Feed Utilization Efficiency and Growth Potentials of the African catfish (*Clarias gariepinus*) Cultured on *Gongronema latifolium* leaf meal Supplement

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Abstract

This study was conducted to determine the effects of *Gongronema latifolium* leaf meal on the feed utilization efficiency and attendant growth potentials of the African catfish (*Clarias gariepinus)* post fingerlings for thirty (30) weeks. Five treatments were used in all, made up of four levels of *G. latifolium* leaf meal (2.5, 5.0, 7.5 and 10.0) and the control diet (0g/kg, in triplicate. The experimental diets were fed to fish in fifteen tarpaulin tanks of 100 by 80 by 100 cm^3 capacity each and stocked randomly with twenty *C. gariepinus* post fingerlings of mean initial bulk body weight of 2.881± 0.00 g and mean total length of 5.552 ± 0.0cm. The fishes were fed twice daily at 8.00 am and 4.00 pm at 3% of their body weight. The proximate composition of five experimental diets contained crude protein, crude fibre, moisture, crude fat, ash and nitrogen-free extract within the recommended range for fish growth. In this study, weight gain (g), growth rate, SGR length gain were significantly higher ($P<0.05$) for the control diet, (0g) than for varying inclusion levels of *G. latifolium* leaf meal. Feed consumption of *C. gariepinus* increase significantly ($P<0.05$), for control diet, (0g) having the highest value and least in diet C (5.0g/kg of GLM), whereas food conversion ratio (FCR) and food conversion efficiency (FCE) recorded higher significant different values ($p<0.05$). Conditional factor of cultured fishes placed on all the experimental diets showed significant difference ($p<0.05$). The inclusion of *G. latifolium* leaf meal in *C. gariepinus* feed led to improved growth performance by improving the feed utilization efficiency of the experimental fish.

Keywords: Feed Conversion Ratio, FCE, Feed intake, SGR, leaf meal, weight and length gain, Catfish

1.1 Introduction

Global prices of feed commodities have increased significantly during recent years. Secondly, the cost implication of establishing a standard commercial fish feed mill is very high. According to El-Sayed (2014) a large amount of capital is required for setting up the initial infrastructure, machinery and subsequent operation of the mill. Over the years, aquaculture has taken over the use of fish meal as the best source of protein in aquafeed. But fish meal usage has faced serious competition with humans and livestock resulting in extremely high price for fish meal. (Ekanem *et al* 2010; Eyo and Ekanem 2011, Ekanem *et al* 2013). In Africa, high cost of protein, especially fish meal, has hindered the development of the industry.

In aquaculture, replacement of fish meal with plant protein reduces the cost of production of the feed and the cost per kilogram of produced fish weight (Falaye, 1992). The replacement of fish meal with plant protein from more sustainable sources has been carried out (Fagbenro and Davies, 2001, Ogunj and Wirth, 2001, Osuigwe *et al* 2002; Fagbenro & Davies, 2003, Ogunji; et al 2003). Plant leaf meal sustains the potentials of replaced fish meal

(Abdelghany, 2004; Inywere *et al* 2010). Also, a comparative study on growth and gonad development of *C. gariepinus* fed on plant diet, *Moringa Oleifera*, and animal-based ingredients in concrete tank produced positive effect (Ekanem *et al;* 2012). Amisah and Ofori, (2009) worked on growth performance of the Africa cat fish, *C. gariepinus* fed on varying inclusion levels of *Leucaena leucocephala* leaf meal and obtained positive effects on growth performance of Africa catfish at 20% inclusion of *Leucaena leucocephala* leaf meal. Fahey, (2005) assessed protein quality of moringa leaf compared to that of milk and eggs and found that it contained some essential Amino acids, Calcuim, Iron and Vitamin C which corroborated previous findings.

Currently, the use of invertebrate meal such as earthworm meal, maggot meal as protein source in fish feed is gaining world interest, especially as these insects face a reduced competition with humans as food. Research findings have shown that invertebrate protein can successfully replace conventional feed stuff soybean meal and fish meal as alternative protein sources in fish and livestock feed without any negative impact on fish growth Fasakin and Balogun 1997; Oti, 1988; Sackey, 1989; Sogbesan *et al* 2005, Soybean 1998, Fasakin *et al* 2003; Madu e*t al* 2003, Soybesan and Ugwumba, 2008; Tequia *et al* 2002; Hwangbo *et al* 2009)

The African catfish, *C. gariepinus*, belonging to the family Clariidae dominates the cultured fish species in Nigeria. This is due to several culture characteristics exhibited by this species. Such culture characteristics include its ability to tolerate a varying range of environmental conditions, high stocking densities under culture conditions, fast growth rate, disease resistance, acceptability of artificial feed, high fecundity, good taste and meat quality, ease of artificial breeding and high market value (Eyo *et al* 2014).

G. latifolium commonly known as Utazi and Arokeke by the South-South and South-West inhabitants in Nigeria is found in Africa, Asia and Oceania. It is a tropical phyto-protein that is used as spice (Ugochukwu *et al* 2003). Apart from the proteinous aspect of this plant, it is also used as a traditional medicinal plant due to it phytochemical composition for the treatment of various gastrointestinal disorders such as diarrhea, ulcers, dyspepsia and also in the management of diabetes mellitus (Okafor *et al* 1996; Nwing *et al* 2005). The use of G. *latifolium* to enhance fish growth indices and value are particularly important, since fish contributes to the aquatic resources of socio-economic importance and sustenance for economic stability. Therefore, it is essential to study the feed utilization efficiency and growth growth performance in relation to growth indicators which are directly influenced through the application of different inclusion levels of *G. latifolium* leaf meal in the diets of C. *gariepinus.*

MATERIALS AND METHODS

2.1 Collection of *G. latifolium* leaves

Gogronema latifolium leaves were purchased from Watt Market, Calabar and authenticated by the Department of Botany, University of Calabar. The leaves were washed to remove sand and debris, sun-dried under low intensity sunlight for 7days, pulverized with a sterile grinding machine to obtain a fine powder. The product was stored in dry airtight container.

Plate 1: *Gongronema latifolium* (Utasi) leaves sample used for leaf meal preparation

2.2 **Determination of proximate or nutrient composition of leaves of *G. latifolium***

2.2.1 **Determination of moisture**

Bits of feeds were put in s crucible and weighed on an S. mettle digtal balance and obtained 5g of it. That was kept in an electric oven set at 100^0c to dry.

The determination of moisture content was calculated as follows:

$$\text{Moisture (\%)} = \frac{\text{wt of fresh sample} - \text{wt of dry sample (DW)}}{\text{wt of fresh sample}} \text{ X } 100$$

i.e. $\text{Moisture (\%)} = \frac{S-DW}{S} \text{ X } 100$

2.2.2 **Determination of crude protein**

Total nitrogen was determined by the Kjelldahi method and the result multiplied by 6.25% to give crude protein: The samples were ground to about 1mm grain size (fine powder) with a ceramic mortar and pestle. One (1) gram of the sample was weighed into a digestion flask and 10g of potassium sulphate + 0.7g Mercuric oxide + 20ml Sulphuric acid were added. The flask with the content was heated gently and then boiled until the solution become clear. On cooling, 90ml. of distilled water was added and 25ml Soduim Sulphate (4% solution)

was added and mixed. A small piece of pumic was added to prevent bumping and 80ml of sodium hydroxide solution was also added. While tilting the flask, two layers were formed. The flask was connected rapidly to the condenser unit, heated and the distilled ammonia was collected in 50ml boric acid/indicator solution.The collected distillate was 50ml and this was titrated against 0.1 N hydrochloride acid standard solution.

Nitrogen content of sample (%)

$$= \frac{\text{Volume of acid (ml) x normality of std acid x 0.014}}{\text{Weight of sample}}$$

X 100

Crude protein content (%) = nitrogen content x 6.25

The digestion of the sample in acid was done in Kjeldehl apparatus that is capable of heating 8 samples at a time and completing the process in 45 minutes (Searchtek Digestion Apparatus). The whole procedure of crude protein determination also conformed to AOAC, (1990).

2.2.3 **Determination of crude fat (lipid)**

Three (3g) of the dried and ground sample was weighed into an extraction thimble. The thimble was placed inside the soxhlet apparatus. A dried tarred solvent flask was placed in position beneath and sufficient quantity of petroleum ether added. The flask with the solvent was connected to a condenser and heated. Extraction was completed in 1 hour and the thimble removed and ether reclaimed using the apparatus. The removal of ether was completed on a boiling water bath and dry flask at 105^0c for 30 minutes. After cooling, the flask was weighed and the weight of fat obtained..

Crude fat (CL) (% of DM) = $\frac{\text{Weight of fat}}{\text{Weight of sample}}$ X 100

2.2.4 **Ash Determination of content**

Two (2g) of finely ground sample was weighed into a dry tarred porcelain dish

and then placed in a muffle furnace at 600 °C for 6 hours. It was cooled in a desiccator and weighed

$$\text{Ash (\%)} = \frac{\text{Weight of Ash}}{\text{Weight of sample}} \text{ X } 100$$

2.2.5 **Determination of crude fibre (CF)**

Crude fibre was determined as that fraction remaining after digestion with standard solutions of Sulphuric acid and sodium hydroxide under carefully controlled conditions. Two (2g) of the dried fat-free sample was weighed into a 600 ml beaker (using residue from ether extraction). Two hundred (200) ml of hot Sulphuric acid was added. The beaker was placed under the condenser and brought to boiling within 1 minute. It was boiled gently for 30min, using distilled water to maintain volume and to wash down particles adhering to the sides. That was filtered through Whatman No. 541 paper in a Buchner funnel using suction and washed well with boiling water. The residue was transferred back to a beaker and 200 ml hot Sodium hydroxide solution was added. It was replaced under the condenser and again brought to boiling within 1 minute. After boiling for 30 minutes, the solution was filtered through porous crucible and washed with boiling water, followed by 1% hydrochloric acid and then again with boiling water. The residue was washed twice with alcohol, dried overnight at 100^0C, cooled and weighed. It was ashed at 500 °C for 3 hours, cooled and weighed. The weight of fibre was calculated by difference: -.

$$\text{Crude fibre (\% of fat free DM)} = \frac{(\text{Wt of crucible} + \text{Dried residue}) - (\text{Wt of crucible} + \text{Ashed residue})}{\text{Weight of sample}}$$

Plate 2: African Catfish (*Clarias garieinus*) sample used for the study

2.3 Composition, formulation and preparation of *Gongronema latifolium* leaf meal

Five experimental feeds (A 0g/kg, B 2.5g, C 5.0g, D 7.5g and E 10.0g/kg GLM) containing 42 % crude protein was used for this study. Feed A was the control (0g/kg) whereas B 2.5 g, C 5.0g, D 7.5g and E 10.0g/kg were formulated with the inclusion of varying levels of *G. latifolium* leaf meal with other plant-based ingredients according to Pearson square method. The ingredients used to formulate the experimental feed include *G. latifolium* leaf meal (GLM), soybean meal (SBM), groundnut cake (GNC), wheat offal, wheat flour, lysine, calcium, methionine, sodium chloride (NaCl) and vitamin premix. After processing the ingredients to powdery form, the feedstuffs were mixed based on the calculated proportions. After mixing, the mixed ingredients were pelletized using a locally fabricated pelletizer before sun drying (Table 1).

TABLE 1

Composition of experimental diets (/g/kg) with varying inclusion levels of *G. latifolium* leaf meal (GLM)

Ingredients	Diet A (0/gkg)	Diet B (2.5 % GLM)	Diet C (5.0 % GLM)	Diet D (7.5 % GLM)	Diet E (10.0 % GLM)
G. latifolium (GLM)	0	25	50	75	100
Fish meal (FM)	344	339	332	327	320
Groundnut meal (GNM)	210	205	200	196	192
Soybean meal (SBM)	216	211	208	202	198
Wheat offal (WO)	179	160	150	140	130
Vitamin premix	20	20	20	20	20

Calcium powder	5	5	5	5	5
Lysine	5	5	5	5	5
Methionine	5	5	5	5	5
Sodium chloride	5	5	5	5	5
Wheat flour	10	10	10	10	10
Palm oil	10	10	10	10	10
Total	100	1000	1000	1000	1000

2.4 **Experimental design**

The design used for the study was Complete Randomized Design (CRD). Feeding experiment lasted for 30 weeks and was conducted using 15 tarpaulin unit measuring 100 by 80 by 100 cm (Plate 6). Four levels of *G. latifolium* leaf meal of 2.5 g/kg^{-1}, $5g/kg^{-1}$, 7.5 g/kg^{-1} and $10g/kg^{-1}$ and the control giving a total of five treatments were used for this study. The five experimental diets were labeled A (0g/kg), B (2.5g /kg), C (5.0 g/kg), D (7.5 g/kg) and E (10.0 g/kg). The 15 tarpaulin units were labeled A_1, A_2, A_3, B_1, B_2, B_3, C_1, C_2, C_3, D_1, D_2, D_3, E_1, E_2 and E_3 to aid triplication of the experiment. Three hundred (300) healthy *C. gariepinus* post fingerlings were purchased from the fish farm hatchery unit of University of Calabar. The 15 experimental units were stocked with fishes (20per unit) and acclimated for fourteen days before the beginning of the experiment.

During the 14 days period of acclimatization, the experimental fishes were fed to satiation two times daily with Coppens feed. At the commencement of the feed experiment, the acclimated fishes were allowed to starve for a day. At the end of the 24 hours starvation period, the initial wet body weight and total length were scaled with METLAR MT-5000D balance/electronic scale for weight to the closest gram and measuring board for length to the nearest 0.1 cm (Eyo and Ekanem, 2011).

Moreover, fishes in tarpaulin units A_1, A_2 and A_3were fed on the control diet (feed A), fishes in tarpaulin units B_1, B_2 and B_3were fed on Treatment B (2.5 g/kg of GLM), in tarpaulin units C_1, C_2 and C_3 were fed on feed C (5.0 g/kg of GLM), while tarpaulin units D_1, D_2 and D_3 were fed on Treatment D (7.5 g/kg of GLM) whereas fishes in tarpaulin units E_1, E_2 and E_3 were fed on Treatment E (10.0 g/kg of GLM). The fishes attained 3 % of their body weights two times daily at 8.00 am and 4.00 pm. Initial, total length (TL) and total weight (TW) were measured bi-weekly.

2.5 Food utilization indices and growth indices determination

2.5.1 Food utilization indices of experimental fishes

This was calculated using De Silva and Anderson (1995) formula as follows;

2.5.2 Food consumption (g)

This was calculated as 3% fish bulk body weight /No. of days.

2.5.3 Food conversion ratio (FCR) of experimental fish

This was calculated as feed consumed by fish (g)/ weight gain.

2.5.4 Food conversion efficiency (FCE)

This was calculated by weight gained by fish (g)/ feed consumed by fish (g) x 100

2.6 Calculation of growth performance and food utilization indices were as follows

2.6.1 Growth performance indices

Growth performance indices that were evaluated in this study included weight gain in (gram), length increment (cm), specific growth rate (%/day), mean growth rate (mg/day) and growth rate in (gm/day) These indices were evaluated according to De Silva and Anderson, (1995).

2.6.2 Weight gain (WG/g):

This was calculated as bulk weight (final-W_2) - initial weight (bulk-W_1)

2.6.3 Length increment (L_1/cm):

This was calculated as final fish length L_2 - L_1

2.6.4 Growth rate (GR //day):

This was calculated as bulk weight (final-W_2) - initial weight (bulk-W_1) / Day
Where:
W_2 is the bulk weight (final) in grams
W_1 is the bulk weight (initial) in grams

2.6.5 Specific growth rate (SGR %/day):

This was calculated as the percentage of weight gain per day
SGR = Ln final fish weight (w_2) – Ln initial fish weight (w_1)/(No. of days) x 100
Where Ln is the base of natural logarithm

3.1 RESULTS

Food conversion ratio (FCR) and food conversion efficiency (FCE) results were highest (6.32±0.00%) and (15.86+0.00%) respectively in diet A (coppens). (6.31±0.00% and 15.86±0.00%) and (6.30±0.00%) and 15.83+0.00%) values were obtained from both fish in diet D (7.5g/kg GLM) and E (10.0g/kg GLM) and fish-fed diet B (2.5g/kg GLM) respectively. Their differences in values were statistically insignificant ($P>0.05$) (Table 2) for fish food conversion ratio (FCR) but significantly difference ($P<0.05$) food conversion efficiency (FCE) (Table 2).

TABLE 2

Food utilization indices of *Clarias gariepinus* fed on experimental diets

Treatments	initial weight(g)	Final weight (g)	Weight gain (g)	Food consumed	FCR	FCE (%)
0/gkg	3.229± 0.00	4129.298±0.129	4126.261±0.166	26014.58±0.81	6.32±6.00a	15.86±0.00a
2.5lkg(GLm)	2.588±0.00	3956.495±5.204	3953.907±5.204	24925.92±32.79	6.30±0.00b	15.83±0.00b
5.0glkg(GLm)	3±0.00	3349.501±0.328	3346.39±0.327	5430.05±3.31	6.30±0.00c	15.86±0.00c
7.5glkg(GLm)	3.111±0.00	1516.62±0.213	1513.392±0.213	21101.85±2.06	6.31±0.00d	15.86±0.00d
10.0glkg(GLm)	2.476±0.00	861.913±0.525	859.437±0.525	9554.71±1.35	6.31±0.00e	15.86±0.00e
LSD (P<0.05)				49.45	0.0064	0.051

FCR - Food conversion ratio

FCE - Food conversion efficiency

Mean values having the same superscript are insignificant (P>0.05)

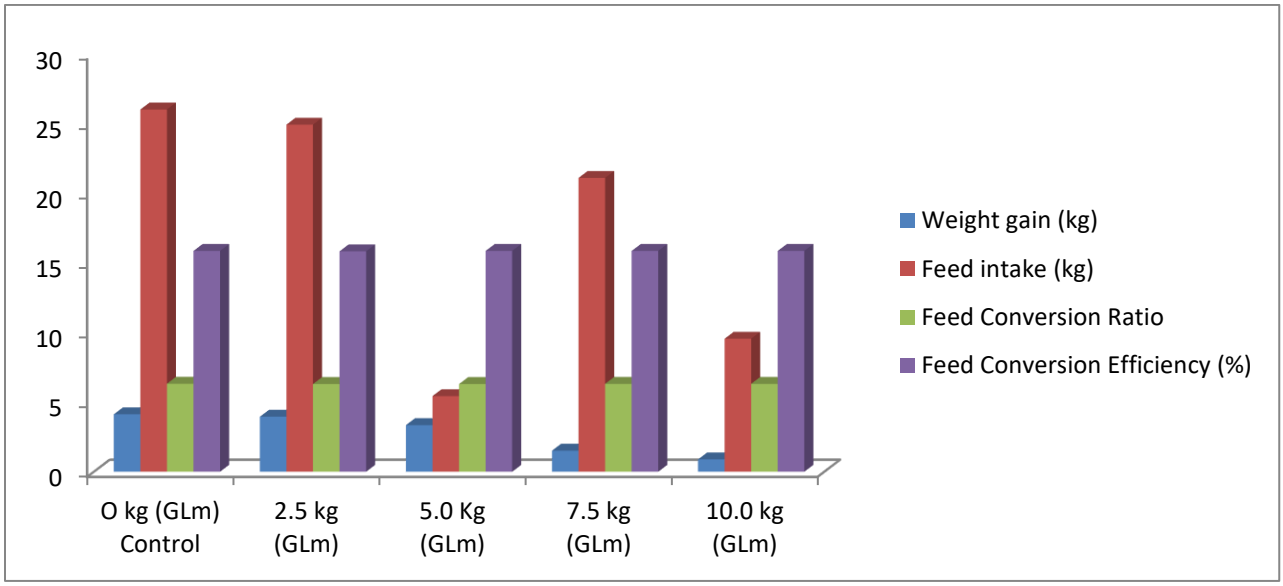

Figure 1: Chart showing feed utilization efficiency of African catfish fed with *G. latifolium* leaf meal

Statistical evaluation of food utilization parameters of fish fed on the experimental feed

Analysis of variance (ANOVA) for food utilization of fish fed on experimental feed (Table 3) shows that food consumed with p-value 0.00000, food conversion ratio 0.00000, feed conversion efficiency 0.00000 shows statistical significance, ($p<0.05$), in fish fed on different concentrations of the experimental diets

TABLE 3

Analysis of variance for determination of the significant differences in food utilization of fish fed on *G.latifolium* lea meal diet

Indices	p-value	Inference
Food consumed	0.000000	Significant (P<0.05)
FCR	0.000000	Significant (P<0.05)
FCE	0.000000	Significant (P<0.05)

3.2 Proximate composition of *G.latifolium* leaf meal and the experimental diets

Results of the proximate composition (Table 4) of the dry matter of the experimental feed (mg/100g) showed that in diet A (0g/kg), crude protein was (40.70 ± 0.09%), crude fibre (8.26 ± 0.01%), ash (8.32 ± 0.13%), moisture (14.32 ± 0.14%), crude fat (8.17 ± 0.12 %) and Nitrogen free extract (44.23 ± 0.01%).In diet B (2.5g/kg GLM), had crude protein 40.16 ± 0.20%, crude fibre (8.42 ± 0.07 %), ash (8.24 ±0.28 %), moisture (14.37 ± 0.03%), crude fat (8.17 ± 0.11%) and nitrogen free extract (44.85 ± 0.33 %). In diet C (5g/kg GLM), crude protein was 40.12 ± 0.20%, crude fibre (8.22 ± 0.04 %), ash (8.19 ± 0.12 %), moisture (14.60 ± 0.04%), crude fat (8.02 ± 0.05 %) and nitrogen free extract (14.60 ± 0.04 %). The diet D (7.5g/kg GLM), crude protein was 40.36 ± 0.20%, crude fibre (8.36 ± 0.03%), ash (8.38 ± 0.22%), moisture (14.28 ± 0.02%), crude fat (8.56 ± 0.23%)

and nitrogen free extract (45.20 ± 0.40%).where as diet E (10g/kg GLM), crude protein was 40.54 ± 0.08%, crude fibre (8.27 ± 0.08 %), ash (8.50 ± 0.09%), moisture (14.78 ± 0.06%), crude fat (8.38 ± 0.13%) and nitrogen free extract (44.39 ± 0.02%).

Proximate composition of *G. latifolium* leaf meal (GLM) crude protein was 16.11 ± 0.11 %, crude fibre (15.78 ± 0.01%), ash (13.18 ± 0.11%), moisture (14.19 ± 0.09%), crude fat (0.77 ± 0.01%) and nitrogen free extract (54.52 ± 0.06%).

TABLE 4

Proximate composition of the experimental diets

Indices	Diet A Control 0/gkg	Diet B 2.5g/kg	Diet C 5.0g/kg	Diet D 7.5gkg	Diet E
Crude protein	40.70±0.09a	40.16±0.20b	40.12±0.20c	40.36±0.20d	40.54±0.08e
Crude fiber	8.26±0.01a	8.42±0.07 a	8.22±0.04 a	8.36±0.03 a	8.27±0.08 a
Crude fat	8.17±0.12 a	8.17±0.11 a	8.02±0.05 a	8.56±0.23 a	8.38±0.13 a
Ash	8.32±0.13 a	8.24±0.28 a	8.19±0.12 a	8.38±0.22 a	8.50±0.09 a
Moisture	14.32±0.14 a	14.37±0.03 a	14.60±0.04 a	14.28±0.02 a	14.78±0.06 a
Carbohydrate (NFE)	44.33±0.01 a	44.85±0.33 a	44.60±0.04 a	45.20±0.40 a	44.39±0.02 a

The mean values having the same superscript are not significant (p>0.05).

3.2 Mean growth performance indices of *C. garienpinus* fed on the G.latifolium leaf meal

Result of growth performance indices (Table 5) of *C. gariepinus* shows that weight gain (g) was highest 4126.261±0.166 in fish fed diet A, (0g/kg), (Control). The weight grain (g) of fish fed in the varying concentrations of GLM were as follows: 3953.907±5.201 in fish fed diet B (2.5G/Kg GLM), 3346.39±0.327 for diet C (5.0g/kg/GLM), followed by 1513.392+0.213 for diet D (7.5g/kg/GLM) and 859.437±0.525 for diet E (10.0g/kg GLM.) The highest and the lowest weight grains were obtained diets B and E

containing 2.5g/kg GLM and E (10.0g/kg GLM) respectively.

Length gain (cm) result was highest 144.184+0.346 in diet A (0g/kg) followed in descending order by 117.539±0.278cm for B (2.5G/Kg GLM), 96.810±0.840 for diet C (5.0g/kg/GLM), 94.122+0.247 for diet D (7.5g/kg/GLM) and the least 86.453±0.196 for diet E (10.0g/kg GLM). Successive increase in concentration of *G. latifolium* leaf meal (GLM.) from 2.5/kg to 10.0g/kg caused significant (P<0.05) increase in length gain value of *C. gariepinus*.

Mean growth rate was highest 142.670±0.00 in diet A (0g/kg) followed in descending order of growth rate by 142.648+0.001 in diet B (2.5G/Kg GLM), 142.592±0.000 diet C (5.0g/kg/GLM), 142.250+0.000 diet D (7.5g/kg/GLM) while the lowest was 142.040±0.000 for diet E (10.0g/kg GLM.).

Growth rate was highest 294.733±0.012% diet A 0g/kg. The highest 142.648±0.001% was recorded in fish fed diet B (2.5G/Kg GLM), while 61.388±0.038% was recorded for diet E (10.0g/kg GLM). Successive increase in concentration of *G. latifolium* leaf meal (GLM) from 3.5/kg to 10.0/kg cause significant (p<0.05) increase in growth rate of *C. gariepinus*

Specific growth rate (SGR) result was highest 52.488±0.009% for diet A (0g/kg), The higher value 51.725+0.001% was found in fish fed diet B (2.5G/Kg GLM), and the least 42.007±0.000% was in fish fed diet E (10.0g/kg GLM.). Successive increase in concentration of the *G. latifolium* leaf meal (GLM.) from 2.5/kg to 7.5/kg did not cause significant increase (p>0.05) in (SGR). However, when concentration was increased from 7.5/kg to 10.0/kg there was significant (P<0.05) increase in (SGR)

TABLE 5

Mean growth performance indices of *C. gariepinus* fed on experimental diet

Treatment	Mean Intial Wt(g)	Mean Final wt (g)	Mean Initial Length (cm)	Mean Final Length (cm)	Mean Weight Gain (g)	Mean Length Gain (cm)	Mean Growth rate (g)	Growth rate (%)	SGR
0g/kg	3.229±0.00	4129.298±0.129	6.152±0.00	150.335±0.346	4126.261±0.166a	144.184±0.346a	142.670±0.000a	294.733±0.012a	52.488±0.009a
2.5g/kg(GLM)	2.598±0.00	3956.495±5.204	4.865±0.00	123.068±0.331	3953907±5.204b	117.537±0.278b	142.648±0.001b	282.422±0.372b	51.725±0.000b
5.0g/kg(GLM)	3±0.00	3349. 501±0.328	5.695±0.00	102.240±0.840	3346.39±9.327c	96.810±0. 840c	142.592±0.000c	239.028±0.023c	49.972±0.001c
7.5g/kg(GLM)	3.111±0.00	1516. 62±0.213	5.430±0.00	99.742±0.247	1513.392±0.213d	94.122±0.247d	142.250±0.000d	108.099±0.015d	46.818±2.746d
10.0g/kg(GLM	2.476±0.00	861. 913±0.525	5.62±0.00	91.38±0.196	859.437±0.525e	86.453±0.196e	142.040±0.000e	61.388±0.038e	42.007±0.00e
LSD (P<0.05)					7.78	1.47	0.000615	0.56	4.00

Mean values having superscript are insignificant (p>0.05)

Statistical evaluation of growth indices of fish fed on the experimental diet

Analysis of variance (ANOVA) (for growth indices of fish fed experimental diets (Table 6) shows that weight gain with p-value of 0.00000, length gain 0.00000, growth rate 0.00000, specific growth rate 0.001765, mean growth rate 0.00000 shows statistical significance ($p<0.05$) in fish fed on different concentrations of experimental diets.

Table 6

Analysis of variance for determination of the significant differences in growth indices of *C. gariepinus* fish fed on experimental diets

Proximate indices	P-value	Inference
Weight gain (g)	0.000000	Significant ($p<0.05$)
Length gain (Cm)	0.000000	Significant ($P<0.05$)
Growth Rate %day	0.000000	Significant ($p<0.05$)
Specific growth rate %/day	0.001765	Significant ($p<0.05$)

Discussion

In fish culture, feed accounts for at least 60% of total cost of fish production which determine the viability and profitability of fish farming enterprise (Jamu and Ayinla, 2003). Though *G. latifolium l*eaf meal (GLM) is newly introduced in fish feed, feeds are generally formulated mainly for the purpose of maximizing nutrient relation and minimizing nutrient loss (Allen et al 2010). The nutritional requirements met by fish feed are used to assess feed quality which could be evaluated from its growth performance indices. Results obtained in this study shows positive responses by the experimental fishes to all diets as observed in the evaluated growth performance indices of length gain, growth rate, specific growth rate (SGR), mean growth rate and percentage weight gain.

Weight gain of fishes fed on 0g/kg had significantly highest weigh when compare to fishes value 4126.261±0.166 when compared to fishes fed on *G. latifolium* leaf meal. The values obtained from the experimented ($p<0.05$), though not similar to observation of Amisah *et al* (2009) who documented that *Clarias gariepinus* fed *Leucaena leucocephala* grew better at 20% inclusion compare to fish group fed control diet.

In the present study, increase in growth rate of fishes fed on 0g/kg had highest mean growth rate when compare to fishes fed *Gongronema latifolium*. The values obtained from the experimental diets B, C and D was significant ($p<0.05$).

This finding is dissimilar to observation of Ekanem *et al* (2012) who documented that *Clarias gariepinus* that were fed *Moringa Oleifera* grew better compare to fish group fed control diet.

The mean Length gain of fishes fed on 0g/kg had significantly highest weigh when compare to fishes value 4126.261±0.166 when compared to fishes fed on *G. latifolium* leaf meal. The values obtained from the experimented ($p<0.05$), though not in agreement to observation of Amisah *et al* (2009) who documented that *Clarias gariepinus* fed *Leucaena leucocephala* grew better at 20% inclusion compare to fish group fed control diet.

Specific growth rate of fish fed on 0g/kg and different concentrations of GLM 2.5g, 5.0g, 7.5g and 10.0g (kg) were significant ($P>0.05$). The value 52.488±0.001 obtained from fish fed on 0g/kg was higher than 49.972±0.001 in fish fed on diet C (5.0g/kg GLM), 46.818±2.746 in fish fed on diet D (7.5g/kg GLM) and the least 42.007±0.000 in fish fed on diet E (10.0g/kg). However, increased in GLM from 2.5g/kg to 10.0g/kg (GLM) recorded declined values of SGR of *C. gariepinus* with the least value of 42.007± 0.00 occurring in fish fed on diet E (10.0g/kg GLM).

. This finding is dissimilar to the observation of Edi & Mohammed, (2008) who documented that *O. niloticus* fed on supplemented diets grew better compared to fish fed on control diet. The positive growth performance obtained in this study is in line with the finding of Amisah and Ofori, (2009) who had the best growth performance of *C. gariepinus* at 20% inclusion containing *Leucaena leucocephate* leaf meal. These finding also agrees with findings of other researchers (Obasa *et al* 2013, Ekanem *et al* 2013). The growth responses of fishes fed on *G.latifolium* leaf meal in this study was also as a result of richness of G.L.M in nutritional elements such as fat, protein, vitamins, minerals and essential amino acid. This is in agreement with the findings of Elayinmi (2007) and Kubarava *et al* (2007) that *G.latifolium* usage in animal culture has been very beneficial in terms of immune system and aids to eradicate common pathogenic strains in animal. This is in agreement with the findings of Mensah *et al* (2008).

In this study, high feed comsumption by experimental fishes indicate that *Gongronema Latifolium* feed had maintained maximal nutritional retention and appetite for growth. This is in conformity to Ekanem *et al* (2012) the quantity of feed consumed by fish is crucial in calculating food utilization indices.

Values of food conversion efficiency and all the diets conversion obtained in this study were significant ($P<0.05$) for fishes fed on 0g/kg and all the diets. These are consistent with the range obtained by different authors for optimal growth of *C. gariepinus* by Ekanem *et al* (2011). According to Ekanem *et al* (2013) a good knowledge of FCR and FCE will enable a fish farmer in feeding fish to satiation level which will result in fast growth.

Conclusion

In conclusion, the supplementation of different levels of *G. latifiolium* leaf meal has shown beneficial effects on growth potentials and feed utilization indices of *C. gariepinus* when compared to the control, 0g/kg diet. The nutrient composition of the leaf also play significant role in the overall influence on the growth indices such as weight gain (g), growth rate (g/day), length gain and specific growth rate, food consumption, food conversion ratio and food conversion efficiency of *C. gariepinus.* The growth potentials and feed utilization indices were found to increase significantly with increasing levels of *G. latifolium* leaf meal.

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