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Growth performance, carcass and organ characteristics of grower pigs fed varying levels of tigernut (Cyperus Esculentus) seed meal

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Target Audience: Nutritionist, physiologists, Researchers

Abstract

Eight weeks feeding trial involving 20 Large White × Landrace cross was carried out to evaluate the effect of tigernut meal based diets on the growth performance, carcass and organ characteristics of growing pigs. Five experimental diets were formulated to incorporate tigernut meal as maize substitute at 0%, 12%, 24%, 36% and 48% for T_1, T_2, T_3, T_4 and T_5 respectively. Pigs were allotted to these five treatment diets with four pigs per treatment in a completely randomized design (CRD). Results of performance indices revealed that pigs on treatment two diet (12% tigernut) had the best final body weight, daily weight gain, feed intake and feed conversion ratio. Carcass characteristics of pigs showed significant ($p<0.05$) differences in live weight, carcass weight, back fat, abdominal fat and carcass length while there were no significant differences ($P>0.05$) in cut parts (ham, hand and shoulder, hind leg and trotters). Organ indices decreased as the level of tigernut increased in the diet. In conclusion, incorporating tigernut meal at 12% and 48% levels in growing pigs diet resulted in better performance and carcass values suggesting that tigernut could be used in pig's diet without any deleterious effect on these production functions.

Key words: Grower pigs. Growth performance. Carcass characteristics. Tigernut

Description of Problem

Profitability of pig enterprise depends on efficient use of feed for lean tissue growth and the rate of growth (1). Feed is the largest cost element in the production of pigs; it contributes about 75-80% of the cost of production (2). The continued increase in the price of conventional feed ingredients in Nigeria has led to an increase in the total cost of intensive pig production. The resultant effect is high cost of animal protein hence inability of the populace to meet the minimum dietary protein intake of 56g per person per day as recommended by FAO (3). Energy sources are those feed ingredients that contain less than 18% crude protein on dry matter basis (4), the cereals and some of their byproducts, starchy roots, fats and oil, sugar and syrup fall into this category.

Maize is one of the costly conventional feed ingredients in pig production particularly in the tropics where demand for maize for human consumption is very high and the production and yield is low (5). The focus in livestock industry today is the search for alternative feed ingredients, which could substitute maize directly or could be incorporated at certain levels to attain a comparable quality with the conventional maize, which must not be deleterious to the health of the animal (5).

Various researchers have evaluated most of the under-utilized feed resources both energy and protein feed ingredients in pigs and poultry such as tigernut (6), *Adenanthera pavonina* (7), palm oil sludge (8), *Anthonatha*

macrophylla (9), wild variegated cocoyam (10) and tigernut (11). Increased crude protein and fibre digestibility as the level of tiger nut increased in the diet for West African dwarf goats have been reported (12). There was also report of better carcass yield and low cost of feed consumed when 33.3% tiger nut was used to replace maize in the diet of cockerels (13).

Tigernut (*Cyperus esculentus L*) is widely cultivated and used as feed supplement in the Arabian Peninsula, Spain, East Africa, and many West African countries including Nigeria (14) and has been reported to be rich in energy while its oil content (about 25%) is resistant to peroxidation (12). It has excellent nutritional qualities with a fat composition similar to olive oil and very rich in minerals, especially phosphorus and potassium (15). The nut is also fairly rich in mineral content such as Sodium, Calcium, Potassium Magnesium, Zinc and traces of Copper (16). The use of tiger nut would be possibly another cheaper energy source for pig production. It would also reduce high competition for maize and other grains by human beings and non-ruminant animals. Tigernut has been reported to be eaten raw, fermented and processed as beverages. It has the medicinal quality of preventing colon cancer, heart attack and diabetes (12).

This study was therefore undertaken to evaluate the effect of tigernut meal on the growth performance, carcass and organ characteristics of growing pigs.

Table 1: Composition of experimental diets with graded levels of Tigernut

	Tigernut Inclusion Levels in Diets (%)				
Ingredients	T_1	T_2	T_3	T_4	T_5
Maize	48.00	36.00	24.00	12.00	0
Tigernut	0	12.00	24.00	36.00	48.00
Soyabean meal	15.00	15.00	15.00	15.00	15.00
Palm kernel cake	16.00	16.00	16.00	16.00	16.00
Rice bran	10.00	10.00	10.00	10.00	10.00
Blood meal	5.00	5.00	5.00	5.00	5.00
Fish meal	2.75	2.75	2.75	2.75	2.75
Bone meal	2.00	2.00	2.00	2.00	2.00
Premix*	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Calculated composition					
Crude protein (%)	19.95	19.56	19.2	18.85	18.49
DE (MJ/kg)	13.03	13.02	13.11	13.00	13.01
Determined composition (%)					
Dry matter	89.88	87.08	86.99	86.54	90.97
Crude protein	18.00	18.05	18.23	17.56	19.00
Crude fibre	8.02	9.00	11.57	13.00	14.1
Ether extract	5.01	5.53	5.65	5.05	8.54
Ash	12.25	12.17	10.21	10.68	10.68
NFE	46.6	42.33	41.33	40.25	40.65

*Vitamin mineral premix provides per kg diet: vit. A, 13.340 iu, vit D_3 2680 iu, vit E $_{10}$ iu, vit. K, 2.68 iu, Calcium panthonate, 10.68mg, vit. B_{12} 0.022mg; Folic acid, 0.668mg; Choline Chloride 400mg; Chlorotetracycline, 26-28mg; Manganese, 133.34mg; Iron, 66.68mg; Zinc, 53.34mg Copper, 3.2mg; Iodine, 1.86mg; Cobalt, 0.268mg; Selenium, 0.108mg.

Materials and Methods

Experimental location:

This research was conducted at the Piggery Unit of the Teaching and Research Farm of Abia State University, Umudike location. Umudike bears a coordinate of 7°31¹ East and 5°28¹ North, and lies at an altitude of 122 meters above sea level (17).

Procurement of Tigernut and Pigs

Tiger nuts were procured from the Hausa community in Umuahia while other ingredients were purchased from livestock feed dealers in Umuahia. Pigs were obtained from the Teaching and Research Farm of Abia State University, Umudike location.

Experimental Design

A total number of 20 pigs were housed with an average live weight of 22.64kg and 17 weeks of age. The pigs were randomly allotted to five treatment diets with four pigs per treatment in a completely randomized design (CRD). Each pig was housed in an individual replicate pen and was allowed to acclimatize 7 days and fed basal diet before the commencement of the experiment. Standard routine management practices were employed during the experiment.

Table 2 Performance of growing pigs fed graded levels of tigernut

	Tigernut Inclusion Levels in the Diets (%)					
Parameter	T_1 (0)	T_2 (12)	T_3 (24)	T_4 (36)	T_5 (48)	SEM
Initial weight (kg)	22.38	22.50	23.62	22.22	22.50	0.44
Final weight (kg)	50.00^b	60.75^a	47.00^c	48.00^c	59.00^a	0.90
Daily weight gain (kg)	0.46^b	0.64^a	0.39^c	0.43^b	0.61^a	0.02
Daily feed intake (kg)	1.52^a	1.54^a	1.31^c	1.21^d	1.34^b	0.01
FCR	3.30^a	2.09^c	3.36^a	2.81^b	2.36^c	0.11

^{abcd} Means in the same row with different superscripts are significantly different (P<0.05), FCR = Feed conversion ratio, SEM = standard error of means

Table 3 Carcass characteristics of pigs fed graded levels of tigernut

	Tigernut Inclusion Levels in the Diets (%)					
Parameter	T_1 (0)	T_2 (12)	T_3 (24)	T_4 (36)	T_5 (48)	SEM
Liveweight (kg)	50.00^b	65.75^a	47.00c	48.00^c	59.00^a	0.90
Dressed percentage (%)	57.20^b	58.37^a	56.13^c	47.87^e	48.80^d	0.76
Carcass weight (kg)	28.60^b	35.00^a	26.40^c	23.00^d	28.80^b	0.39
Ham (%)	34.19	31.62	33.49	34.71	35.75	1.49
Hand and shoulder (%)	35.81	37.90	36.48	36.15	31.85	1.25
Hind leg (%)	3.59	4.86	4.67	5.49	4.98	0.40
Trotters (%)	4.53	4.87	5.23	5.17	4.47	0.38
Back fat thickness (%)	2.00^a	1.50^b	1.50^b	1.30^c	1.00^d	0.11
Abdominal fat (%)	3.00^a	1.80^c	2.00^b	1.20^d	0.80^e	0.10
Carcass length (cm	43.0^b	45.0^a	39.0^c	34.0^e	36.0^d	1.27

^{abcd} Means in the same row with different superscripts are significantly different (P<0.05) SEM = Standard error of means

Experimental Diets

Diets were formulated to meet the nutrient requirements of the grower pigs. Five experimental diets were formulated to contain varying levels of tiger nut. Treatment one (T_1) was the control without tiger nut while treatments T_2, T_3, T_4 and T_5 contained 12%, 24%, 36% and 48% tiger nut respectively. Gross composition of the experimental diets and the proximate composition are presented in Table 1

Data Collection

Initial weights were taken and subsequent live weights were recorded weekly using a hanging spring balance. The pigs were fed *ad libitum* with free access to water. Total weight gain was calculated as final weight minus initial live weight. Feed intake was obtained as the difference between the total quantity of feed offered and the quantity not consumed.

Carcass evaluation:

The experiment lasted 60 days after which 3 out of the 4 pigs in each treatment were fasted for 24 hours but were given drinking water. The pigs were weighed, stunned with a metal rod and bled completely. No mortality was recorded throughout the period of the experiment.

After stunning, the animal was suspended by its hind legs and a cut was made on the neck to allow complete bleeding, the slaughtered animals were skinned, the head, trotters, tail, intestinal contents and organs were removed. The remaining carcass was weighed using a 100kg capacity weighing balance and expressed as percentage of the live weight. The organs were weighed using a sensitive weighing balance. Back fat thickness was measured at the 1^{st} and 4^{th} ribs with venier calipers. The carcass length was measured from the anterior tip of the pubic bone to the anterior edge of the first rib.

Chemical analysis

Chemical analysis of the experimental diets and tiger nuts were determined according to the method of (18).

Statistical analysis:

Data on live weights, carcass quality and organ characteristics were subjected to analysis of variance using SPSS package version 21. Significant differences were observed at 0.05 levels, means were separated using Duncans' new multiple range test as outlined in (19).

Results and Discussion

The results for the proximate compostion of tigernut are stated as follows: Dry matter (90.51), crude protein (6.02%), crude fibre (13.56%), ether extract (15.08%), ash (4.075) and nitrogen free extract (51.78%).

The results of performance characteristics of pigs fed tigernut are presented in Table 2. There were significant differences ($P<0.05$) in all the performance parameters measured. Pigs fed 12% tigernut had the highest final weight (60.75kg), which was similar ($p>0.05$) with pigs fed 48% tigernut but differed significantly ($P<0.05$) from pigs on the control (0%), T_3 (24%) and T_4 (36%) tigernut. Pigs on T_2 (12% tigernut) also recorded highest daily weight gain (0.64kg) and daily feed intake (1.54kg) compared to other treatments. This significant increase in final body weight, daily weight gain and feed intake observed in pigs on T_2 (12% tigernut) indicated that pigs on this treatment obtained adequate intake of nutrient required to sustain rapid growth and development (20). This report also agreed with the findings of (21) who reported that higher energy diets support growth rate in pigs and efficient feed utilization than the low energy diets. The feed intake of experimental pigs decreased as the level of tigernut increased in the diet. This could be attributed to inherent high fiber content of tigernut, thus agreeing with earlier reports (22, 23) that feed intake of

non- ruminants is influenced greatly by dietary fiber characteristics. The feed conversion was better in pigs fed T_2 (12%) and T_5 (48%), Pigs on T_2 and T_5 required less feed (2.09kg) and (2.36kg) respectively to gain 1kg weight, indicating that tigernut could be incorporated in growing pigs diet as a better energy feed alternative to maize.

The carcass characteristics of growing pigs fed graded levels of tigernut are presented in Table 3.

Dietary inclusion of tigernut significantly ($P<0.05$) affected the liveweight, carcass weight, dressing %, back fat thickness, abdominal fat and carcass length of the experimental pigs. The obtained results showed higher liveweight recorded in pigs fed T_2 followed by T_5, T_4, and T_3 respectively which corresponded with high dressed weight (35.00kg) in pigs fed T_2 thus agreeing with the report of (24) who confirmed that heavy pigs produced greater dressed weight. Pigs on T_2 had the highest dressed percentage (58.37%), which was statically different ($p<0.05$) from pigs on T_1, T_3, T_4 and T_5. The carcass weights obtained ranged from 23.00kg-35.00kg, Pigs on T_2 had the highest carcass weight compared to those on other treatments and the control. This could be a resultant effect of high liveweight obtained in pigs on T_2 in relation to pigs fed T_1, T_3, T_4 and T_5. The ham, hind legs, trotters, hand and shoulders were not significantly ($P>0.05$) affected by the various dietary treatments, this implied that the use of tigernut in pigs' diet is not likely to adversely affect these carcass traits. The non significant values obtained in this study for ham, hands and shoulder weights of pigs fed tigernut which was expected to increase in relation to increased liveweight and body gain contradicts the reports of (1, 25) who reported increased weight of these cut parts with increased liveweight. Back fat thickness is used as an index for degree of fatness in pigs, in this research, back fat thickness declined as tigernut increased in the diet, this could be attributed to the high fibre content of the test ingredient as high fibre foodstuff is associated with lowering body fats, obesity and diabetics (26). This agreed with the finding of (24) who reported that high fibre diets reduce fat thickness in pigs. The trend in back fat thickness also agreed with the findings of (27) who reported reduced back fat thickness in pigs fed *Moringa oleifera* leaf meal. Pigs fed T_5 (48%) tigernut had the least back fat thickness (1.00) which was significantly ($P<0.05$) different from other treatments. This further suggests that when pigs are fed on a tigernut based diet, it possibly could reduce the overall fat content of the pork.

The values for abdominal fat recorded in this research ranged from 0.80-3.00. Pigs fed T_5 (48%) had the least abdominal fat of 0.80, which differed significantly from pigs on the control diet and other treatments. The abdominal fat values decreased with an increase in tigernut inclusion in the diets, the significant decrease ($P<0.05$) could suggest that pigs on tigernut diet have the advantage of producing lean carcass compared to those on the control diet. Incorporating tigernut in pigs' diet may enhance the lipid profile of the resultant product (pork) due to its high fibre content as it was reported that dietary fibre often has beneficial effects on the lipid profile and glucose metabolism (28).

Organ characteristics of pigs fed graded levels of tigernut are presented in Table 4.

There were significant differences ($P<0.05$) in all the organ parameters measured. The values for heart, liver and gall bladder, kidney and spleen were significantly higher ($P<0.05$) in pigs fed T_1 diet (Control) compared to those on T_2 (12%), T_3 (24%), T_4 (36%) and T_5 (48%). The organ weights generally decreased as tigernut increased in the diet. The decrease in the values obtained could be an indication that tigernut did not affect the functions of these organs. Some known factors

may influence visceral organ size, such factors include body weight, feeding level, diet composition and pig genotype (29). Variability in carcass weight may also have contributed to the differences observed in the visceral organs.

Table 4 Organ Characteristics of grower pigs fed graded levels of tigernut

	Tigernut Inclusion Levels in the Diets (%)					
Parameter (%LWT)	T_1 (0)	T_2 (12)	T_3 (24)	T_4 (36)	T_5 (48)	SEM
Heart	0.78^{a}	0.26^{d}	0.30^{c}	0.39^{b}	0.31^{c}	0.01
Liver and gall bladder	3.15^{a}	0.88^{b}	0.89^{b}	0.45^{c}	0.44^{c}	0.04
Kidney	0.28^{a}	0.10^{d}	0.17^{c}	0.21^{b}	0.17^{c}	0.02
Spleen	0.20^{a}	0.15^{c}	0.23^{a}	0.17^{d}	0.18^{c}	0.03
Small intestine	2.43^{d}	2.15^{e}	4.03^{b}	4.14^{a}	3.03^{c}	0.10
Large intestine	2.02^{c}	1.65^{d}	3.19^{a}	3.10^{a}	2.53^{b}	0.18
Empty stomach	2.03^{d}	4.29^{b}	4.89^{a}	2.89^{c}	1.68^{e}	0.14

^{abcd} Means in the same row with different superscripts are significantly different ($P<0.05$) SEM = Standard error of means; %LWT = % liveweight.

Conclusion and Application:

This study revealed that:

1. Tigernut could be used in growing pigs' diets without adverse effect on their performance, carcass and organ indices, thus posing as a good alternative to maize in pig nutrition.
2. Pigs fed on diets containing 12% tigernut and 48% tigernut had better final weight, gained more weight and converted their feed more efficiently than pigs on other diets.
3. The backfat and abdominal fats of pigs fed tigernut meal based diet decreased with an increase in tigernut meal across the treatment means indicating that tigernut could be a good alternative to maize in terms of producing pigs with lean carcass.

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