GROWTH PERFORMANCE AND NUTRIENT UTILIZATION OF AFRICAN CATFISH (*Clarias gariepinus*) FINGERLINGS FED DIETS WITH GRADED INCLUSION LEVELS OF DUCKWEED (*Lemna* sp)

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ABSTRACT

A twelve-week nutritional study was carried out to investigate the growth performance and nutrient utilization of African catfish (*Clarias gariepinus*) fingerlings fed diets with ~~fish~~ graded levels of duckweed (*Lemna* sp.) meal inclusion. The diets I – V contained 0%, 25%, 50%, 75% and 100% respectively of duckweed. The experiment was carried out in circular plastic tanks of 28 litres volume under normal room condition. Each treatment contained 10 fingerlings of 3.84 ± 0.13a average weight in three replicates. Feeding was done at 5% body weight per day and weight changes of fish were recorded every two weeks. Weight of feed were adjusted accordingly. Growth parameters such as weight gain, specific growth rate and nutrient utilization parameters such as Food Conversion Ratio (FCR), Protein Efficiency Ratio (PER), Gross Conversion of Food Efficiency (GCFC) were monitored. Mean weight gain of (1.58g), survival rate (90%) and SGR 2.40% were highest in fish fed diet I with 0% duckweed inclusion while lowest mean weight gain, survival rate, and SGR (0.00%) were recorded in fish fed diet V (100% duckweed inclusion). The lowest mean weight gain and survival rate were recorded in fish fed diet V (100% duckweed inclusion). There was no significant deviation from the mean between the SGR of fish fed diets II, III and IV ($P > 0.05$). The Food Conversion Ratio (FCR) was lowest in fish fed diet I (2.91) and highest in fish fed diet III (5.51); no gain in weight was observed in treatment 5 hence no FCR was recorded in treatment V. Gross Conversion of Food Efficiency (GCFE) was highest in treatment I (34.45), closely followed by treatment IV (21.45) and the lowest in treatment III (18.15). no GCFE was recorded in treatment V. Protein Efficiency Ratio (PER) was highest in treatment I (0.38) and non existing in treatment V. The water quality parameters monitored during the period of the experiment (temperature, dissolved oxygen and pH) fell within the optimum range for growth and survival of *C. gariepinus*. The comparison of the proximate carcass composition of experimental fish before and after experiment showed an increase in crude protein level from the initial 59.87% to the highest recorded in fish fed diet IV (66.30%). In all the parameters measured (mean weight gain, specific growth rate, fish fed diet I. %DWM showed the best growth performance followed by fish fed diets II IV and III in that order. It is striken that there is no significant difference in the MWG and SGR of Diets II, III and IV containing DWM. Fish fed diet V (100% duckweed inclusion) however recorded the poorest performance. Therefore, it can be inferred that for optimum growth performance and optimum catfish protein content 75% level of duckweed meal in the diet of *C. gariepinus* can be tolerated. The catfish fingerlings were able to digest up to 75% inclusion level of DWM with much gain in carcass protein; improved FCR, GCFE and PER.

KEYWORDS: Growth performance, Nutrient utilization, Duckweed meal, medium

PROBLEM DESCRIPTION

Population explosion coupled with the ever-increasing demand for dietary animal protein in Nigeria, has consequently increased the demand for fish (9). Fish in the wild have thus been indiscriminately exploited leaving the government with the option of fish importation to feed her ever growing population.

In order to ensure steady and continuous supply of fish to the Nigerian populace and avoid unfavourably balance of payment due to heavy importation, there is the need to intensify aquaculture so as to boost local production of fish and gradually phase out importation of fish. Yet, there are several factors militating against the efforts made to develop fish farming in order to increase fish supply. The factors being identified include lack of modern fishing imputs, loss of products owing to improper handling, processing, transportation and marketing equipment. Others include uncontrolled aquatic weeds in culture medium, poor finance and little incentive from government, as well as the scarcity and high cost of conventional feedstuffs e.g. fishmeal, which make it difficult to match production with demand (2).

Of all the factors highlighted, feeding plays the most vital role as the farmer must supply his fish with rations, which must contain good quality dietary protein. However these ingredients are expensive and their supply unsteady. This lack of nutritionally adequate cost effective diets is a major constraint to aquaculture (6). Therefore in order to reduce reliance upon conventional meals, which are expensive, alternatives and ideally less expensive sources of good quality protein must be researched.

Exploitation of aquatic flora as source of edible protein has received little attention in Nigeria despite being in abundance and constituting a menace to the beneficial used of water sources. Many aquatic weeds have been used in the diet of herbivorous fishes. Agbede and Falaye (1996)[1], fed *Azolla filliculoides* (water fern), *Elodea Sp* and *Pistia straitiotes* (water lettuce) to Juvenile Nile tilapia

(*Oreochromis niloticus*). The experiment showed that there was no significant difference in the protein content of the fish fed control diet and those fed on aquatic weeds after the experiment.

The use of aquatic weeds e.g. duckweed in the diet of fish therefore would no doubt reduce the cost of input while serving as a way of making the most discarded, the most useful". This study is therefore designed to investigate the nutritional potential of varying levels of duckweed meal (DWM) inclusion on the growth of African cat fish fingerlings.

MATERIALS AND METHODS

Fresh duckweeds were harvested on the abandoned production ponds at the Department of Wildlife and Fisheries Management fish farm, University of Ibadan, Nigeria, sun dried for 3 days (5hours maximum/day) under intense sunlight until they become fluffy and blended into fine powder. The other feedstuffs were obtained from a livestock feed mill in Ibadan, Nigeria. Five diets - I, II, III, IV and V were formulated with varying proportions –O%, 25%, 50%, 75% and 100% respectively of sun dried duckweed meal (DWM) included into the basal diets to replace soyabean meal (SBM) protein (44% CP). The difference in crude protein content of SBM and duckweed (36.7% CP) was balanced by multiplying the inclusion level of DWM in the diets by a factor of 1.24. Altschul (1958).

The control diet had O% DWM inclusion. The crude protein level of the diets was 40%. The experimental diets were weighed, thoroughly mixed, moisture pelletted, dried for 5hours and stored at -18°C in polythene bags until used. Ten fingerlings of *Clarias gariepinus*, mean weight 3.84 ± 0.13g were allotted per tank with three replicates per treatment. Each tank contained 28L volume of fresh water changed 100% every other day. Water temperature, dissolved oxygen and pH levels were monitored weekly.

The fingerlings were fed 5% of their total body weight twice daily and weighing was done fortnightly. The quantity of feed fed to the fish was adjusted relative to the weight gained.

. The proximate analysis of the diets and carcasses were done using standard analytical methods (1). The data obtained were analysed using the one way analysis of variance and comparison of means.

RESULTS AND DISCUSSION

The water quality parameters for all the experimental tanks were within acceptable ranges as recommended for fish culture by Body (1982).

PROXIMATE ANALYSES OF THE DIETS.

The proximate composition of sun dried DWM is crude protein 36.7%, Ash 14.03%, Crude fibre 4.23%, Moisture 12.84%, Fat 8.27%, NFE 23.93%. The results of the proximate analysis of the sun dried DWM, the gross and proximate analysis of experimental diets are recorded in table 1.0 (a) and (b). The proximate analysis showed that the experimental diets contained an average of 42.93% crude protein and they were all accepted by the test fish.

Table 1.0 (a). Gross Composition of Experimental Diets (%)

	Diets				
Ingredients	I	II	III	IV	V
Fish meal	15.28	15.28	15.28	15.28	15.28
Soya bean meal	31.28	23.46	15.64	7.82	
Duckweed meal		8.76	17.52	26.28	35.03
Groundnut cake	31.28	31.28	31.28	31.28	31.28
Mezolina	11.48	11.48	11.48	11.48	11.48
Wheat offal	3.82	2.88	1.94	1.00	0.07
Calcium phosphate	1.00	1.00	1.00	1.00	1.00
Premix	1.00	1.00	1.00	1.00	1.00
Vitamin C	1.00	1.00	1.00	1.00	1.00
Cod liver Oil	3.00	3.00	3.00	3.00	3.00
Salt	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00

Table 1.0 (b) Proximate Composition of Experimental Diets.

Diets	Crude Protein	Ash	Crude fibre	Moisture	Lipid	NFE
I	44.96	9.12	5.24	9.22	4.98	27.81
II	44.63	11.36	4.12	10.08	4.56	25.25
III	43.66	10.56	5.38	11.24	4.12	25.04
IV	41.74	10.98	4.57	9.88	4.08	28.75
V	39.67	11.01	5.03	10.38	5.07	28.16
Mean	42.93	10.61	4.87	10.16	4.56	27.00

Proximate composition of experimental fish

The proximate composition of the experimental fish before and after feeding trials is presented in table 2.0. All the fish fed the experimental diets appreciated in weight at the end of the experiment. Fish fed diet IV with 75% DWM has the highest body protein (66.3%).

The carcass of fish fed diet II (65.95%CP), diet III (64.9%CP) and diet V (65.78%CP), are not significantly different form one another ($P > 0.05$) but they are significantly different at $P < 0.05$ from diet I (64.22%).

Table 2.0: Carcass Composition of fish before and after Experiment

	%crude protein	% Ash	%fibre	%Moisture	% Lipid
	59.07	15.72	3.46	9.68	6.56
Diets					
I	64.22[c]	14.76[b]	1.18[a]	8.72[d]	3.69[d]
II	65.95[b]	15.26[a]	1.07[a]	9.08[c]	3.24[b]
III	64.90[b]	13.71[d]	1.11[a]	9.76[b]	3.96[c]
IV	66.30[a]	12.97[e]	1.05[a]	9.81[a]	3.18[b]
V	65.78[b]	14.24[c]	1.14[a]	8.68[e]	3.52[a]
Mean	65.43+0.54	14.19+0.25	1.11+0.07	9.21+0.2	3.52+0.13

a,b,c value along the same column with different superscripts differ significantly from their respective mean values

The crude protein in the initial fish was 59.07%. There was a significant improvement in the crude protein stored in the flesh of all the fish fed the experimental diets when compared with the crude protein content of the initial fish. However, fish fed diet I had the lowest crude protein contents (64.22%)

There was no significant difference in the carcass fibre composition of all the fish fed the experimental diets; but fish fed diets II, III, IV and V differ significantly in carcass ash, moisture and lipid composition from the control (treatment I) at $P > 0.05$.

The best growth performance was achieved in fish fed diet I containing 0% DWM while fish fed diet V containing the highest inclusion (100%) of DWM recorded the poorest performance in terms of growth, food conversion ratio and protein efficiency ratio.

Growth Performance and Nutrient Utilization.

Table 3.0 shows the growth performance and nutrient utilization of African cat fish fed the test diets for 84days. Fish placed on the control diet (1) had the best SGR (2.46), FCR 2.91 and PER (0.38) while fish fed diet 5 had the lowest SGR and PER that were undetectable. Treatments 2, 4, 3 had significantly ($P < 0.05$) different MWG from the control however, Diets 3 and 4 were not significantly different from each other The Protein Efficiency Ratio (PER) of the control diet (0.38) was the highest followed by treatment IV (0.33). the PER of treatment II and III do not show any significant difference from each other ($P > 0.05$).

Table 3.0: Growth Performance and Nutrient Utilization of African Cat fish Fingerlings Fed varying level of sun dried DWM

Growth parameters	1	2	3	4	5	Grand mean
Mean initial weight (g)	3.83[a]	3.80[a]	3.87[a]	3.87[a]	3.83[a]	3.84±0.13
Mean final weight (g)	5.41[b]	4.72[a]	4.63[a]	4.75[a]	3.83[c]	4.67±0.14
Mean weight gain(g)	1.58[a]	0.90[b]	0.76[c]	0.88[c]	0.00[d]	0.82±0.06
Total %weight gain (g)	41.25[a]	23.68[b]	19.64[c]	22.74[d]	0.00[e]	21.46±0.31
Specific growth rate (SGR)	2.46[a]	1.52[b]	1.51[b]	1.47[b]	0.00[b]	1.39±0.08
Feed intake (g)	4.60[a]	4.01[c]	4.19[b]	3.15[d]	3.70[b]	3.93±0.13
Feed conversion ratio (FCR)	2.91[a]	4.46[c]	5.51[d]	3.58[b]		4.12±0.14
Gross conversion Food efficiency (GCFE)	34.48[a]	22.42[c]	18.15[d]	31.45[b]	0.00	26.63±0.34
Protein intake (PI)	4.14[a]	3.65[b]	3.69[b]	2.64[c]	2.94[c]	3.41±0.12
Protein Efficiency ratio (PER)	0.38[a]	0.25[c]	0.21[d]	0.33[b]	0.00[c]	0.41±0.03

Means with the same superscripts along the rows are not significantly different from the mean at $P < 0.05$.

DISCUSSION AND RECOMMENDATION

The study revealed that the best growth performance similar to the control was the 25% DWM while the poorest growth performance was recorded with diet containing 100% DWM. It can therefore be inferred that catfish cannot be fattened on a 100%CP DWM diet at best the fish were sustained on a maintenance level hence the no growth performance in Diet V. However, treatment 4 with higher inclusion (75%) of DWM encouraged good food conversion (3.58) and efficiency (0.33) but lower protein intake (2.64). It can be inferred that the higher fiber content in Diet III (5.38% CF) encouraged faster evacuation of faecal material but lower protein assimilation 64.90% CP in carcass. Mbagwu and Adeniji (1988) carried out series of preliminary experiments to determine the extent to which duckweed and its components are digested and assimilated by tilapia. They concluded that tilapia was able to digest duckweed efficiently because of the possession of sharp pharyngeal teeth and the long coiled intestine which are absent in catfishes. The lower FCR (3.58), higher GCFE (31.45) and PER (0.33) of Diet (IV) suggest that catfish fingerling is able to digest a high (75%) inclusion levels of duckweed in its diet. This could have been influenced by the high CP content of this DWM gotten from ponds heavily fertilized with organic manure and supplemented feeds.

This view is supported by Mbagwu and Adeniji (1988), Stambelie *et al.* (1994) and later by Fasakin (1999) that the leaf protein concentrate of duckweed though of high quality, has its protein content dependent on source. In addition, Mbagwu and Adeniji (1988) and Rusoff *et* al., (1980) further reported DWM's great potential as an inexpensive effective and culturable source of protein supplement because it contains higher concentration of amino acids than most plant proteins. This research supports Skillicorn's *et al* (1993) suggestion of 25% replacement level of DWM in fish diet to supporting good growth with the SGR, FCR and PER as good as the fish fed soyabean meal based diet containing an average of 42.93% CP/100% CP of the diet. However, this work differs from Skillicorn *et al.*, (1993) in that DWM when cultured in a nutritional rich medium can be included in fish diet to as high as 75% inclusion level without much significant difference ($P < 0.05$) in MWG and SGR. In fact a much improved FCR of the diet can be obtained than in the 25% DWM inclusion from a DWM raised in a poor nutrient medium. A diet with 75% inclusion level of DWM gave a significantly higher carcass protein than Diets I (control) and II 25% DWM. A multiple protein source diet gives a better carcass protein and it is to be recommended in catfish diets. Altschul (1958) and Olukunle (1996).

However, efforts must be made to reduce level of anti-nutritional factor (Calcium oxalate) in duckweed to the barest minimum or completely removed for better performance through improvement of the culture medium Francis *et al.* (2001).