Utilization of Nuisance Aquatic Plant (Duckweed) in Partial Replacement of Soybean Meal in Feeding Clarias gariepinus (Burchell, 1822) Fingerlings.

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Abstract

Duckweed (*Lemna gibba*), a nuisance aquatic macrophyte, was studied as a substitute for the partially replacement ofsoya bean meal in the diet of *Clarias gariepinus* fingerlings. Four dry diets formulated at 4% crude protein were fed to fingerlings at 0% (control) 10%, 20% and 30% inclusion levels of duckweed meal named as Diet A, B, C and D respectively. The fish were feed at 5% body weight and was assessed for feed conversion ratio (FCR), protein efficiency ratio (PER), survival rate among others. The highest growth performance and nutrient utilization was recorded at diet D i.e. 30% inclusion rate of duckweed with a mean weight gain of 5.45 $\pm$ 0.309g, and food conversion ratioof 3.32 $\pm$ 0.43 which was significantly different ($P < 0.05$) to the values obtained for other diets. The lowest weight gain was recorded in diet A i.e. the control diet, with a value of 3.06 $\pm$ 0.03g. The result of this study showed that as the inclusion rate of duckweed is increased, there was a corresponding increase in the growth rate of the fish. The study demonstrated that duckweed can be used for the replacement of soya beans in the diet of catfish fingerlings, thus converting a nuisance weed into useful feed component for the reduction of feeding cost.

Key words: Problematic Aquatic Weed, Protein Ingredient, Economic Weed, Utility plant.

Introduction

Aquaculture ventures in developing countries is challenged by a huge cost of input arising only from fish feeding (Gabriel *et al*., 2007; Adeleke, 2012). Protein feed materials especially of animal origin are the single most expensive ingredients (Nwana *et al*., 2008). This has led to several attempts made to substitute animal protein source with plant based protein sources. One of such plants is soya beans, which has of date received wide attention and acceptance as ingredient not only for livestock feed, but for humans as well. This increased demand placed on soya bean had in turn led to hike in their prices. Hence, several researchers have considered the replacement of soya beans with cheaper alternatives (Bekibele, 2015; Yusuf *et al.,* 2015).

Meanwhile, lots of researchers have implicated aquatic plants as nuisance to the wellbeing of fisheries and humans. Duckweed like other aquatic plants are characterized by rapid colonial growth in water bodies (Hassan *et al*., 2009). Some of their noxious characteristics include among others, the blockage of canals for agricultural irrigation and drainage system, flooding, soil erosion, hindering offishing activities and boaters navigation (Mitchel *et al.,* 1990; Ndinwa *et al.,* 2012).

Findings of some researchershave proved that aquatic plants especially duckweed is a potential in feed formulation for fish (Kio and Ola – Adams, 1987; Nwana *et al.,* 2008; Sotolu, 2008), which is considered as a blessing for the fishery industry, against the previous school of thought that sees them as impediment. This is particularly become necessary if aquaculture must meet the world's population demands for food fish to augment the shortfall from capture fisheries (Pakunle *et al*., 2009).

The shortage of major feed stuffs is partly because they are utilized also by man. A condition which has led to hike in their prices. This makes their continuous utilization in fish feed formulation unsustainable (FAO, 2006Fagbenro *et al*., 2009; Olukunle 2006). Protein is the single most expensive feed stuff ingredient (Sotolu, 2008). Meanwhile, the nuisance duckweed has well over 40% crude protein concentration, hence could be used in partial replacement of protein feed stuff and thereby reducing the cost of fish farming (Ahmmad *et al*., 2003; Leonard, 1995; Edward, 1992). This study was therefore designed to determine the performance of *Clarias gariepinus* fed duckweed at different replacement levels with soya bean in the diet of catfish and to determine the best inclusion rate of duckweed.

Materials and methods:

Experimental Site

The study was conducted in the Fishery Hatchery building of the Niger Delta University Teaching and Research Farm, Wilberforce Island, Bayelsa State.

Diet Formulation:

Freshly harvested duckweed was sun dried for 3 days and grounded to powder using hammer mill and sieved to remove stones and other underground materials to ensure homogenous size. All other ingredients were also ground to similar size.Four dried diets were prepared in which soya beans was replaced with duck weed at 0%., 10%, 20% and 30% levels respectively representing Diet A, Diet B, Diet C and Diet D (Table 1), according to Akegbejo-Samson (1999) method at 40% crude protein level.

Table 1: Showing the Percentage Composition of Experimental Feed.

Diets	**A**	**B**	**C**	**D**
Ingredient	**0%**	**10%**	**20%**	**30%**
Duckweed meal	-	1.5	3.0	4.5
Soya bean meal	15.0	13.5	12.0	10.5
Fish meal	26.0	26.0	26.0	26.0
Yellow maize	46.0	46.0	46.0	46.0
Groundnut cake	6.0	6.0	6.0	6.0
Vitamin/mineral Premix	3.5	3.5	3.5	3.5
Palm oil	2.0	2.0	2.0	2.0
Starch	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5
Total	**100.0**	**100.0**	**100.0**	**100.0**

Experimental Design: Sixteen plastic aquaria tank of 25 litres capacity were used as holding facility. A completely randomization design (CRD) was employed for the treatment, each with four replicates. The experimental fish, *Clarias gariepinus* fingerlings (160) were obtained from a reputable farm in Bayelsa State. The fingerlings from the population were selected randomly and placed in a plastic containers (10 each) filled 2/3 of its capacity with unchlorinated water. The initial mean weight (g) and mean length (cm) were taken using digital scale and metre rule.

Experimental Procedure: The fish were fed 5% body weight twice daily (morning and late afternoon) of the respective appropriate test diet. The uneaten feed were siphoned off and water changed every morning for the 49 days of the experiment.

Measurement of Water Quality: Temperature was measured with a laboratory thermometer, while DO and pH values were obtained with aid of digital oxygen and pH (Hach) meter respectively.

Measurement of Experimental Fish:

Performance Parameter: A meter rule and a sensitive analytical weighing balance were used to obtain total length and body weight measurement every week.

Condition Factor: This factor indicates the fitness or well-being of the fish.

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

Where W and L are the total weight (g) and total length (cm) respectively.

Survival Rate of Fish (%)

This is the number of fish alive at the end of the experiment relative to the number alive at its inception.

$$S = \frac{N_1}{N_0} \times 100$$

Where N_1 is the number of fish at the end of the experiment. N_0 is the number at the beginning of the experiment.

Feed Conversion Ratio (FCR)

$$FCR = \frac{\text{Feed intake g}}{\text{Weight gain (g)}}$$

Chemical Analysis: The proximate analysis of the diets were carried out using the method described by AOAC (1995).

Statistical Analysis: The data collected were subjected to one-way analysis of variance (ANOVA), while Duncan's multiple range test was used to separate the means for individual diets at 5% (0.05) significance level.

Results: The water quality Parameter measured were not significantly different (P>0.05) in the different diets (Table 2). The proximate analysis of the different diets used in the experiment is presented in Table 3. The crude protein content were in the order Diet D (41.00%) > Diet B (40.80%) > Diet A (40.50%) > Diet C (40.30%).

Table 2: Values of Water Quality Parameters from Aquaria Used in the Study.

Parameters	Diet A 0 %	Diet B 10%	Diet C 20%	Diet D (30%)
Temperature ^{0}C	27.10±0.32	27.14 ± 0.33	27.16 ± 0.31	27.13 ± 0.35
Dissolved oxygen mgl^{-1}	5.0 ± 0.11	4.87 ± 0.14	4.99 ± 0.11	4.99 ± 0.14
pH	6.55 ± 0.24	6.60 ± 0.25	6.62 ± 0.21	6.59 ± 0.22

Table 3: Proximate Composition of Experimental Diets.

Experimental Diets	%Crude Protein	%Ether Extract	%Ash Content	%Moisture Content	%Crude Fibre
Diet (A) (0%)	40.50	11.76	13.29	2.00	4.90
Diet (B) (10%)	40.80	12.02	12.30	1.50	5.50
Diet (C) (20%)	40.30	12.29	12.00	1.00	4.50
Diet (D) (30%)	41.00	12.08	11.90	2.00	5.10

Table 4: Growth, Nutrient Utilization of *Clarias gariepinus* fingerlings fed varying dietary levels of duckweed.

PARAMETERS	DIET A (0%)	DIET B (10%)	DIET C (20%)	DIET D (30%)
Mean final weight (g)	5.45 ± 0.04^{a}	6.37 ± 0.04^{b}	6.50 ± 0.04^{b}	7.84 ± 0.04^{c}
Mean initial weight (g)	2.39±0.02a	2.40±0.02a	2.39 ± 0.02^{a}	2.39 ± 0.02^{a}
Mean weight gain (g)	3.06 ± 0.03^{a}	3.97 ± 0.03^{b}	4.11 ± 0.30^{c}	5.45 ± 0.30^{d}
Mean total length (cm)	6.5 ± 0.05^{a}	6.8 ± 0.05^{a}	7.20 ± 0.50^{b}	7.90 ± 0.50^{bc}
Mean initial length (cm)	2.52 ± 0.19^{a}	2.67 ± 0.19^{a}	2.50 ± 0.19^{a}	2.6 ± 0.19^{a}
Mean length increase (cm)	3.98 ± 0.31^{a}	4.13 ± 0.31^{b}	4.70 ± 0.31^{c}	5.30 ± 0.31^{c}
Condition factor	1.26 ± 0.17^{b}	1.21 ± 0.17^{a}	1.17 ± 0.17^{a}	1.11 ± 0.17^{a}
Percentage survival (%)	80^{a}	82.5^{b}	80^{a}	82^{b}
Food conversion ratio	4.53 ± 0.43^{c}	4.48 ± 0.43^{b}	4.32 ± 0.43^{b}	3.32 ± 043^{a}
Protein efficiency (%)	90	95	85	75

Along the rows, mean±SDwith the same alphabets are not statistically different (P>0.05) according to Duncan Multiple Range Comparison

At the beginning of the experiment, the initial weight and length of the fingerlings were not significantly different (P>0.05). All experimental animal recorded increments (Table 4). There was a significant difference (P<0.05) in growth parameters between dietary treatments. The highest weight gain (5.45±0.30g) and length increase (5.30±0.31cm) were computed in Diet D i.e. 30% duckweed inclusion, while the least were recorded in Diet A i.e. the control.The study showed that the fish length and weight gained increased as the inclusion rate of duckweed is increases. The highest survival rate 82.5% was obtained in Diet B and the least 80 in diet A and C. The best conditioned fish was those in diet D (1.11±0.17) with the corresponding least (1.26±0.17) obtained in Diet A.

Discussion

The acceptance of the experimental diet by the fish shows that that duckweed can be used as ingredient for catfish feed formulation. It has also been used for the formulation of feeds of other animals such as rats (Phuc *et al.*, 2001), cattle (Huque *et al.*, 1996), chickens (Samnang, 1999), swine (Dong *et al.*, 2002), sheep (Damry *et al.*, 2001), fish (Fasakin *et al.*, 2001) and Humans (Rusoff *et al.*, 1980).

Findings of this study showed that duckweed fed at 30% inclusion rate had a higher significant impact on weight gain and length increase. This is actually marginally different from the findings of Patra *et al.*, (2013)) who reported highest growth at15% and 20% inclusion rates for LabeoRohita and Channel catfish respectively. Data generated in this study differs from those ofFasakin*et al.* (1999) and Yilmaz *et al.* (2005). Both authors reported that there were no significant difference in growth and nutrient utilization of fish diet containing up to 20% duckweed and fish fed the control diet. While this is also possible, it is interesting to note that the 10%duckweed inclusion level (Diet B) performed best in all growth parameters measured even far ahead of the control.

In conclusion, this study showed that the inclusion of duckweed meal in the diet of *Clarias gariepinus* fingerlings enhanced their growth. Duckweed meal has the ability to serve a twin effect of reducing cost of fish feeding and ameliorating its adverse effect on the water bodies, fish ecology, fishing and irrigation farming besides problem of navigation.

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