

Original Research Article

Impact of Three-Different Commercial Feed on the Growth and Survival of *Clarias gariepinus* Fry in Aquaria Glass Tanks

ABSTRACT

Aims: To compare the growth response and survival rates of *Clarias gariepinus* fry fed artificially formulated fry feed using Artemia 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. Fry were stocked at 130 fry per aquarium glass tank measuring 40cm x 30cm x 30cm and aeration of tanks was provided using RESUN Air-pump (ACD - 9800). Twelve (12) glass aquarium tanks were used for the experiment. Four (4) experimental fry diets which translated to four Treatments were compared namely Artemia shell free (Treatment T₁), Coppens (Treatment T₂), Durante (Treatment T₃) and Luck Star (Treatment 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. Samples of water from each treatment were taken daily to determine the values of pH, dissolved oxygen concentration, total ammonia and temperature degrees. 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 ± 0.02 g. Treatment T₁ and T₄ showed final mean weights of 1.06 ± 0.04 g and 0.87 ± 0.06 g respectively while 0.06 ± 0.03 g and 0.06 ± 0.04 g were obtained in Treatment T₂ and T₃ respectively. There was no significant difference ($P \neq .05$) in values obtained in Treatment T₂ and T₃. Percentage cannibalism of $3.0 \pm 0.07\%$ was obtained in Treatment T₂ and T₃ while 2.0 ± 0.13 and 2.0 ± 0.16 were recorded for Treatment T₁ and T₄ respectively. Highest specific growth rate (SGR) of $12.73 \pm 0.92\%$ was calculated for Treatment T₁. This was followed by Treatment T₄ (SGR = $12.03 \pm 0.13\%$). SGR value was the same for Treatment T₂ ($2.48 \pm 0.08\%$) and T₃ (2.48 ± 0.05). There was no significant difference ($P \neq .05$) in SGR values obtained in Treatment T₁ and T₄. Highest survival rates percentage of $96.0 \pm 1.76\%$ and $88.0 \pm 1.56\%$ was recorded in Treatment T₁ and T₄ respectively while a relatively lower values of $69.0 \pm 0.94\%$ and $67.0 \pm 1.03\%$ were obtained for Treatment T₂ and T₃ respectively. The best FCE value of 0.8% was obtained in Treatment T₁ followed by T₄ (0.9%). Treatment 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. The recorded mean values of all these parameters were within the acceptable limit for fish growth survival. On the average, Treatment T₁ performed the best, T₄ second while T₃ and T₄ performed the least.

Conclusion: Starter feeds are important in the growth of African catfish *C. gariepinus* (Burchell) fry. Artemia 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 lucky star fry feed can compete favourable with Artemia shell free in growth performance and survival of *C. gariepinus* fry if feed at recommend water quality parameter range. We recommend the use of Artemia shell free as the best starter feed for the rearing of *C. gariepinus* fry.

However, where Artemia 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* 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 depends 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. Substitution of commercial compounded diet for live feed is essential for lowering production cost while sustaining production quality fishes [6]. In this regards, efforts towards the search for alternatives to live feeds have been on going.

Fish nutritionist aim at producing a balanced commercial diets that promote 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 has 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 Artemia shell free as control.

2. MATERIAL 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 (40cm x 30cm x 30cm) were washed, cleaned and allowed to dry. Water was then poured into them up to the depth 20cm leaving 10cm 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 (Mettler 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 aquarium water was done daily after siphoning debris and counting of dead fry.

2.2 Experimental Diets and Treatments:

The following four (4) experimental fry diets were used - Artemia salina shell free (500g, INVE Aquaculture Inc., Thailand) (Treatment T₁), Coppens (Coppens International, Germany) (Treatment T₂), Durante (Durante Fish Industries Ltd, Nigeria) (Treatment T₃) and Luck Star (Hung Kuo Industrial Co., Ltd., Taiwan) (Treatment T₄). Artemia, 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. Artemia 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:

$$\text{Specific growth rate (SGR \% day)} = \frac{100 \times [\ln(\text{Final body weight}) - \ln(\text{Initial body weight})]}{\text{Rearing period in days}} \quad [11]$$

Where “ln” represents natural logarithm.

$$\text{Feed conversion efficiency (FCE)} = \frac{\text{Final Weight by Fish} \times 100}{\text{Weight of feed given}} \quad [12]$$

$$\text{Survival rate (SR \%)} = \frac{\text{Total fish number harvested}}{\text{Total fish number stocked}} \times 100 \quad [13]$$

$$\text{Performance Index (PI)} = \frac{\text{Survival Rate} \times \text{Final Mean Weight (g)} - \text{Initial Mean body weight (g)}}{\text{Rearing duration in days}} \quad [14]$$

$$\text{Percentage (\%)} \text{ of cannibalism} = 100\% - \% \text{mortality} - \% \text{survival} \quad [5]$$

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 test 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 $0.03 \pm 0.02\text{g}$. Treatment T_1 and T_4 showed final mean weights of $1.06 \pm 0.04\text{g}$ and $0.87 \pm 0.06\text{g}$ respectively while $0.06 \pm 0.03\text{g}$ and $0.06 \pm 0.04\text{g}$ were obtained in Treatment T_2 and T_3 respectively. There was no significant difference ($P \neq .05$) in values obtained in Treatment T_2 and T_3 . Percentage cannibalism of $3.0 \pm 0.07\%$ was obtained in Treatment T_2 and T_3 while 2.0 ± 0.13 and 2.0 ± 0.16 were recorded for Treatment T_1 and T_4 respectively. Highest specific growth rate (SGR) of $12.73 \pm 0.92\%$ was calculated for Treatment T_1 . This was followed by Treatment T_4 (SGR = $12.03 \pm 0.13\%$). SGR value was the same for Treatment T_2 ($2.48 \pm 0.08\%$) and T_3 (2.48 ± 0.05). There was no significant difference ($P \neq .05$) in SGR values obtained in Treatment T_1 and T_4 . Highest survival rates percentage of $96.0 \pm 1.76\%$ and $88.0 \pm 1.56\%$ was recorded in Treatment T_1 and T_4 respectively while a relatively lower values of $69.0 \pm 0.94\%$ and $67.0 \pm 1.03\%$ were obtained for Treatment T_2 and T_3 respectively.

On the average, Treatment T_1 performed the best, T_4 second while T_3 and T_2 performed the least. Our findings that Artemia 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 Artemia to the fact that it had balanced nutrient composition compared to other feeds. Pooling [16] showed that the use of Artemia in fry culture of African catfish (*C. gariepinus*) allowed excellent growth performance and survival rates. This can be attested by the best feed conversion efficiency (FCE) value of 0.8% recorded for Artemia Shell free which translated to better growth. Lucky star feed ranked second after Artemia shell free. The possibility that Lucky star feed was less palatable compared to Artemia 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 but percentage mortality of higher values of $20.0 \pm 1.23\%$ and $30.0 \pm 0.26\%$ was recorded for Treatments T_2 and T_3 . This could be caused by poor acceptability of the feeds by the fry. Acceptance of the formulated diet and growth performance of fry fed these depends on 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. 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.

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 (CuSO 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 = Artemia shell free, T₂ = Coppens, T₃ = Durante, T₄ = lucky Star

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

Growth Parameter	Treatments			
	T ₁	T ₂	T ₃	T ₄
Initial Mean Weight (g)	0.03 ± 0.02 ^a	0.03 ± 0.02 ^a	0.03 ± 0.02 ^a	0.03 ± 0.02 ^a
Final Mean Weight (g)	1.06 ± 0.04 ^b	0.06 ± 0.03 ^a	0.06 ± 0.03 ^a	0.87 ± 0.06 ^c
% Mortality	2.0 ± 1.44 ^a	28.0 ± 1.23 ^b	30.0 ± 0.26 ^b	10.0 ± 1.39 ^c
Survival Rate (SR %)	96.0 ± 1.76 ^a	69.0 ± 0.94 ^b	67.0 ± 1.03 ^b	88.0 ± 1.56 ^b
% Cannibalism	2.0 ± 0.13 ^b	3.0 ± 0.07 ^a	3.0 ± 0.07 ^a	2.0 ± 0.16 ^b
Specific growth Rate (SGR % day)	12.73 ± 0.92 ^a	2.48 ± 0.08 ^b	2.48 ± 0.05 ^b	12.03 ± 0.13 ^a
Feed Conversion Efficiency (FCE %)	0.8 ^a	1.2 ^c	1.2 ^c	0.9 ^b
Performance Index (PI)	3.63 ± 0.01 ^a	0.15 ± 0.01 ^b	0.14 ± 0.51 ^b	2.73 ± 0.16 ^a

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

4. CONCLUSION

Starter feeds are important in the growth of African catfish *C. gariepinus* (Burchell) fry. Artemia 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. Our study showed that Lucky Star fry feed can compete favourable with Artemia in growth performance and survival of *C. gariepinus* fry if feed at recommend water quality parameter. This study recommends the use of Artemia shell free as the best starter feed for the rearing of *C. gariepinus* fry. However, where Artemia shell free is not available Lucky Star fry feed may be employed.

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