Cyperusesculentus)* Sievate On The Performance Of Broilers

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Abstract
Background: *The performance of broilers fed varying replacement levels of maize with tigernut (Cyperusesculentus) sievate (TNS) as energy sources was investigated. Thefour diets utilized were: T_1 = 0% TNS + 100% maize; T_2 = 25% TNS + 75% maize; T_3 = 50% TNS + 50% maize and T_4 = 75% TNS + 25% maize respectively. T_1 = 0% TNS + 100% maize was used as control. One hundred and twenty (120) Zartech Cobb 500 broiler day-old chicks were randomly assigned to the four dietary treatments in a Complete Randomized Design to evaluate the effects of the test diets.*
Materials and Methods:*The experiment lasted for ten weeks from the brooding stage. Feed consumption and mortality rate were recorded daily while body weights were recorded on weekly basis. The performance parameters recorded were: feed intake, body weight gain, feed conversion efficiency and mortality.*
Results:*There was no significant difference ($P > 0.05$) in the initial body weight, while average final body weights, average body weight gain (g/birds), total feed intake, average daily feed intake and feed conversion efficiency were significantly different ($P < 0.05$). Mortality was affected ($P < 0.05$) by the dietary treatments with a decreasing inclusion of tigernutsievate.*
Conclusion: *The overall results showed that birds fed with 50% TNS + 50% Maize performed better than control and other dietary levels. It is therefore recommended that tigernutsievate can replace maize at 50% TNS + 50% Maize dietary levels.*

Keywords*: Maize, Tigernutsievate, Broilers, Performance.*

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I. Introduction

Broilers are poultry birds reared mainly for the purpose of meat production[1]. Broiler and other poultry birds form the major source of high-quality animal protein, accounting for about 36.6% of total protein intake by Nigerians[2]. Broiler production in Nigeria has been the most profitable enterprise intended to reduce the high rate of malnutrition resulting from inadequate protein consumption in the diets of humans[3]. Poultry production especially broiler production is one of the highest profitable investment in Nigeria agriculture with a net worth of two hundred and fifty billion naira[2].[4]opined that 30% of chicken consumed annually in Nigeria is produced locally and this has caused the country loosing close to six hundred billion naira to chicken importation and smuggling in addition to alarming health implications of consuming imported chicken. This condition is experienced not because the country does not have the technology to produce, but because of high cost of inputs and pricing especially the feed resulting in the nation consuming 1.5million tonnes of chicken annually and producing only 30% (450,000 tonnes) of it.This situation calls for more attention in ensuring that poultry production especially broiler production is being encouraged. The major focus of this encouragement must be in the area of feed formulation using cheap and available feed stuffs. This is imperative because the increase in price of feed ingredients in developing countries like Nigeria has greatly affected the rate of expansion of the poultry industry, making beneficiaries of poultry development few[5].In Nigeria, feed is a major factor affecting the net return from the poultry enterprise accounting for about 65-70% cost of broiler production[6]. The use of maize in feeding farm animals, its role in human feed as a stable food and use as alternative fuel in ethanol production have increased the demand for maize and hence, making it more expensive which has resulted in researchers exploiting other sources of energy for livestock rations[7]. It is therefore necessary to explore energy feed ingredients that can replace the conventional energy feed ingredients like maize without having any effects on the growth efficiency and performance of broilers. Consequently, the present reality in the Nigerian poultry industry in sourcing for alternative energy sources for maize has led to the need to work on the ability of other feed ingredients like tigernut (*Cyperusesculentus*) sievate (byproducts derived after its milk extraction) which is not valued by humans. Therefore, the objective of this study was to investigate the effects of feeding replacement levels of maize with tigernut*(Cyperusesculentus)* sievate on the performance of broilers.

II. Materials And Methods

The study investigated broilers fed varying replacement levels of maize with tigernut (Cyperusesculentus) sievate (TNS) as energy sources. Thefour diets utilized were: T_1 = 0% TNS + 100% maize; T_2 = 25% TNS + 75% maize; T_3 = 50% TNS + 50% maize and T_4 = 75% TNS + 25% maize respectively. T_1 = 0% TNS + 100% maize was used as control. A total of 120 Zartech Cobb 500 broiler day-old chicks were used for the study.

Study design: The Complete Randomized Design was used to evaluate the effects of the test diets on the experimental broiler birds.
Study Location: The experiment was conducted at the Teaching and Research Farm of Ignatius Ajuru University of Education, Ndele Campus, Rivers State (Latitude 4^0 58' N and Longitude 6^0 48' E), Nigeria[8].
Study duration: The experiment lasted for ten (10) weeks.

Source, collection and drying of tiger nut sievate

The tigernutsievate used for the study were collected from tiger nut milk producers located at Aluu, Isiokpo, Rumuekini and Ndele campus in Ikwerre, Obio/Akpor and Emohua Local Government Areas, Rivers State respectively. The sievate were air dried for two (2) weeks in a well-ventilated open room. After proper air-drying they were mixed with other feed ingredients to produce the broiler starter and finisher rations respectively.

Experimental birds, sanitary and management practices

The birds were brooded for four weeks with charcoal as heat source. They were assigned to four (4) dietary treatments and replicated three (3) times, with each replicate having ten (10) birds. The birds were reared in separate deep litter pens with the floor covered with wood shavings and also provided with feed and water *ad libitum*. Sanitary and management practices were carried out in the poultry house daily. These include, daily cleaning of the watering and feeding troughs, supply of fresh feed and water, changing litters periodically and regular sanitation of the research environment. Recommended vaccines and medications were administered to the birds as at when due.

Experimental diet

The air driedtigernutsievate were mixed withother feed ingredients such as maize, groundnut cake, soya bean meal, wheat bran, bone meal, limestone, lysine, methionine, salt, mineral and vitamin premix, palm oil at varying ratios to form the compounded experimental broiler starter and finisher diets. The purpose of the drying was to reduce excessive moisture from the sievate so as to avoid molds growth and emission of offensive odour of the material. Four experimental diets were formulated for the starter and finisher phases in order to replace maize with tigernutsievate at 0%, 25%, 50%, and 75% dietary levels respectively (Table 1). The 0% inclusion dietary levels of tigernutsievate were used as control diet.

Data collection

Data collected were based on the following performance parameters: feed intake, body weight gain, feed conversion efficiency and mortality rate of broilers. Data collection on body weight gain and feed conversion ratio were carried out on a weekly basis, while feed intake and mortality were carried out daily.

Chemical analysis

The proximate composition of the test feed ingredients: maize and tigernutsievate and the experimental diets were determined by the methods of[9].

Statistical analysis

The data obtained on performance parameters of the broilers were compared statistically on the basis of their different dietary treatments using Analysis of Variance (ANOVA) procedure for a Completely Randomized Design (CRD) (Obi, 2001). Significant means were separated using the Duncan's New Multiple Range Test [10].

Table 1: Experimental broiler starter and finisher rations.

Feed Ingredients (kg)	**Broiler Starter**				**Broiler Finisher**			
	T_1	**T_2**	**T_3**	**T_4**	**T_1**	**T_2**	**T_3**	**T_4**
Groundnut Cake	15.00	15.00	15.00	15.00	20.00	20.00	20.00	20.00
Maize (M)	**50.00**	**37.50**	**25.00**	**12.50**	**40.00**	**30.00**	**20.00**	**10.00**
Palm Kernel Cake	12.00	12.00	12.00	12.00	15.00	15.00	15.00	15.00
Palm Oil	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00
Soya Bean Meal	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Wheat Bran	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
TigernutSievate (TNS)	**0.00**	**12.50**	**25.00**	**37.50**	**0.00**	**10.00**	**20.00**	**30.00**
Bone Meal (Dicalcium Phosphate)	3.00	3.00	3.00	3.00	4.00	4.00	4.00	4.00
Lime stone	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Mineral/Vitamin Premix	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

T_1 = 0% tigernutsievate + 100% maize; T_2 = 25% tigernutsievate + 75% Maize; T_3 = 50% tigernutsievate + 50% maize and T_4 = 75% tigernutsievate + 25% maize respectively; Premix contained the following: (Univit 15 Roche) 1500 I.U, Vit A: 1500 I.U, Vit D: 3000 I.U, Vit E: 3.0g, Vit K: 0.3g, Vit B2: 8.0g, Vit B6: 0.3g, Vit B12: 3.0g, Nicotinic Acid: 5.0g, Ca-Pantothenate: 10.00g, Fe: 0.2g, AL: 3.5g, Cu: 0.15g, Zn: 0.02g, I: 0.01g, Co: 0.01g Se.

III. RESULTS

The proximate composition results of the broiler starter and finisher diets of tigernutseviate and maize at various replacement levels for the different experimental birds is presented in Table 2 and 3. The nutrient composition as presented by the proximate analysis of the formulated diets (T_1- 100%M + 0%TNS; T_2- 75%M + 25%TNS; T_3 – 50%M + 50%TNS and T_4- 25%M + 75%TNS) is a reflection of the individual nutrients (especially, CP and NFE).The experimental feeds at increasing replacement levels for tigernutseviate (T_2- 75%M + 25%TNS; T_3 – 50%M + 50%TNS and T_4- 25%M + 75%TNS) with commensurate CP levels possessed higher CP in the formulated diets.The NFE composition was higher for the T_1- 100%M + 0%TNS diets and decreased at the increased levels of tigernutseviate replacement with maize for both the broiler starter and finisher diets.The metabolizable energy (ME) values for the experimental broiler starter and finisher diets were 2,805.00 – 2,905.00 kcal/kg and 2,974.86 – 3,223.51 kcal/kg respectively.

Table 2: Proximate composition (g/100g Dry matter) of broiler starter diets of Tigernut residues and maize at various replacement levels.

Parameters	**T_1 (0% TNS + 100% M)**	**T_2 (25% TNS + 75% M)**	**T_3 (50% TNS + 50% M)**	**T_4 (75% TNS + 25% M)**	**Mean**	**SEM±**
Crude protein (CP)	19.00^{ab}	19.06^{ab}	19.31^{a}	18.75^{b}	19.03	0.42
Ash	13.98^{d}	15.13^{a}	15.02^{b}	14.96^{c}	14.77	0.04
Ether extracts (EE)	8.00^{b}	7.96^{b}	8.90^{a}	6.06^{d}	7.73	0.28
Crude fibre (CF)	6.00^{d}	12.77^{b}	9.50^{c}	13.28^{a}	10.39	0. 42
Nitrogen free extracts (NFE)	53.02^{a}	45.08^{c}	47.27^{b}	46.95^{bc}	48.08	2.05
**ME (kcal/kg DM)	$2,905.00^{a}$	$2,875.00^{b}$	$2,900.00^{a}$	$2,805.00^{c}$	2,871.25	20.06

$^{a,b\&c}$Means bearing different superscripts along the same row are significantly different (P< 0.05);**ME (kcal/kg) = (35 × % CP) + (81.8 × % EE) + (35.5 × % NFE)[13].

Table 3: Proximate composition (g/100g Dry matter) of broiler finisher diets of Tigernut residues and maize at various replacement levels

Parameters	T_1 (0% TNS + 100% M)	T_2 (25% TNS + 75% M)	T_3 (50% TNS + 50% M)	T_4 (75% TNS + 25% M)	Mean	SEM±
Crude protein (CP)	15.45b^{c}	14.75^{c}	18.32^{a}	16.56^{b}	16.27	1.52
Ash	8.00^{b}	10.5^{a}	8.55^{b}	11.00^{a}	9.51	0.75
Ether extracts (EE)	5.00a	4.55	4.75	4.05	4.59	0.25
Crude fibre (CF)	7.50^{c}	9.50^{b}	10.00^{ab}	10.25^{a}	9.31	1.07
Nitrogen free extracts (NFE)	64.05^{a}	60.70^{a}	58.38^{b}	58.14^{b}	60.32	2.05
**ME (kcal/kg DM)	3223.51^{a}	3043.29^{b}	3102.24^{b}	2974.86^{c}	3,085.98	101.04

$^{a,b\&c}$Means bearing different superscripts along the same row are significantly different (*P*< 0.05);**ME (kcal/kg) = (35 × % CP) + (81.8 × % EE) + (35.5 × % NFE)[11].

Theoverall performance of broiler chickens fed the experimental diets with varying replacement levels of tigernut residues and maize: T_1 - 0% TNS + 100% M, T_2 - 25% TNS + 75% M, T_3 - 50% TNS + 50% M, T_4 - 75% TNS + 25% M is presented in Table 4.

The initial body weights of the broiler given to the different experimental diets were not significantly (*P* > 0.05) different. However, the other performance parameters such as, average final body weight, average body weight gain (g/bird), total feed intake, average daily feed intake and feed conversion efficiency were significantly (*P*< 0.05) different. The average final body weights of the broiler chicks were in the order of 2,330.00; 2,340.00; 2,600.00 and 2,650.00 g/bird for T_4 (75% TNS + 25% M), T_1 (0% TNS + 100% M), T_2 (25% TNS + 75% M) and T_3 (50% TNS + 50% M) respectively. The highest weight among the birds was recorded by T_3 - 50% TNS + 50% M (2,650.00 g/bird), while the least weight was recorded by T_4 - 75% TNS + 25% M (2,330.00 g/bird). The trend in the average final weights of the birds increased with the increasing levels TNS inclusion in the broiler diets except for the T_4 (75% TNS + 25% M) group. Thus, birds of the T_3 - 50% TNS + 50% M (2,650.00 g/bird) group exhibited better terminal body weights when compared to the control group (T_1 - 0% TNS + 100% M) with average final body weights of2,340.00 g/bird.

The total and daily feed intake of the broiler given the various experimental diets were significantly (*P* < 0.05) different. The total feed intake of the broiler chicks was in the order of 7,259.00; 7,740.00; 7,963.00 and 8,040.00 g/bird for T_1 - 0% TNS + 100% M; T_2 - 25% TNS + 75% M; T_4 - 75% TNS + 25% M and T_3 - 50% TNS + 50% M.

The feed efficiency of birds fed the experimental diets were significantly (*P*< 0.05) different. The feed efficiency of the broilers was 0.23, 0.25,0.26 and 0.27 for T_4 - 75% TNS + 25% M, T_1 - 0% TNS + 100% M, T_3 - 50% TNS + 50% M and T_2 - 25% TNS + 75% M respectively. Although, T_2 - 25% TNS + 75% M, T_3 - 50% TNS + 50% M and T_1 - 0% TNS + 100% M are statically not different.

The result of the study further revealed that mortality was affected (*P*< 0.05) by the dietary treatments with a decreasing inclusion of tigernutseviate (T_1 - 0% TNS + 100% M) and T_2 - 25% TNS + 75% M as observed in mortality of 13% and 10% respectively in the treatment groups.

Table 4: Performance of broilers fed diets of tigernutseviate and maize at various replacement levels.

Parameters	Treatments					
	T_1 (0% TNS + 100% M)	T_2 (25% TNS + 75% M)	T_3 (50% TNS + 50% M)	T_4 (75% TNS + 25% M)	Mean	SEM±
Average Initial weight (g/bird)	500.00 ^{ns}	500.00 ^{ns}	500.00 ^{ns}	500.00 ^{ns}	500.00	0.01
Average Final Body weight (g/bird)	2,340.00 ^{c}	2,600.00 ^{b}	2,650.00 ^{a}	2,330.00 ^{c}	2,480.00	48.70
Average Body weight gain (g/bird)	1,840.00 ^{c}	2,100.00 ^{b}	2,150.00 ^{a}	1,830.00 ^{c}	1,980.00	48.70
Average Daily Body weight gain (g/bird)	26.29 ^{b}	30.00 ^{a}	30.71 ^{a}	26.14 ^{b}	28.29	0.79
Total feed intake (g/bird)	7,259.00 ^{c}	7,740.00 ^{b}	8,040.00 ^{a}	7,963.00 ^{a}	7,751.00	117.17
Average Daily feed intake (g/bird)	103.70 ^{c}	110.57 ^{b}	114.86 ^{a}	113.78 ^{a}	110.73	1.66
Feed Efficiency (Gain/Intake)	0.25 ^{a}	0.27 ^{a}	0.26 ^{a}	0.23 ^{b}	0.25	0.02
Mortality	4 ^{a}	3 ^{b}	0 ^{c}	0 ^{c}	1.75	1.05
% Mortality	13.00^{a}	10.00^{b}	0.00^{c}	0.00^{c}	5.75	2.05

[a,b&c]Means bearing different superscripts along the same row are significantly different ($P< 0.05$); ns = Non-significant.

IV. DISCUSSION

The differences in the nutrient composition of the experimental broiler starter and finisher diets presented in Table 2 and 3 respectively may be attributed to the variations in the replacement levels of tigernutseviates with maize. For instance, the nutrient composition as presented by the proximate analysis of the formulated diets (T_1- 100%M + 0%TNS; T_2- 75%M + 25%TNS; T_3 – 50%M + 50%TNS and T_4- 25%M + 75%TNS) is a reflection of the individual nutrients (especially, CP and NFE). Hence, the experimental feeds at increasing replacement levels for tigernutseviate (T_2- 75%M + 25%TNS; T_3 – 50%M + 50%TNS and T_4- 25%M + 75%TNS) with commensurate CP levels possessed higher CP in the formulated diets. On the contrary, the NFE composition was higher for the T_1- 100%M + 0%TNS diets and decreased at the increased levels of tigernutseviate replacement with maize for both the broiler starter and finisher diets. However, the range of CP content (18.75 – 19.31%) for the formulated experimental broiler diets was lower than the range of CP content (23 – 25%) recommended by[12]for starter broiler chickens. In the same way, the range of CP content (14.75 – 18.32%) for the formulated experimental broiler finisher diets was lower than the average CP content (19.00%) recommended by[13] while determining the minimum crude protein level of broiler finisher rations in the tropics. Furthermore, the metabolizable energy (ME) values of 2,805.00 – 2,905.00 kcal/kg and 2,974.86 – 3,223.51 kcal/kg for the experimental broiler starter and finisher diets respectively, were within the values 2,800kca/kg recommended by[13] for starter broilers and 3,200kcal/kg metabolizable energy for finisher broilers recommended by [13].

Theoverall performance such as, average final body weight, average body weight gain (g/bird), total feed intake, average daily feed intake and feed conversion efficiency were investigated.

The highest weight among the birds was recorded by T_3 - 50% TNS + 50% M (2,650.00 g/bird), while the least weight was recorded by T_4 - 75% TNS + 25% M (2,330.00 g/bird). The trend in the average final weights of the birds increased with the increasing levels TNS inclusion in the broiler diets except for the T_4 (75% TNS + 25% M) group. Birds of the T_3 - 50% TNS + 50% M (2,650.00 g/bird) group exhibited better terminal body weights when compared to the control group (T_1 - 0% TNS + 100% M) with average final body weights of2,340.00 g/bird. The variations in the final weights of the birds may be attributed to the variations in the metabolizable energy (ME) of the different feeds as birds fed with diets containing higher metabolizable energy (ME) tend to eat and grow better. This is agreement with findings as reported by[14] that diets of high energy bring about fast growth. Similarly, the findings of this study are in agreement with the findings of [15] who reported a better body weight and weight gains in layers fed cassava peel meal (CPM) levels at 0%, 25% and 50% respectively.

The result of the feed intake of the broilers revealed relationship between voluntary feed intake and caloric content of the experimental broiler diets. Thus, the T_3 - 50% TNS + 50% M group with higher energy (3,001.12 kcal/kg DM – average values for starter and finisher diets) exhibited a higher feed intake to content with their energy requirements. This is because animals will eat high-energy diet in an attempt to cancel out energy deficit [16].

The feed efficiency results implied that the T_2 - 25% TNS + 75% M (0.27) and T_3 - 50% TNS + 50% M (0.26) diets were better utilized, thus resulted in increased body weight gain. This observation agreed with the findings of [17] and [18] whose reports stated that the higher the weight gain to feed intake (feed efficiency) or the lower the feed intake to weight gain (feed conversion ratio), the better the diet.

The higher inclusion rates oftigernutseviate as observed inT_3 - 50% TNS + 50% M and T_4 - 75% TNS + 25% M groups with 0% mortality respectively agree with its relevant health benefits [19] because of the nutritional composition of the tiger nut residues which can improve the wellbeing of animals [20].

V. Conclusion

The performance parameters (final body weight, weight gain, feed intake, feed efficiency and mortality) investigated based on the experimental diets revealed that the broilers fed T_3 - 50% TNS + 50% M had better performance characteristics compared to the other experimental groups. It is therefore recommended that tigernut substitution for maize, especially at the T_3 - 50% TNS + 50% M be utilized based on the performance characteristics of the broilers.

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