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Comparative Performance of African Catfish (*Clarias gariepinus*) Fed Artificial and Live Feeds

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Abstract

A feeding trial was conducted on Clarias gariepinus larvae using two diets: decapsulated *Artemia*, and special formulated feed. After the absorption of yoke, the fish larvae were randomly distributed into six plastic tanks at a density of 200 fish per tank, using a completely randomized design. Each treatment which comprised of fish fed with live and artificial feed was carried out in triplicates. Survival was higher in fish fed with special formulated starter diet than the fish fed *Artemia*. Growth rate, specific growth rate and final weight were higher in fish fed *Artemia*, than the formulated fish feed. The percentage survival was higher in larvae fish fed with special feed than *Artemia*. Moreover, in terms of nutrient utilization between the two feeds, special feed had a better feed conversion ratio of 1.33, while *Artemia* had 1.87. It is concluded based on the findings from this work that special formulated feed is suitable in first feeding of *C. gariepinus* larvae.

Key words: Aquaculture; Catfish, Fish larvae; Hatchery management; live feeds;

Introduction

The Clarias gariepinus is a preferred fish for aquaculture because of its growth rate, good market price, robustness, easy to breed and this has made it a subject of investigation among several species of fish. Studies on *C. gariepinus* include that of its nutrition [1] and production of its fingerlings [2]. Hatchery production of larvae as against collection from the wild has become a routine operation in modern aquaculture. The highest mortalities during rearing of *C. gariepinus* have been observed between the larvae and fry stage. The first important stage in the life of the larvae is the transition stage, from the endogenous to the exogenous feeding, and live food is a necessity for the *C. gariepinus* at this stage [3]. Before *C. gariepinus* larvae can attain 5g in size, the feed should contain at least 50.0% protein [4]. It should be noted that the protein content of the various feeds differs, be it live or formulated. When larval feed is poor in nutritional quality, cannibalism is enhanced in the system [5].

Live feeds are preferred as choice feed in larvae stage of fish in aquaculture. Moreover, *Artemia*, otherwise known as brine shrimp is the most widely utilized live food item used in culture of larval stage in fish [6]. Annually, over 2000 metric tons of dry *Artemia* cysts are marketed all over the world for use in hatchery production process [7]. Conversely, the distinctive characteristic of the minute branchiopod crustacean *Artemia* to form dormant embryos, so- called 'cysts', may account to a great extent for it widely usage as an expedient and appropriate, larval food source in aquaculture operations [8]. Those cysts are available all year round in large quantities along the shorelines of hyper saline lakes, coastal lagoons and solar salt works scattered around the globe. After harvesting and processing, cysts are made available in cans as storable 'on demand' live food, which makes them the most suitable, least labour-intensive live food available for use fish hatchery production [9].

The use of complete artificial diets is increasingly important among the fish farmers in Nigeria in recent times [10]. Artificial feeds that are used in rearing of fish larvae should satisfy the nutritional requirements of the species and should readily be accepted by the fish [11]. In view of this, artificial diets should be formulated to enhance production of larvae fish which is the bedrock for the sustainability of aquaculture development in different parts of the world [12]. Fish species in the hatchery require good dietary protein, as this significantly influences their growth and survival [13]. In developing countries of the world several locally available feed stuffs for fish feed have been identified, and their proximate nutrient composition has been analyzed. However, these feed stuffs have not been formulated into commercial or local fish feeds for use as starter diets in aquaculture. Also, research on comparative assessment of locally produced fish feeds and live feeds such as *Artemia* in fish larvae is limited, hence the need for this work. This study therefore evaluates the performance of *C.gariepinus* fed *Artemia* live with specially formulated complete fish feed.

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Materials and Methods

Fish larvae were obtained through the hypophysation technique. After absorption of yoke, a total of two hundred (200) larvae of 4.8 ± 0.16mg weight and 6.16 ± 0.30mm length were transferred to six experimental tanks (40 x 25x 25cm^3) that were properly labeled. At the onset of the experiment, twenty fish were removed from each tank and batch weighed to determine the average initial weight of fish, leaving 80 fish per tank and length measurements were determined for ten fish each using a calibrated meter rule with magnifying hand lens. Larvae in triplicate tanks were fed each of the experimental diets: decapsulated *Artemia* (control) and formulated special diet, twice a day ad-libitum in the morning and in the evening for 21 days. Tanks were cleaned daily before feeding and dead larvae were siphoned and counted to estimate survival. At the end of the experiment, 20 larvae were removed from each tank and batch weighed, while lengths of ten individual fish were measured to determine average length.

Preparation of Special Feed

The special feed was prepared by mixing broilers starter feeds (poultry) produced by Vital Feeds Ltd, Nigeria, Dana fish meal, vitamin C, and premix (containing vitamins) they were procured from Agro-services centre at Rumudomaya, in Port Harcourt, Rivers State. This Special feed contains 1.18kg of fish meal, 0.78kg of broilers starter feeds, 0.02kg of vitamin C and 0.02kg of premix, given a total of 2kg of starter fish feed.

Proximate Nutrient Composition of Experimental Diets

The four experimental feed samples were analysed using the standard analysis method of the Association of Official Analytical Chemist [14].

Physico-Chemical Parameters

The physico-chemical parameters of water in the experimental tanks during the study period were determined with the methods described by APHA [15]. The temperature was taken by the use of mercury in glass thermometer calibrated in degree centigrade (0-100oC). The pH value of the water was determined by the use of a pH meter, pocket pen pH meter model 700, made in Japan. The Dissolved Oxygen (DO) was determined using a 9-series multi-parameter water quality meter (BANTE 980 PRECISION DO. METER) Version Number: 2009070200.The ammonia, nitrite and nitrate test was conducted using La Motte Aquaculture test kit MODEL AQ-4, CODE 3635-04, chester town, Maryland, 21620. USA.

Growth Parameters

The length was measured by the use of a transmitted millimeter calibrated ruler and a magnifying hand lens. The initial larva length was 6.16 + 0.30mm and measurements were done at days 7, 14 and 21.The weight was determined by the use of an electric sensitive weighing balance (model: 3002N, No.110628014, made in Shangai, China by Wart Instrument Co. Ltd). The initial larva weight before stocking was 4.8 + 0.16mg, and weighing was done at days, 7, 14 and 21.

Survival

The survival rate was determined using the formula

$$\% \text{ survival rate} = \frac{final\ number\ of\ larva}{initial\ numberoflarvae\ stocked} x100$$

Specific Growth Rate (SGR)

Specific Growth Rate (SGR): This was calculated using:

$$SGR = \frac{InW_t - InW_o}{t} \quad [16]$$

Where: W= Final body weight; W_o =Initial body weight; t = Time (days)

Ln = Logarithms of numbers

Fulton's Condition Factor (K)

The Fulton's Condition Factor (K): this was calculated using the formula:

$$K = \frac{W}{L^3} \times 100\% \quad [17]$$

W=Weight (g)

L = Length

Feed Conversion Ratio (FCR)

This was calculated using the formula:

$$FCR = \frac{Live Weight\ gain\ (g)}{Dry\ feed\ fed\ (g)} \quad [18]$$

Feed Intake (g)

Total weight of food consumed by fish within the experimental period

Protein Efficiency Ratio (PER)

This was calculated using the formula

$$PER = \frac{Gain\ in\ Fish\ Weight\ (g)}{\text{Protein intake}\ (g)} \quad [19]$$

Percentage Weight Gain

$$PWG = \frac{Weight\ gain\ (g)}{Fish\ weight\ (g)} x\ 100 \quad [20]$$

Absolute Growth Rate

$$AGR = \frac{Final\ weight\ -\ Initial\ weight}{Growth\ Period} \quad [21]$$

Daily Weight Gain

$$DWG = \frac{Mean\ wt\ increase\ per\ day}{Body\ weight\ of\ fish} \quad [22]$$

Average Daily Length Gain

$$ADLG = \frac{Final\ Length - Initial\ Length}{Days} \quad [23]$$

Relative Weight Gain (RWG)

$$\frac{Final\ weight - Initial\ weight}{Initial\ weight} \quad [24]$$

Gross Feed Conversion Efficiency (GFCE)

$$GFCE = \frac{I}{FCR} x100 \qquad [24]$$

Statistical Analysis of Data

Statistical analysis was carried out on all data using the SPSS VERSION 22 for windows, 2000. Data was pooled by treatment and presented as mean + Standard Deviation (SD) and Standard Error (SE); Data was analyzed for treatment effect by one way analysis of variance (ANOVA). The Turkey Post hoc test was used to 95% confidence level to produce specific information on which means are significantly different from each other.

Results

The proximate composition of the two feeds is presented in Table 1. The special feed compared favorably with artemia in protein and carbohydrate quality. However, values of moisture, fiber, fat and energy were significantly (P<0.05) higher in special feeds when compared to *Artemia*. The water quality parameters in artemia and special feeds rearing containers were within the same range with no significant difference (P>0.05) in all parameters in all parameters (Table 2). Survival was higher in fish fed special formulated starter diet than the fish fed decapsulated *Artemia*. Growth rate, specific growth rate and final weight were higher in fish fed decapsulated *Artemia*, than the formulated fish feed. While the least growth was observed in fish fed commercial starter diet. Moreover, in terms of nutrient utilization between the two feeds, special feed has a better feed conversion ratio of 1.33, while *Artemia* had 1.87. Also, protein intake and protein efficiency ratio were significantly higher (P>0.05) in fish fed with *Artemia* than the one fed with special formulated feed (Tables 3 and 4).

Table 1: Proximate Composition of Experimental Feeds (Mean ± S D)

Parameters	Artemia	Special Feeds
Moisture Content (%)	10.25 ± 0.04 [a]	11.76 ± 0.04 [b]
Protein (%)	48.55 ± 0.03[b]	42.72 ± 0.03[a]
Fibre (%)	6.42 ± 0.03[a]	7.22 ± 0.02[b]
Fat (%)	2.95 ± 0.04[a]	10.64 ± 0.02[b]
Ash Content (%)	14.74 ± 0.03 [b]	12.11 ± 0.10 [a]
Carbohydrate (%)	17.06 ± 0.03 [b]	15.64 ± 0.03[a]
Energy (cal/100g)	298.0 ± 0.03[a]	329.25 ± 0.03 [b]

Means within the same row with different superscript are significantly different (P<0.05)

Table 2: Physico-chemical Parameters of Water in the Experimental Tanks during Flow through Period 21 Days (Mean±SE)

Parameters	Artemia	Special Feeds
Temperature (°C)	27.49 ± 1.29[a]	27.96 ± 1.34[a]
pH	6.13 ± 0.48[a]	6.26 ± 0.19[a]
Dissolved Oxygen (mg/l)	6.37 ± 0.16[a]	6.09 ± 0.11[a]
NH_3(mg/l)	0.00 ± 0.00[a]	0.00 ± 0.00[a]
Nitrate (mg/l)	0.00 ± 0.00[a]	0.00 ± 0.00[a]
Nitrite(mg/l)	0.00 ± 0.00[a]	0.00 ± 0.00[a]

Means within the same row with different superscript are significantly different *(P<0.05)*

Table 3: Growth Response in *C.gariepinus* Fry Fed Experimental Diets within 21 Days (Mean±SE)

Parameters	Artemia	Special Feed
Survival (%)	49.61± 20.77[a]	65.53± 11.33[b]
Final Length (mm)	13.37 ± 4.61[a]	15.19 ± 7.30[b]
Final Weight (mg)	29.44 ± 14.45[b]	22.11 ± 11.30[a]
Weight Gained (mg)	24.64 ± 14.45[b]	16.29 ± 11.30[a]
Length Increase (mm)	7.21 ± 4.61[a]	8.96 ± 7.11[b]
Specific Growth Rate (% d^{-1})	12.40 ± 1.44[b]	9.72 ± 1.85[a]
Condition Factor	1.42± 0.46[b]	0.94± 0.31[a]
Feed Intake (mg)	16.43 ± 13.81[b]	13.16 ± 10.50[a]
Percentage Weight Gained (%)	78.00 ± 13.64[b]	67.45 ± 20.00[a]
Absolute Growth Rate(mg)	1.62 ± 0.47[a]	1.03 ± 0.43[a]
Daily Weight Gained (mg)	0.09 ± 0.04[a]	0.09 ± 0.04[a]
Average Daily Length Gain (mm)	0.78 ± 0.16[a]	0.78± 0.16[a]
Relative Weight Gained (%)	5.13 ± 3.01[b]	3.95 ± 2.37[a]

Means within the same row with different superscript are significantly different (*P<0.05*)

Table 4: Nutrient Utilization in *C. gariepinus* Fry Fed Experimental Diets within 21 Days (Mean±SE)

Parameters	Artemia	Special Feed
Protein Intake	7.97± 3.69[b]	5.61± 3.24[a]
Protein Efficiency Ratio	3.88 ± 1.16[b]	2.03 ± 1.45[a]
Feed Conversion Ratio	1.87 ± 0.55[a]	1.33 ± 0.45[a]
Gross Feed Conversion Efficiency	59.16 ± 21.98[a]	80.27 ± 30.00[c]

Means within the same row with different superscript are significantly different (*P<0.05*)

Discussion

In previous studies involving the larvae of African catfish, C. gariepinus, decapsulated *Artemia* also gave the best growth performance in terms of weight gained [25]. Decapsulated *Artemia* cysts have also been reported as a good starter diet for freshwater and marine fishes [27], because of its balanced nutritional composition. A major advantage of *Artemia* cysts in aquaculture is that they can be kept for a longer periods of time. In terms of growth fish fed with *artemia* did better, while survival rate was better in *C.gariepinus* larvae fed with special feeds. This result agrees with the report of Abduraheem et al. [26], in *C.gariepinus* larvae fed live feed and artificial feeds. Like other live feeds such as artemia, this implies that the fry did not have fully developed guts, as well as poor perception organs such as the olfactory. Even fry could die with guts full of food, suggesting their inability to digest formulated diets.

Though the result of the proximate analysis of the feeds shows that protein content of special feed were comparable to the protein content of Artemia. As *Artemia* had the best result in terms of specific growth rate and weight gain compared to special formulated feed. This could arise from the fact that Artemia being a natural feed, has it's protein properly utilized by the fish, it could also be that the protein in Artemia as a live food was properly digested than the artificial diets at this stage of the fish growth. The digestive systems of the larvae are poorly developed and lack proper digestive enzymes, but live feeds come with exogenous enzymes that facilitate digestion at this stage of the fish [27]. This result is in agreement with the report of Bukola et al. [28], who observed the same trend in the hatchlings of *C.gariepinus* fed with *Artemia* and artificial diets. Further still, obtaining feeds that satisfy the nutritional needs of the fry was difficult since mechanisms of digestion and absorption, as well as nutritional requirements change during their development. The findings in this study that formulated diets resulted in the least growth and better survival when used for feeding fish fry is in line with findings in the investigations conducted by other researchers [28-29], in early feeding of catfish species.

Conclusions

In conclusion, C. gariepinus fry grow best on diet of live feed Artemia. While, special formulated feed had the best survival of fish. Hence, considerable growth and survival can be obtained when fish fry are fed with a combination of live and formulated feeds.

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