

GROWTH AND NUTRIENT UTILIZATION OF AFRICAN CATFISH (*CLARIAS GARIEPINUS* BURCHELL, 1822) FED VARYING LEVELS OF ALBIZIA LEBBECK (BENTH) LEAF MEAL

*Oyelere, E.A., Balogun, J.K. and Abubakar, B.Y.

Department of Biological Sciences, Ahmadu Bello University, Zaria. P.O.Box 25, Samaru. Zaria, Kaduna State.

lizoyelere@gmail.com

ABSTRACT

Ten *Clarias gariepinus* fingerlings were stocked into each of fifteen plastic tanks and were subjected to five treatments with replicates of three each. Inclusion level of *Albizia lebeck* was at 0%, 10%, 20%, and 30% and commercial diet. Fish were fed 40% crude protein and the experiment lasted 70 days. Fish fed diet two (10%), had the best Weight gain of 60.66g \pm 3.30, which was highly significant $p=0.05$, Specific growth rate of 3.93g, Average daily growth of 0.87 and Percentage weight gain 1472.07. There was no significant difference in the NPU of fish fed experimental diets though fish fed diet two had higher value (61.32g) among others. There was significant difference $p=0.05$ in Protein efficiency ratio where diet two had the highest value (2.57g). The best FCR was also obtained in diet two and was significantly different ($p=0.01$) from others. This result recommends that protein in the diet of *C. gariepinus* can be replaced up to 10% *Albizia lebeck* inclusion level.

Key words: Growth performance, Nutrient utilization, *Clarias gariepinus*, *Albizia lebeck*, Protein source.

INTRODUCTION

Around the world, fish protein makes up complete protein sources in many people's diets. Proteins of high quality, as found in most fresh fish, can be used to maintain an active metabolism (Ayoola, 2011). The projected human population in Nigeria from year 2000 to year 2014 is 114.4 to 169.1 Fish demand is 1,430.00 to 2,175.00 and supply is 467.098 to 730.248 (Ozigbo, 2014). The challenge therefore is to bridge the wide gap between demand and supply of fish. In order to meet the growing demand of fish in Nigeria, aquaculture industry is growing. Nutrition in aquaculture accounts for 40-65% of total operating costs (Bake et al., 2014). Leaf meal inclusion in aquaculture feed is fast gaining global attention due to availability, protein contents and economic feasibility (Udo and John, 2015). Ayoola et al. (2013) stated that fish feed is a high protein feed supplement that can be mixed with other ingredients to obtain a balanced diet for fish. *Albizia lebeck* leaf is a potential part for usage in fish feed formulation.

MATERIALS AND METHODS

Albizia lebeck leaves and fruits were collected from Ahmadu Bello University, Samaru campus,

Zaria- Kaduna State and the plant was identified at the Herbarium of Biological Sciences Department. The leaves were processed by soaking for 24 hours and shade-dried for three days which was thereafter ground to powder.

Table 1: Percentage Composition of Experimental Diets

Ingredients	Diet One (0 %)	Diet Two (10 %)	Diet Three (20 %)	Diet Four (30 %)
Fish Meal	36	36	36	36
Albizia lebeck leaf meal	0	3.28	6.56	9.84
Soya bean	32.8	29.52	26.24	22.96
Yellow maize	27.7	27.7	27.7	27.7
Vitamin premix	1.5	1.5	1.5	1.5
Methionine	0.5	0.5	0.5	0.5
Lysine	0.5	0.5	0.5	0.5
Palm oil	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100
Crude protein	40.2	40.15	40.06	40.1
Crude fibre	3.8	4.3	4.8	5.29
Ether extract	6.48	6.62	6.78	6.82
M.E.	2854	2858	2862	2859

The proximate composition of diet ingredients and fish carcass were determined using the standard methods of AOAC (2006). The ground ingredients were thoroughly mixed with a wooden rod, warm water was added to a dough. Dough was pelleted using a fabricated hammer mill which was spread on plastic surfaces to dry, it was then air-tightly packed, labelled and stored in a dry place. One hundred and fifty *C. gariepinus* fingerlings with average body weight 4.11g were obtained from a commercial fish hatchery, Kaduna State. They were transported to fishery laboratory of Biological Sciences Department, Ahmadu Bello University, Zaria - Kaduna State in aerated plastic container and were allowed to acclimatize for seven days while fed commercial diet. Ten fingerlings were stocked per partial flow- through plastic aquarium with a dimension of 50×31×32cm containing twenty litres water. Fish were fed twice daily at 5% of their body weight and feed was administered manually throughout the experimental period. The inclusion level was: 0% (control) i.e. without

Albizia lebbbeck leaf, 10%, 20%, and 30% of the Albizia lebbbeck leaf meal (Table 1) and a commercial diet. Fish was weighed using analytical weighing balance before the experiment commenced then fortnightly to adjust feeding level for subsequent weeks. The experiment lasted for ten weeks after which individual weights of all the surviving fingerlings from all the groups were measured to obtain their final mean weight after evacuation of feed by starving process.

Physico- Chemical Parameters

Hydrogen ion concentration (pH) and temperature were measured using Hannan Instrument (Model H190129) while dissolved oxygen concentration was measured by Winkler (1888) titrimetric method.

Studies on Growth Parameters and Feed utilization

Various parameters used in evaluation were calculated as follows: Mean weight gain (WTG), Specific Growth Rate (SGR), Percentage Weight Gain (PWG), Average daily growth (ADG). Protein Efficiency Ratio (PER), Apparent Net Protein Utilization (ANPU), Feed Intake (FI), Protein Intake (PI), Feed Conversion Ratio (FCR), Survival rate (S).

Statistical Analysis

Data on growth parameters were subjected to one way analysis of variance while means were separated using Duncan multiple range test (Duncan, 1955). Analysis was performed using the SPSS (Statistical Package for Social Sciences) version 21. Significant level was $p=0.05$, values were expressed as Means \pm SD.

RESULTS

The C.P. (Crude Protein) and NFE (Nitrogen free Extract) of percentage proximate composition of the experimental diets obtained in this study were not significantly different ($p>0.05$) among the diets (Table 5). D.M. (Dry Matter), E.E. (Ether Extract), and CF (Crude Fibre) were highly significantly different ($p=0.01$) with values of 93.20% (diet five), 12.21% (diet five) and 8.58% (four) respectively being the highest obtained among the diets. The MISL (Mean Initial Standard Length) and MIBW (Mean Initial Body Weight) of fish fed experimental diets showed no significant difference ($p>0.05$). The MFSL (Mean Final Standard Length) observed was significantly different ($p=0.05$) where the highest occurred in Diets two (10% Albizia lebbbeck inclusion) (17.06%). The MFBW (Mean Final Body Weight), MBWG (Mean Body Weight Gain) and PWG (Percentage Weight Gain) of fish fed experimental diets were highly significantly different ($p=0.01$) where Diet two (10% Albizia lebbbeck inclusion) had the highest values of 64.81%, 60.66% and 1472% respectively. The SGR (Specific Growth Rate) and ADG (Average Daily Growth) of fish showed significant differences ($p<0.05$) where Diet two (10% Albizia lebbbeck inclusion) had the highest values while C.F (Condition Factor) and S.R (Survival Rate) of fish fed experimental diets showed no significant differences

($p>0.05$). The FI (Feed Intake), PER (Protein efficiency Ratio) and FCR (Feed conversion Ratio) of fish was significantly different ($p=0.05$) among the treatments but NPU (Net Protein Utilization) showed no significant difference ($p>0.05$). The C.P (Crude Protein), ASH and NFE (Nitrogen Free Extract) of fish carcass composition showed significant difference ($p=0.05$) but D.M (Dry Matter) and E.E (Ether Extract) showed no significant difference ($p>0.05$) among the treatments.

Table 2: Carcass Composition *Clarias gariepinus* Fed Experimental diets

DIET	D.M (%)	C.P. (%)	E.E. (%)	ASH (%)	NFE (%)
Initial	91.05±0.00	46.34±0.71 ^d	10.88±0.24 ^a	12.03±0.48 ^c	30.76±1.43 ^a
Diet One	89.93±0.00	51.07±0.16 ^c	10.61±0.46 ^a	15.49±0.17 ^{ab}	22.84±0.44 ^b
Diet Two	90.52±0.00	54.95±0.05 ^a	10.40±0.84 ^a	15.16±0.29 ^{ab}	19.50±0.50 ^{cd}
Diet Three	90.88±0.00	51.36±0.75 ^c	11.50±0.64 ^a	14.92±0.47 ^b	22.23±0.36 ^b
Diet Four	89.61±0.00	52.62±0.47 ^{bc}	11.09±0.48 ^a	14.81±0.26 ^b	21.50±0.22 ^{bc}
Diet Five	90.19±0.00	53.16±0.08 ^b	11.89±0.21 ^a	16.35±0.52 ^a	18.61±0.40 ^d
P value		0.000**	0.431ns	0.003**	0.000**

Table 3: Growth Performance of *Clarias gariepinus* Fed Experimental diets

DIET	Mean Initial Standard length (cm)	Mean Final Standard length (cm)	Mean Initial Body weight (g)	Mean Final Body weight (g)	Mean Body Weight Gain (g)	Percentage weight Gain (%)
Diet One	7.25±0.14a	13.69±0.48b	3.92±0.10a	33.09±3.52c	29.17±3.43c	740.96±72.69c
Diet Two	7.57±0.20a	17.06±0.70a	4.15±0.33a	64.81±3.47a	60.66±3.30a	1472.07±97.51a
Diet Three	7.53±0.10a	16.34±0.62a	4.35±0.06a	54.50±5.49ab	50.15±5.47ab	1153.06±122.61b
Diet Four	7.57±0.23a	15.53±0.41a	4.24±0.34a	44.12±3.74bc	39.88±3.42bc	940.68±26.84bc
Diet Five	7.55±0.13a	16.33±0.59a	4.39±0.07a	54.49±5.47ab	50.11±5.45ab	1141.70±121.95b
P value	0.619ns	0.016*	0.597ns	0.005**	0.004**	0.003**

Table 4: Nutrient Utilization of *Clarias gariepinus* Fed Experimental diets

DIET	Feed Intake (FI)(g)	Protein Efficiency Ratio (PER) (%)	Net Protein utilization (NPU) (g)	Feed Conversion Ratio (FCR)%
Diet One	44.23±3.59c	1.67±0.25b	56.67±4.67a	1.57±0.24a
Diet Two	58.18±1.23a	2.57±0.13a	61.32±1.30a	0.96±0.05b
Diet Three	55.36±4.57ab	2.36±0.29ab	59.85±5.32a	1.13±0.15ab
Diet Four	55.72±0.74ab	1.81±0.14ab	59.88±0.80a	1.41±0.11ab
Diet Five	47.17±0.36bc	2.58±0.30a	61.22±0.48a	0.97±0.10b
p value	0.017*	0.052*	0.847ns	0.049*

Table 5: Percentage Proximate Composition of Experimental Diets

DIET	Dry Matter (%)	Crude Protein (%)	Crude Fibre (%)	Ether Extract (%)	ASH (%)	Nitrogen Free Extract (%)
Diet One	91.85±0.01b	39.95±0.07a	5.00±0.51b	7.82±0.70b	8.00±0.22b	39.24±1.35a
Diet Two	91.86±0.05b	40.51±2.07a	5.17±0.30b	7.76±0.48b	7.94±0.36b	38.64±2.25a
Diet Three	91.63±0.05c	39.72±0.84a	4.21±0.18b	7.81±0.26b	7.85±0.16b	41.43±0.91a
Diet Four	91.62±0.02c	39.46±0.65a	8.58±0.43a	7.75±0.70b	8.15±0.13b	36.08±1.90ab
Diet Five	93.20±0.01a	41.56±0.01a	4.47±0.02b	12.15±0.05a	9.50±0.10a	32.33±0.16b
P value	0.000*	0.459ns	0.001**	0.05*	0.012*	0.047*

Table 6: Specific Growth Rate, Condition Factor, Average Daily Growth and Survival Rate of *Clarias gariepinus* Fed Experimental Diets

DIET	Specific Growth Rate (SGR)%	Condition Factor (CF) (g/cm ³)	Average Daily Growth (ADR) (g)	Survival Rate (SR) (g)
Diet One	3.03±0.13c	1.28±0.02a	0.42±0.05d	90.00±5.77a
Diet Two	3.93±0.09a	1.32±0.12a	0.87±0.05a	90.00±0.00a
Diet Three	3.60±0.14ab	1.24±0.04a	0.72±0.08ab	93.33±3.33a
Diet Four	3.34±0.04bc	1.18±0.10a	0.57±0.05c	96.67±3.33a
Diet Five	3.58±0.14ab	1.24±0.03a	0.72±0.08ab	90.00±0.00a
P value	0.003**	0.760n.s	0.005**	0.552ns

Means with different superscripts along same column are significantly different (p=0.05).

DISCUSSION

The C.P. was not significantly different ($p>0.05$) among the diets. Moisture content in diet was not high which showed that the feed was properly dried to prevent fungal growth. The C.F. was highly and significantly different ($p=0.01$) among the various diets due to the various inclusion level of Albizia lebbeck leaf. The crude fibre obtained in the experimental diets were within the range stated by Robinson et al. (2001) except for the 30% inclusion level of Albizia lebbeck (diet four) which had (8.58%) fibre content. This showed that higher inclusion level of Albizia lebbeck can increase the fibre content in the diet of catfish. The C.P. of the various diets was isonitrogenous, and this is ideal for the study because the essential component in fish feed is the protein (Table 5).

Physicochemical Parameters: Temperature, pH and dissolved oxygen show no significant difference ($p>0.05$) among the various diets. The range of mean dissolved oxygen of the treatments was between 3.96-4.35mg/L; mean temperature, 26.13-26.61°C and mean pH, 6.9-7.18. These values fell within the reported by Ndimele and Owodeinde (2012) as the best for tropical fishes.

Growth Performance of *Clarias gariepinus* Fed Experimental diets: The experimental fish fed all the treatments showed great increase in weight (Table 3). However, there was decrease in growth performance of the experimental fish as the inclusion level of Albizia lebbeck leaf increased. This may be due to fibre content in the experimental diets which increased with increase in inclusion level. Lawal et. al. (2013) reported decrease in weight gain at high fibre level inclusion when Sun-hemp seed was fed to *C. gariepinus* juveniles. Experimental fish fed Diet two (10% Albizia lebbeck inclusion level) had the highest values for MFSL (17.06cm), MFBW (64.81g), MBWG (60.66g) and PWG (1472.07%) (Table 3). Experimental fish fed Diet two (10% Albizia lebbeck inclusion level) performed better than those fed with control diet. Reason could be that the fish used the available protein in the diet (10% Albizia lebbeck inclusion level) efficiently than others which led to increase in weight. The growth result obtained in this study agrees with the report of Farahi et al. (2012). Also, the fish fed with the control diet had the least growth performance probably because of the effect of heat on the bioavailability of nutrients or the presence of alcohol-soluble carbohydrates in soybean meal which affected better digestion of the meal. Thermal treatment can reduce the solubility of nutrients through the formation of protein complexes with polyphenols, carbohydrates, and general denaturation of protein. These may be partly responsible for the comparatively low digestibility of the control diet (Alegbeleye et al., 2012). Nnaji et al. (2010) reported that cassava leaf meal included at 10% in the diet of tilapia fingerlings gave the best growth, feed conversion ratio and survival compared to the control diet and other test diets. There was significant difference ($p=0.01$) in specific growth rate of the fish (Table 6) where fish fed Diet 2 (10% Albizia lebbeck inclusion) had the highest value (3.93%), this might be due to different percentages of inclusion in the diets. This finding supports that of Aderolu et al. (2011) where fish fed with lowest inclusion level (5 % ripe banana) had the highest specific growth rate. The condition factor (K) of the experimental fish fed different diets was not significantly different. The mean condition factor proved that fish in all the treatments were in good condition throughout the period of this study (there was no sign of illness or

infection), reason being that they all showed a relatively constancy all through. Olurin and Aderibigbe (2006) documented that a fish well fed will obtain a higher condition factor than one poorly fed. The Average daily growth of fish recorded in this study was higher than that of Jegede and Fagbenro (2008). There was no significant difference ($p>0.05$) in survival rate of experimental fish fed with different diets (Table 6). The Survival rate observed in this study was higher than that of Dayal et al. (2012) in India who had 62% as the highest Survival rate.

The feed conversion ratio of 0.96 and 0.97 obtained by fish fed with diet two (10% inclusion level of Albizia lebbeck) and commercial diet (diet five) respectively are lower in comparison with others (Table 4), this is an indication that diet two aside the commercial diet is of better quality than the other diets. This finding corroborates with that of Olele et al. (2013). The lowest FCR of fish obtained indicated better feed utilization by the fish (Table 4) and this obviously accounted for better growth performance of *C. gariepinus* fed Diet 2 (10% inclusion level of Albizia lebbeck) (0.96 ± 0.05) among others, this result supports the observation made by Shabbir et al. (2003) in related study. The PER of the experimental fish obtained in this study exhibited significant differences in all treatments. PER values increased among the experimental fish with respect to the quantity of total feed intake. Similar observations were made by Sotolu, (2008). The highest PER value obtained by fish fed Diet 2 (10% inclusion level of Albizia lebbeck) indicated maximum utilization of inherent nutrients in the diet which was not possible at higher inclusion level (30%), (Table 4). This agrees with the observation made by Adejumo (2005). The PER values obtained in this study is higher, compared to that documented by Jimoh et al. (2014). The NPU of fish fed different experimental diet in this study was not significant ($p>0.05$) though the value obtained in Diet 2 (10% inclusion level of Albizia lebbeck) was higher (61.32g) than other treatments, this agrees with the report of Sogbesan et al. (2007). Feed intake was highly significant ($p=0.01$) in fish Diet 2 compared to other diets, this may be due to lower inclusion level of Albizia lebbeck (Table 4). The dry matter of the initial carcass composition was 91.05% which reduced in the final value obtained in all the experimental diets, though not significantly different ($p>0.05$). The initial carcass crude protein of the fish was 46.34%. There was increase in the final carcass crude protein values obtained by the experimental fish but the fish fed Diet 2 (10% inclusion level of Albizia lebbeck) was highly significantly different ($p=0.01$) among the treatments (Table 2).

Bi-weekly Growth Performance of *Clarias gariepinus* Fed Experimental Diets

Fish had similar initial weight at the beginning of the experiment which progressively changed as the fishes were administered diets. After eight weeks of feeding, fish fed with diet two obtained a higher weight compared to others and this trend continued until the terminal end (week ten), this may be due to the low level of fibre in the diet.

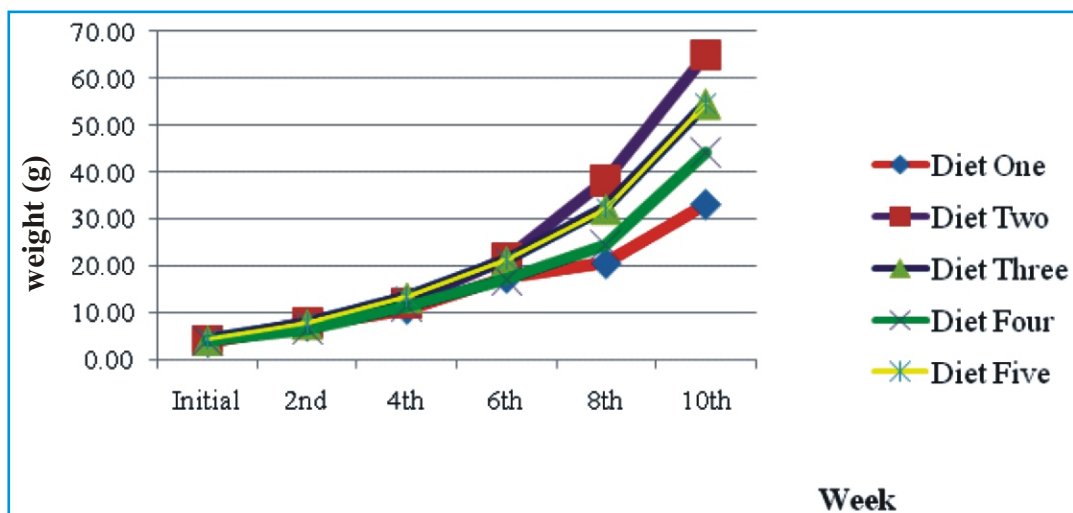


Fig: I Bi- weekly performance of *Clarias gariepinus*

CONCLUSION AND RECOMMENDATION

Based on the findings of this study, there was significant difference ($p=0.05$) between growth and nutrient utilization of African catfish fed with varying levels of *Albizia lebbek* leaf meal. It is inferred that usage of *Albizia lebbek* leaves do not in any way conflict with human food security interests, that is, this leaf is not eaten by man. It also showed that *Albizia lebbek* leaves have the potential to partly replace soya beans at 10%. Based on the findings in this study, it is therefore recommended that 10% inclusion level of *Albizia lebbek* leaf meal can be adopted in the formulation of feed for *C. gariepinus*.

REFERENCES

- Adejumo, O.K. (2005). Haematological and Histopathological effects of cassava mill effluent in *Clarias gariepinus*. **African Journal of Biomedical Research**. 8: 179-183.
- Aderolu, A., Adekoya, A. and Aarode, O. (2011). Utilization of graded levels of ripe and unripe banana in the diet of hybrid catfish, *Heteroclaris* (*Heterobranchus longifilis* X *Clarias gariepinus*). **International Research on Food Security, Natural Resource Management and Rural Development Tropentag**, University of Bonn. 5 7:1-4.
- Alegbeleye, W.O., Obasa, S.O., Olude O.O., Moronkeji, T. and Abdullaheem, I. (2012). Growth Performance and Nutrient Utilization of African Mud Catfish (*Clarias gariepinus*) Fingerlings Fed Different Levels of Fermented Pigeon Pea (*Cajanus cajan*) Meal. **The Israeli Journal of Aquaculture - Bamidgeh, IJA**. 64(731): 1-8.

- AOAC, (2006). Official Methods of Analysis Associations of Analytical Chemists. Washington D.C. 69-88.
- Ayoola, S.O. (2011). Haematological Characteristics of *Clarias gariepinus* (Burchell, 1822) juveniles. Dietary phytase: An Ideal Approach for a Cost Effective and Low-Polluting Aqua Feed. Department of Marine Sciences, University of Lagos, Akoka, Yaba, Lagos State, Nigeria. **Iranica Journal of Energy and Environment**, 2(1): 18-23.
- Ayoola, S. O., Kuton, M.P. and Shokefun, O. O. (2013). An Evaluation of Nutritional Quality and Haematological Parameters of Moringa (*Moringa oleifera*) Lam Leaves in the Diet of African catfish (*Clarias gariepinus*). **Agrosearch**. 13(1): 1-15.
- Bake, G.G., Martins, E.I. and Sadiku, S.O.E. (2014). Nutritional Evaluation of Varying Levels of Cooked Flamboyant Seed Meal (*Delonix regia*) on the Growth Performance and Body Composition of Nile Tilapia (*Oreochromis niloticus*) Fingerlings. **Agriculture, Forestry and Fisheries**. 3(4): 233-239.
- Dayal, R., Srivastava, P.P., Bhatnagar, A., Chowdhary, S., Yadav, A.K. and Lakra, W. S. (2012). Comparative Utilization Impact of Various Dietary Lipids, on Growth Indices, in Striped Murrel, *Channa striatus* (Bloch) Fingerlings. **Online Journal of Animal and Feed Research**. 2(1): 64-69.
- Duncan, D. B. (1955). Multiple Range and Multiple F tests, **Biometrics**, 11, 1-42.
- Farahi, A., Kasiri, M., Sudagar, M., Soleimani Iraei, M. and Zorriehzahra, S.M.J. (2012). Effect of Dietary Supplementation of *Melissa officinalis* and *Aloe vera* on Hematological Traits, Lipid Oxidation of Carcass and Performance in Rainbow Trout (*Oncorhynchus mykiss*). **Online Journal of Animal and Feed Research**. 2(1): 01-05.
- Jegede, T. and Fagbenro, O (2008). Dietary Neem, *Azadirachta indica* Leaf Meal as Reproduction Inhibitor in Redbelly Tilapia, *Tilapia zilli*. 8th International Symposium on Tilapia in Aquaculture. In Aquaculture. Proceedings. Cairo, Egypt, 12-14: 365-373.
- Jimoh W. A., Sodamola M. O., Ayeloja A. A., Oladele-Bukola M. O. and Shittu M. O. (2014). The Influence of Replacing Maize with *Chrysophyllum albidum* Seed Meal on Growth Response and Nutrient Utilization in *Clarias gariepinus*. **Agrosearch**. 14(1):54-61
- Lawal, M.O., Aderolu, A.Z., Adeyemi, B. and Aarode, O.O. (2013). Dietary Effects of Sun-hemp (*Crotalaria juncea* Linn.) in the Diet of African catfish, *Clarias gariepinus* juveniles. **actaSATECH** 4(2): 108 - 118.
- Ndimele, P.E. and Owodeinde, F.G., (2012). Comparative Reproductive and Growth Performance of *Clarias gariepinus* (Burchell, 1822) and its Hybrid Induced with Synthetic Hormone and Pituitary Gland of *Clarias gariepinus*. **Turkish Journal of Fisheries and Aquatic Sciences**. 12: 619-626.
- Nnaji, J.C., Okoye, F.C. and Omeje, V.O. (2010). Screening of Leaf Meals as Feed Supplements in the Culture of *Oreochromis niloticus*. **African Journal of Food Agriculture, Nutrition and Development**. 10(2):2112-2124.

- Olele, N. F., Onyema, M. I. and Odiko, A.E., (2013). Growth Performance, Survival Rate and Nutrient Profile of *Clarias gariepinus* Fingerlings Fed Rations of Soybean as Alternative Protein Source. **Academic Journal of Interdisciplinary Studies**. 2(10):58-66.
- Olurin, K.B. and Aderibighe, O.A. (2006). Length-weight and Condition Factor of Pond Reared Juvenile *O. niloticus*. **World Journal of Zoology**. 1(2): 82-85.
- Ozigbo, E., Anyadike, C., Adegbite, O. and Kolawole, P. (2014). Review of Aquaculture Production and Management in Nigeria. **American Journal of Experimental Agriculture**. 4(10): 1137-1151.
- Robinson, E. H., Li, M. H. and Manning, B. B. (2001). A Practical Guide to Nutrition: Feeds, and Feeding of Catfish. Division of Agriculture, Forestry, and Veterinary Medicine, State University. Mississippi, 2nd Revision No.111: 7.
- Shabbir, S., Salim, M. and Rashid, M. (2003). Study on the Feed Conversion Ratio (FCR) in Major Carp (*Cirrhinus mrigala*) Fed on Sunflower Meal, Wheat Bran and Maize Gluten (30%). **Pakistan Veterinary Journal**. 23(1):1-3.
- Sogbesan, O.A., Madu, C.T. and Ugwumba, A.A.A. (2007). Culture and Utilization of Tadpole as Animal Protein Supplement in the Diet of *Heterobranchus longifilis* Fingerlings. **Journal of Fisheries and Aquatic Sciences**. 25: 353-360.
- Sotolu, A. O. (2008). Nutrient Potential of Water Hyacinth as a Feed Supplement in Sustainable Aquaculture. **Obeche**. 26 (1): 45-51.
- Udo, I.U. and John, J. F. (2015). Effect of Processing Methods on the Utilization of Cassava (*Manihot esculenta* Crantz) Leaf Meal (CLM) by African catfish (*Clarias gariepinus*). **Livestock Research for Rural Development**. 27(8): 13.
- Winkler, L.W. (1888). Die Bestimmung des in Wasser gelösten Sauerstoffes. *SBerichte der Deutschen Chemischen Gesellschaft*, 21: 2843 - 2855.