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Research Article

Effect of Dietary Replacing Soybean Meal with Fluted Pumpkin Seed Meal in the Diets of African Catfish *Clarias gariepinus* (Burchell, 1822)

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Abstract

Feeding trial was conducted to evaluate the effects of fermented fluted pumpkin (*Telfairia occidentalis* seed meal in the diets of *Clarias gariepinus* fingerlings with respect to their growth performance, feed efficiency, haematological indices, proximate composition and cost benefit analysis and nutrient utilization. Five iso-nitrogenous experimental diets were formulated to contain 0%, 25%, 50%, and 75% and 100% of fermented *Telfairia occidentalis* seed meal and were designated as T1 (0% inclusion), T2 (25% inclusion), T3 (50% inclusion), T4 (75% inclusion) and T5 (100%) in a completely randomized design. Fifteen net hapa 1m×1m×1.2m were suspended in polythene- lined earthen pond (7m×5m×1m) with the aid of kuralon twine tied to iron pegs, the polythene lined earthen pond was filled to brim borehole water. Each treatment had three replicates with 15 fish were accommodated in each hapa (mean initial body weight (8.85±0.03 g) per fish. Water temperature and other water quality parameters were monitored daily. There were significant differences ($P<0.05$) in the final weight, weight gain, specific growth rate, feed conversion ratio, protein efficiency ratio, and condition factor between the treatment groups. The results show that final weight, weight gain, feed conversion ratio were highest in treatment T5 in fish fed 100% (204.40g) fermented fluted pumpkin seed meal, better growth and nutrient utilization was observed in fish fed 100% fermented fluted pumpkin seed meal. The haematological indices shows that fish fed 100% fermented fluted pumpkin seed meal had better haemoglobin (14.47g/dl), packed cell volume, red blood (4.13 million/m^3) cell and white blood cell. There was significant difference ($P<0.05$) between the haemoglobin concentration of fish fed 100% and all the others treatment group. The crude protein in the fish indicates fish fed 100% fermented fluted pumpkin seed meal was significantly better (62.42) than the other treatment groups. The cost benefit also indicates positive return for fish fed 100% fermented fluted pumpkin seed meal. This result indicated, that inclusion of fermented *Telfairia occidentalis* seed meal at 100% in the diet of *Clarias gariepinus* fingerlings improves the nutritive value for fish, hence can serve as alternative ingredients and replacement of soybean in fish feed production.

Keywords

Fluted Pumpkin Seed, *Clarias gariepinus*, Proximate Composition

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1. Introduction

The expansion and intensification of aquaculture production has been recommended towards ensuring increase in fish production in order to meet up with the global demand since capture fisheries have continued to be on the decline over decades. Over the past decade aquaculture has grown in response to an increasing demand for fish as a source of protein globally [10]. This is because production from captured fisheries has reached its possible maximum- potential, as the catch is dwindling with each passing days [18]. The present requirement of fish puts our production at 1.1 million metric tonnes leaving a deficit of a little over 2 million metric tonnes [29]. Therefore, there is the need for a viable alternative fish production that can sufficiently meet this demand, and aquaculture fits exactly into this role. As aquaculture production becomes more intensive in Nigeria, fish feed is a significant factor in increasing the productivity and profitability of aquaculture [10]. The importance of fish feed cannot be over emphasized; it remains a basic need in aquaculture [23]. The quality of the feed is of utmost important for increase in weight, length and nutrients parameters of the fish needed for the increasing population. Ochokwu reported that with expansion in aquaculture, there is a need to improve the quality and nutrient components of feeds consumed by the fish through sourcing for natural and available ingredients which will promote growth and hence nutrients absorption for fish wellbeing [24]. One of the biggest targets of successful aquaculture is to attain highest growth by investing lowest inputs at lowest price [31]. However the need for excellent feed and high rate of fish consumption among the people as a cheap source of protein has necessitated the research. The research centered on improving the growth of the fish using available ingredients, including *Telfairia occidentalis*. Soybean (SBM) among all plant protein sources, represents the high protein content, most secured amino acid profile, stable source, and realistic cost [20, 27]. Soybean meal is considered as the most nutritive plant ingredients widely used in fish, pig and poultry feed.

Many studies have shown considerable success in partially or total replacement of Soybean with other non-conventional feed ingredients.

Telfairia occidentalis (fluted pumpkin) seeds have high nutritive values such as protein, fats and oils, and minerals (Potassium, Iron) but their utilization could be affected by the presence of antinutritional factors such as lectins and trypsin inhibitor that are present in the seeds [19]. *Telfairia occidentalis* is rich in bioflavonoid, an active chemical that stimulate growth in animal. *Telfairia occidentalis* has quite a number of antioxidants such as phenols. There is, therefore a high possibility that *Telfairia occidentalis* can promote fertility. Several researchers at different times have evaluated the importance of various parts of the plant. The seed of *Telfairia Occidentalis* which was locally available in Doma local villages was procured from a local market in Doma Local Government Area of Nasarawa State, Nigeria. This study was therefore carried out to investigate the effects of the dietary supplementation of *Telfairia occidentalis* seed meal with soybean meal in diet of *Clarias gariepinus* fingerlings.

2. Materials and Methods

2.1. Ingredients and Diet Formulation

2.1.1. Soybean Meal

Soybean was obtained from Maiduguri Monday market, Borno State Nigeria, and was toasted using a frying pan and allow to cool before milling with the aid of a grinding machine. Toasting was done to remove the anti-nutritional factor present in the seed.

2.1.2. Fluted Pumpkin

The seed of Fluted pumpkin was procured from a local market in Doma Local Government Area of Nasarawa State, The seeds of Fluted pumpkin seed were smashed using mortar and allowed to ferment for 3days in an air tight container (solid fermentation) using borehole water. The fermented seeds were dried before grinding to smooth powder using Panasonic kitchen blender. The processed seeds of Fluted pumpkin was analyzed for proximate composition.

2.1.3. Experimental Diets

Five isonitrogenous diets were formulated at 38% crude protein based on the nutritional requirements of *Clarias gariepinus* fingerlings, containing 25-100% fermented Fluted pumpkin seed meal at different levels of inclusion. The experimental feed were subject to proximate composition analysis before commencing the feeding trials according to the method of [13]. The, moisture, crude protein crude fibre, lipid, ash content and nitrogen free extract of the feed were determined (Table 1).

Table 1. *Composition of the Experimental Diets.*

Ingredients	0%	25%	50%	75%	100%
Fish meal	40.40	40.40	40.40	40.40	40.40
Soybean meal	40.40	30.30	20.20	10.10	0.00
T. Occidentalis seed meal	0.00	10.10	20.20	30.30	40.40
Groundnut cake	2.00	2.00	2.00	2.00	2.00
Maize	13.20	13.20	13.20	13.20	13.20
Vegetable oil	0.50	0.50	0.50	0.50	0.50
Methionine	0.50	0.50	0.50	0.50	0.50
Lysine	0.50	0.50	0.50	0.50	0.50
Ascorbic acid	0.50	0.50	0.50	0.50	0.50
Vitamin premix	0.50	0.50	0.50	0.50	0.50
Di-calcium phosphate	0.30	0.30	0.30	0.30	0.30
Salt	0.20	0.20	0.20	0.20	0.20
Cassava starch	1.00	1.00	1.00	1.00	1.00
Total	100	100	100	100	100
Moisture	8.64	7.69	7.57	8.25	7.90
Crude protein	38.03	38.01	38.02	38.04	38.01
Crude fibre	4.04	4.01	4.03	4.02	3.99
Ether extract	8.25	7.30	8.10	8.12	8.10
Ash	11.71	11.65	10.55	10.75	11.51
NFE	29.33	31.34	31.78	30.82	30.49

2.1.4. Experimental System, Fish and Procedure

The experimental fish, pure- bred *C. gariepinus fingerlings*, with an initial mean weight of (8.85±03 g) were purchased from reputable fish farm in Maiduguri Borno State Nigeria. The fish were transferred in a jerican from hatchery to the Department of Fisheries experimental fish farm, University of Maiduguri Nigeria where the feeding trial was conducted. Upon arrival they were acclimatized for three days and were fed commercial feed at 40% crude protein once a day before the experiment commenced. The fish were subsequently fed with 38% iso-nitrogenous diets and fermented Fluted pumpkin seed meal, designated as T1 (0% inclusion), T2 (25% inclusion), T3 (50% inclusion), T4 (75% inclusion) T5 and (100% inclusion) for 16 weeks. Fifteen net hapa (1×1×1.2m) were suspended in polythene- lined earthen pond with the aid of kuralon twine tied to iron pegs. The polythene- lined earthen pond was filled to the brim with borehole water. Fifteen (15) fish due to the size of the experimental hapa to avoid overstocking and were randomly allocated in each hapa and each of the five treatments has three hapas. The water quality parameters in the system were monitored weekly. The feed was manually administered and the fish were fed three times daily at 5% of body weight in a day (9am, 1pm and 5pm) for 16 weeks. Feeding rate was subsequently adjusted according to their growth rates per hapa. The fish were denied feed 24 h prior to sampling. The fish were weighed collectively every four (4) weekly intervals, their average weight and length were recorded and the daily amount of feed for each tank was readjusted accordingly. Some of the fish were killed after use experiment while some are kept for future use.

2.2. Determination of Growth Performance and Nutrient Utilization Parameters

During the experiment, growth performance were evaluated using the indices: weight gain, survival rate and condition factor with the following formulae.

i Weight gain (WG) = Final weight − Initial weight [9]

ii Survival rate (SR) $=\frac{\text{Final number of fish}}{\text{Initial number of fish}} \times 100$ [11]

iii Condition factor (K)$=\frac{\text{Body weight}}{\text{Body lengh3}} \times 100$ [38]

iv Specific growth rate (SGR) = 100 $\frac{\text{LL final weight} - \text{LL Initial weight}}{\text{T}}$ [17]

Where LL = natural log of Initial and final weight, and T is number of experimental days.

v Net Protein Utilization (NPU) = $\frac{\text{Protein gained}}{\text{Protein consumed}} \times 100$

Where protein gained = protein content in the fish at stocking, and protein consume = is the protein content of the fish at the end of the feeding trial.

vi Feed conversion ratio (FCR) =$\frac{\text{Feed intake}}{\text{weight gain}}$

vii Protein Efficiency Ratio (PER) =$\frac{\text{weight gain}}{\text{Protein intake}}$ [38]

2.3. Haematological Analysis

Blood samples were collected from three (3) *C. gariepinus* in each treatment at the termination of the study through caudal peduncle puncture as described by [14]. A 2mml plastic syringe was used to draw the blood into EDTA bottle. The blood sample was transported in a cool pack to the haematology laboratory Faculty of Veterinary Medicine University of Maiduguri Borno State Nigeria for haematological analysis.

2.4. Cost Benefits Analysis

Cost benefit analysis for each treatment group at the end of the experimental period were estimated. Cost of feed and value of fish were estimated on the prevailing market price in Maiduguri, Borno State Nigeria.

The following parameters were calculated as described by Sogbesan, Aderolu and Abarike. [35, 5] and [1]

i Incidence of cost (IC) = Cost of feed / Weight of fish produced.

ii Profit index (PI), was estimated using this formula.

PI=value of fish /cost of feed [1].

iii Net Profit (NP) = sales – expenditure [16]

iv Total cost (TC) = fixed cost (FC) + total variable cost (TVC) [35]

Where FC= cost of fingerlings, TVC = Cost of producing Different diets.

2.5. Data Analysis

The data obtained from the study were subjected to One-Way Analysis of Variance (ANOVA), to determine for significance difference of the mean values, Duncan's Multiple Range Test (DMRT) was used to separate the means at P< 0.05 with the aid of the statistix 10.0.

3. Results

3.1. Growth Performance and Nutrient Utilization of *Clarias gariepinus* Fingerling Fed Experimental Diets

Growth performance and nutrient utilization of *Clarias gariepinus* fed different level of fermented fluted pumpkin seed meal are presented in Table 2.

The final weight of the experimental fish were from 148..47 to 204.40g, the highest (204.40g) was recorded in fish fed with 100% fermented fluted pumpkin seed meal and least (148.47g) was recorded in fish fed with 50% fluted pumpkin seed meal, there was a significant difference (P< 0.05) between fish fed 100% fermented fluted pumpkin seed meal compare to all other treatment. However there was no significant difference (P>0.05) between fish fed 0% fermented fluted pumpkin seed meal and fish fed 25% fluted pumpkin seed meal diet.

Similarly the highest weight gain (195.53g) was recorded in fish fed 100% fermented fluted pumpkin seed meal while the lowest (139.59g) was recorded in fish fed 50% fluted pumpkin seed meal, there was significant difference ((P<0.05) in weight gain between fish fed 100% fermented fluted pumpkin seed meal compare to the rest treatment. However there was no significant different (P>0.05) between weight gain in control and fish fed 25% fermented fluted pumpkin seed meal.

Fish fed 100% fermented fluted pumpkin seed meal produce a better specific growth rate (0.91%/day) specific growth rate value (SGR) followed by 0.89 and 0.87%/day, for fish fed 75 and 25% fermented fluted pumpkin seed meal, the lowest (0.81%/day) was recorded in fish fed 50% fermented fluted pumpkin seed meal. There was significant (P< 0.05) difference between fish fed 100% fermented fluted pumpkin seed meal compare to fish fed 75 and 25% fermented fluted pumpkin seed meal. However there was no significant (P> 0.05) difference between fish fed 25% and 75% fermented fluted pumpkin seed meal.

The best feed conversion ratio (FCR) was observed in fish fed 100% (1.36) fermented fluted pumpkin seed meal while the poorest (1.94) was recorded in fish fed 50% fermented fluted pumpkin seed meal. All the treatment groups significantly (P<0.05) differs from each other.

Protein efficiency ratio (PER) ranges from 3.67 to 5.14. The highest PER value were observe in fish fed 100% fermented fluted pumpkin seed meal (5.14) while he lowest (3.67) was observe in fish fed 50% fermented fluted pumpkin seed meal. There was significant difference (P<0.05) in PER among the treatment groups. However there is no significant variation (P>0.05) between fish fed 0 and 25% fluted pumpkin seed meal.

Table 2. Growth Performance and Nutrient Utilization of Clarias gariepinus Fingerling Fed Experimental Diets.

Parameters	Fermented Fluted Pumpkin Seed Meal Treatment/ Replacement Level (%)					
	0	25	50	75	100	SEM
FI (g)	260.33^{d}	280.00^{a}	271.00^{b}	263.00^{d}	265.00^{c}	1.21*
IW (g)	8.89	8.86	8.88	8.87	8.85	0.15^{ns}
FW (g)	170.30^{c}	175.63^{c}	148.47^{d}	190.40^{b}	204.40^{a}	3.11*
WG (g)	162.30^{c}	166.77^{c}	139.59^{d}	181.50^{b}	195.53^{a}	3.11*
SGR (g)	0.86^{c}	0.87^{b}	0.81^{d}	0.89^{b}	0.91^{a}	0.01*
FCR	1.59^{c}	1.68^{b}	1.94^{a}	1.45^{d}	1.36^{e}	0.21*
PER	4.27^{c}	4.39^{c}	3.67^{d}	4.77^{b}	5.14a	0.82*
K	0.75^{ab}	0.74^{ab}	0.80^{a}	0.81^{a}	0.68^{b}	0.04*
NPU	86.53^{b}	93.67^{a}	85.37^{b}	80.13^{c}	75.1^{d}	0.63*
SR (%)	71.13	64.43	70.80	68.90	73.33	7.43^{ns}

Means across the same row bearing different superscripts differs significantly (P<0.05)
Key: ns= not significant
IW = initial weight, FW = final weight, WG = weight gain, FI = feed intake, SGR = specific growth rate, FCR = feed conversion ratio, PER = protein efficiency ratio, K = condition factor, SR = survival rate, NPU = net protein utilization.

3.2. Heamatological Indices of *Clarias gariepnus* Fed Expermental Diet

The haematological indices of *Clarias gariepinus* fed experimental diet are presented in Table 3.

Table 3. Heamatological indices of Clarias gariepnus Fed Expermental diet.

Parameters	Fermented Fluted Pumpkin Seed Meal Treatment/ Replacement Level (%)					
	0	25	50	75	100	SEM
PCV (%)	34.67	33.33	33.00	34.3	35.33	1.18^{ns}
RBC ($\times$106/mm^3)	3.27bc	3.08c	3.30b	3.17bc	4.13a	0.08*
WBC ($\times$106/mm^3)	4.38a	4.27a	3.85b	3.95b	4.29a	0.12*
Hb (g/dl)	12.27^{b}	12.90^{b}	13.47^{ab}	13.33^{ab}	14.47^{a}	0.56*
MCV (fl)	10.61^{a}	10.80^{a}	10.00^{a}	10.86^{a}	8.55^{b}	0.42*
MCH (pg)	37.84^{ab}	41.81^{a}	40.81^{a}	42.18^{a}	34.13^{b}	2.06*
MCHC (%)	35.49^{b}	38.74^{ab}	40.80^{a}	38.85^{ab}	40.12^{a}	1.56*

Means across the same row bearing different superscripts differs significantly (p<0.05)
Key: ns= not significant
PCV=Packed Cell Volume, RBC=Red Blood Cell, WBC=White Blood Cell, Hb=Haemoglobin, MCV= Mean Corpuscular Volume, MCH= Mean Corpuscular Haemoglobin, MCHC= Mean Corpuscular Haemoglobin Concentration

Haematological indices of *C. gariepinus* fingerlings fed varying levels of fermented fluted pumpkin seed meal are presented in Table 4. Packed cell volume value obtained ranged from 33.00 to 35.33%, all the treatment group was not affect (P>0.05) by the test materials.

Red blood cell (RBC) value of fish fed varying level of fermented fluted pumpkin seed meal ranges from 3.08 to 4.13 million/m$^{3.}$ The highest (4.13 million/m^3) was observed in fish fed 100% fermented fluted pumpkin seed meal while the lower is recorded in fish fed 0, 25, and 75%. There was significance (P<0.05) difference between fish fed 100% and fish fed 500%. However there was no significant (P>0.05) difference between fish fed 0, 25 and 75%.

White blood cell (WBC) value of fish fed fermented fluted pumpkin seed meal ranged from 3.85 to 4.29 million/m^3 the higher recorded was obtained in fish fed 0, 25 and 100% fermented fluted pumpkin seed meal, there was significant (P<0.05) difference between fish fed 50 and 75% compared to fish fed 100%, 25% and 0% fermented fluted pumpkin seed meal. However there was no significant (P<0.05) difference between fish fed 0, 25 and 100% fermented fluted pumpkin seed meal.

Haemoglobin concentration (Hb) was highest (14.47g/dl) in fish fed 100% fermented fluted pumpkin seed meal while the lower (12.27 and 12.90g/dl) was recorded for fish fed 0 and 25% fermented fluted pumpkin seed meal. There was significant (P<0.05) difference between fish fed 100% fermented fluted pumpkin seed meal compare to those fed 0 and 25% fermented fluted pumpkin seed meal but similar to those fed 50 and 75% fermented fluted pumpkin seed meal.

3.3. Carcass Composition

Fish carcass proximate compositions analyzed before and after feeding with the experimental diets are presented in Table 4.

3.4. Proximate Composition of *Clarias gariepinus* Fed Fermented Fluted Pumpkin Seed Meal

The proximate composition of the initial and final carcass quality of the experimental *Clarias gariepinus* fluted pumpkin seed meal fed are presented in Table 4. The moisture content ranges from 6.59 to 11.91%. The highest (11.91%) moisture content was recorded in fish fed 25% fermented fluted pumpkin seed meal while the lowest (6.59%) moisture content was recorded in fish fed 100% fermented fluted pumpkin seed meal. There was a significant (P<0.05) difference between fish fed 25% fermented fluted pumpkin seed meal compared to other treatment groups. However fish fed 0 and 50% did not affected (P > 0.05) by the test material.

The initial crude protein (CP) experimental fingerling obtained was (46.65%). Ether extract (8.95%) moisture content (16.73%) crude fibre (0.17%) and ash (6.29%). The proximate composition of the carcass of *Clarias gariepinus* fed fermented fluted pumpkin seed meal ranged from 47.99 to 62.42%. The highest (62.42 and 58.74%) CP was obtained in fish fed 100 and 75% fermented fluted pumpkin seed meal. The lowest was obtained in fish fed the 25% (47.99%) fermented fluted pumpkin seed meal.

Table 4. *Proximate Composition of Clarias gariepinus Fed fermented Fluted Pumpkin Seed Meal.*

Nutrients (%)	Fermented Fluted Pumpkin Seed Meal Treatment / Replacement Level (%)						
	Initial	0	25	50	75	100	SEM
Moisture	16.73	8.11c	11.91a	7.51c	8.74b	6.59d	0.28*
Crude protein	46.65	54.56ab	47.99b	55.40ab	58.74a	62.42a	9.49*
Lipid	8.95	12.52b	12.69b	12.35b	12.19b	14.35a	0.49*
Ash	6.27	12.37b	14.92a	10.92c	9.73d	8.24e	0.58*
NFE	21.4	12.44b	12.49bb	13.54a	10.60c	8.40d	0.66*

Means across the same row bearing different superscripts differs significantly (p<0.05)
Key: NFE = Nitrogen free extract

3.5. Cost-benefit Indices of *Clarias gariepinus* Fed Fermented Fluted Pumpkin Seed Meal

The cost benefit indices of *Clarias gariepinus* fed fermented fluted pumpkin seed meal are presented in Table 4. The cost of producing different feed was highest in fish fed 0% fermented fluted pumpkin seed meal (₦1700), while the least was recorded in fish fed 100% fluted pumpkin seed meal (₦1300). There was significant (P< 0.05) difference in all the treatment groups. Total expenditure obtained in this study was highest (₦5360) in fish fed 0% fermented fluted pumpkin seed meal and the least (₦4965) expenditure was recorded in fish fed 100% fluted pumpkin seed meal. There was significant (P< 0.05) variation among all the treatment groups.

Net profit (NP) revealed highest value (₦2535) in fish fed 100% fermented fluted pumpkin seed meal and lowest

(₦2140) in fish fed 0% fermented fluted pumpkin seed meal. There was significant (P<0.05) difference in all the treatment groups.

Incidence cost (IC) recorded higher value (10.47 and 10.75) in fish fed 0 and 50% fermented fluted pumpkin seed meal and the lowest was recorded in fish fed 100% (6.65) respectively. There was significant (P<0.05) difference in all the treatment groups. However there was no significant (P> 0.05) between fish fed 0 and 50% fermented fluted pumpkin seed meal.

Profit index (PI) revealed highest value (5.80) in fish fed 100% fermented fluted pumpkin seed meal and the lower value (4.43, 4.70, and 5.00,) in treatment fed with 0, 25 and 50% fermented fluted pumpkin seed meal. There was significant (P<0.05) difference between fish fed 100% fermented fluted pumpkin seed meal and fish fed 0, 25 and 50% fermented fluted pumpkin seed meal but similar to fish fed 75% fermented fluted pumpkin seed meal.

Total cost recorded highest in fish fed 0 and 100% fermented fluted pumpkin seed meal, there was significant difference between fish fed 0 and 100% fermented fluted pumpkin seed meal but similar to fish fed 25 and 50% fermented fluted pumpkin seed meal.

Table 5. *Cost and benefit analysis of Clarias gariepinus fed experimental diet.*

Parameters	Fermented Fluted pumpkin seed meal Treatment / Replacement level					
	0	**25**	**50**	**75**	**100**	**SEM**
Weight gain (g)	162.30c	166.77c	139.59d	181.50b	195.53a	3.11*
Cost of feed (₦)	1700.0a	1600.0ab	1500.0bc	1400.0cd	1300.0d	75.28*
Cost of fish (₦)	1350	1350	1350	1350	1350	
Cost of feeding (₦)	810	830	820	813	815	
Fueling/water cost (₦)	1500	1500	1500	1500	1500	
Expenditure	5360a	5280ab	5170bc	5063cd	4965d	75.28*
Unit price of fish (₦)	500	500	500	500	500	
Value of fish (₦)	7500	7500	7500	7500	7500	
Net profit	2140d	2220cd	2330bc	2437ab	2535a	75.27*
Incidence cost	10.47a	9.59b	10.75a	7.72c	6.65d	0.39*
Profit index	4.43c	4.70c	5.00bc	5.40ab	5.80a	0.26*
Total cost	3050a	2956.7ab	2850ab	2321.0b	2650a	310.35*

Means across the same row bearing different superscripts differs significantly (p<0.05)

4. Discussion

The study shows increase in growth with increasing supplementation of fluted pumpkin seed meal. *Clarias gariepinus* fed varying inclusion levels of fluted pumpkin seed meal feed showed a positive response to the feed. Fish fed 100% fermented fluted pumpkin seed meal had the best weight gain (195.5). The higher growth performance observed in the group containing 100% fermented fluted pumpkin seed meal might be due to presence of essential and non-essential amino acids in the seed which synthesis protein for growth. The increasing growth performance could be due to high mineral concentrations present in the fluted pumpkin seed [21]. Lower feed conversion ratio (FCR) was recorded for this study (1.35) in fish fed 100% fermented fluted pumpkin seed meal, lower FCR is an indicator of feed well utilized [34]. The results indicate that the feed had better influence on the fish.

Protein efficiency ratio (PER) value was similar to the value (5.30) reported by [4] for *Clarias gariepinus* fed sweet potato peel. However lower value (0.14) was reported by Abdulmalik for *Oreochromis niloticus* fed fermented tarmarid [3].

The ability of an organism to utilize nutrients especially protein will positively influence its growth performance [35]. This is justified by the best Mean weight gain, Feed conversion ratio, Protein efficiency ratio and Specific growth rate as observed in Fish fed 100% fermented fluted pumpkin seed meal. The packed cell volume (PCV) values ranged from (33.0% to 35.33%) for this study, PCV recommended value ranged from between 20% to 35%, the variation in PCV value may be associated with increase in red blood cell [28]. The result of this study was similar to the value (33.16%) recorded by [25] for *H. bidorsalis*. However the value was higher than the value (21.58% and 9.41%) recorded by [25] for *H. longiflis*.

The red blood cell (RBC) value recorded in this study ranged from (3.08 $\times10^6$/mm^3 to 4.13 $\times10^6$/mm^3), RBC value greater than 1 $\times10^6$/mm^3 is considered high and indication of high oxygen carrying capacity of the blood [6]. This result was higher than the value (2.57 $\times10^6$/mm^3) reported by Umate for *Clarias gariepinus* fed roselle seed as substitute for soybean [37]. However, Onyia reported higher value (30.3 $\times10^6$/mm^3 and 31.2$\times10^6$/mm^3) as RBC of *H. bidorsalis* male and female respectively [25]

White blood cell (WBC) recorded in this study ranged from (3.85 $\times10^6$/mm^3 to 4.38 $\times10^6$/mm^3). The highest value (4.38 $\times10^6$/mm^3) in fish fed 0% fermented fluted pumpkin seed meal. RBC are known in the role of immune system and response of living organism. The Low WBC in this study could be attributed to a reduction in the number of lymphocyte and which may be due to pollutant. The value recorded in ds study was, lower than the value (12.53 $\times10^6$/mm^3 for) reported by Adesina for *C. gariepinus* juvenile fed 80% *Helianthus annus* seed meal [6].

Haemoglobin (Hb) concentration of *Clarias gariepinus* fed fermented fluted pumpkin seed meal obtained in this study ranged from (12.27g/dl to 14.47g/dl), this value recorded are within the optimal range for a healthy fish [10]. The value for this study are quite high and can be associated to anaerobic process of *Clarias gariepinus* and the air breathing activities of the fish. The value recorded for this study was similar to the value (12.70 g/dl) Reported by [6]. However Saviour reported lower (8.8) Hb values for *Oreochromis niloticus* fed dietary *delonix regia* [33]. The value The mean corpuscular volume (MCV) recorded (10.86fl) are lower than (155.43fl) reported by [33]. However Oghenefejiro, recorded a lower value (2.35fl) than this report. [22]

The mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentraton are similar to the value (33.60) reported [33]. However Adi reported lower value [8]. The variation in the haematological values may be due to the nutritional composition of the diet.

The carcass crude protein in this study increases significantly with increase in fermented fluted pumpkin seed meal. The mean initial crude protein (46.65%) was lower than the value obtained after feeding. The high value obtained for the carcass in this experiment indicates that fish fed 100% fermented fluted pumpkin seed meal has significantly different from other supplementation level, and it indicates that fermented fluted pumpkin seed meal can completely replace soybean in the diet of *Clarias gariepinus*. This indicate that fermented fluted pumpkin seed meal contains the essential nutrient that are absorbed in fish feed.

The carcass crude protein for this study (62.06) is similar to the value (64.00) reported by Adi for Hetroclaria fed fluted pumpkin seed cake [8]. Lower value (43.87) were reported [30]. However higher value (65.29) were reported by [4]. The increase in the crude protein of the fish carcass showed that all the fish were able to utilize protein in the feed efficiently. This indicates reasonable protein accumulation due to optimal protein utilization for growth [16, 12, 15, 2] indicating that the nutrient in fish fed 100% fermented fluted pumpkin seed meal was well utilized.

Fish fed with 100% fermented fluted pumpkin seed inclusion level shows higher lipid concentration than other treatment, this indicates that fermented fluted pumpkin seed has the ability to prevent certain liver disease associated with fatty acid [26]. The higher lipid concentration is reported to be antioxidant and anticancer [32]. The ash content, crude fibre moisture content and nitrogen free extract for the carcass in this study shows lower concentration for fish fed 100% fermented fluted pumpkin seed meal, showing that nutrient are efficiently used.

The cost benefits indicates positive returns for all the treatment groups with increasing returns as the inclusion level increase. The best return was recorded in fish fed 100% fermented fluted pumpkin seed meal. Similarly most nonconventional feed ingredient have been reported to increase profit index [4, 7]. The best profit index (5.7) was recorded n fish fed 100% fermented fluted pumpkin seed meal. Abdurrazzaq reported profit index 5.6 for *Clarias gariepinus* fed sweet potato peel [4]. However Adewole reported higher profit index (6.28) after replacing Soybean meal with *H. sabdariffa* meal at 1.30 g/100g in the diet of *C. gariepinus* [7]. The reduction in the value of Cost of feed used in the 100% inclusion level diets compared with the control is an indication of a cheaper and cost-effective conventional feed ingredient called fermented fluted pumpkin seed meal as an ingredient in fish feed formulation. This is in line with the work of Sogbesan who worked on the cost effectiveness of fermented groundnut shell as supplementary feed in the diets of *Clarias gariepinus* fingerlings [36].

5. Conclusion and Recommendation

Fermented fluted pumpkin seed meal at 100% inclusion level can be used as replacement for soybean in the diet of *Clarias gariepinus* without any detrimental effect.

For optimum growth of *Clarias gariepinus*, 100% replacement of fermented fluted pumpkin seed meal is recommended.

Abbreviations

T. Occidentalis	*Telfairia occidentalis*
SBM	Soybean
C. gariepinus	*Clarias gariepinus*
FI	Feed Intake
IW	Initial Weight
FW	Final Weight

WG	Weight Gain
SGR	Specific Growth Rate
FCR	Feed Conversion Ratio
PER	Protein Efficiency Ratio
K	Condition Factor
NPU	Net Protein Utilization
SR	Survival Rate
EDTA	Ethylenediaminetetraacetic Acid
PCV	Packed Cell Volume
PI	Profit Index

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Conflicts of Interest

The authors declare no conflicts of interest.

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