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Growth Response and Survival Rate of *Clarias gariepinus* Juveniles Fed Cashew (*Anacardium occidentale*) Leaves and Vitamin C Supplemented Diets

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Abstract
An 8-week feeding trial was conducted in ten (10) experimental bowls to assess the performance of juvenile *Clarias gariepinus* fed diets containing Cashew leaves (CL) and vitamin C (VIT C). The diets composed of control (0%), CL2 (1%), CL3 (2%), VIT C4 (250mg/kg diet) and (VIT C+ CL) 5 were formulated and replicated twice at 45% crude protein. Fish with initial body weight of 4.86±0.02g were fed at 3% body weight. Weight Gain (WG), Specific Growth Rate (SGR), Protein Efficiency Ratio (PER), Nitrogen Metabolism (NM), and water quality parameters (pH and temperature) was measured. Data were analyzed using ANOVA at P = 0.05. Results of the study showed that fish fed treated diets performed better (p<0.05) than the control diet. Among the treated groups, CL3 (2%) produced the best results in terms of WG (3.24±0.42), SGR (0.45±0.04), PER (0.07±0.01), and NM (174.25±5.5) than the control of 2.78±0.43, 0.40±0.05, 0.06±0.01, and 167.93±5.85 respectively. The value of temperature and pH were still within the range for fish culture in the tropics. We suggested that inclusion of cashew leaves in the diet of *C. gariepinus* would enhance productivity in organic aquaculture.

Keywords: *Clarias gariepinus*, Vitamin C, Cashew leaves, Growth, Water quality

Introduction

Clarias gariepinus is the most important fish species cultured in Nigeria, this specie has shown considerable potential as a fish suitable for intensive aquaculture; grows rapidly, are resistant to disease and stress, sturdy and highly productive even in polyculture with many other fish species like Nile Tilapia (*Oreochromis niloticus*) (Fagbenro *et al., 2003)*. The rise in global awareness of the importance of fish led to increase progress in aqua feeds with diets being specifically designed to meet the nutritional requirements of species, life cycle and health condition of fish (Rawling *et al*., 2012).

Feed accounts for more than 50% of the total production costs in modern intensive aquaculture (Ibrahem *et al*., 2010). In other to optimize the fish feed there is a need to increase feed efficiency, especially by improving the assimilation of dietary nutrients (Ibrahem *et al*., 2010). The cashew tree (*Anacardium occidentale*) is large and evergreen, growing to 10–12 m (33–39 ft) tall, with a short, often irregularly shaped trunk. Cashew leaves are phytotherapic plants used in folk medicine that is believed to have active components that help to enhance growth, treat and manage various diseases. The many parts of the plant have been used in traditional medicine to manage various diseases but there is a dearth of information about its uses in fish farming.

This study was conducted to assess the performance of *C. gariepinus* juveniles fed diets containing cashew leaves and vitamin C.

Materials and Methods

Cashew leaves were plucked and air dried at an ambient temperature (25^{o}C) for four weeks. After which it was grinded to fine powder and soaked in 2500ml of 95% ethanol for 48 hours. The plant was stirred every three hours for proper extraction and filtered using sterile muslin cloth, after which the extract was obtained, air dried and stored until required.

The experiment was carried out in ten aquaria for 8 weeks in the Fisheries and Aquaculture Laboratory, Ondo State University of Science and Technology, Okitipupa. The water level in each aquarium was maintained at volume of 35 litres throughout the experimental period. Water in each bowl was replaced every three (3) days throughout the period of the experiment to maintain relatively uniform physiochemical parameters and also to prevent fouling that may result from food residues. The water temperature of the experimental bowls was measured by mecury- in- glass thermometer while the PH value was measured using Model PHS- 3B PH metre.

Each treatment have two replicates, 20 fish per replicate with mean initial body weight of 4.86 ± 0.02 g and uniform-sized fish was selected from 460 juveniles, weighed and distributed in the experimental bowls. The fish was acclimatized for fourteen days before the experiment. The experiment lasted for 8 weeks during which the fish was fed at 3% body weight daily. The diet per day was divided into two; 1.5% was given in the morning by 9.00-10.00 am and 1.5% in the evening by 5.00 pm. Measurement of the weight changes was performed weekly and the feeding rate adjusted every week according to the new

body weight. After preparation, feed ingredients were mixed together to formulate 45% crude protein diet. The pelleted diets were sun dried, packed in labeled polythene bags and stored in a cool dry place to prevent mycotoxin formation (Table 1).

Table 1: Gross and proximate composition of experimental diets (g/100g)

Ingredients/Parameters	Control	CL2	CL3	VIT C	VIT C + CL
Fish meal	18.80	18.80	18.80	18.80	18.80
Soy bean	40.59	40.59	40.59	40.59	40.59
Yellow maize	16.31	15.31	14.31	14.31	14.31
Wheat bran	16.31	16.31	16.31	16.31	16.31
Starch	1.00	1.00	1.00	1.00	1.00
Cod liver oil	3.00	3.00	3.00	3.00	3.00
DCP	2.00	2.00	2.00	2.00	2.00
Vitamin premix	2.00	2.00	2.00	2.00	2.00
Cashew leaf	-	1.00	2.00	-	1.00
Vitamin C	-	-	-	2.00	1.00
Total	100.01	100.01	100.01	100.01	100.01
Moisture (%)	7.00±0.02^{a}	8.15±0.00^{d}	7.98±0.01^{c}	7.25±0.01^{b}	6.95±0.02^{a}
Crude protein (%)	44.85±0.02^{a}	44.69±0.18^{a}	44.71±0.02^{a}	44.79±0.08^{a}	44.84±0.00^{a}
Ether extract (%)	16.20±0.01^{b}	15.75±0.00^{a}	16.11±0.17^{b}	16.64±0.05^{c}	16.70±0.07^{c}
Ash (%)	15.52±0.05^{b}	15.80±0.03^{c}	14.64±0.07^{a}	15.98±0.00^{d}	15.85±0.05^{cd}
NFE (%)	24.55±0.23^{e}	19.99±0.11^{a}	20.71±0.00^{b}	21.89±0.02^{c}	22.74±0.00^{d}

CL = Cashew leaves, VIT C = Vitamin C, DCP = Dicalcium phosphate, the mean values in each rows with similar superscript are not significantly different (p> 0.05)

Fish were evaluated as follows: weight gain = final body weight - initial body weight; weight gain (%) = 100 (final body weight - initial body weight)/initial body weight; specific growth rate (SGR) = 100 (loge final body weight - loge initial body weight)/time (days); feed conversion ratio (FCR) = dry weight of feed fed (g)/fish weight gain (g); protein efficiency ratio (PER) = wet body weight gain (g)/crude protein fed; protein productive value (PPV) = 100 (final fish body protein - initial body protein)/crude protein intake; survival (%) = 100 (initial number of fish stocked - mortality)/initial number of fish stocked and protein intake = (feed intake × percent protein in diet)/100. Experimental diets and fish carcasses were analyzed for proximate composition before and after the experiment according to the methods of Association of Official Analytical Chemists [A.O.A.C] (2005). Growth performance and nutrient utilization indices resulting from the experiment were subjected to one- way analysis of variance (ANOVA) and Duncan multiple range test was used to compare differences among individual means at P = 0.05

RESULTS

Proximate Composition of Experimental Diets

The proximate composition of experimental diets showed significant differences (p< 0.05) in the moisture, crude protein, ether extract, ash and Nitrogen Free Extract (NFE) (Table 1).

Proximate composition of experimental fish before and after the experiment

The proximate composition of experimental fish after the experiment were better in the treated groups (p< 0.05) compared to the control and value obtained before experiments in terms of moisture, crude protein, ash and Nitrogen Free Extract (NFE), while there was no significant difference (p< 0.05) in the ether extract among the treatments (Table 2).

Table 2: Proximate composition of fish before and after experiment (DM)

Parameter	Before	Control	CL2	CL3	VIT C	VIT C+CL
Moisture (%)	78.02±0.05^{d}	67.00±0.00^{b}	60.17±0.02^{a}	68.94±0.03^{b}	67.55±0.05^{c}	66.95±0.00^{c}
Crude protein (%)	48.04±0.07^{a}	59.05±0.33^{b}	68.19±0.25^{c}	70.11±0.22^{c}	74.81±0.08^{d}	74.84±0.12^{d}
Ether extract (%)	3.05±0.02^{a}	5.01±0.05^{a}	4.05±0.00^{a}	3.11±0.10^{a}	3.88±0.00^{a}	4.80±0.03^{a}
Ash (%)	8.85±0.01^{a}	10.92±0.02^{a}	17.51±0.05^{b}	18.72±0.01^{b}	18.66±0.00^{b}	19.35±0.01^{b}
NFE (%)	40.06±0.00^{d}	25.02±0.03^{c}	10.25±0.11^{b}	8.06±0.02^{b}	2.05±0.18^{a}	1.01±0.02^{a}

CL = Cashew leaves, Vit C = Vitamin C, the mean values in each rows with similar superscript are not significantly different (p>0.05)

Growth Performances and Nutrients utilization of *C. gariepinus* fed Vitamin C, Cashew Leaves extracts.

The growth performances and feed utilization in terms of body weight gain, feed conversion ratio, protein efficiency ratio, specific growth rate and nitrogen metabolism was better in the treated groups than the control as presented in Table 3.

Table 3: Growth Performances and Nutrients utilization of *C. gariepinus* fed Vitamin C, Cashew Leaves extracts

PARAMETERS	Control (0%)	CL 2 (1%)	CL 3 (2%)	VIT C	VIT C + CL
Initial body weight(g)	4.86±0.001^{a}	4.86±0.001^{a}	4.86±0.001^{a}	4.85±0.001^{a}	4.87±0.001^{a}
Final body weight(g)	7.63±0.27^{a}	7.80±0.27^{a}	8.10±0.42^{a}	7.19±0.09^{a}	7.16±0.25^{a}
Body weight gain (g)	2.78±0.43^{a}	2.94±0.27^{a}	3.24±0.42^{a}	2.34±0.10^{a}	2.29±0.10^{a}
Body weight gain (%)	57.15±0.70^{b}	60.57±0.63^{bc}	66.56±0.54^{c}	48.15±2.06^{a}	47.07±0.89^{a}
Food conversion ratio	4.32±0.67^{a}	3.30±0.31^{a}	3.85±0.50^{a}	4.29±0.18^{a}	4.06±0.43^{a}
Protein efficiency ratio	0.06±0.01^{a}	0.07±0.01^{a}	0.07±0.01^{a}	0.06±0.01^{a}	0.06±0.01^{a}
Protein productive value	24.55±0.57^{a}	44.59±0.06^{b}	49.36±0.29^{c}	59.77±0.11^{d}	59.77±0.09^{d}
Protein intake (g)	209.77±0.10^{d}	171.59±0.69^{b}	218.68±0.10^{e}	178.82±0.32^{c}	164.79±0.00^{a}
Survival rate (%)	77.50±2.50^{a}	77.50±2.50^{a}	77.50±2.50^{a}	85.00±0.00^{ab}	87.50±2.50^{b}
Nitrogen metabolism	167.93±5.85^{a}	170.15±3.50^{a}	174.25±5.58^{a}	161.88±1.01^{a}	161.68±3.37^{a}
Specific growth rate	0.40±0.05^{a}	0.42±0.03^{a}	0.45±0.04^{a}	0.35±0.02^{a}	0.34±0.03^{a}

Keys: CL = Cashew leaves, Vit C = Vitamin C, the mean values in each rows with similar superscript are not significantly different ($p>0.05$)

Water Quality Parameters

The highest temperature was recorded in CL 3 and lowest was recorded in VIT C while the highest pH was recorded in CL 1 and the lowest in VIT C + CL. The values range between 26.01^{0}C – 26.80^{0}C and 7.50 -7.76 for temperature and pH respectively.

Discussion

All the experimental diets were accepted by the fish which showed that the incorporation of Vitamin C, cashew leaves extracts in the diets had no adverse effect on the palatability of the diets. The results of proximate composition of experimental diets obtained in this study corroborates with the findings of Obe (2014) who reported 45% crude protein for *C. gariepinus* juveniles fed graded levels of sorghum supplemented diet. The proximate composition of experimental fish after the experiment were better in treated groups ($p<0.05$) in moisture, crude protein, ash and Nitrogen Free Extract (NFE) compared to control and the value obtained before the experiment. This study agrees with the report of Diyaware *et al*., (2011) who observed higher values in crude protein and ash content in final fish composition than those obtained in control and before experiment.

The experimental fish within all the treatments showed great increase in weight, which indicates that the fishes were able to convert feed protein to extra muscles as weight gain and specific growth rate are usually considered as the most important measurement of productivity of diets. The results of this study showed that treated groups better than the control. Cashew leaves extracts performed better than vitamin C supplementation. This result is in agreement with the report of Bello *et al.,* (2012) who obtained high growth performance in *C. gariepinus* with 1.5% walnut leaves and onion bulb extracts as well as that of Farahi *et al*. (2012) who observed better performance in rainbow trout fed dietary supplementation of lemon balm and *Aloe vera* than the control. The temperature, dissolved oxygen and pH measured during this study were within recommended limits for warm water fishes (Boyd, 1981; Bello *et al*., 2012)

Conclusion

This study has demonstrated that vitamin C and cashew leaves extracts appears to be useful feed components that can be used to enhance growth and survival rate.

Therefore, inclusion of 2% *A. occidentale* in the diet of fish will positively affect the growth and productivity in fish farming.

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