Effect of partial replacement of fishmeal with duckweed (L*emna pauciscostata*) meal on the growth performance of *Heterobranchus longifilis* fingerlings.

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ABSTRACT: Duckweed (*Lemna pauciscostata*) meal was experimented for its ability to partially replace fishmeal in the diet of *Heterobranchus longifilis* fingerlings under aquarium culture system. Five-dry diets formulated at 40% crude protein were fed to fingerlings (0.92g± 0.01) at 0%, 10%, 20%, 30% inclusion levels of duckweed meal where the 0% served as control. The experiment, which was conducted for 70 days, measured among other parameters feed conversion ratio (FCR), specific growth rate (SGR) and survival rate (S) in the fish samples. The fish were fed at 5% body weight twice daily morning and evening. Although the three inclusion levels of duckweed supported the growth of *Heterobranchus longifilis* fingerlings, growth performance and feed utilization was favored by low inclusion of duckweed meal. From the result, 10% duckweed meal inclusion gave the best final mean weight of 3.86g, mean weight gain (MWG) of 1.51g,feed conversion ratio (FCR) of 0.11,specific growth rate of 2.11% and percentage survival of 80%. There was no significant difference ($P<0.005$) in the growth parameters between 10% inclusion level and the control diet. [Report and Opinion. 2009;1(3):76-81]. (ISSN: 1553-9873).

Key Words: Partial replacement, growth performance, survival, *Heterobranchus longifilis*, aquaria tanks

INTRODUCTION

Aquaculture shares the same challenges with Agriculture in increasing food supply and this brings about competition in the use of feeds for livestock and fish farming. Shortages of major feedstuff has been on the increase in recent times in Nigeria and with the poultry and livestock industry expanding, the aquaculture industry is finding it increasingly more difficult to source for critical feed ingredients (Adikwu, 2003; Fagbenro et al., 2003; Adejinmi, 2000).

For aquaculture to supply the population's growing demand for fish as food and to fill the gap in declining yield from capture fisheries, basic but critical information should be available especially regarding feed that are less competitive and of low cost value but with replaceable capacity for fish meals with the aim of making fish to attain table size at reduced culture time and minimum production cost.

Utilization of non-conventional protein supplements of both animal and plants origin in practical fish that has been at the fore in Nigeria in recent times. It is imperative for such practical diet to contain optimum protein, required essential amino and fatty acids.

Duckweed meal has been known for its high nutritive value with as much as 40% and above crude protein depending on the culture system (Ahmmad et al., 2003; Leonard, 1995; Hassan and Edward, 1992, Robinette et al., 1980; Hanczakowaski et al., 1995).

From the foregoing therefore, this experiment was conducted to assess the suitability or otherwise of duckweed meal as a partial replacement for fish meal in the diet of *Heterobranchus longifilis* fingerlings.

MATERIALS AND METHODS.

Diet formation and preparation

Freshly harvested duckweed from the Green House of the National Institute for Freshwater Fisheries Research, New Bussa, Nigeria was sun dried for thee days and thereafter grounded into fine powder using the hammer mill. All the other feed ingredients were milled using locally fabricated hammer mill and sieved through a 595um sieve to remove stones and dirt as well as ensure homogeneous size profile before analysed for proximate composition.

Five dry diets were prepared in which fish meal was replaced with duckweed meal at 0%, 10%, 20% and 30% levels using the method of Akegbejo Samson (1999) at 40% crude protein level.

The diets were fortified with vitamin premix. They were thoroughly mixed in a bowl and pelletized in an improvised pelleting machine using 1% starch as binder.

Table 1: Percentage Composition of experimental feed

Ingredients	Percentage inclusion level of duckweed meal			
	0%	**10%**	**20%**	**30%**
Duckweed Meal	0	2.6	5.2	7.8
Fish Meal	26	23.4	20.8	18.2
Yellow Maize	48	48	48	48
Soybean meal	15	15	15	15
Groundnut Cake	6	6	6	6
Vitamin Premix	2	2	2	2
Bone – meal	1.5	1.5	1.5	1.5
Starch	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5
Total	**100**	**100**	**100**	**100**

EXPERIMENTAL SITE

The study was conducted in the fish processing laboratory Federal College of Freshwater Fisheries technology, New Bussa, Nigeria.

EXPERIMENTAL SYSTEM AND FEEDING TRIAL

The Feeding trial was conducted in glass aquaria (30 x 30 x 60cm^3). The glass aquaria tanks were properly washed and rinsed with clean water. They were filled with borehole water and aerated using air pumps to ensure proper oxygenation and continual aeration. The experimental fish *Heterobranchus longifilis* fingerlings were collected from the Genetic Improvement Laboratory, National Institute for Freshwater Fisheries Research, New Bussa, Nigeria. They were acclimatized for three days before the take off of the experiment. This was necessary to enable the fingerlings empty their stomach content and to force them to adjust to the new diet.

EXPERIMENTAL PROCEDURE

The experimental fish were randomly distributed at a stocking density of 15 fingerlings per aquarium tank in triplicates. They were fed at 5% body weight twice daily morning ad evening at equal ration. Sampling was done weekly using a sensitive electronic balance (OHAS – LS – 500g Model) to determine the average weight of the fish and adjust the feed accordingly.

The study was conducted for 70 days. All analyses for proximate composition including the carcass composition before and after the experiment were determined according to the methods of AOAC (2000). Water temperature was monitored daily with a standardized mercury thermometer while dissolved oxygen and $_p$H were determined using Digital DO meter and Jenway Automatic $_p$H meter (Jenway 3015) respectively.

Table 2: Proximate composition of experimental feeds

Duckweed Sample	% Crude Protein	0% Ether Extract	% Ash	% Moisture	% Crude Fibre
0%	45.06	11.76	13.29	2.00	4.90
10%	43.35	14.02	12.30	1.00	6.50
20%	42.56	14.29	12.00	1.00	4.46
30%	41.87	12.83	11.90	2.00	5.13

MEASUREMENT OF GROWTH PARAMETERS

Food conversion ratio (FCR), specific growth rate (SGR) and percentage survival rate were determined as follows (After Fagbenro et al., 1992).

$$FCR = \frac{\text{Dry Weight Feed Supplied}}{\text{Total Weight gain by fish (g)}}$$

$$SGR\ (\%) = 100\ \frac{(\text{Log}^e\ Wt - \text{Log}^e\ WO}{T\ (\text{days})}$$

$$\text{Average Daily Wt gain} = \frac{Wt - Wo}{T\ (\text{days})}$$

$$S\ (\%) = \frac{Nt}{NO} \times 100$$

Where Wt = final body weight of fish in grams at the end of the experiment.
WO = Initial body weight of fish in grams at the beginning of experiments.
Log^e = Natural Logarithm of both final and initial body weight of fish in grams.
T = Duration (time) of the feeding trial in days.
No = Number of fingerlings alive at the end of experiment.
S = % survival

Gross Protein Value (GPV): This is commonly used biological method for evaluating proteins. This was determined using Devendra (1988) method as.
GPV = A/AO where

$$A = \frac{\text{g increase in weight gain}}{\text{g test protein}}$$

$$AO = \frac{\text{g increase in weight gain}}{\text{g test protein}}$$

Protein Intake (PI)

This was determined following Sveier et al., (2000) method using the formula: PI = Total feed intake x % crude protein in the diet.

Protein efficiency ratio (PER)

This index use growth as a measure of nutritive value of dietary protein. At was determined using Wilson (1989) as

$$PER = \text{Mean } \frac{\text{weight gain (g)}}{\text{Mean protein intake (mg)}}$$

Productive protein value (PPV)

This expresses the percentage of ingested protein that is retained by disposition in the carcass. It is usually calculated by the carcass analyses method of miller and Bender (1955). When no correction for endogenous nitrogen losses is made the results are expressed as apparent net protein utilization (ANPU)

$$PPV\ (\%) = \frac{(P2 - PI)\ X\ 100}{\text{Total Protein consumed}}$$

Where PI is the protein in fish carcass (g) at the beginning of the experimental and P2 is the protein in fish carcass (g) at the end of the experiment.

Statistical Analysis

Data were subjected to analysis of variance (ANOVA) to compare the result. Statistical tables were used to evaluate the difference between means for individual diets at 5% (0.05) significance level.

RESULT AND DISCUSSION

The three-inclusion level of duckweed in the experimental feed supported the growth for *Heterobranchus longifilis.* However, growth performance and feed utilization was favored by low inclusion level of duckweed meal in the experimental feed.

This result is similar to the report of several authors who have demonstrated the use of several species of duckweed as a partial replacement for fishmeal in the diet of fish and other animals. Fasakin et al., (2001) reported the use of duckweed *Spirodellla polyrrhiza* in the diet of the Nile Tilapia *(Oreochromis niloticus).* They stated that fish fed duckweed based diet had higher growth rates than fish fed diet containing water fern meals.

The authors indicated the possibility of partial replacement of fishmeal with duckweed in the diet of Nile Tilapia. Shireman et al., (1978) reported that grass carp performance on a duckweed diet was superior to fish maintained on catfish chow. Robinette et al., (1980) fed channel catfish on prepared diet consisting of 20% dry duckweed; the weight gain, food conversion and energy use were equal to central diets (a standard catfish feed).

Ahamad et al., (2003) reported also the replacement of sesame oil cake by duckweed in broiler diet. They stated that partial replacement of the costly oil seed by cheaper unconventional duckweed in broiler diet resulted in increase profitability.

The protein efficiency ratio in the diets at 10 to 20% inclusive levels of duckweed meal in the experimental diet showed no significant difference compared with the control diet.

Bairagi et al., (2002) reported that 30% fermented lemna leaf meal incorporated in the diet of *Labeo rohita* gave the best performance in terms of growth response, food conversion ratio and protein efficiency. From this result, 10% duckweed meal diet had the best specific growth rate and food conversation ratio.

Fasakin et al., (1999) reported that there was no significant difference in growth performance and nutrient utilization of fish fed on diets containing up to 20% duckweed inclusion and the control. They however, stated that increase in dietary duckweed inclusion resulted in progressively reduced growth performance and nutrients utilization of fish. This report is similar to the findings of this study. Inclusion of duckweed meal in the diet of other animals to replace fishmeal or soybean has also been reported by Samnang (1999), Hang (1998) and Becerra et al., (1995).

Yilmaz et al., (2005) reported no significant difference between the growth performance of fish that were fed diets containing up to 20% duckweed and fish that were fed the control diet, while carcass lipid and carcass protein also increased except for the diet with 15% duckweed meal in the common carp, *Cyprinus carpio*, fry. These authors concluded that a diet containing up to 20% duckweed could be used as a complete replacement of fishmeal for commercial feed in the diet formulation for common carp fry.

The findings of this study revealed increase in the carcass lipid similar to the report of these authors.

Table 3: Growth performance and feed utilization of *Heterobranchus longifilis* fingerlings fed duckweed meal based diet for 70 days.

Parameters	0%	10%	20%	30%
Initial Total	13.92	12.81	13.08	14.59
Mean	0.93	0.85	0.87	0.97
Final Total	60.08	55.97	44.07	40.17
Mean	4.45	3.86	3.39	3.09
Total Weight gain (g)	46.16	43.79	30.99	25.58
Mean Weight gain (g/fish)	1.71	1.51	1.19	0.98
Weekly Weight gain (g)	4.62	4.38	3.10	2.56
Specific Growth rate (SGR) (% / day)	2.08	2.11	1.74	1.45
Feed Conversion Ratio (FCR)	0.13	0.11	0.14	0.17
No. Stocked	15	15	15	15
No. of Survival	13	12	10	11
% Survival	87	80	67	73

Table 4: Nutrient utilization by experimental fish samples

Parameters	0%	10%	20%	30%
Protein (Intake)	14.83	11.92	10.41	10.88
Protein Efficiency Ratio (PER)	0.74	0.71	0.75	0.84
Productive Protein Value (PPV)%	14.09	15.69	7.88	5.97
Conversion Efficiency	1.0	0.75	0.50	0.22
Mean Protein intake (mg/fish)	1.14	1.19	1.04	0.99

CONLUSION: This study showed that duckweed (*Lemna pauciscostata*) meal, which is almost costless, could be used to partially replace the very expensive fishmeal in the diet of *Heterobranchus longifilis* fingerlings at regulated inclusion levels. This will no doubt reduce cost of production and thereby further boost aquaculture development in Nigeria.

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