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Growth and Nutrient Utilization of *Clarias gariepinus* Juvenile Fed Graded Levels of Fresh Water Lettuce (*Pistia stratiotes*) As Supplement

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Abstract

Growth, nutrient utilization and survival rate of Clarias gariepinus juvenile fed vital feed with graded levels of cultured fresh water lettuce (Pistia stratiotes) as feed supplement was investigated in Lafia, Nigeria. Six concrete Tanks (1.5 x 1.00 x 1.5)m in triplicates were each stocked with 60 juveniles of Clarias gariepinus under flow through system. They were fed commercial feed and then complemented with fresh water lettuce at 0%, 0.4%, 0.6%, 0.8%, 1.0% and 1.2% of their daily ration to give six treatments as WLFS1, WLFS2, WLFS3, WLFS4, WLFS5, WLFS6 respectively. Feeding was done 08:00hrs am and 17:00hrs at 3% body weight/day for 90 days but adjusted fortnightly at new weight. Water quality parameters monitored like temperature 27.20°C–27.32°C, dissolved oxygen (7.21-7.22mg/L), total alkalinity (15.22mg/L) and free carbon dioxide (4.11mg/L) were within acceptable range for fish production and were not significantly different ($p>0.05$). Results showed that feed utilization was significantly different ($p<0.05$) among treatment. Percentage mean weight gain (1023.14 ±4.00 %) and feed efficiency (87.23±0.41) of WLFS4 were significantly ($p<0.05$) higher than other treatments. Specific growth rate (2.24 ±0.02 and 2.23±0.02), Protein efficiency ratio (PER) 2.29 ±0.03 and 2.27±0.02 for treatments WLFS4 and WLFS3 respectively were not significantly different but significantly higher than other treatments ($p<0.05$). The best feed conversion ratio (1.15 ±0.01) for the study was recorded in WLFS4 while survival rate was not significantly different ($P>0.05$) across the treatments. Use of water lettuce as supplementary feed for Clarias gariepinus juveniles is highly recommended at 0.8% inclusion.

Keywords: *Water lettuce, graded levels, feed supplement, Clarias gariepinus,*

Introduction

The efficacy of artificial feed in promoting maximum growth in a fresh water culture system depends upon the quality, quantity and feeding strategies employed. Besides of balance nutrients, feed should be palatable and economically viable. Selective utilization of various aquatic weeds in aquaculture is suspected to be one of the best ways to overcome the utilization of feed by fish in compounded diets. Supplementary feeding in a culture practice system varies in accordance to need of the fish cultivated (Rahman *et al*., 2006). The effectiveness of the leaves of various terrestrial and aquatic macrophytes for partial replacement of fish meal in fish diets has been investigated by a number of workers (Bairagi *et al*., 2002, 2004, Mohapatra and Patra, 2013a, 2013b). *Pistia stratiotes* is one of the most abundantly fast growing aquatic weeds in tropical and sub-tropical countries. This fast growing plant is a good source of animal feed and one of the rich sources of organic resources which has drawn attention for its utilization (Marwat *et al.,* 2010). The catfish, *C. gariepinus*, is a much sorted fish species for culture in Nigeria because of its rapid growth rate, efficient utilization of supplementary foods and ease of production in captivity. Studies have been conducted on the utilization of Pistia however information on the utilization of *P.stratiotes* as live feed for *C. gariepinus* juvenile is not available for farmers. The possibility of using *P. stratiotes* as catfish feed seems promising because my observation *Clarias gariepinus* feeds directly on all parts of the plant. This study therefore tends to evaluate the level of utilization of *P. stratiotes* as supplementary feed for *Clarias gariepinus* juveniles.

Materials and Methods

Experimental Procedures

The study was conducted in the Fisheries Unit of the Experimental Farm of the Department of Aquaculture and Fisheries Management of the Faculty of Agriculture, Nasarawa State University Keffi, Shabu- Lafia Campus. The experiment was done in a rectangular outdoor concrete tanks of 1.5m by 1.0m by 1.5m with water volume maintained at 2000 litres. Three hundred and sixty (360) *Clarias gariepinus* juveniles with an average weight 28.67g were obtained from a recognized fish farm and were acclimatized to experimental condition for 7 days. 60 *Clarias gariepinus* juveniles were randomly stocked in each concrete tank. The fish were starved for twenty four (24hrs) to maintain uniform stomach condition and to induce their appetite prior to the use of experimental diets. The fish were randomly distributed into six (6) concrete tanks in three replicates. The fish were assigned randomly to each tank and each treatment was fed on 3% of their body weight on vital feed/ day for 12 weeks and supplementary diet of water lettuce at 0% and 0.4%, 0.6%, 0.8%, 1.0%, 1.2% of daily feed supplied. Water quality parameters (D.O, pH, temperature and carbon dioxide) were kept in acceptable level for fish throughout the experimental period in a flow through system.

Table 1: Proximate composition of 4-6mm floating Feed Fed to Fish in this Study

Analysis	**% Composition**
Crude protein	38% (Max)
Moisture	12% (Max)
Crude lipid	9.5% (Max)
Crude fiber	3.5% (Max)
Calcium	2.0% (Max)
Phosphorus	0.9% (Max)
Dry matter	33%

Source: Vital feed

Data Collection

Data on fish feed utilization and growth performance were collected fortnightly and were processed for feed utilization and growth assessment using the methods described by Jobling (1982).The weight gain of fish in each treatment group were taken. All fish per treatment were individually weighed on a spring weighing balance and the respective means were recorded.

Mean Weight Gain (MWG)

$$MWG = W_f - W_i ;$$

Where, W_f is final mean weight and W_i is initial mean weight.

Percentage Mean Weight Gain (PMWG)

$$PMWG = (W_f - W_i) / W_i) \times 100$$

Where: W_f is final mean weight and W_i is initial mean weight

Specific Growth Rate (SGR)

$$SGR = \frac{(\ln W_f - \ln W_i) \times 100}{T \text{ (days)}}$$

Where: W_f= final mean weight. W_i= initial mean weight. T = culture period and In = Natural logarithms

Feed Intake (FI)

$FI = W_o - W_1$;

Where: W_o= the weight of feed supplied and W_1= the left over feed.

Feed Conversion Ratio (FCR)

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

Protein Efficiency Ratio (PER)

$$PER = \frac{\text{Mean weight gain}}{\text{Protein intake}}$$

Where: protein intake = feed intake (F1) x % protein in diet.

Survival rate % $= \frac{\text{No of fish survived at the end of experiment}}{\text{Initial number of fish stocked}} \times 100$

Condition factor (CF)

$K = (W/ L3) \times 100$

Where: W = fish weight in gram. L = fish length in centimeter (Hile, 1936)

Procedure for the water quality analysis

Water quality analysis of the source of water for the period of the study was investigated and water temperature of each treatment tank every recorded Morning (6.00am) and Evening (6.00pm). The temperature of the water was determined by dipping the automatic temperature compensation digital thermometer into the water and suspended it at 4cm in the water column for about 3 minutes before the temperature readings were taken (Agarwal, 1999).Water pH was determined at the course of this experiment through the use of a digital pH meter. The pH meter was dipped into the water column in the concrete tank for 4 minutes to stabilize before the readings were taken (Agarwal, 1999). Dissolved Oxygen (mg/L), Total Alkalinity (mg/L) and Water carbon dioxide (mg/L) during the experiment were monitored by water testing kits.

Statistical analysis of data

Data collected in this experiment were analyzed by Analysis of variance (ANOVA) and significant mean were separated at 0.05 probability level as described by (Steel *et al*., 1997).

Results and Discussion

Results revealed that treatments were at variance significantly different ($P<0.05$). Percentage mean weight gain (1023.14 ±4.00 %) and feed efficiency (87.23±0.41) of WLFS4 were significantly ($p<0.05$) higher than other treatments. However the lowest value of the results were recorded in control and the highest inclusion (1.2%) of water Lettuce treatments. Specific growth rate (2.24 ±0.02 and 2.23±0.02), Protein efficiency ratio (PER) 2.29 ±0.03 and 2.27±0.02 of treatments WLFS4 and WLFS3 respectively were significantly same but they were significantly higher than

other treatments this study. The best feed conversion ratio (1.15 ±0.01)) for this investigation was recorded in WLFS4 while results from treatments of percentage survival rate was not significantly different (P>0.05) each other. The growth pattern of the fish was significantly improved in treatments WLFS4 followed by WLFS3 and WLFS4 (Figure 1) The mean weight gain (%) obtained in this study shows improvement in weight gain of the fish more than the control as obtained by Mohapatra and Patra (2014) in *Cyprinus carpio* fed water lettuce leaf meal as partial substitute for fish meal. The specific growth rate in this study was in line with Lawan *et al.,* (2015) who reported 2.23-2.85 and Odulate *et al*., (2015) who also reported between 2.30-2.84 as specific growth rate for *Clarias gariepinus* fed *Ipomea batatas* based diets.

Table 2: Growth and nutrient utilization of *Clarias gariepinus* juvenile fed supplemented *Pistia stratiotes*

Parameters	WLFS1	WLFS2	WLFS3	WLFS4	WLFS5	WLFS6
Initial weight (g)	28.67 (±0.17)	28.67 (±0.18)	28.67 (±0.15)	28.67 (±0.19)	28.67 (±0.17)	28.67 (±0.16)
Final weight (g)	270.38 (±1.21)	300.85 (±1.23)	314.80 (±1.40)	321.30 (±1.32)	265.04 (±1.33)	224.04 (±1.45)
Mean weight gain (g)	241.71^{d} (±1.22)	272.18^{c} (±1.21)	286.08^{b} (±1.20)	292.63^{a} (±1.20)	236.17^{e} (±0.71)	195.37^{f} (±1.21)
Mean weight gain (%)	841.50^{d} (±6.21)	947.81^{c} (±4.32)	996.23^{b} (±4.54)	1023.14^{a} (±4.00)	817.14_{e} (±4.01)	684.19^{f} (±4.01)
Specific growth rate	2.06^{c} (±0.02)	2.15^{b} (±0.01)	2.23^{a} (±0.02)	2.24^{a} (±0.02)	2.06^{c} (±0.03)	1.92^{d} (±0.03)
Protein efficiency ratio	2.05^{d} (±0.01)	2.13^{c} (±0.02)	2.27^{a} (±0.02)	2.29^{a} (±0.03)	2.20^{b} (±0.02)	1.69^{e} (±0.01)
Feed efficiency	77.92^{e} (±0.20)	81.08^{d} (±0.40)	86.32^{b} (±0.42)	87.23^{a} (±0.41)	83.69^{c} (±0.40)	41.33^{f} (±0.41)
Feed conversion ration	1.29^{b} (±0.03)	1.23^{c} (±0.01)	1.16^{e} (±0.02)	1.15^{f} (±0.01)	1.20^{d} (±0.03)	$1..56^{a}$ (±0.05)

Mean with same superscript along the row is not significantly different (P>0.05) and the value in parentheses is the standard error of the mean. WLFS = Water lettuce feed supplement

Condition factor and Survival rate of *Clarias gariepinus* juveniles fed supplemented *Pistia stratiotes*

The condition factor of *C. gariepinus* juveniles fed supplemented *P. stratiotes* is presented in Figure 2. The results showed that condition factor of the experimental fish fed WLFS1, WLFS2, WLFS3 and WLFS4 were significantly higher (p<0.05) than fish fed WLFS5 and WLFS6. However highest condition factor value (1.94) was obtained in *C. gariepinus* fed WLFS 4. Since condition factors above one (1) indicates better wellbeing of a fish in an environment, the condition factor in all the treatments in this study shows good condition of the experimental fish in the study. However the results of condition factor from this investigation were higher than that of Reginald and Timothy (2014) who reported condition factors between 0.59 – 0.79 in *Clarias gariepinus* fed

fern plant (*Asplenium berteri*). Survival rate of *Clarias gariepinus* juvenile fed with supplemented (*P. stratiotes*) was shown in Table 3. Result from the Anova shows that the treatments were not significantly different from each other (p>0.05). The indication of this result is that all the feed used for this study support the survival rate of the fish.

Proximate composition of leaves, root and stock of *Pistia stratiotes* (Water lettuce)

The proximate composition of *P. stratiotes* leaves, root and stock is presented in Table 3. The result revealed the water lettuce leaves contains highest moisture, crude protein and ether extract (35%, 9.63% and 5.00%) respectively. Ash and crude fibre contents were highest in the roots (40.0% and 15.0%) respectively, while NFE value was highest in the stock. Wasagu *et al.,* (2013) obtained 4.5, 35.2, 6.96, 2.17, 17.5 and 38.21 as proximate values for moisture, ash, crude protein, lipid, fibre and NFE of water lettuce leaves. They further obtained 4.5, 44.5, 3.18, 1.83, 20.5 and 30.0 as proximate values for moisture, ash, crude protein, lipid, fibre, and NFE of water lettuce roots. The implication of this result shows that whole plant parts are very useful for their contribution to feed nutrient and feed utilization.

Water Quality Parameters of Source of Water used for this Experiment

The obtained results for pH values, temperature (°C), total alkalinity (mg/L), dissolved oxygen (mg/L) and free carbon dioxide (mg/L) of each of the treatments of this research work are presented in Table 4. The results show that all the water quality parameters from source of water supplied for the treatments were not significantly different (P>0.05) from each other and they were within the acceptable range according to WHO, (2010).

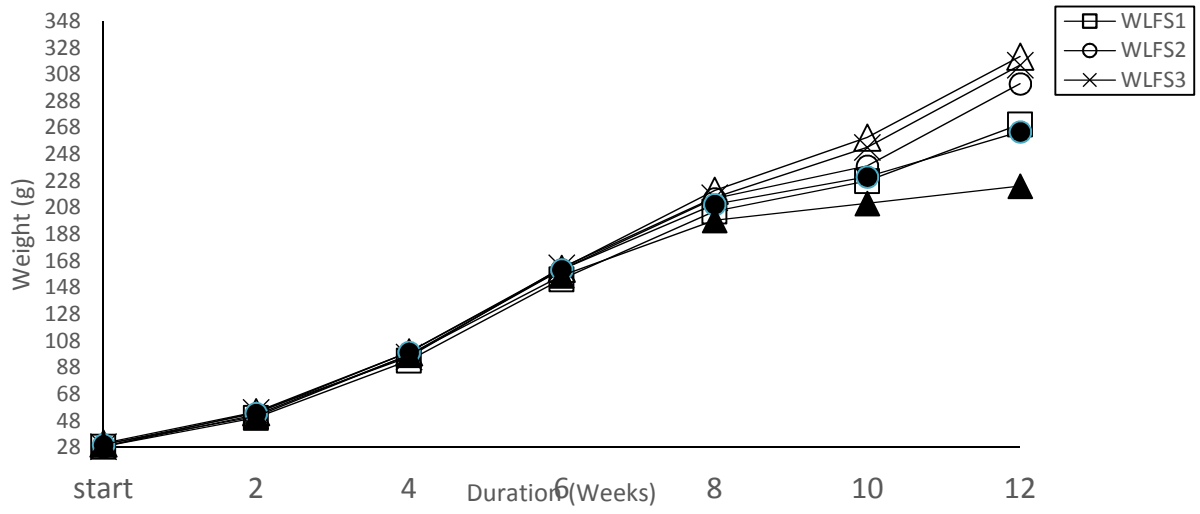

Fig. 1: Growth pattern of *Clarias gariepinus* juveniles fed supplemented fresh *Pistia stratiotes*

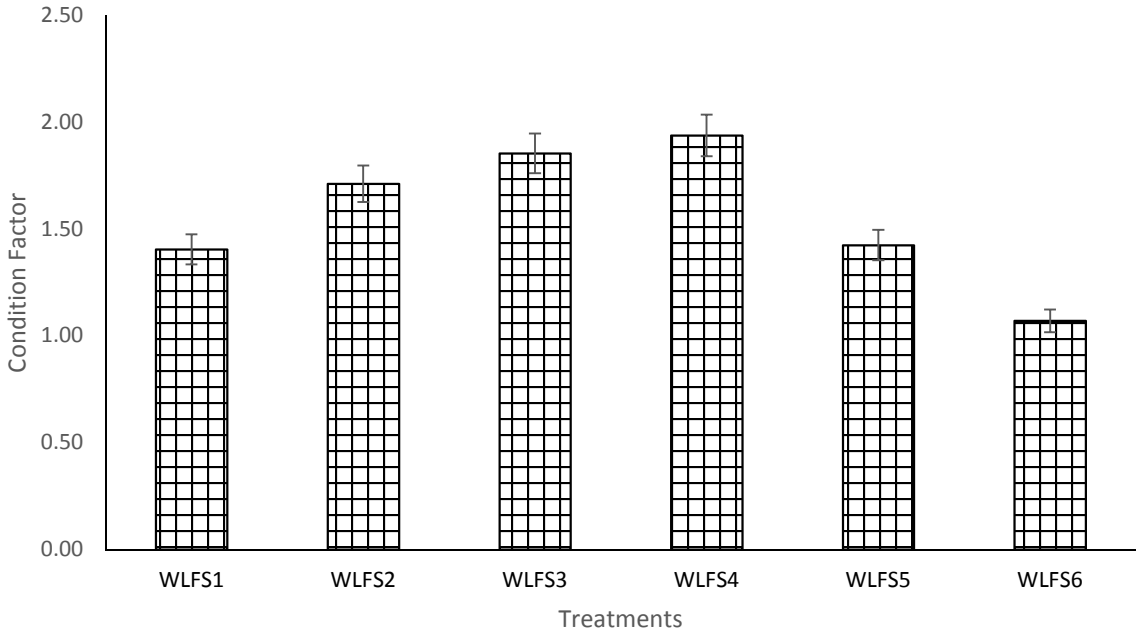

Fig. 2: Condition Factor of *Clarias gariepinus* juveniles fed supplemented *Pistia stratiotes*

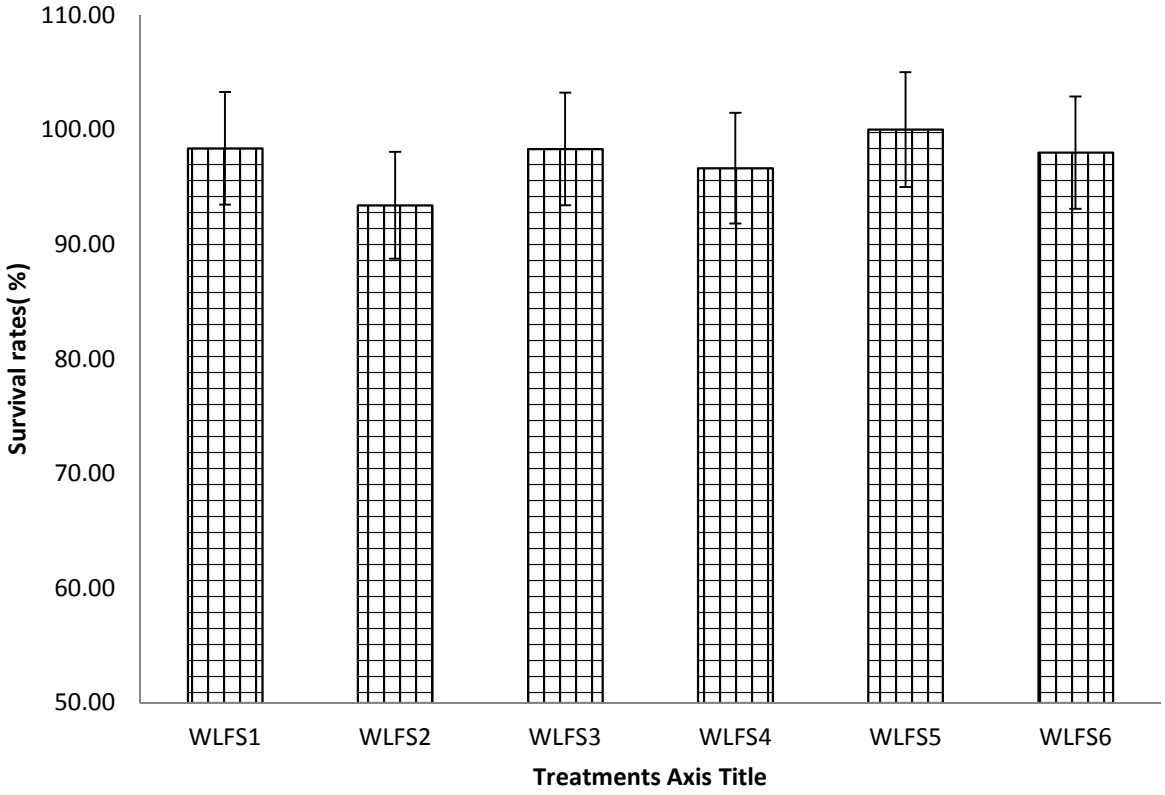

Fig. 4: Survival rate of *Clarias gariepinus* juveniles fed supplemented *Pistia stratiotes*

Table 3: Proximate composition of *Pistia stratiotes* (Water lettuce)

	M.D (%)	ASH (%)	C.P (%)	EE (%)	C.F (%)	NFE (%)
Leaves	35.00	30.00	9.63	5.00	9.50	10.87
Roots	25.00	40.00	6.56	2.50	15.00	10.94
Stock	20.00	25.00	4.34	2.50	5.00	43.16

Table 4: Water quality parameters of *Clarias gariepinus* juveniles fed supplemented *Pistia stratiotes*

Parameters	WLFS1 (Control)	WLFS2	WLFS3	WLFS4	WLFS5	WLFS6
Temperature (°C)	27.20±0.4	27.23±0.6	27.32±0.2	27.31±0.5	27.30±0.5	27.32±0.2
pH	7.25±0.02	7.24±0.0.03	7.25±0.0.02	7.24±0.02	7.23±0.05	7.22±0.05
Total alkalinity	15.22±0.01	15.22±0.01	15.22±0.03	15.22±0.02	15.22±0.02	15.22±0.02
DO (mg^{-l})	5.22±0.03	5.21±0.0.03	5.22±0.03	5.22±0.03	5.21±0.01	5.22±0.02
CO_2 (mg^{-l})	4.11±0.01	4.10±0.03	4.11±0.02	4.11±0.01	4.11±0.02	4.11±0.02

Conclusion and Recommendation

Pistia stratiotes supplementary diet improve growth, nutrient utilization, and condition factor without any negative effect on the survival rate of *Clarias gariepinus* juveniles. The inclusion of water lettuce at 0.8% gave the best growth and nutrient utilization with survival rate in the fish. The use of water lettuce supplement is recommended for farmers at 0.8%, of the 3% body weight of the daily feed of the fish especially towards improved growth and survival rate of *Clarias gariepinus* thus ensuring low external input use for sustainable aquaculture production system.

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