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Growth and survival of *Clarias gariepinus* fingerlings fed water lily leaf meal as partial replacement for soybean meal

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Abstract
This study assessed the growth attainment nutrient utilization potential of *Clarias gariepinus* fingerlings nurtured with levels of Water lily meal (WLM) in partial replacement with Soybean meal (SBM). A total of 160 *C. gariepinus* of mean weight 1.77±0.04 and mean length of 5.43 cm were randomly placed in 16 transparent rectangular 25 lites plastic aquaria -10 each and feed diet containing about 40% CP whilst each of the four diets were substituted with water lily at varying treatment levels A (0%) the control, B (10%), C (20%) D (30%)). Each of the treatment had four replicates. The fish were fed 5% body weight for 49 days. The various diet were accepted by the fish but there was a decrease in growth performance as the level of WLM was increased. Meanwhile, all water characteristics measured proved to supportive of fish rearing in the tropics except pH (the water quality parameters were in ranges DO (6.18±0.03 - 6.37±0.03 mg/l) pH (6.19±0.051 - 6.30±0.051) and Temperature (26.5±0.03 -27.5±0.30 ^{0}C). The highest and lowest mean weight gain of the 1.79±0.04g and 1.66±0.04g were obtained in treatments A (10%) and C (20%) respectively. There was no significant different between fish feed diet A and B in terms of weight gained. The protein efficiency ratio (PER) recorded for diet A (control) 0.72±0.01 had no significant difference (P> 0.05) with all diets containing WLM. In terms of percentage survival. Diet B attained the highest (90±4.46%), followed by A (67±4.46) C (55.00±4.46%) and D (52.54±4.46%) respectively. The performance of *Clarias gariepenus* proved that the fingerlings fed diet B (10%) had the optimum level of WLM inclusion level in this study and it is therefore recommended to farmers. And should be adopted, also, the threat of the evasive nature of water lily would be put in check in the process.

Keywords: Water lily, non-conventional, feed ingredient, fish feeding, *Clarias gariepinus,* growth

Introduction

Fish products play important roles to the economic and security of over 800 million people on the globe (World Fish, 2015) [22]. Put differently fish is a vital source of high protein consumed worldwide (FAO, 1997), whilst it also provides commerce for ancillary individuals in the fish production chain. The rapid increase in human population and demand for animal protein especially in developing countries like Nigeria, requires a corresponding expansion of fish farming activities (Little and Edward, 2003; Okoko *et al.,* 2015) [13, 15]. Pauly (2017) [16] posits that Aquaculture production shall sooner or later be in excess of capture fisheries No thanks to the dwindling catches from the Capture Fisheries Sector (Delgado *et al,* 2003, FAO 2004, Gabriel 2007) [5]. Spinlli (2021) [17], opined that the rapid growth of aquaculture and livestock production will definitely stir up huge crisis in terms of high demand for fish / livestock feed industry. FAO (2010) [8] report, affirms hike in the prices of fish feed ingredient especially of protein origin. In this circumstance the quest to use ingredient from non-conventional sources is therefore imperative (Falaye and Oloruntuyi 2008, Olatunde 1996, Baruah *et al,* 2003, Eyo, 2004) [7, 2, 6]. The cost of soya bean meal is currently unsustainable in economic teams because it is prohibitive in terms of cost (Tewe, 2004) [19]. It therefore seem economically obligatory to seek cheaper protein sources to replace expensive soybean in compounding fish feed (France, *et al,* 2001; Vhanalakar and Muley 2014) [10, 21] or else fish productivity and profitability will be a mirage (Akinrotimi *et al.,* 2007) [1].

Vegetable protein sources like aquatic weeds have been advocated by serveral workers (Gupta, 2001; Nwana *et al.* 2008; Worldfish, 2015) [11, 14, 22] since their derivation is relatively free - requiring only efforts to harvest them. Water lily like other aquatic weeds abounds prolifically in nature on water ways (Briggs 2006) [4].

The water lily poses several environmental problems such as disruption of biodiversity impacting swimming and boating areas as well as clogging irrigation drains and ditches (World fish 2015) [22]. The prolific nature and abundance of water lily in our surface waters as well as their menacee which has hitherto hampered on human endeavours, can therefore be put into advantage in stirring the ship of feed industry through filling the gap as protein feed ingredient in aquaculture feed industry. Any attempt at reducing the feed cost which takes about 60% of the entire production process (FAO, 2014) [9] without necessarily compromising growth is welcomed development. This study assessed the effect of varying levels of Water lily meal in the diet of *Clarias gariepinus* fingerlings.

Material and methods

Experimental Site

The study was conducted in the Department of Fisheries Hatchery of the Niger Delta University Teaching and Research Farm.

Preparation of Feed Trial Diets.

Water lily whole plant was harvested from a borrow pit in Wilberforce Island, Bayelsa State. The leaves were plucked, selected washed and dried for 3days and ground. All other ingredient were purchased from local market in Yenagoa. Four experimental diets which had approximately 40% crude protein were prepared using soybean meal substituted with Water lily meal at vary levels of 0%, 10%, 20% and 30% respectively. The composition of each diet as formulated is shown in the Table 1.

Table 1: The Gross Composition of Experimental Diet ingredient

Parameter	T_1(0%)	T_2(10%)	T_3(20%)	T_4(30%)
Fish meal	28.5	29.5	30.5	32.5
SBM	30.0	27.0	24.0	21.0
Water lily	-	3.0	6.0	9.0
GNC	16.5	16.5	16.5	16.5
Oil	6	6	6	6
Yellow maize	11.0	10.0	9.0	8.0
Vitamin/Mineral Premix	0.2	0.2	0.2	0.2
Table salt	0.7	0.7	0.7	0.7
Vitamin C	0.1	0.1	0.1	0.1
Bone Meal	1.5	1.5	1.5	1.5
Methionine	0.5	0.5	0.5	0.5
Total	100	100	100	100
Crude protein	40.07	39.98	39.97	39.97

Each ground ingredient was sieved and weighed according to the required proportion into clean basin and thoroughly hand mixed and labelled. Water of about 10% of the experimental diet was added to each mixture and mixed thoroughly to form dough. The dough was made to pass through a meat mincer to produce strands of feed to form pellets. The products were then dried with a smoking kiln for 24 hours and allowed to cool and then packaged in clean labelled containers.

Proximate composition of Experimental Diet

All feed stuff in dried and ground form were analysed for Moisture, Crude protein, fibre, Lipid and Ash according to the procedures of Association of official analysis chemistry AOAC (1990). The Nitrogen Free Extract NFE= 100-%Protein+%Lipid+%Fibre+%ash+%moisture.

Experimental Fish

A total of 160 *Clarias gariepinus* fingerlings of mean length and weight of 5.43 cm and 1.79g respectively were purchased from a reputable Fish Farm. They were acclimatized for 24hrs in plastic holding aquaria.

Experimental set up

A total of 16 experimental plastic aquaria with capacity of 25 Litres each were used for the feeding trial. Each was washed and filled with dechlorinated tap water up to $^1/_3$ level of the aquaria. Four tanks were used for each treatment.

Stocking and Feeding of Fish

Each aquarium was stocked with 10 fingerlings. The fingerlings were fed 5% body weight daily, divided into 2 rations at 0800hr and 1600hr.

Water Quality Measurement

Temperature was measured daily with a laboratory thermometer, while Dissolved Oxygen DO and p^H level were taken with aid of DO meter and pHmeter respectively (Boyd, 1979) [3].

Measurement of Experimental Fish and Performance Parameter

The total length and body weight measurement of experimental fish were taken weekly with aid of meter rule and weighing balance.

Mean Body Weight Gain (g): was derived through taking the difference between the final weight and initial weight (W_{f-} $_{Wi}$).

Percentage weight gain (%)

$$Weight\ gain\ (\%) = \frac{W_f - W_i}{W_i} \times 100$$

(Adewolu *et al*, 2008)

Where W_i = final mean body weight;
W_i = initial mean body weight of experimental fish.

Mean Increase in Fish Length (cm)

Mean increase in fish length was calculated as the difference between the initial and final length values of the fish.

$$L_1 - L_0,$$

Where L_i = final mean length increase; L_o= initial mean length of experimental fish.
Where T represents trial duration (day)

Condition Factor (CF)

Fulton's condition factor (K) was calculated thus:

$$K = \frac{100w}{L^3}$$

Bagenal and Tescha (1978):

Where W and L are the observed total weight (g) and length (cm) of experimental fish.

Percentage Survival Rate (S)

Percentage Survival Rate (S is the number of fish achieved at the end of the growth period relative to the number alive at the beginning of the experiment;

$$S\ (\%) = \frac{N_t}{N_0} x100$$

(Effiong *et al.* 2009).

Where:
N_i= Number of fish fingerlings at the end of the experiment, while N_0 is number of fish fingerlings at the beginning of the experiment.

Food Conversion Ratio (FCR)-

Food Conversion Ratio (FCR)- this is the mass of feed intake divided by the weight gain over a period of time by the weight gain

$$FCR = \frac{\text{Dry Feed Intake (g)}}{\text{Wet Weight Gain (g)}}$$

Protein efficiency ratio (PER)

$$PER = \frac{\text{Mean Weight Gain (g)}}{\text{weight Protein Intake}}$$

(Zeitoun *et al.*) [23]

Statistical Analysis

Data collected were subjected to Analysis of Variance (ANOVA) using the SPSS Package version 17, while significant mean difference level were separated at 0.05 probability levels *P*> 0.05 Steel *et al.*

Result and Discussion

Experimental Diets

Values of the respective 4 diets are presented in Table 2. The proximate composition of the diets were crude protein (38.20-39.60) are similar to those reported by ikenweiwe *et al*., (2015) [12]. Although the crude fibre and ash contents of this study which are in ranges (5.70-8.9) and (2.30 – 3.30) are lower than that documented by the aforementioned authors. This might be probably because the protein ingredients of their experiment is of animal origin while that of this study is of plant base.

Table 2: Proximate Composition (dry mater %) of Experimental Diet

Parameters	Diet			
	T1(0%)	T2(10%)	T3(20%)	T4(30%)
Crud Protein(%)	39.60	39.52	38.20	29.02
Moisture (%)	7.00	6.08	5.59	6.09
Crude Fat(%)	5.70	8.30	8.90	8.20
Ether extract (%)	7.20	5.20	5.30	4.0
Ash (%)	2.30	2.00	3.30	3.10
Nitrogen Free Extract	38.20	37.94	38.71	35.59

Table 3: Values of Water Quality Parameters

Parameters	Diet			
	T1(0%)	T2(10%)	T3(20%)	T4(30%)
Temperature (^{0}C)	26.8±0.30	27.5±0.30	27.0±0.30	26.5±0.30
Dissolved Oxygen (mg/l)	6.37±0.03	6.35±0.03	6.18±0.03	6.21±0.03
pH	6.30±0.05	6.28±0.05	6.21±0.05	6.19±0.05

Table 4: Growth, Survival, Nutrient Utilization and Cost of Feed for *Clarias gariepinus* Fingerlings fed Varying Dietary levels of *Nympaea alba* (Water lily)

Parameter	Diet			
	T1(0%)	T2(10%)	T3(20%)	T4(30%)
Initial mean Weight (g)	1.42	1.40	1.39	1.39
Final mean Weight	3.19	3.20	3.05	3.0
Mean weight Gain (g)	1.77±0.04	1.79±0.04	1.66±0.04	1.69±0.04
Initial mean length (cm)	2.34	2.37	2.34	2.39
Final mean length (cm)	5.43	5.20	5.23	5.10
Mean length increase (cm)	3.10±0.10	3.10±0.10	3.10±0.10	3.10±0.10
Percentage weight gain(%)	25.05±3.10	27.56±3.10	19.05±3.10	21.46±3.10
Percentage Survival (%)	67.5±4.46	90.0±4.46	55.5±4.46	52.5±4.46
Food Conversion Ratio	2.71±0.50	2.70±0.50	2.9±0.50	2.84±0.50
Protein Efficiency Ratio	0.72±0.10	0.73±0.10	0.68±0.10	0.69±0.10
Condition Factor (k)	1.99±0.06	2.30±0.06	2.13±0.06	2.32±0.06
Cost of Feed (N /g.wt)	178	171	166	159

Values of physicochemical parameters of this study were in ranges pH (6.19±0.05 - 6.30±0.051) and did not vary significantly (*P* > 0.05) across the treatments This might be due mainly to the fact that all the treatments were from the same source and also that pH is basically a buffered parameter (Ubong and Gobo, 2001). Dissolved oxygen ranges of the study were (6.18±0.03 – 6.37±0.03) which are enterprising for fish rearing in the tropics (Uzuchukwu, *et al*., 2010) [20]. Similarly the water temperature range of (26.3 ± 0.3 – 27.5 ± 0.03) meets the desired range of water temperature for warm water fish culture (Boyd 1979) [3]. In terms of nutrient utilization weight gain (WG), mean length increase LI Survival Rate (SR) and food conversation ratio (FCR) are presented in Table 4. There was no significant difference in all the growth parameters across all treatments. The best result was obtained in treatment B (10%) water lily meal) for all growth parameters measured namely mean body weight gain (1.79±0.40g), body length 3.30±0.2, PER (0.73±0.10). Highest survival rate (90.0±4.46%) was equally recorded in Treatment B. One other fact that emanated from the study proves that the general growth parameters under review decrease regressively as the percentage of the WLM progressively increased.

Conclusion

The result of this study has proven that water lily is a veritable ingredient for fish feed manufacture. Data generated in this study revealed that Water lily meal WLM inclusion in the diet of *Clarias gariepinus* was utilized for its growth without delivering effect on the experimental animal when used as partial replacement level with SBM at 10%. The result of this study therefore provides two folds' benefits which are namely; the inclusion of water lily in the fish diet to replace SBM at 10% level (readily aavailable at no cost) and thereby reducing amount spent on Soybean for feed production while on the other hand, it aids in reduction of growth and the menace caused by their evasive nature as they

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