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GROWTH AND FEED CONVERSION EFFICIENCY OF *CLARIAS gariepinus* (AFRICAN CATFISH) FED WITH SOYA BEAN MEAL AND GROUNDNUT MEAL

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ABSTRACT

An experiment was conducted to evaluate the effect of replacing fish meal with soya bean meal (SBM) and groundnut cake (GNC) on the growth performance of African Catfish (*Clarias gariepinus*) for the period of 8 weeks (56 days). Fish meal in the control diet (D1) was replaced with SBM and GNC at 50% level in (D4 and D5) and 100% level in (D2 and D3)

Introduction

Aquaculture is one of the world's fastest-growing food-producing industries. Ayinla 2012, stated that global aquaculture production has quadrupled in the last twenty years, It is a potential means of nation food security and socio-economic development, directly, by producing fish for human consumption and indirectly by creating jobs for the country's growing army of unemployed youth as well as generating foreign exchange through the export of fish and fish products.

Fish is highly nutritious and valued for its highly digestible protein which is of high quality compared to meat and egg (Ojukwu *et al.*, 2009). It contributes to the world protein and is a source of therapeutic substances for the treatment of coronary diseases, auto-immune diseases, anaemia and protein energy malnutrition (Iheanacho *et al.*, 2017).

respectively. 150 fishes were used for the experiment, the fish were stocked ten (10) per tank with three replicate per treatment. Five experimental diets were prepared. Results show that SBM, GNC incorporated diets have no significant effect on the physico-chemical parameters of the water. High growth rate in average final body weight, Protein Efficiency Ratio (PER) and Specific Growth Rate (SGR) were observed in D1, D4, D3, D2 and D5 respectively. Lowest growth was observed in D5. In the present study it has been seen that fish meal can be partially and completely replaced by soya bean meal (SBM) (D4 and D2) without hampering growth, hence formulating nutritionally balanced diet for *Clarias gariepinus* (African catfish).

Key words: *Experimental Diets; Protein Efficiency Ratio; Fish Meal; Specific Growth rate; Physico-Chemical Parameters.*

Fish has long been recognized as a valuable source of cheap, affordable high-quality protein and other nutrient needed in human diet especially those required for body growth and maintenance (Adeyemi *et al*., 2013).

The African catfish, (*Clarias gariepinus*), is the most cultured fish in Nigeria and is of great economic interest, it has enjoyed wide acceptability in most parts of the country because of its unique taste, flavour and good texture (Osibona *et al.,* 2016). *Clarias gariepinus* has shown considerable potential for use in intensive aquaculture because of its omnivorous feeding habit which allows them to feed on wide range of food materials such as oil cakes, barns, brewers' wastes, and maggot (De-Silva *et al.,* 1998).

In fish culture, feed importance cannot be over emphasized as it accounts for more than 60% of total input cost and in order to meet up with the nutritional requirements of fish under culture, supplementary diet must be provided to complement natural feed supply (Sharmal *et al.,* 2001, Karapan Agbottidis, 2002 and Solomon *et al.,* 2012).

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Fishmeal which serves as the main protein source for fish feed because of its high-quality protein content, it is not only expensive but equally unavailable (Tacon and Barg 1998, Fagbenro and Davies, 2003).

The major decline in production of fish meal in the year 1994 and 2012, gave rise to the search for alternative sources of protein that would allow aquaculture to remain economically and environmentally sustainable (Medale *et al.,* 2014, Barroso *et al.,* 2014). Efforts have been made to replace fishmeal with plant protein by many researchers (Ogunji *et al.,* 2003) but this work is to assess the comparative efficacy of plant protein sources (SBM and GNM) as substitutes for partial or total replacement of fish meal in catfish (*Clarias gariepinus*) diet, growth and survival of catfish and the effect of these diets on physico-chemical parameters of water.

MATERIALS AND METHODOLOGY

Study Area

The experiment was conducted between October 2021 to December 2021 in the Water Quality Laboratory of Department of Aquaculture and Fisheries Management, Lagos State University of Science and Technology, Ikorodu.

Experimental Fish

A total of 150 fingerlings of the African catfish (*Clarias gariepinus*) were purchased from a fish farmer at Odogunyan and were transported in a well aerated plastic container to the experimental laboratory.

Experimental Design

Rectangular plastics of the same sizes (46.5 cm X 30.9 cm X 23.8 cm) were used as the research tanks. The fish were acclimatized in the laboratory for two weeks prior to the experiment. During acclimatization, they were fed with 1.5 mm imported feed (Aller qua feed). Ten fish per tank were randomly distributed into the research tanks. The average weight of the fish was 14.0g

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Feed Formulation Calculation

Trial and error method was used to formulate the experimental diets for the catfish fingerlings; the feed formulated had 63% crude protein (C.P)

Table 1: Showing the Crude Protein Level of the Ingredients Used

S/N	INGREDIENTS	CRUDE PROTEIN LEVEL (C.P)
1.	Wheat	12%
2.	Maize	10%
3.	Fish meal	72%
4.	Soya bean meal	44%
5.	Groundnut cake (GNC)	45%

Table 2: Diet 1(Control Diet) Fish Meal

S/N	Ingredients	Crude Protein Level (C.P)	Quantity(kg)	Crude protein level in the feed
1.	Wheat	12%	5	5*12/100=0.6
2.	Maize	10%	4.9	4.9*10/100=0.49
3.	Fish meal	72%	86	86*72/100=61.92

Total crude protein in diet one (D1) = 63%C. P

Table 3: Diet Two (D2- total replacement of fish meal with soya bean)

S/N	Ingredient	Crude Protein Level (C.P)	Quantity(kg)	Crude protein level in the feed
1.	Wheat	12%	5	5*12/100=0.6
2.	Maize	10%	4.9	4.9*10/100=0.49
3.	Soya bean	44%	86	86*44/100=37.84

Total crude protein in diet two(D2) =38.93%C. P

Table 4: Diet Three (D3- total replacement of fish meal with groundnut cake-GNC)

S/N	Ingredients	Crude Protein Level (C.P)	Quantity(kg)	Crude protein level in the feed
1.	Wheat	12%	5	5*12/100=0.6
2.	Maize	10%	4.9	4.9*10/100=0.49

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3.	Groundnut Cake(GNC)	45%	86	86*45/100=37.84

Total crude protein in diet three(D2) =39.74%C. P

Table 5: Diet Four (D4- partial replacement of fish meal with soya bean)

S/N	Ingredients	Crude Protein Level (C.P)	Quantity (kg)	Crude protein level in the feed
1.	Wheat	12%	5	5*12/100=0.6
2.	Maize	10%	4.9	4.9*10/100=0.49
3.	Fish meal	72%	60	60*72/100=43.2
4.	Soya bean	44%	26	26*44/100=11.44

Total crude protein in diet three(D2) =39.74%C. P

Table 6: Diet Five (D5- partial replacement of fish meal with Groundnut cake)

S/N	Ingredients	Crude Protein Level (C.P)	Quantity (kg)	Crude protein level in the feed
1.	Wheat	12%	5	5*12/100=0.6
2.	Maize	10%	4.9	4.9*10/100=0.49
3.	Fish meal	72%	60	60*72/100=43.2
4.	Groundnut cake	45%	26	26*45/100=11.7

Total crude protein in diet five(D5) =55.99%C. P

Table 7: Showing the Percent Composition of all the Experimental Diets

S/N	INGREDIENTS	EXPERIMENTAL DIETS				
		D1	**D2**	**D3**	**D4**	**D5**
1.	Wheat	5	5	5	5	5
2.	Maize	4.9	4.9	4.9	4.9	4.9
3.	Fish Meal	86	_	_	60	60
4.	Soya Bean	_	86	_	26	_
5.	Groundnut cake	_	_	86	_	26

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Additives in all the diets: Di-calcium phosphate, Lysine, Methionine, Vitamin C, Fish premix, fish oil

Feeding Schedule

Feed was given at 5% of the body weight for 56 days, twice a day at 8:00 am and 5:00 pm. The fish weights were measured individually (i.e. unit by unit) once a week and the quantity of feed was adjusted based on the changes in body weight of fish.

Growth Indices Monitored During the Study

Diet performance was evaluated as follows using formulae adapted from Peterson and small (2007)

Weight Gain (ΔW) = Final Weight (Wf) - Initial Weight (Wi)

Mean Weight gain (MWG) = Wf - Wi/N!

Specific Growth Rate (SGR)

Specific growth rate is the logarithmic exponent of weight gained by the fish per unit time expressed in percentage.

The formula is: SGR = $(Log_eW_2 - LogW_1)/T*100$

Where W = weight (g) at stocking

W2 = Weight (g) at the end of the experiment

T = Duration of experimental days

Log = Natural logarithms

Feed Conversion Ratio (FCR)

FCR is the ratio of dry weight of food eaten to the weight gained, and is given as: Dry weight of food eaten (g)/fish weight gain (ΔW) = feed intake (g)/fish weight gain

Protein intake: Feed intake*crude protein of feed

Protein efficiency ratio (PER): Weight gain (g)/protein intake

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STATISTICAL ANALYSIS

The experimental design used was completely randomized design; the data collected were subjected to a one-way analysis of variance (ANOVA). The difference between the treatments was analysed with Duncan multiple range test with a significance level of 0.05

RESULT

The growth and feed performance values in terms of weight gain (g), specific growth rate, feed conversion ratio, protein efficiency and mortality rate (%) of *Clarias gariepinus* fingerlings in the different treatment are present in (Table 8). The weight gain from the treatments shows that there is a significant difference between the treatments as shown in (Table 9). Water quality parameter in the experimental tanks shows no variations throughout the duration of the experimental trial as shown in (Table 10).

The performance in terms of mortality rate on different diet (Table 8) shows that there was no mortality in all the treatments.

The growth response in all treatment is presented in (Table 8), the percentage weight gain recorded in catfish fed with diet 1,2,3,4 and 5 were all significantly different. The performance of catfish fed with diet 1, 2, 3 and 4 is better than that of diet 5.

The same trend was observed for specific growth rate (SGR) and feed conversion ratio (FCR) as recorded (Table 8) which shows the increasing rate from treatment 1, 4, 2, 3 and 5.

There is no significant difference between ($P>0.05$) treatments as seen in protein efficiency ratio (PER).

WATER QUALITY PARAMETER

Results of water quality parameter monitored during the course of the experiment/study are shown in the fig. 1:

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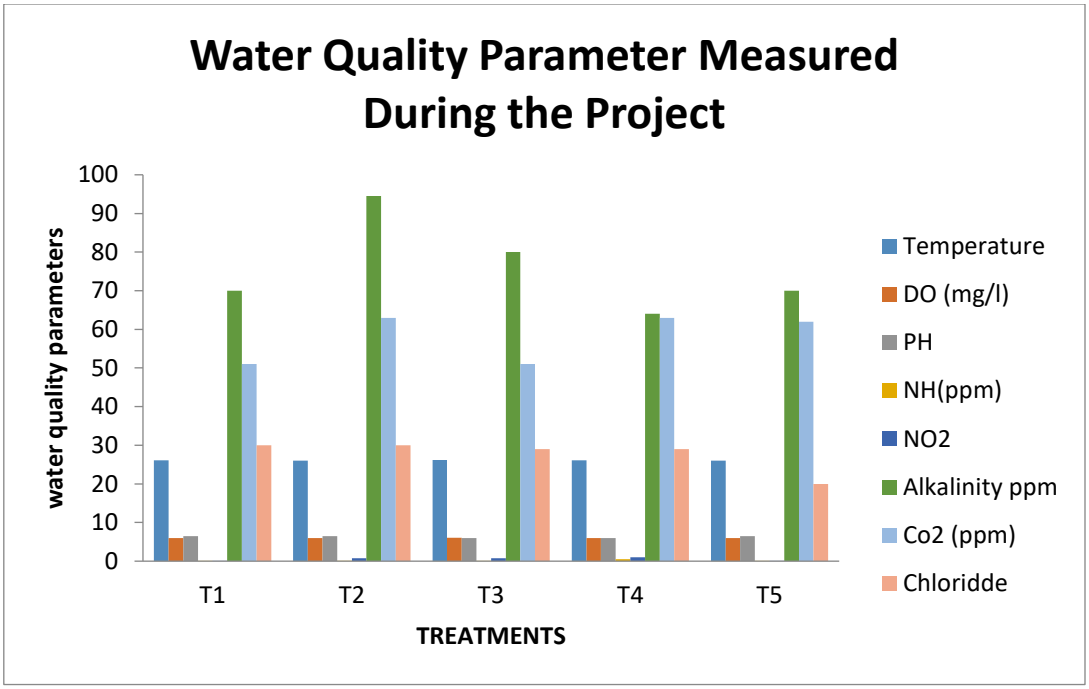

Fig 1: Water quality parameter measured during the experiment

Table 8: Growth and feed utilization parameters of *Clarias gariepinus* fed at 5% body weight

DATA	TREATMENTS				
	T1	**T2**	**T3**	**T4**	**T5**
Initial Weight (g)	140 ± 0.01	140 ± 0.01	140 ± 0.01	140 ± 0.01	140 ± 0.01
Final Weight (g)	371 ± 0.02	318 ± 0.14	140 ± 0.01	140 ± 0.01	140 ± 0.01
Weight Gain (g)	281 ± 0.23	178 ± 0.19	140 ± 0.01	140 ± 0.01	140 ± 0.01
Specific Growth Weight (g)	2.62 ± 0.03	2.50 ± 0.02	140 ± 0.01	140 ± 0.01	140 ± 0.01
Feed Intake (g)	66.29 ± 0.16	65.0 ± 0.15	140 ± 0.01	140 ± 0.01	140 ± 0.01

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Feed Conversion Ratio	0.31 ± 0.10	0.37 ± 0.12	140 ± 0.01	140 ± 0.01	140 ± 0.01
Protein Efficiency	0.06 ± 0.04	0.07 ± 0.05	140 ± 0.01	140 ± 0.01	140 ± 0.01
Mortality Rate (%)	0	0	0	0	0

Table 9: ANOVA Statistics for weight gain of fish

SV	DF	SS	MS	F. Cal	F-Tab(P>0.05)	F-Tab (P>0.01
Treatment	4	928.75	232	2.64	2.64	3.91
Error	35	3083.43	88.1			
Total	39	4012.18				

If F-Cal is greater or equal to F-Tab, then there is significant different among treatment

SV= sum of variance
DF= Degree of Freedom
SS= Sum of Square
MS= Mean Square
F-Cal= Variance Ratio (E-Calculated)
F-Tab= Frequency Table

Table 10: ANOVA Statistics for Feed Intake of Fish

SV	DF	SS	MS	F. Cal	F-Tab(P>0.05)	F-Tab (P>0.01
Treatment	4	279.56	697.6	2.41	2.64	3.91
Error	35	10154.3	290.1			
Total	39	12944.8				

If F-Cal is greater or equal to F-Tab, then there is significant different among treatment

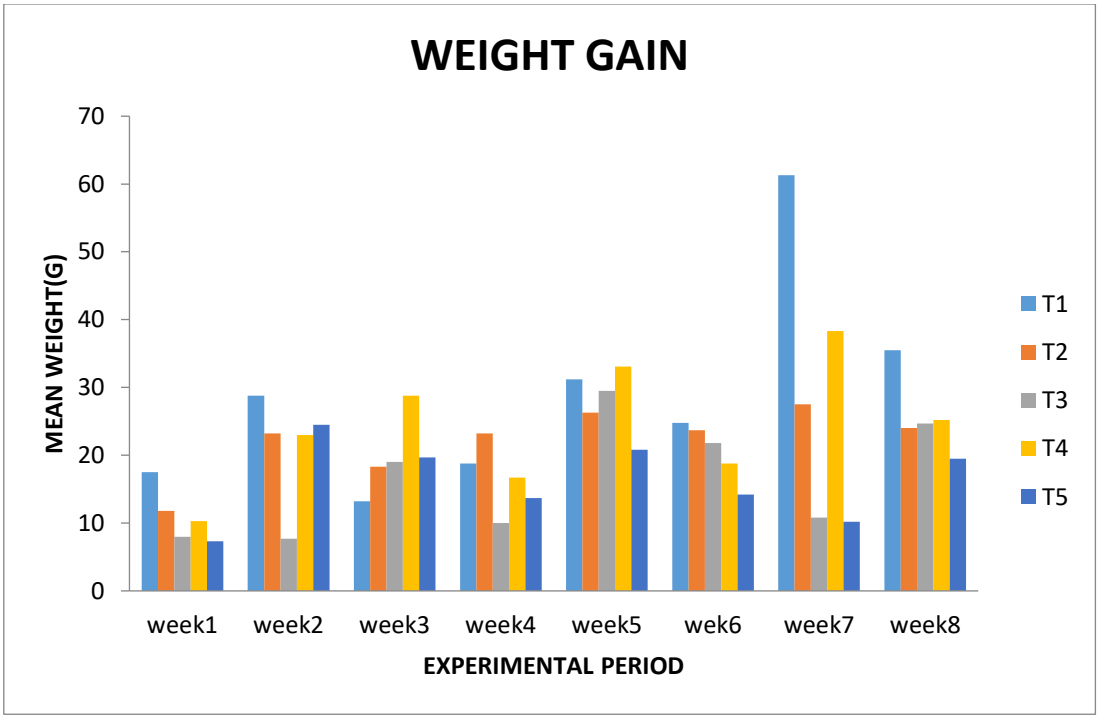
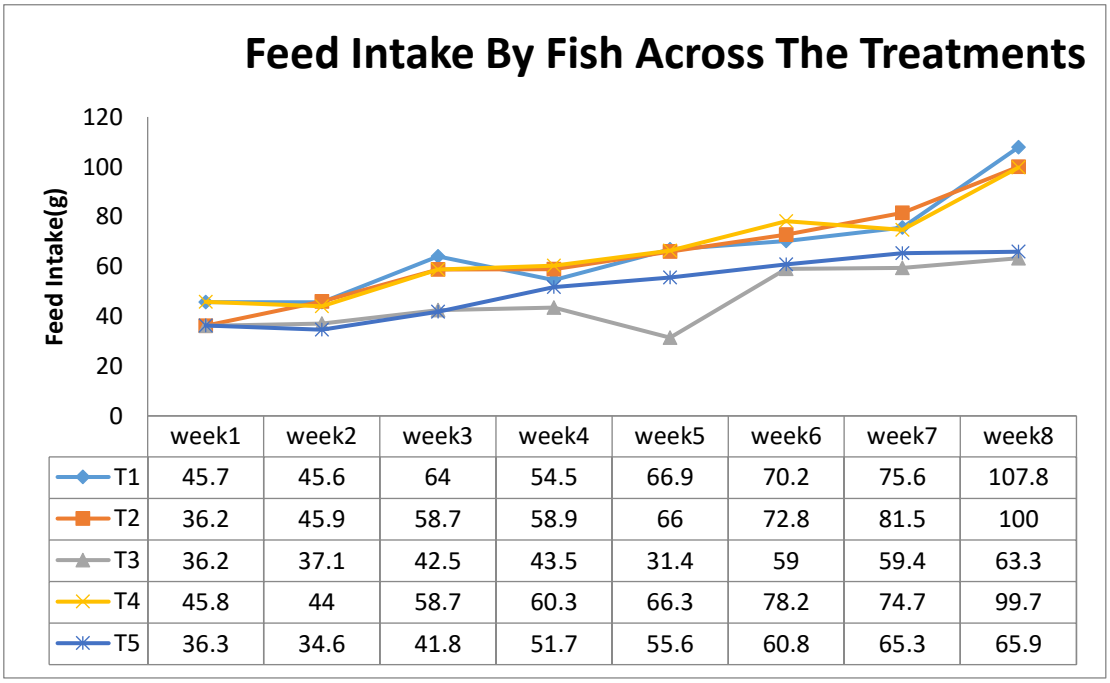


Fig 2: Shows the difference in weight gain of *Clarias gariepinus* fed with five different formulated feed.



	week1	week2	week3	week4	week5	week6	week7	week8
T1	45.7	45.6	64	54.5	66.9	70.2	75.6	107.8
T2	36.2	45.9	58.7	58.9	66	72.8	81.5	100
T3	36.2	37.1	42.5	43.5	31.4	59	59.4	63.3
T4	45.8	44	58.7	60.3	66.3	78.2	74.7	99.7
T5	36.3	34.6	41.8	51.7	55.6	60.8	65.3	65.9

Fig 3: Shows the feed intake per week by the fish in each treatment

DISCUSSION

The ANOVA remits indicated significant difference in weight gained and specific growth rate among treatment means (P>0.05). No mortality was recorded throughout the experimental trial, survival rate for all the treatments were 100% which shows that the fish are not affected by the diets. The result indicates that all the diets promoted growth in *Clarias gariepinus* fingerlings, but fish grew significantly larger on those feed containing high protein and lipid levels (63%, 55.64% respectively). The trend in the weight gain which is shown in Fig 2. Show that there is increase and decrease in the weight gain by fish in each week which might happen when the fish did not pick up their experimental feed. Our results are in agreement with that of Giri *et al.,* 2003, also reported an increase in weight gained and SGR in larvae of Clarias hybrid fed uneven level of protein during the study conducted using 250, 300, 400g (CP) kg^{-1} dry matter in the study, it was observed that acceptability of soya bean meal (SBM) up to a certain level in place of fish meal. Reigh, 2000, Li *et al,* 1999 reported that complete replacement of fish meal with SBM or other ingredients such as cotton seed meal, meal gum, bone meal showed no impairment in growth and feed efficiency rather higher growth rate in terms of SGR and FCR as observed in *Oreochromis Karonfae* (Vyirendea et al, 2000). The acceptability of soya bean meal (SBM) at 100% and 50% in treatments 2 and 4 respectively in the present studies also demonstrate its utilization by *Clarias gariepinus* without any reducing effect, Bhilave *et al*., 2012, used different soya beans formulated diets which resulted in best PER in 100% Soybean diets in Fran carp, *(Tenophargagodon idella).*

Groundnut cake (GNC) showed low acceptability up to 100% from 50% (D3and D5) in place of fish meal (rich in lysine and methionine) and this affected their growth parameters. Nguyen and Doris, 2009 reported that combining groundnut meal with fish meal result in growth enhancement but in this study, Diet 5 having combination of groundnut cake (GNC) and fishmeal showed a declined result, which may be due to the deficiency of sulphur containing amino acids i.e. methionine and lysine, vitamin B12 and calcium in groundnut meal (Jauneery, 1998).

CONCLUSION

The replacement of fish meal at 50% and 100% with soya bean meal (SBM) showed no negative impact on the growth and feed conversion efficiency of the fish, therefore SBM could be used as an alternative to fish meal in order to produce a cost-effective diet for fingerling *Clarias gariepinus*.

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