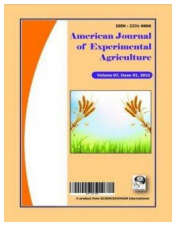

American Journal of Experimental Agriculture
9(1): 1-6, 2015, Article no.AJEA.16342
ISSN: 2231-0606

SCIENCEDOMAIN *international*
www.sciencedomain.org

Impact of Three-different Commercial Feed on the Growth and Survival of *Clarias gariepinus* Burchell, 1822 Fry in Aquaria Glass Tanks

A. F. Yakubu[1], N. A. Nwogu[1*], E. D. Olaji[1] and T. E. Adams[1]

[1]Department of Aquaculture, Nigerian Institute for Oceanography and Marine Research, P.M.B. 4015, Sapele, Delta State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author AFY designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author NAN performed the statistical analysis, managed the literature searches and wrote the final manuscript. Authors EDO and TEA performed physiochemical quality of water and feeding of fry. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJEA/2015/16342
Editor(s):
(1) Yeamin Hossain, Department of Fisheries, Faculty of Agriculture, University of Rajshahi, Bangladesh.
(2) Anonymous.
Reviewers:
(1) Abdullahi M. Orire, Aquaculture and Fisheries Technology, Federal University of Technology, Nigeria.
(2) Rakesh Kumar Pandey, Department of Zoology, Kamla Nehru Institute, India.
(3) Anonymous, Maejo University, Thailand.
(4) Anonymous, National Institute of Oceanography & Fisheries, Alex, Egypt.
(5) Anonymous, Universidad de Buenos Aires, Mexico.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=1148&id=2&aid=9748

Original Research Article

Received 27th January 2015
Accepted 20th May 2015
Published 12th June 2015

ABSTRACT

Aims: To compare the growth response and survival rates of *Clarias gariepinus* Burchell, 1822 fry fed artificially formulated fry feed using *Artemia salina* shell free as control.
Study Design: Randomized blocked design.
Place and Duration of Study: Wet laboratory of Nigeria Institute for Oceanography and Marine Research (NIOMR), Sapele, Nigeria in November 2014 for twenty-eight (28) days.
Methodology: Five hundred and twenty (520) post yolk absorbed *C. gariepinus* fry were randomly selected from NIOMR hatchery and stocked at 130 fry per aquarium glass tank measuring 40 cm x 30 cm x 30 cm. Four (4) experimental fry diets which translated to four Treatments were compared

**Corresponding author: E-mail: nwogunkem@yahoo.com;*

namely A. salina shell free (T1), Coppens (T2), Durante (T3) and Lucky Star (T4). Each experimental treatment was replicated three (3) times. All diets were administered manually four times a day between 0800 h and 1800 h based on 3% body weight. Physiochemical parameters were determined daily. Replacement of water in each glass aquarium tank was done daily after siphoning debris and counting of dead fry. Nutrient utilization parameters such specific growth rate (SGR), feed conversion efficiency (FCE), survival rate (SR), % cannibalism and performance index (PI) were calculated.

Results: Initial mean weight of fry used in each treatment was 0.03±0.01 g. T1 and T4 showed final mean weights of 1.06±0.02 g and 0.87±0.01 g respectively while 0.06±0.03 g and 0.06±0.03 g were obtained in T2 and T3 respectively. % cannibalism of 3.0±0.02% was obtained in T2 and T3 while 2.0±0.03 and 2.0±0.02 were recorded for T1 and T4 respectively. Highest SGR of 12.73±0.92% was calculated for T1. This was followed by T4 (SGR=12.03±0.13%). SGR value (2.48%) was the same for T2 and T3. Highest SR of 96.0±1.76% and 88.0±1.56% was recorded in T1 and T4 respectively while a relatively lower values of 69.0±0.94% and 67.0±1.03% were obtained for T2 and T3 respectively. The best FCE value of 0.8% was obtained in T1 followed by T4 (0.9%). T2 and T3 had the least FCE value (1.2%). The monitored physiochemical parameters were not affected by the different diets during the 28 days feeding trial. On the average, Treatment T1 performed the best, T4 second while T2 and T3 performed the least.

Conclusion: Our study showed that *A. salina* shell free performed best followed by Lucky Star feed in growth performance and survival of *C. gariepinus* fry. We recommend the use of *A. salina* shell free as the best starter feed for the rearing of *C. gariepinus* fry. However, where *A. salina* shell free is not available Lucky Star fry feed may be employed.

Keywords: Catfish fry; survival rate; growth performance; artemia; commercial feed.

1. INTRODUCTION

Culture of African catfish, *Clarias gariepinus* Burchell, 1822 has received considerable attention since the early 1970s and 1980s [1], but the industry remains relatively undeveloped largely due to dependence on aquatic products from capture fisheries. Currently, due to decline in most of the capture fisheries and increased demand for protein of aquatic products, the need for an alternative source, particularly from aquaculture is growing [2]. One of the major obstacles confronting the development of aquaculture industry is availability of affordable and high-quality fish feed. Fish growth and survival rate depend on the kind of feed, feeding frequency, feed intake and the fish's ability to absorb the nutrients. Starter feeds are important in the growth of African catfish (*C. gariepinus)* larvae. Live feeds such as Artemia, rotifers, copepods, *cladocerans* have been employed with successful outcomes in feeding most fry of *C. gariepinus* [3,4]. Although *Artemia nauplii* and decapsulated cysts have long been used successfully in starter feeds of most fish fry [5], their increasing cost is a major constraint to most fish farmers especially in West Africa. Research on mass culture of *Ceriodaphnia* and *Moina* which can replace the expensive and imported *A. salina* is ongoing. Substitution of commercial compounded diet for live feed is essential for lowering production cost while sustaining production quality fishes [6]. In this regard, efforts towards the search for alternatives to live feeds have been on going.

Fish nutritionist aim at producing a balanced commercial diet that promotes optimal fish growth and health. The quality of commercial feed should be determined for individual feeds to carefully monitor the feed consumption and growth rate of the fry. Good quality feed and optimum feeding frequency may provide maximum utilization of diets and thus, fast growth of the fry [7,8]. However, poor quality fry feed lead to leaching of nutrients, reduction in feed conversion ratio and increase in input list, and also, accumulation of wastes that adversely affect the water quality [9,10]. Therefore, it is important to standardize the quality of commercial feed for the target species in aquaculture for optimum production.

Although, there have been numerous experiments on feeding trial with commercial diets using *C. gariepinus*, however, reports on experiment regarding efficacy of different commercial fry feeds are very few. Therefore, this experiment was designed to compare the growth response, feed efficiency and survival rate of *C. gariepinus* fry fed commercial feed using *A. salina* shell free as control.

2. MATERIALS AND METHODS

2.1 Study Area

The experiment was conducted in wet laboratory of Nigeria Institute for Oceanography and Marine Research (NIOMR), Sapele, Nigeria. Twelve (12) glass aquarium tanks (40 cm x 30 cm x 30 cm) were washed, cleaned and allowed to dry. Water was then poured into them up to the depth 20cm leaving 10 cm freeboard to avoid the spilling of water. Five hundred and twenty (520) post yolk absorbed *C. gariepinus* fry were randomly selected from NIOMR hatchery, weighed using electronic weighing balance (Metller PC 180), and stocked at 130 fry per aquarium glass tank (without substratum), aeration of each tank was done using RESUN Air-pump (ACD-9800). Replacement of each aquarium glass tank water after siphoning debris and counting of dead fry was done daily.

2.2 Experimental Diets and Treatments

The following four (4) experimental fry diets were used - *A. salina* shell free (500 g, INVE Aquaculture Inc., Thailand) (T1), Coppens (Coppens International, Germany) (T2), Durante (Durante Fish Industries Ltd, Nigeria) (T3) and Luck Star (Hung Kuo Industrial Co., Ltd., Taiwan) (T4). *A. salina* shell free, Coppens and Durante fry feed (micro pellets) were obtained from Heritage Global Marketers, Sapele, Nigeria. While Lucky Star fry feed was obtained from Taiwan. Each experimental treatment was replicated three (3) times. *A. salina* shell free which has been used with various level of success for fry rearing was used as control diet. All diets were administered manually four times a day between 0800 h and 1800 h based on 3% body weight. Proximate analyses of the experimental diets were performed at Long Xiang Analytical Research Unit of Shao Township, Yilan County, Taiwan. Obtained results are shown in Table 1.

2.3 Nutrient Utilization Parameters

Nutrient utilization parameters were determined based on the following formulae:

Specific growth rate (SGR % day) =

$$\frac{100 \text{ X } [\text{In}(\text{Final body weight}) - \text{In}(\text{Initial body weight})]}{\text{Rearing period in days}} \quad [11]$$

Where "In" represents natural logarithm.

Feed conversion efficiency (FCE) =

$$\frac{\text{Final Weight by Fish X } 100}{\text{Weight of feed given}} \quad [12]$$

Survival rate (SR %) =

$$\frac{\text{Total fish number harvested}}{\text{Total fish number stocked}} \text{ X } 100 \quad [13]$$

Performance Index (PI) =

$$\frac{\text{SR X FMW (g)} - \text{IMW (g).}}{\text{Rearing duration in days}} \quad [14]$$

SR = Survival Rate, FMW = Final Mean Weight, IMW = Initial Mean Weight.

Percentage (%) of cannibalism = 100% - %mortality - %survival [5]

2.5 Water Quality Analysis

Samples of water from each treatment were taken daily to determine the values of pH, dissolved oxygen concentration, total ammonia and temperature degrees according to the method of [15]. Water temperature in degree Centigrade was measured by using a thermometer. The pH value of water was measured using an electric digital pH meter model (Jenway Ltd, Model 350-pH meter). Dissolved oxygen was determined weekly using an Oxygen meter model (d-5509).

2.6 Statistical Analyses

Data collected were subjected to analysis of variance (ANOVA) using SPSS software (version 16.0). Mean separation was done using Duncan's Multiple Range Test. All tests were carried out at 5% probability level.

3. RESULTS AND DISCUSSION

Growth performance *C. gariepinus* fry fed different feed types is presented in Table 3. Initial mean weight of fry used in each treatment was 0.03±0.01 g. T1 and T4 showed final mean weights of 1.06±0.02 g and 0.87±0.01 g respectively while 0.06±0.03 g and 0.06±0.03 g were obtained in T2 and T3 respectively. There was no significant difference (*P≠.05*) in values obtained in T2 and T3. Percentage cannibalism of 3.0±0.02% was obtained in T2 and T3 while 2.0±0.03 and 2.0±0.02 were recorded for T1 and T4 respectively. Highest specific growth rate (SGR) of 12.73±0.92% was calculated for T1. This was followed by T4(SGR=12.03±0.13%).

SGR value was the same for T2 (2.48±0.08%) and T3 (2.48±0.05). There was no significant difference (*P≠.05*) in SGR values obtained in T1 and T4. Highest survival rates percentage of 96.0±1.76% and 88.0±1.56% was recorded in T1 and T4 respectively while a relatively lower values of 69.0±0.94% and 67.0±1.03% were obtained for T2 and T3 respectively.

On the average, T1 performed the best, T4 second while T2 and T4 performed the least. Our findings that *A. salina* shell free performed best corroborates with that of [4] who compared the performance of decapsulated *Artemia*, Copepods, and a commercial diet. Their work attributed the best performance of *A. salina* to the fact that it had balanced nutrient composition compared to other feeds. Pooling [16] showed that the use of *A. salina* in fry culture of African catfish (*C. gariepinus)* allowed excellent growth performance and survival rates. This can attested by the best feed conversion efficiency (FCE) value of 0.8% recorded in T1 which translated to better growth. Lucky star feed ranked second after *A. salina* shell free. The possibility that Lucky star feed was less palatable compared to *A. salina* shell free cannot be ignored as *C. gariepinus* fry when feeding depend heavily on chemosenses rather than visual or mechanical senses [17]. The poor performance of fry fed Coppens in our study correlates with the findings of [18]. They observed that fry fed 100% Coppens showed the lowest growth rate and survivability compared to other fry feed. The poor performance of Coppens and Durante feeds may be because of poor palatability, size and poor nutrient digestibility. Thus, poor FCE of 1.2% obtained in both Treatments.

Percentage cannibalism was low in all Treatment (Table 3) but percentage mortality of higher values of 20.0±1.23% and 30.0±0.26% was recorded for T2 and T3 respectively. This could be caused by poor acceptability of Coppens and Durante feeds by the fry. Acceptance of formulated diet depends on the feed composition, size, texture, flavor or mixture of these factors. Lovell [19] stated that protein quality of feed can affect the growth performance of fish and protein quality is affected by amino acid composition and digestibility. Although, Coppens and Durante feeds had higher crude protein (CP) content (CP=56% and 57% respectively), least final mean weight and survival rates were obtained in them. This observation is in accordance with our previous work on feeding trial [9]. It is important to note that percentage of protein in feed determined by chemical analysis is not synonymous with the amount of protein available from feed stuff to the fish [9]. Our findings showed that the best crude protein content of fry feed should be between 53.2%-54%.

Physiochemical water quality parameters such as Temperature, pH, dissolved Oxygen, Total ammonia and Ammonia nitrogen are shown in Table 2. The monitored physiochemical parameters were not affected by the different diets during the 28 days feeding trial.

Table 1. Proximate analyses of the experimental diets

Raw materials	Artemia	Coppens	Durante	Lucky star
Crude protein	54%	56%	57%	53.2%
Crude fat	-	0.6%	0.4%	12.8%
Crude fiber	9%	15%	15%	1.8%
Ash	4%	8.9%%	11%	12.01%
Moisture	5%	-	-	7.11%
Phosphorous	--	1.4	1.6%	-
Copper sulphate ($CuS0_4$)		-	8mg/kg	-

Table 2. Water quality parameters

Treatments	Parameters				
	Temperature	pH	Dissolved oxygen	Total ammonia	Ammonia nitrate
T_1	28.13±0.06^a	7.55±0.03^a	4.70±0.03^b	0.2^a	0.8^a
T_2	28.03±0.06^a	7.56±0.03^a	4.50±0.03^a	0.2^a	0.8^a
T_3	28.16±0.03^a	7.57±0.03^a	4.50±0.03^a	0.2^a	0.8^a
T_4	28.47±0.06^b	7.56±0.03^a	4.50±0.03^a	0.2^a	0.8^a

a, b, c denote significantly different values in the same column, Mean values = Mean±Standard error
T1 = A. salina shell free, T2 = Coppens, T3 = Durante, T4 = lucky Star

Table 3. Growth performance of *C. gariepinus* fry in different treatments

Growth parameter	Treatments			
	T1	T2	T3	T4
Initial Mean Weight (g)	0.03±0.01[a]	0.03±0.01[a]	0.03± 0.01[a]	0.03±0.01[a]
Final Mean Weight (g)	1.06±0.02[c]	0.06±0.03[a]	0.06± 0.03[a]	0.87±0.01[b]
% Mortality	2.0±0.04[a]	28.0±1.23[c]	30.0± 0.26[d]	10.0±1.39[b]
Survival Rate (SR %)	96.0±1.76[d]	69.0±0.94[b]	67.0± 1.03[a]	88.0±1.56[c]
% Cannibalism	2.0±0.03 [a]	3.0±0.02[b]	3.0±0.01[b]	2.0±0.02[a]
Specific growth Rate (SGR % day)	12.73±0.92[b]	2.48±0.08[a]	2.48±0.05[a]	12.03±0.13[b]
Feed Conversion Efficiency (FCE %)	0.8±0.01[a]	1.2±0.01[c]	1.2±0.01[c]	0.9±0.01[b]
Performance Index (PI)	3.63±0.01[c]	0.15±0.01[a]	0.14±0.11[a]	2.73±0.16[b]

a, b, c, d denote significantly different values in the same row, Mean values = Mean±Standard error, T1 = A. salina shell free, T2 = Coppens, T3 = Durante, T4 = lucky star

The recorded mean values of all these parameters were within the acceptable limit for fish growth survival [20,21]. This may be due to daily replacement of the water in culture tanks.

4. CONCLUSION

Starter feeds are important in the growth of African catfish *C. gariepinus* fry. *A. salina* shell free has been used with various level of success for fry rearing. However, the increasing cost is a major constraint to most fish farmers. Substitution of commercial compounded diet for live feed is essential for lowering production cost while at the same time sustaining production of high-quality fishes. Our study showed that *A. salina* shell free fed fry performed best in growth performance and survival, followed by Lucky Star fed fry. This study recommends the use of *A. salina* shell free as the best starter feed for the rearing of *C. gariepinus* fry. However, where *A. salina* shell free is not available Lucky Star fry feed may be employed.

ACKNOWLEDGEMENTS

The authors are grateful to Mr. Ganiyu Tairu for providing the Lucky Star fry feed to us. We also want to appreciate the staff of Long Xiang Analytical Research Unit of Shao Township, Yilan County, Taiwan for assisting us with the proximate analyses of the feeds.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Clay D. Utilisation of plant materials by juvenile African catfish (*Clarias gariepinus*) and its importance in fish culture. J Limn Soc South Afr. 1981;7(2):7-56.
2. Mwanja WW, Akol A, Abubaker L, Mwanja M, Msuku BS, Bugenyi F. Status and impact of rural aquaculture practice on the Lake Victoria basin wetlands. Afr J Eco. 2006;45:165-174.
3. Hamre K. Nutrition in cod (*Gadus morhua*) larvae and juveniles. ICES J Mar Sci. 2006;63:267-274.
4. Olurin KB, Iwuchukwu PO, Oladapo O. Larval rearing of African catfish, *Clarias gariepinus* fed decapsulated Artemia, wild copepods or commercial diet. Afr J food Sci Tech. 2012;3(8):182-185.
5. Pector R. A comparative study on the use of different preparations of decapsulated Artemia cysts as food for rearing African catfish (*Clarias gariepinus*) larvae. J World Aquacult Soc. 1994;25(3):320–324.
6. Bai SC, Young TC, Xiaojie W. A preliminary study on the dietary protein requirement of Larval Japanese Flounder, *Paralichthys olivaceus*. N Am J Aquacult. 2001;63:92–98.
7. Hung LT, Tuan NA, Lazard J. Effects of frequency and time of feeding on growth and feed utilization in two Asian catfishes, *Pangasius bocourti* (Sauvage, 1880) and *P. hypophthalmus* (Sauvage, 1878). J Aquac Trop. 2001;16 (2): 171– 184.
8. Dwyer KS, Brown JA, Parrish C, Lall SP. Feeding frequency affects food consumption, feeding pattern and growth of juvenile yellowtail flounder (*Limanda ferruginea*). Aquacult. 2002;213 (1–4): 279 – 292.
9. Yakubu AF, Okonji VA, Nwogu NA**,** Olaji ED, Ajiboye OO, Adams TE. Effect of stocking density on survival and body composition of Nile tilapia (*Oreochromis niloticus*) fed multi feed and NIOMR feed in

semi flow-through culture systems. J Nat Sci Res. 2013;3(14):29-37.
10. Neoske TA, Spieler RE. Corcadian feeding time affects growth of fish. Rhythm Fish. 1984;113540-544.
11. Benedict OO, Gabriel UI, Ezekiel OA. Effect of stocking size of the predatory African catfish (*Heterobranchus longifilis* V.) on the growth performance of Nile Tilapia (*Oreochromis niloticus* L.) in pond culture. Int J Fish Aquacult. 2005;1(3):38-43.
12. TBoujard L, Labbé L, Aupérin B. Feeding behaviour, energy expenditure and growth of rainbow in relation to stocking density and food accessibility. Aquacult Res. 2002;(33):1233-1242.
13. Coulibaly AIN, Ouattara T, Koné V, Douba JN, Snoeks GBG, Kouamelan EP. First results of floating cage culture of the African catfish *Heterobranchus longifilis* Valenciennes, 1840. Effect of stocking density on survival and growth rates. Aquacult. 2007;263:61-67.
14. Engle CR, Valderrama D. Effect of stocking density on production characteristics, coasts, and risk of producing fingerlings channel catfish. N Am J Aquacult. 2001;63:201-207.
15. Yakubu AF, Nwogu NA**,** Olaji ED, Ajiboye OO, Apochi JO, Adams TE, Obule EE, Eke M. A comparative study on growth performance and survival rate of *Clarias gariepinus* burchell, 1822 and *Heterobranchus longifilis* valenciesnnes, 1840 under water recirculation system. Agric Fores Fish. 2014;3(1):30-33.
16. Pooling L, Schoonbee J, Prinsloo H, Wild AJB. The evaluation of live feed in the early larval growth of the sharptooth catfish (*C. gariepinus*). Water SA. 1988;14:19-24.
17. Ngupula GW, Shoko AP, Musiba M, Ndikumana J, Zziwa E. Performance of Artemia shell-free Embryos, *Moina micrura* and phytoplankton on larvae of reared African Catfish. Afr Crop Sci J. 2014;22(s4):875–881.
18. Adebayo IA, Akin-Obasola BJ. Effect of partial and total replacement of live feed (artemia) with formulated diets in early stage growth of hybrid catfish (*Heterobranchus bidorsalis* x *Heterobranchus longifilis)* fry. Int J Fish Aquacult Sci. 2014;1(3):143-146.
19. Lovell RT. Nutrition and feeding of fish, An AVI Book, Van Nostrand-Reinhold, New York. 1989;260.
20. Boyd CE. Water quality in warm water fish ponds. Auburn University Agriculture Experiment Station, Auburn, Alabama. 1979.
21. Mazik PM, Hinman ML, Winkleman DA, Kleine SJ, Simco BA. Influence of nitrite and chloride concentrations on survival and hematological profiles of striped bass. T Am Fish Soc. 1991;120: 247-254.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=1148&id=2&aid=9748