International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 01 | Jan -2017 www.irjet.net p-ISSN: 2395-0072

Survival and Growth Rate of *Clarias gariepinus* Larvae Fed with *Artemia salina* and Inert Diet.

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Abstract - *The growth and survival of Clarias gariepinus larvae (0.42mg) fed Artemia salina (D1), inert diet (egg white + fish meal) (D2) and a combination of both diets (D3) was investigated for 42 days. Each diet was feed to 80 post yolk-sac fry, in triplicate plastic tanks holding 40L of water. The specific growth rate, survival, percentage weight gain, mean weight gain and performance index were investigated. The percentage weight gain and specific growth rate were not significantly different (P>0.05) for the various diets, while the final mean weight, survival and performance index of the larvae fed D1, D2 and D3 were significantly different (P<0.05) from each other.The highest specific growth rate (14.86 g/day), final weight (4.39g) and survival (60.42%) were recorded in fish fed D3 while the least growth was recorded in fish fed D2 with specific growth rate of 11.88g/day, final weight of 0.993g and survival of 30.42%. The result indicated that there was an increase in body weight among diets types; the mean was 0.731g for larvae fed D3, 0.421g for larvae fed D1 and 0.165g for larvae fed D2. The performance index for Clarias gariepinus larvae fed D3 was the highest (6.3) followed by D1 (2.51) and then D2 (0.714). It was therefore recommended that Clarias gariepinus larvae be fed with a combination of the inert diet and Artemia salina to achieve better growth performance and higher survival rate.*

***Key Words*: larvae, *Clarias gariepinus,* live feed, *Artemia salina,* inert diet**

INTRODUCTION

The African catfish *Clarias gariepinus* is a major warm water species in Africa (Ghana, Ethiopia, Egypt, Mali and Nigeria) and Asia (Malaysia, the Philippines and Thailand) and has been introduced recently in Europe (the Netherland, Germany and Belgium) Latin America (Brazil) [8;2]. Culture of African catfish, *Clarias gariepinus* has received considerable attention since the early 1970s and 1980s but the industry remains relatively undeveloped largely due to dependence on aquatic products from capture fisheries [1]. 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 as reported by [1]. This is to augment fish supply from the wild (capture fisheries).

The importance of aquaculture; in improving the diet of the people, generating employment in rural areas and in conserving foreign exchange; through import substitution, has increased in recent years. For aquaculture industry to thrive, apart from development of adequate manpower, there is need to research and develop various inputs of production, such as feed. The need for feed development for various life stages of fish is becoming increasingly urgent. Fish production is made practically impossible without the supply or availability of fish seeds [7;10]. For many fish species, the larval period is considered critical in the life history. The transition from endogenous to exogenous feeding is a critical event in the life of a fish. Great losses are sustained in the hatchery, noted [16], as fry weans over from yolk absorption to exogenous feeding. It is generally acknowledged that the farmer's choice of food during the first few days of hatching is critical to larval survival. Hitherto, the reliance has been on importation of encapsulated *Artemia*. However, in recent years, Nigerian fish culturists have made use of several materials to rear the larvae of *Clarias gariepinus* [1]. Success of larval rearing depends mainly on the availability of suitable diets that are readily consumed, efficiently digested and provides the required nutrients to support good growth and health [10]. One of the major obstacles confronting the development of aquaculture industry is availability of affordable and high-quality fish feed [9; 15]. 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* [18]. Although *Artemia nauplii* and decapsulated cysts have long been used successfully in starter feeds of most fish fry [21; 12], their increasing cost and especially the current rise in adulterated *Artemia,* is a major constraint to most fish farmers especially

in West Africa. The use of artificial feeds alone is also not encouraging, as it tends to pollute the aquatic environment of the fish hatchlings. As a result, there is the need to find alternative feed or a combination, for fish fry. Attempts have also been made to use inert diets solely or in combination with live food for fish larvae rearing [6]. [19] Investigated the use of formulated diet as a starter diet for *C. batrachus*, are worth mentioning. Although a level of success was attained but their choice of ingredients (fish meal, baker's yeast, powdered milk, whole egg, boiled chicken egg yolk, cod liver oil, agar, vitamin premix, mineral premix, attractant amongst others) is very expensive which is almost no difference from the high cost of *Artemia salina.* Growth and survival data are powerful tools for understanding the effects of both live and manufactured diets on first-feeding fish larvae [20]. No perfectly suitable larval diet has yet been developed, especially to meet our demand in Nigeria. This work therefore is focused on the search for an efficient and effective feed for fish fry.

Materials and Methods

This study was conducted in the main laboratory of Faculty of Agriculture, University of Benin, Benin-city, Edo state, Nigeria, for forty-two (42) days. *Clarias gariepinus* larval were obtained through the hypophysation technique. On the fourth day after hatching, 720 healthy larvae were randomly selected from the hatchery and distributed into nine pre-prepared transparent plastic tanks holding 40L of water (see Plate 1) at a density of 80 larval per tank under natural photoperiod regime. At the onset of the experiments, the average initial weight of fish was taken per tank as follows: Diet 1, 0.0084g; Diet 2, (0.0067g); Diet 3, (0.0084g).

Plate 1; fish culture facility and layout of experiment

Preparation of Inert Diet

Fish crumb was purchased from the market and then sun-dried for two days to ensure that the moisture content was drastically reduced. After sun-drying, it was milled to fine particles with a milling machine. The fishmeal was then sieved with a small mesh filter to obtain a uniform and fine particle size fishmeal. In the preparation of inert diet, raw eggs were boiled for about 10 minutes after which the egg white was separated from the yolk. The egg white was then crushed to a very fine particle and then mixed with the fishmeal earlier prepared to serve as a binder (see Plate 2).

Plate 2**:** Preparation of the inert diet in a mortar.

Experimental Diets and Treatments

Three (3) experimental diets were used viz- *A. salina* shell free (D1); the inert diet (D2) and a combination of *Artemia* and the inert diet (D3). 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 three times a day between 8:00am and 18:00hr.The experiment was laid out in a complete randomized design. Proximate analysis of the experimental diet was performed at Faculty of Agriculture Main Laboratory.

Management Practice

The water was changed once every morning. Changing of the water was done prior to feeding in the morning. 15-20 minutes after each feeding in the morning and evening, the unconsumed feeds were removed by siphoning them out of the transparent plastic tanks into a drainage channel in the laboratory. Once every week, total changing of the water, washing of the tanks, weighing of the fry and determination of feed consumed was carried out. This helped to keep the water temperature, pH, dissolved oxygen, ammonia and nitrate under control.

Proximate analysis of experimental diet

Proximate analyses of the experimental diet were carried out. Moisture content, nitrogen, ether extract, crude fibre and nitrogen-free extract (NFE) were determined according to the procedures of Association of Official Analytical Chemists (A.O.A.C., 2000). A factor of 6.25 was used to convert the total nitrogen content to protein.

Growth parameters determined

Growth parameters were determined using both length and weight.

1. Weight gain (g) = Final weight – initial weight,

2. Percentage weight gain (PWG) = $\frac{\text{weight gain}}{\text{initial weight}} \times 100$
3. Specific growth rate (g/day) = $\frac{100 \times [\ln(\text{Final weight}) - \ln(\text{Initial weight})]}{\text{Rearing period in days}}$

   Where "In" represent natural logarithm.
4. Survival rate (SR %) = $\frac{\text{Total number of fish harvested}}{\text{Total number of fish stocked}} \times 100$
5. Performance index = $\frac{\text{survival rate} \times \text{weight gain}}{\text{culture duration in days}}$

Statistical Analysis

Data obtained were analysed using one way analysis of variance and differences in means were compared using Least Significance Difference at P=0.05. Analysis was done using a statistical software programme (GenStat version 12.5).

Result and Discussion

Table 1: Proximate Composition (%) of *Artemia salina* and experimental diets

DIETS	Crude protein (%)	Fat (%)	Ash (%)	Fibre (%)	Moisture (%)	NFE (%)
Diet 1 (*A. salina)*	54	9	4	6	5	22
Diet 2(inert diet)	43.17	9.99	4.12	2.93	31.02	8.77

NFE= nitrogen-free extract. It was determined by subtracting the summation of the values of crude protein, fat, fibre, ash and moisture from 100%

Table 2: Cost analysis of dietary treatments after 42 days of feeding

Diets	Cost (N)
Diet 1 (*A. salina*)	780
Diet 2 (Inert diet)	495
Diet 3 (Combination of Diet1 and Diet2)	715

Table 3: Growth performance of *Clarias gariepinus* larvae after 42 days of feeding

	Dietary treatments		
	Diet 1	Diet 2	Diet 3
Initial mean weight (g) at day4	0.0084	0.0067	0.0084
Final mean weight(g) at day42	2.54^{c}	0.993^{a}	4.39^{b}
Feed intake (g)	0.355^{ab}	0.195^{a}	0.468^{b}
Mean weight gain (g)	0.4214^{b}	0.1654^{a}	0.7308^{c}
Percentage weight gain	383.4^{a}	259.4^{a}	445.5^{a}
Specific growth rate	13.55^{a}	11.88^{a}	14.86^{a}
% Survival	41.7^{ab}	30.42^{a}	60.42^{b}
Performance index	2.51^{a}	0.714^{b}	6.3^{c}

N/B: Values with the same superscript on the same row are not significantly different, (P> 0.05)

The mean weight gain was significantly different among the treatments (P > 0.05). The highest mean weight gain was recorded in Treatment 3or Diet 3 (0.7308g) ,followed by Treatment 1 or Diet 1 (*Artemia salina* only) (0.4214g) and finally, Treatment 2or Diet 2 (inert diet only) as the lowest mean weight recorded (0.1654g).There was also significant difference ($p<0.05$) in the level of feed intake with Diet 3 (0.4681) having the highest feed intake and Diet 2(0.1950) having the least feed intake.

Percentage weight gain showed no significant difference (P > 0.05) between all treatments. Although there was no significant difference ($p<0.05$) in the specific growth rate but Diet 3 (14.86) maintained a higher specific growth rate than other dietary treatment followed by Diet 1(13.55) with Diet 2 (11.88) having the least specific growth rate. The study fish accepted all the diets as supported by earlier work by [3] that African Catfish *Heterobranchus bidorsalis* and *Clarias gariepinus* are important tropical fish that readily accept prepared feeds from fry to adult size in culture system.

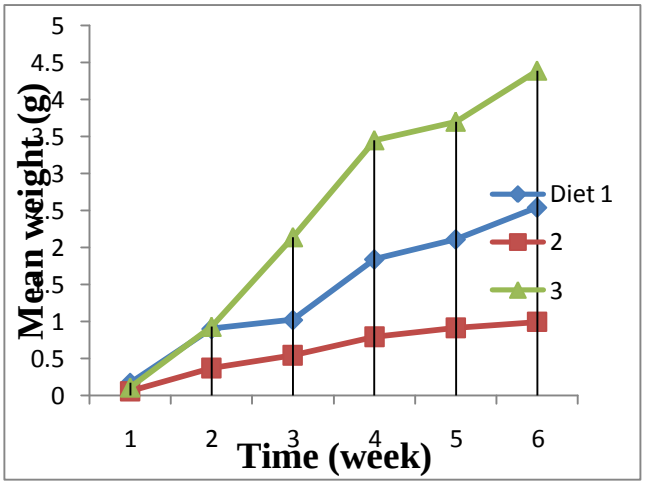

Figure 1: Growth curve for *Clarias gariepinus* on various feed treatment during the 42 days study period.

The survival was significantly different (P > 0.05) in each treatment. From Table 3, Diet 3 (60.42) (*Artemia* + inert diet) had a highest survival followed by Diet 1 (41.70) and then Diet 2 (30.42) having the lowest survival. The performance index was significantly different (P > 0.05) among all three (3) Treatments. Diet 3 (6.3) having the highest performance index followed by Diet 1(2.51) and then diet 2(0.714).

In this study of *C. gariepinus* larval nutrition, Diet 3 (combination of *Artemia* and inert diet) gave the best growth performance and highest survival rate i.e. low mortality, compared to other diets. The specific growth rate was higher (14.86%) and the fry also had higher performance index (6.3). The growth performance of *C. gariepinus* larvae fed on *Artemia* was intermediate between those fed on inert diet and the combination. It was observed that the growth rate of the larvae fed on *Artemia* was rapid and somewhat greater than the combined diet within the first week because the fry fed this diet ate more than any other treatment during the first week but this rapid growth rate was not sustained after the first week. This means that the use of *Artemia* as starter diet should not exceed one week. *Artemia* have been reported as a good starter diet for freshwater and marine fish [12; 13 and 11], because of its balanced nutritional composition.

The inert diet gave the least performance in terms of growth performance and survival. It was observed that the feed was not easily accepted by the fry. Similar observation was made by [18], with respect to inert diet usage. The mortality of the larvae fed on inert diet was significantly higher than that fed on *Artemia* and a combination of both diets. Although survival has never been a major concern in the culture of *C. gariepinus* because of its resistant to water quality stress as well as common diseases [16], use of poor feeding strategies are major sources of mortalities in larval stages of this species. Feeding on *Artemia* as well as combination of *Artemia* and inert diets did not compromise survival when compared to feeding inert diets alone in agreement with [4]. Various reasons adduced for the poor performance of the inert diet include nutritional status of diet which is inferior to the other diets, the diet not being well adapted for the larvae, and the fact that most larvae have not developed the required enzymes and digestive systems required to digest formulated diet [5]. Furthermore, [7] reported that the apparent inability of *Clarias gariepinus* larvae to digest dry food during the first week supports the hypothesis that larvae with a simply organized digestive system lack the necessary digestive enzymes. This fact therefore calls for the need for exogenous enzymes, which are richly present in live feed like *Artemia*. The finding that *Artemia* alone was superior to the inert diet alone in this study, corroborates the work of [17] and [18] who compared the performance of *Artemia*, copepods, and an inert diet.

In terms of cost, *Artemia salina* proves to be the most expensive as a total of ₦780 was spent during the culture period followed by the combination of both diets (₦715) and, then the inert diet (₦495).

CONCLUSIONS

This study recommends the use of the combination of *Artemia salina* and the inert diet as the starter diet for *C. gariepinus* larvae. *Artemia salina* should not be used to feed larvae of the study fish beyond one week. The live feed may also be used for experimental purpose and demonstrations. Further studies should be conducted on this specie using an inert diet that combines plant protein.

ACKNOWLEDGEMENT

I acknowledge A.C. Esume for typesetting of this research work.

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