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Growth performance of *Clarias gariepinus* fry using soybean meal, blood meal and maize bran

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Abstract

Fish feed is one of the major inputs in aquaculture production which accounts for at least 60% of the total cost of production and its feed technology is one of the least developed sectors of aquaculture particularly in Africa and other developing countries of the World. Therefore there is the need to bridge the gap in the demand for protein by culturing fish that grows fast to raise the level of fish production using locally available feed stuff. Hence an investigation into the growth performance of *Clarias gariepinus* fry was carried out at the department of Zoology, Nasarawa State University with a view of determining the most suitable compounded feed to supplement with the normal commercial feed of higher cost in the market so as to bridge the gap existing therein. Two hundred and eighty fry's of *Clarias spp* were stocked, seventy per aquarium in a 45.6x32cm plastic tanks. The result obtained indicates an increase in growth parameter for the four treatments. Fry's fed with Artemia recorded the highest value in the final mean weight (FMW), Feed conversion Ratio (FCR), protein efficiency ratio (PER) as compared with the formulated ones, but the three compounded feeds had lower values for specific growth rate (SGR), while there was no significant difference ($P > 0.05$) in the survival rate and condition factor (CF) among the treatments. Feeds of Soybean meal, Blood meal and maize bran had the best cost benefit, as compared to Artemia.

Keywords: *Clarias gariepinus* fry, growth rate, survival, fish feeds, cost benefit

Introduction

Fish consumption is growing at the rate of 2.4% per annum while the human population is increasing at the rate of 2% per annum, (FAO, 2006). Thus, the growth of human population is outpacing that of fish as food since 1980, thereby creating increasing market demand. This has led to the overexploitation of capture fisheries due to overcapacity and over fishing, hence there is need for increased aquaculture production to supplement the capture fisheries and solve the market demand of fish and fish products. Gabriel, *et al*. (2007) [18] stated that, the species selected to portray yield potential in Africa for aquaculture production are, Nile tilapia (Oreochromis niloticus), Common carp (Cyprinus carpio), and African catfish (Clarias gariepinus), they further explained the biology and geographical distribution of the said species that they are widely distributed and have already performed well for fish farming in the continent, hence under small-scale conditions, African catfish because of its tolerance to crowding produces a critical standing crop of about 21 metric tonnes for commercial farming. They are also known as omnivorous scavenger that eats everything it finds, the African catfish is particularly adaptable to the farming practices of smallholders who comprise the majority of farmers in developing countries, and they also have been known to favor the farmer in terms of controlling tilapia recruitment since it fetches higher market prices than other "police" species (C. gariepinus), however, the persistent lack and/or high price of even small catfish fingerlings in underdeveloped and developing countries is a major constraint to quaculture development, (Ogunji, Rahat-Ul-Ani, Carsten and Wermer, 2008).

The aquaculture potential of Clarias gariepinus in Africa was first realized by Douglas Hey at the Jonkershoek Fish Hatchery in the Western Cape Province in South Africa in 1941. Until the mid-1970s, however, the aquaculture research effort was relatively low key until the publication of two important papers, the one by De Kimpe and Micha and the other by Ritcher that could have triggered more research efforts in aquaculture (Hecht, 2000). He noted also that, since the mid-1970s, research on African catfish culture has risen/grown and has been undertaken in several laboratories as in The Netherlands, South Africa, Belgium, Central African Republic, and Ivory Coast, these largely independent but parallel research initiatives resulted in the rapid development of the technology throughout Africa. (Hecht, 2000). African catfish, Clarias gariepinus, from a biological perspective, is undoubtedly the ideal aquaculture species in the world. It is widely distributed, thrives in diverse environments (temperate to tropical), and is hardy, adaptable, and it's an ecological pioneer species, principally as a major consequence of its air-breathing ability. (Nyina-Wamwiza, Wathelet, Richir, Rollin and Kestemont, 2010). It is also known to feeds on a wide array of natural prey and can adapt its feeding habits depending on food availability, these fishes are able to withstand adverse environmental conditions, and are highly fecund and easily spawned under captive conditions, Nyina-Wamwiza *et al*., (2010). Thus, this research work is aimed at determining the growth performance of three feed types (Artemia, Blood meal, Soybean meal and Maize bran on Clarias gariepinus fry and their survival rates).

Fish feed is one of the major inputs in aquaculture production which accounts for at least 60% of the total cost of production (National Research Council, 1993). Fish feed technology is one of the least developed sectors of aquaculture particularly in Africa and other developing countries of the World. The main constraints of fish feed production include scarcity of fish feedstuff, high cost of ingredients and competition of ingredients for human use.

This constraints have motivated the research for locally available and cheap alternative protein feed source that compete less with human for aquaculture industry which aim to reduce the cost of production without compromising fish quality, in the view of the worldwide demand for additional sources of food to meet the needs of ever increasing population, the exploitation of plants and or dietary products of low economic importance are steps towards better resource utilization (Ogunji, Kloas, Wirth, Schulz, and Rennert, 2006).

Materials and Methods

Experimental Unit

The study was conducted at Nasarawa State University, Keffi campus, and the specific area was at the Zoology Laboratory of the Department. This was to enhance the usage of laboratory equipment such as; Weighing balance, EXTECHRDO600, Thermometer, pH meter, Scapular, Bowl and Basins, Nets and Sieves, Sockets and Extension wires, Beakers and Crucibles, and Aerators and Aquaria.

Experimental Fish

Clarias gariepinus larvae were obtained from Rayuwa Farm at Masaka area of Karu LGA. The fish were transported to the Zoology Laboratory of the University and were kept in tanks separately at temperature of 24-26°C with air stone aerators and allowed to acclimatize for 7 days. The catfish fry were fed on artemia for 7 days as starter feed to obtain uniform growth length before they were transferred to the 3 experimental tanks to be fed on three different diets (Artemia, Soybean, Blood meal, Maize bran).

Culture Unit

Culture units consist of 4 glass aquaria (45.6 cm in length, 32 cm wide, and 31 cm in height). Experimental tanks were washed with detergents then allowed to air dry and were filled with 20.0 L of dechlorinated tap water whose temperature were about 24-26°C. Water in each tank was gently aerated with a single air stone. A total of 4 tanks w ere each stocked with 70 fish larvae at the start of the experiment.

Determination of Physico-Chemical Parameters.

For the monitoring of water quality, bottom debris was siphoned from each tank twice a day, once before the first feeding, and again 30 minutes after the last feeding. Since water loss may occur during siphoning, 0.5–1.0 L of dechlorinated tap water was added daily to each tank to maintain water volume at 20.0 L. However, after every 5 days, 60 – 80 % of the water in each tank was changed this coincided with the sampling for growth parameters this parameters were measured using the EXTECHRDO600 meter, for which ever parameter to analyzed you will first of all switch to it then place in the water media allow for some time then readings are taken. Laboratory Analytical Procedure for Proximate Analysis were done using the procedures of Official Methods for Analysis by; Association of Analytical, Chemistry (A.O.C.A., 1990) [5]. Growth Parameters of Clarias gariepinus were calculated using standard procedures and formulae (specific Growth Rate SGR, Protein Efficiency Ratio PER, Condition factor Kf, Feed Conversion Ratio FCR,) by; Brown 1957 and Halver, 1979. Data are analyzed using one-way analysis of variance (ANOVA) so as to check for significant differences among the treatments. Relationship between water quality parameters, growth and survival of catfish fry and also between survival rate and total length were determined.

Results

Table 1: Water Quality Parameters Analyzed During the Study Period

	Experimental Units			
Parameters	**Tank A**	**Tank B**	**Tank C**	**Tank D**
DO (mg/L)	18.56	19.01	18.76	18.82
Temp. °C	24.20	24.50	25.00	24.60
pH	6.98	7.00	7.15	7.25
Ammonia (mg/L)	0.12	0.11	0.11	0.12
Salinity	17.00	17.00	17.00	17.00
Conductivity	23.00	23.50	23.45	23.00
Hardness ($CaCO_3$)	17.10	17.10	17.10	17.10
Free CO_2	20.23	20.40	21.00	20.65

Table 2: Morphometric Measurements of Clarias gariepinus fry During the Period of Study.

	Experimental Units					
Parameter	**IL (cm)**	**FL (cm)**	**SL (cm)**	**I Wt (g)**	**F Wt(g)**	**WtG**
Artemia	0.31	7.20	6.90	0.2 ± 0.1	5.06±0.2	4.81
Soybean Meal	0.31	6.90	6.59	0.2 ±0.1	4.60±0.2	4.36
Maize bran	0.31	4.30	4.00	0.2 ±0.1	2.56±0.2	2.35
Blood Meal	0.31	6.50	6.10	0.2 ±0.1	4.20±0.2	3.98

Key: I L = Initial Length (cm) Wt G = Weight gain (g)
F L =final length (cm)
S L =Standard Length (cm)
I Wt = initial weight (g)
F Wt = Final Weight (g)

Table 3: Proximate Analysis of Compounded Feed Stuff Used During the Period of Investigation

	Proximate Components					
Feed stuff	**Protein**	**Fibre**	**Moisture**	**Ash**	**Lipids/fats**	**Carbohydrate**
Artemia	51.70	6.73	1.71	5.10	9.70	4137.10
Soybean Meal	24.40	6.40	9.70	14.42	7.50	2781.60
Maize Bran	25.00	6.40	10.40	12.26	6.50	2787.10
Blood Meal	42.60	3.60	9.00	6.42	10.20	3346.86

Analyzed By; Animal Health Care Mararaba, Nyanya- Abuja

Table 4: Determination of Growth Indices during the Period of Study.

Units	%SGR	FCR	PER	%SR	WtG(g)	K
Artemia	4.60	87.33	0.07	64.28	4.81	1.46
Soybean Meal	4.58	96.33	0.18	65.71	4.36	1.53
Maize bran	3.88	178.71	0.09	52.28	2.35	3.69
Blood Meal	4.58	105.52	0.09	67.14	3.98	1.68

Key: %SGR = Percentage specific growth rate
FCR = Feed conversion ratio
PER = Protein efficiency ratio
%SR = Percentage survival rate
K = Condition factor

Table 5: Cost Benefit Analysis of Different Compounded Feed.

Feed Ingredients	Proximate analysis value			Price (N)
	48%	42%	25%	
Blood meal (cow blood)	30.20	-	-	100
Soybean meal (soya bean)	-	30.10	-	110
Maize bran (maize)	-	-	32.6	55
Salt	0.5	0.5	0.5	5
Lysine	1.0	1.0	1.0	15
Vitamin C	1.0	1.0	1.0	30
Bone meal	0.5	0.5	0.5	100
G/Nut oil	0.5	0.5	0.5	20
Total				435

Discussions

For aquaculture activity to take place certain parameters have to be put in place for adequate production/ breeding to commence, one of the major factors for proper culturing are proper examination of water; water parameters such as; Temperature, dissolved oxygen(DO), pH, Ammonia, Conductivity and Hardness were monitored and the results presented in table (1). Water source was from tap therefore it has to be dechlorinated by complete aeration and exposure to atmosphere for a time limit of 18hrs and above. Continuous aeration of the water was to keep the oxygen level close to saturation which actually gave values of 18.56-19.01. These values gotten are in line with the saturation level of dissolve oxygen in indoor breeding, the dissolve oxygen tended to decrease with increase in Temperature. Temperature values ranged between 24.20 - 25.00 degree centigrade with the average at 24.57 OC since it is within an enclosure (room temperature). PH, of water had some form of fluctuation in values from 6.98-7.25 with an average of 7.09. This fluctuation may have arisen from the source of water. The concentration of Ammonia in the water was found to be minimal and nearly below range which provided the Frys a convenient environment to live in. Ammonia values ranged between 0.11- 0.12 with an average value of 0.12 approximately. The values obtained also could be as a result of the continuous aeration of the water. Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. This ions charge the water and provide the aqua life a suitable environment, since it was a tap source the conductivity level was slightly above normal range but not significantly been harmful to the fry's because of exposure of the tap water for 18 - 24hrs before usage. Hardness of water occur as a result of the presence of certain minerals such as $CaCO3$, $MnO4$ some hardness are permanent while others are temporary. This hardness can be removed by treatment using chlorine. In this case since it was tap water that was used, it therefore implies that it must have been treated with chlorine and since chlorine is not a good substance for aqua life, the water is dechlorinated by exposure to atmosphere by leaving the water open in a bowl or basin for at least 18hrs. Hardness tested after exposure was 17.10. There was a relative weak correlation between water parameters and survival rates of the fish fry ($r = 0.11$; $P > 0.05$). Pearson correlation showed strong relationship between total length and survival rate ($r = 0.87$). Survival rate was relative high for fish fed on artemia nauplii unlike fish fed Soybean meal, Blood meal and Maize bran which had significantly lower values ($P < 0.05$). Maize bran was the feed that had the lowest performance (SGR= 3.88) and highest mortality 32% for the catfish fry. At the end of the feed trial it was observed that soybean had the highest performance (4.58) than it counters.

Conclusions

This study "Growth performance of C. gariepinus fry using Soybean Meal, Blood Meal and Maize Bran" which was done in the Zoology Laboratory shows that:

That soybean meal and blood meal had a better yield production when compared with the co-compounded feed stuff maize bran therefore can be used in fry rearing, dry feed stuff is not a good feed for starter feed (Maize bran). This is in line with the work of Nyina-Wamwiza *et al*., (2010), dried feed are not a good feed for rearing of frys but can be used in the their later stage.

For all treatment media there was no notable difference in the control- Artemia with Soybean and Blood meal, but maize bran had a poor growth output. Condition factor of Artemia, Soybean meal and Blood meal were all in good state, hence it is can be said that the water and environment favored all the test media. The water parameter indices values were all normal with regards to environmental standard range for all culture media.

Recommendations

Thus the following recommendations are based on the results recorded in this research;

The results of this research work shows that Artemia are quite a very good food feed for Clarias gariepinus fry and larvae for the purpose of enhancing faster growth performance and survival. Nevertheless, soybeans and blood meal would be preferred as starter feed also due to the availability and cost implications of obtaining them as compared to the commercial feeds (Artemia cysts) in developing nations as ours.

This work also shows that maize bran are not a good first time (starter) feeding feeds for Clarias gariepinus frys.

Cost benefit analysis should be done to measure the quality and cost of ingredients putting into consideration the best-buy approach to monitor excesses.

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References

1. Abdel-Tawwab M, Khattab YAE, Ahmed MH, Shalaby AME. Compensatory growth, Feed Utilization, whole body composition and haematological changes in starved juvenile Nile tilapia, Oreochromis niloticus. Journal of Applied Aquaculture, 2006; 18:17-36
2. ADCP. "Aquaculture development and coordination programme, fish feeds and feeding in developing countries," Report on the ADCP Feed Development Programme, FAO-ADCP/REP/07/26, Rome, Italy, 1987, 56-70
3. Adewunmi AA, Olaleye VF. Growth performance and survival of Clarias gariepinus hatchlings fed different starter diets. African Journal of Agric Research. 2015; 6(6):1281-1285.
4. Alabaster JS, Loyd R. Water quality criteria for fresh water fish 2nd edition, 1980, 235-374.
5. AOAC. Official Methods of Analysis, Association of Analytical, Chemistry 15th Edition, Washington D.C, 1990, 854-865.
6. Alastise PS, Ogundele O, Eyo AA, Oludnjoye F. Evaluation of different soybean- based diets on growth and nutrient utilization of H. longifilis in aquaculture tanks. FISON Conference proceedings, Calabar, 2006, 225-262.
7. Alegbeleye WO, Odulate DO, Obasa SO, George FOA. Potential of Toasted Lima bean (Phaseolus lunatus L) as a substitute for full fat soyabean meal in the diets for (Oreochromis niloticus) fingerlings. Moor Journal of Agricultural Research, 2005; 6:92-98.
8. Alonso RA Aguirre, Marzo F. Effects of extrusion and traditional processing methods on anti-nutrients and in vitro digestibility of protein and starch in faba and kidney beans. Food Chemistry. 2000; 68(2):159-165.
9. Atuguba GA, Annune PA, Ogbe FG. Growth Performance of two African catfish C. gariepinus and H. longifilis and their hybrids in plastic aquaria. Journal Livestock Research for Rural Development. 2010; 22(2):16.
10. Bergot F. Digestibility of natives starches of various botanical origins by rainbow trout (Oncorhynchus mykiss). (In: S.J. Kaushik and P. Luquet, Editors, Fish Nutrition in Practice.) Proceedings of the IVth International Symposium on Fish Nutrition and Feeding, France INRA Editions Paris, 1993; 6:857-865.
11. Bergot F, Breque J. Digestibility of starch by rainbow trout: Effects of the physical state of starch and of the intake level. Aquaculture, 1983; 34:203-212.
12. Bichi AH, Ahmad MK. Growth performance and nutrient utilization of African catfish (Clarias gariepinus) fed varying dietary levels of processed cassava leaves. European Journal of Experimental Biology. 2010; 5(3):1-5.
13. De Kimpe P, Micha JC. Prossessing and Utilization of feed in Clarias gariepinus. Advances in Aquaculture, Cambridge University Press, New York, NY, USA, 1974.
14. Dipanjali K, Bouchet B. Quantitative feed requirements of African catfish Clarias gariepinus (Burchell) larvae fed with decapsulated cysts of artemia. Journal of Aquaculture, 2005; 83:251-267.
15. Dongmeza EB, Francis G, Steinbronn S, Focken U, Becker K. Investigations on the digestibility and metabolizability of the major nutrients and energy of maize leaves and barnyard grass in grass carp (Ctenopharyngodon idella). Asia Journal of Aquacultural Nutrition, 2010; 16:313-326.
16. Food and Agriculture Organization, World Agriculture towards 2015/2030, FAO, Rome, Italy, 2006.
17. Food and Drink Federation, Growth Performance, Feed Efficiency, Digestibility and Conversion ratio of H. bidorsalis. African Journal of Agriculture Research, 2008; 4:167-173.
18. Gabriel UU, Akinrotimi OA, Bekibele DO, Onunkwo DN, Anyanwu PE. Locally produced fish feed: Potentials for aquaculture development in Sub-saharan Africa. African Journal of Agriculture Research, 2007; 2:287-295.
19. Gallant DJ, Bouchet B, Buléon A, Pérez S. Physical characteristics of starch granules and susceptibility to enzymatic degradation. European Journal of Clinical Nutrition. 1992; 46(suppl. 2):S3-S16.
20. Gea T. Replacement of fishmeal in Cobial (Rachycentron canadum) Diets Using an Organically Certified Protein. Journal of Aquacultre, 2009; 257:393-399.
21. Gea T. Evaluation; the Effects of Local and Imported yeast as supplementary Food on the African catfish (Clarias gariepinus) in Egypt. Journal of Aquaclyure Marine Biology. 2010; 2(3):24.
22. Van Dijke, Van Damme P, Pacolet W, Sulem Yong S. proteolytic Enzymes in Clariase gariepinus larvae fed with dry diets, special publication 10. European aquaculture society, Breden, Belgium, 2001; 10:255-256.
23. Yem I, Alabi FO. Ecology, Biology and Distribution of African catfish. Textbook; The Ecologist, A publication of the Zoological Society of Nigeria. 2009; 3(2):49-78
24. Yem I. Nutritional Utilization and growth responses of C. lazera fed different dietary protein levels. NIFFR. Journal of applied fish hydrobiology, 2010; 4:6-12.
25. Verreth JE, Eding GRM, Huskens R, Segner H. A review of feeding practices, growth and Nutritional physiology in Larvae of the Catfishes Clarias gariepinus and Clarias batrachus. Journal of the world Aquaculture society. 1992; 24(2):135-144
26. Wu XY, Liu YJ, Tian LX, Mai KS, Yang HJ, Liang GY, *et al*. Effects of raw starch levels on growth, feed utilization, plasma chemical indices and enzyme activities in juvenile yellowfin seabream Sparus latus Houttuyn. Aquaculture Research, 2007; 38:1330-1338.