EFFICACY OF DIETARY FEEDING STIMULANTS ON GROWTH PERFORMANCE AND NUTRIENT UTILIZATION OF *Clarias gariepinus* JUVENILES

Olusola , Sunday Emmanuel
Department of Biological Sciences (Fisheries and Aquaculture Programme), Ondo State University of Science and Technology, Okitipupa.
belloolus@yahoo.com; se.olusola@osustech.edu.ng, +2348034110139

ABSTRACT
The efficacy of Almond Leaves (AL) extracts and Vitamin C (VIT C) as an ingredient in the diet of *Clarias gariepinus* of mean weight (4.86±0.02g) was evaluated over a 56-day rearing period. Five experimental diets: Control (0%), AL_2 (1%), AL_3 (2%), $VITC_4$ (250mg/kg), and $(VITC+AL)_5$ were formulated and replicated twice at 45% crude protein. Weight gain (WG), Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), Protein Productive Value (PPV), and Nitrogen Metabolism (NM) were measured. Data were analyzed using ANOVA at P = 0.05. Results showed that the fish on VIT C and AL extracts based diets had higher values in WG, SGR, FCR, PPV, and NM and they were significantly difference ($p<0.05$) than those on control diet. The results suggest that inclusion of VIT C and AL leaves extracts in fish diets for two months could positively affect growth of *C. gariepinus* juveniles in organic and sustainable aquaculture.

Keywords: *Clarias gariepinus,* Almond leaves, Growth, Vitamin C, Fish feeds

INTRODUCTION
Nigerians are large consumers of fish and it remains one of the main products consumed in terms of animal protein. It is cheap and highly acceptable, with little or no religious bias, which gives it an advantage over pork or beef (Eyo, 2001). Aquaculture production has increased over the years and as a result of wild fisheries approaching their biological limits and the world demand for cultured fish continuing to increase (Ayinla, 2012). Feed formulation 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 increasing pressure on the aquaculture to reduce or eliminate feed antibiotics as growth enhancers has initiated new research to find safe and efficient natural alternatives. This new generation of feed additives includes herbs and their essential oils and extracts (Brenes and Roura, 2010). Scientists have confirmed that the addition of plants or their extracts in the diets has a beneficial effect to improve growth parameters and protect from diseases in aquaculture (Johnson and Banerji, 2007). *Terminalia catappa* Linn (Combretaceae) also known as tropical almond is a medium size deciduous medicinal plant**.** All parts of the plant contain secondary metabolites that are used in traditional medicine (Akharaiyi *et al*., 2011). The leaves of the plant are used in aquarium to lower the pH and heavy metal content of water, and are active against some parasites and bacterial pathogens (Hnawia *et al*., 2011). It also helps to prevent fungus forming on the eggs of the fish (Hnawia *et al*., 2011). This study was carried out to assess the effect of *T. catappa* leaves extracts and vitamin C on growth performance and nutrient utilization of African catfish (*C. gariepinus*).

MATERIALS AND METHODS
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 35litres 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 mercury- 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 was 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	AL_2	AL_3	VIT C_4	(VIT C + AL)$_5$
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	16.31	16.31	16.31	16.31
Wheat bran	16.31	15.31	14.31	14.31	14.31
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
Almond leaf	-	1.00	2.00	-	1.00
Vitamin C	-	-	-	2.00	1.00
Total	100.00	100.00	100.00	100.00	100.00
Moisture (%)	7.00 ± 0.02^a	8.00 ± 0.02^e	7.18 ± 0.02^b	7.25 ± 0.01^c	7.50 ± 0.02^d
Crude protein (%)	44.85 ± 0.02^a	44.79 ± 0.07^a	44.80 ± 0.05^a	44.79 ± 0.08^a	44.88 ± 0.01^a
Ether extract (%)	16.20 ± 0.01^d	15.52 ± 0.05^a	15.80 ± 0.01^b	16.64 ± 0.05^e	16.00 ± 0.02^c
Ash (%)	15.52 ± 0.05^c	14.70 ± 0.07^a	15.00 ± 0.03^b	15.98 ± 0.00^d	16.20 ± 0.04^e
NFE (%)	24.55 ± 0.23^a	19.69 ± 0.20^d	22.60 ± 0.08^c	21.89 ± 0.02^b	19.88 ± 0.01^a

AL = Almond 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, protein intake = (feed intake × percent protein in diet)/100 and Nitrogen metabolism = (0.549)(a + b)h/ 2 Where, a= initial mean weight of fish; b= final mean weight of fish; h= experimental periods in days.

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 no significant differences (P> 0.05) in crude protein among the dietary groups while moisture, ether extract, ash and Nitrogen Free Extract (NFE) showed significant differences (P< 0.05) among the dietary groups (Table 1).

Proximate composition of fish before and after the experiment

The proximate composition of experimental fish after the experiment showed an increase in the values (P< 0.05) of moisture, crude protein, ash and Nitrogen Free Extract (NFE) obtained in the treated groups compared to the value obtained in the control and before the experiment (Table 2).

Table 2: Proximate composition of fish before and after the experiment

	Before	Control	AL $_2$ (1%)	AL $_3$ (2%)	VIT C $_4$ (250mg/kg)	(VIT C + AL) $_5$
Moisture	78.02±0.05^a	67.00±0.00^b	70.10±0.02^f	69.85±0.02^d	67.55±0.05^e	72.50±0.15^c
Crude protein	48.04±0.07^a	59.05±0.33^b	69.89±0.07^c	72.80±0.15^e	74.81±0.08^f	71.97±0.03^d
Ether extracts	3.05±0.02^a	5.01±0.05^e	2.92±0.07^a	3.60±0.05^b	3.88±0.00^c	4.40±0.05^d
Ash	8.85±0.01^a	10.92±0.02^b	15.15±0.02^c	19.10±0.00^e	18.66±0.00^d	18.99±0.07^e
NFE	25.30±0.00^a	40.22±0.03^f	6.54±0.40^a	9.78±0.01^c	10.55±0.18^d	8.12±0.07^b

Keys: AL = Almond leaves, VIT C = Vitamin C, the above values are mean of duplicate data, 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 and Almond leaves extracts.

There was no significant difference (P> 0.05) among the dietary groups in the mean initial body weight and protein efficiency ratio, while there was significant difference (P< 0.05) in protein productive value, protein intake, final body Weight, body weight gain, specific growth rate, food conversion ratio, nitrogen metabolism, survival rate and percentage body weight of fish fed experimental diets (Table 3)

Table 3: Growth performances and nutrients utilization of *C. gariepinus* fed Vitamin C and Almond leaves extracts for 56 days

Parameters	Control	AL2 (1%)	AL 3(2%)	VIT C (250mg/kg)	(VIT +AL) 5 (2%)
IBW(g)	4.86±0.001^a	4.85±0.01^a	4.86±0.01^a	4.85±0.01^a	4.86±0.01^a
FWG(g)	7.63±0.27^b	7.94±0.20^d	7.82±0.47^c	7.19±0.09^a	7.58±0.05^b
BWG (g)	2.78±0.43^b	3.09±0.20^d	2.97±0.48^c	2.34±0.10^a	2.72±0.05^b
BWG%	57.15±0.70^c	63.61±0.02^e	61.08±0.85^d	48.15±2.06^a	56.03±1.09^b
FCR	4.32±0.67^c	3.66±0.24^b	3.40±0.55^a	4.29±0.18^c	4.25±0.08^c
PER	0.06±0.01^a	0.07±0.01^a	0.07±0.01^a	0.06±0.01^a	0.06±0.00^a
PPV	24.55±0.57^a	48.77±0.40^b	55.27±0.10^d	59.77±0.11^e	53.32±0.23^c
PI	209.77±0.10^e	201.25±0.32^c	175.64±0.20^a	178.82±0.32^b	207.55±0.05^d
SR	77.50±2.50^a	77.50±2.50^a	80.00±5.00^b	85.00±0.00^c	85.00±0.00^c
NM	167.93±5.85^c	171.97±2.63^e	170.49±6.26^d	161.88±1.01^a	167.19±0.54^b
SGR	0.40±0.05^b	0.43±0.02^{ab}	0.42±0.05^{ab}	0.35±0.02^a	0.39±0.00^{ab}

IBW=Initial Body Weight, FWG= Final Weight Gain, BWG= Body Weight Gain, BWG%= Percent Body Weight Gain, FCR= Feed Conversion Ratio, PER= Protein Efficiency Ratio, PPV= Protein Productive Value, PI= Protein Intake, SR-= Survival Rate, NM= Nitrogen Metabolism, SGR= Specific Growth Rate, the mean values in each rows with similar superscript are not significantly different (P> 0.05)

DISCUSSION

The results of proximate composition of experimental diets obtained in this study corroborates with the findings of Robinson *et al*., (2001) who reported that the inclusion of 45% crude protein in fish diets as well as the use of standard formulation and processing techniques resulted in production of diets with reduced moisture content, relatively high nutrients and highly durable diets which enhanced better palatability and growth in fish. The proximate composition of experimental fish after the experiment highly showed significant differences (P < 0.05) in the moisture, crude protein, ash and nitrogen free extract compared to the result obtained before the experiment and this agrees with the work of Ozovehe (2013).

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 species growth rate are usually considered as the most important measurement of productivity of diets as shown in the result which are in accordance with the findings of Bello *et al*. (2012). Reasons for the results obtained could be that the fish having higher values in the respective parameters measured used the available protein and other nutrients in the diet efficiently than others which led to increase in weight and some other measured parameters such as percentage weight gain, protein efficiency ratio, specific growth rate, protein productive

value, nitrogen metabolism and this findings concur with that of Farahi *et al*. (2012) whose fish fed experimental diets performed better than the control in the dietary supplementation (of lemon balm and *Aloe vera*) fed to Rainbow trout

CONCLUSION

It can be concluded from the results of the study that vitamin C and almond leaves extracts had nutritional properties that enhance growth of *C. gariepinus* juveniles and the inclusion of almond leaves extracts may significantly enhanced productivity in aquaculture industry.

REFERENCES

Akharaiyi, F. C, Ilori, R. M and Adesida, J. A. (2011). Antibacterial effect of *Terminalia catappa* on some selected pathogenic bacteria. *Int J. Pharm Biomed Res*., 2(2): 64-67

Association of Official Analytical Chemist AOAC (2005). Official methods of analysis (W. Horwit zeachtor) 18th edition A.O.A.C Washington, DC: 129-146

Ayinla, A. O. (2012). Aquaculture development and appropriate enterprise combination in the BRACED state In the high level meeting of experts and the meeting of BRACED states commissioners for Agriculture, Songhai, Port- Harcourt, 31st Oct.- 2nd Nov., 2012, Pp 1- 41

Bello, O. S., Olaifa, F. E. and Emikpe, B. O. (2012). The Effect of Walnut (*Tetracarpidium conophorum*) leaf and Onion (*Allium cepa*) Bulb residues on growth performance and nutrient utilization of *Clarias gariepinus* juveniles. *Journal of Agricultural Sciences*, 4(12): 205 - 213.

Brenes, A and Roura, E. (2010). Essential oils in poultry nutrition: Main effects and modes of action. *Anim. Feed Sci Tech*, 158: 1-14.

Eyo, A. A. (2001). Fish Processing Technology in the Tropics. 1- 20 pp

Farahi, A., Kasiri, M., Sudagar, M., Iraei, M. S. and Zorriehzahra, S. M. J. (2012). Effect of dietary supplementation of *Melissa officinalis* and *Aloe vera* on haematological traits, lipid oxidation of carcass and performance in rainbow trout (*Oncorhynchus mykiss*). *Online Journal of Animal and Feed Additives*, 2 (1): 01 – 05

Hnawia, E, Hassani, L, Deharo, E, Maurel, S, Waikedre, J, Cabalion, P, Bourdy, G, Valentin, A, Jullian, V, and Fogliani, B. (2011). Antiplasmodial activity of New Caledonia and Vanuatu traditional medicines. *Pharm Biol*., 49(4): 369-76.

Ibrahem, M. D, Fathi, M, Mesalhy, S and Abd El-Aty, A. M. (2010). Effect of dietary supplementation of insulin and vitamin C on the growth, haematology, innate immunity, and resistance of Nile tilapia (*Oreochromis niloticus*). *Fish and Shellfish Immunology*, 29: 241 - 246

Johnson, C and Banerji, A. (2007). Influence of Extract Isolated from the Plant *Sesuvium portulacastrum* on Growth and Metabolism in Freshwater Teleost, *Labeo rohita* (Rohu). *Fishery Tech*, 44 (2): 229-234.

Ozovehe, B. N. (2013). Growth performance, haematology indices and some biochemical enzymes of juveniles *Clarias gariepinus* (Burchell, 1822) fed varying level of *Moringa oleifera* leaf meal diet. *J. Aquacult. Res. Dev.*, 4(2): 166

Robinson, E. H, Li, M. H and Manning, B. B. (2001). Evaluation of corn gluten feed as a dietary ingredient for pond – raised channel catfish *Ictalurus punctatus. J. World Aquac. Soc.*, 32(1): 68 – 71