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European Journal of Experimental Biology, 2015, 5(3):1-5

ISSN: 2248 –9215
CODEN (USA): EJEBAU

Growth performance and survival of *Clarias gariepinus* hatchlings fed different starter diets

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ABSTRACT

A feeding trial, involving the use of five different starter diets for the feeding of C. gariepinus fry, was carried out in the laboratory. The diets consist of decapsulated Artemia (D1), cultured live Moena micrura (D2), mixed cultured live M. micrura/Artemia (D3), fishmeal (D4) and powdered milk (D5). Each treatment was applied to 50 post yolk-absorbed fry, in triplicate bowls, for eight days. Even though the length gain, condition factor and specific growth rate were not significantly different ($p<0.05$) from one another, the percentage weight gain and survival of the larvae fed D1, D2 and D3 were significantly different ($p>0.05$) from the other dietary treatments. The use of M. micrura (treatment D2) is highly recommended as live food in the hatchery production of the Clarias gariepinus fish.The zooplankton is easily cultivable in freshwater, its bio-nutrients are readily available/utilizable by the fry and the procurement is highly economical. This technology also reuses livestock wastes for production thus contributing towards climate change mitigation and making aquaculture sustainable.

Keywords: Artemia, *Moena micrura*, zooplankton, milk, fry

INTRODUCTION

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 is becoming increasingly urgent. Furthermore, fish nutritionists agree that important gaps still exist in the knowledge of how to administer feed to Clarias larvae, in order to obtain optimal growth and high survival rate.

The transition from endogenous to exogenous feeding is a critical event in the life of a fish. Great losses are sustained in the hatchery, 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].

Fish nutritionists agree that, important gaps exist in the knowledge of how to administer feed to Clarias larvae in order to obtain both optimal growth and a high survival rate. The use of live organisms in aquaculture has, for the past decades received tremendous attention in countries where aquaculture is well developed. The cost of feeding fish fry on Artemia is very high. Only very few farmers in developing countries can afford it. The use of artificial feeds alone is also not encouraging, as it tends to pollute the aquatic environment of the baby fish. As a result, there is the need to find alternative feed or a combination, for fish fry. Consequently, the use of cultured zooplankton, as larvae feed, is being exploited. [2] and [3] named common cultured zooplankton species as *Brachionus* sp., *Daphnia sp, Moina sp, Cyclops* sp. *Copepodita* sp, *Calanoid sp*.

Clarias fish is widely cultured in Nigeria. It is acceptable among consumers and has high economic value. However, the issue at stake is how to ensure high fry survival. After 3–4 days, when about two-thirds of the yolk sac has been absorbed, the larvae (about 2–3 mg) begin to swim vigorously in a fish-like manner searching for exogenous food items, failure of which the larvae weaken beyond recovery. This stimulates cannibalism and high hatchery losses.

Although shell-free Artemia has been reported as good source of food nutrient in fish culture [4], they are costly and not available locally. The prohibitive cost of importation of shell-free Artemia has made its use less viable economically as a natural larval feed, especially in developing countries. It is based on the above information that this study was designed to identify alternative, readily available and acceptable food item (s) for C. *gariepinus* fry. The focus of this study therefore, is to monitor some growth indices and survival rate of Clarias fry, fed on diet of shell-free Artemia, live zooplankton (*Moina micrura*), combination of cultured live *M. micrura/*Artemia, powdered milk and fishmeal.

MATERIALS AND METHODS

The experiment was carried out at the Aquaculture Centre of the Ekiti State University, Ifaki campus, Ifaki Ekiti, Ekiti state, Nigeria. Matured broodstock fish, purchased from Mr. Adebayo Farm, Emure Ekiti, were kept in separate concrete holding tanks in the Centre for conditioning. This was done two to three weeks prior to breeding. The female broodstock was then injected with 0.5ml/kg hormone (ovaprim), to hasten the final maturation of eggs leading to ovulation. The fish was put back into the holding facility for about 9hours at 28^{o}C. Stripping of the fish was done. Fertilization of eggs was effected by mixing of milt collected from the sacrificed male brood stock. After fertilization, incubation was effected by spreading of the eggs on mosquito-net kakkabans, inside well-aerated water. Hatching occurred 18hours after fertilization. The newly hatched larvae were kept in water in a well-aerated plastic trough. No food was given to them as they rely on their yoke for food for the first three days before the use of the trial diets, for 8days.

The feeding trial involved using five different food items: decapsulated artemia (D1), cultured live *Moena micrura* (D2), mixture of cultured live *M. micrura/*Artemia (D3), fishmeal (D4) and human baby powdered milk (D5). Each treatment was applied to 50 frys in triplicate bowls. Artemia, fish meal and powder milk were bought from the market, while *M. micura* zooplankton was cultured in the centre.

For the culture of zooplankton, poultry droppings were collected into jute bag and dipped inside water in a big bowl for 24hours. The various zooplankton that grew out settled at the bottom of the water. These were harvested into a beaker, containing clean water, from which *M. micrura* was identified and used to inoculate a freshly prepared water/poultry dropping medium for multiplication. The zooplankter were harvested and used for feeding of fry in treatments D2 and D3 respectively. The fry in each treatment was fed with the experimental feeds for 8days. Survival, growth (weight in mg, length in mm) and water quality parameters were taken. Fulton's condition factor was calculated from the length/weight data thus:

K=100(W/L3)

Where
W=final weight gain (g)
L=final length (mm)

Specific growth rate (SGR= increase in cell mass per unit time) was calculated thus:

$$SGR= \frac{LogW2-LogW1}{T2-T1} x100$$

Where,
W1= final weight
W2= initial weight
T1= final time (days)
T2= initial time (days)

%Weight gain = W2-W1 x 100

% Survival = $\frac{\text{Number of fry survived x 100}}{\text{Total number of fry stocked}}$

Statistical Analysis

The experimental design was completely randomized. Data obtained were subjected to analysis of variance (ANOVA) test and the means from the various treatments were compared for significant differences ($P<0.05$), using the computer Windows Statistical Package SPSS-15.

RESULTS AND DISCUSSION

The length, weight gains and other growth parameters are presented in Table 1, along with percentage survival. The condition factor, specific growth rate and weight gains of fish fed diets D1, D2, D3, D4 and D5 were not significantly different ($p<0.05$) from one another. However, the percentage weight gain and survival of the larvae fed D1, D2 and D3 were significantly different ($p>0.05$) from the other dietary treatments. The fish fed the cultured zooplankton (D2) had the highest percentage survival (69.5%) and the highest percentage weight gain (350%). This performance was followed by the fish fed D1. The mixture of cultured zooplankton/Artemia diet (D3) gave a comparatively lower ($p>0.05$) percentage weight gain and survival rates compared to D1 and D2. The survival of the fish fed fishmeal and human milk diets were not significantly different ($p<0.05$) from each other, but significantly different ($p>0.05$) from those diets composed of live food organisms. The daily growth pattern, illustrated in Fig. 1 vividly showcases the poor performance of the larvae fed diets devoid of live organisms (D4,D5) compared to fish fed D1, D2 and D3. However, there was no significant difference ($p<0.05$) between the condition factors and specific growth rates recorded (Table 1).

The results showed that zooplankton diets (D1, D2, D3) were good starter diets that can be used to raise cat fish, *Clarias gariepinus* fry. The larvae fed diet *M. micura* (D2) solely, had the overall best growth performance and highest survival rate i.e. low mortality, compared to the other diets. The cultured zooplankton, proved to be the best food organism, compared to Artemia or a mixture of these two zooplankton organisms.

Table 1: Survival and the growth performance indices of the *Clarias gariepinus* fry fed the trial diets

	Treatments				
Parameters	D1	D2	D3	D4	D5
Init. Weight (mg)	0.02^a	0.02^a	0.03^a	0.03^a	0.02^a
Final Weight (mg)	0.06^b	0.09^a	0.07^b	0.06^b	0.04^b
Mean Weight gain	0.04^b	0.07^a	0.04^b	0.03^b	0.02^c
% Weight gain	200^b	350^a	167^c	100^c	100^c
Initial length (mm)	6.01^a	5.90^a	6.00^a	5.81^a	6.02^a
Final length (mm)	8.70^a	8.81^a	8.8^a	8.72^a	8.90^a
Length gain (mm)	2.71^a	2.72^a	2.81^a	2.91^a	2.90^a
Condition factor	3.60^{ab}	3.71^{ab}	3.40^a	3.21^a	3.33^a
Specific growth rate	2.91^a	3.31^a	3.01^a	2.60^a	2.52^a
% Survival	54.21^b	69.50^a	48.41^d	39.71^c	28.60^c

Culturing zooplankton is cost effective as the organisms were bred naturally with little or no cost, compared to other feeds. Other workers [5-6] have also recorded similar findings. [5] reported that fish fed live zooplankton (*M. micrura*) had the highest survival rate (88.83%) compared to fry fed shell-free Artemia with survival rate of 87.36%, while a mixture of *M. Micrura/*shell free Artemia had survival rate of (85.50%), even though the difference was insignificant. This result also agreed with some other workers [5,7] who also reported that in Moena/Artemia mixture, decapsulated Artemia would not have been readily accepted in the presence of live Moena. [5] further reported that uneaten shell-free Artemia absorbed water and increased in volume, thus becoming unavailable and creating a hide out for some of the available live *M. micrura*, which would have been seen easily and eaten by the fry. [6] also showed that *Clarias anguillaris* larvae fed on mixed zooplankton and 40% artificial diet did not show significant difference in growth or survival rate.

The powdered milk diet (D4) was the feed that has the lowest performance for the catfish fry. At the end of the trial, it was also recorded that D4 had the highest mortality (72%), among the other treatments. According to these results, the use of powdered milk is not advisable to feed catfish fry, because it is not their natural feed. The poor growth performance of fish fed these artificial diets is probably due to poor digestibility of the nutrients by the tender digestive system of the larvae. Moreover, milk and fishmeal powder quickly dissolve in water, thus causing pollution, which might have negative effects on the survival rate of the baby fish.

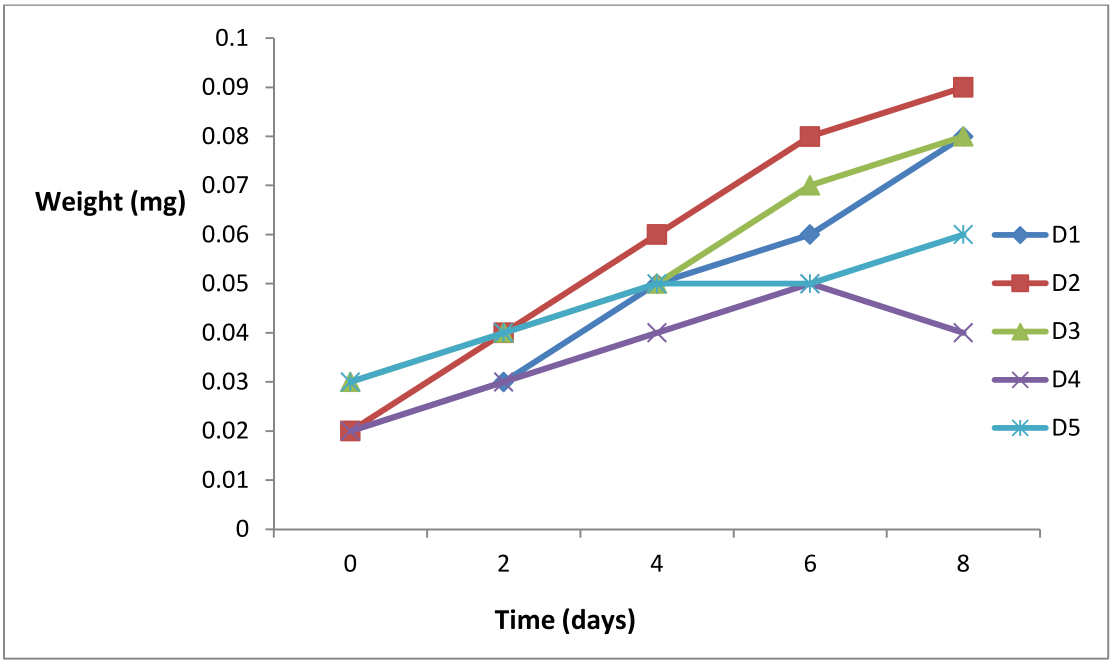

Fig. 1: The daily growth pattern of *C. gariepinus* fry fed the various diets

Interestingly, some successes have been reported in rearing *Clarias gariepinus* larvae with dry foods though poor growth was observed when compounded feed alone was fed. As an alternative strategy however, some authors have proposed supplementing compounded feeds with small portions of live organisms such as *Artemia* nauplii [8]. [9] reported appreciable growth of fry fed with compounded diet supplemented with *Candida* yeasts, but recorded considerable losses due to cannibalism.

It is therefore, considered that dry diets are inadequate to nourish small larvae during the first stages of feeding and that such diets could be used successfully after the larvae had been fed on live food for some time. Many fish fry requires live food at the onset of exogenous feeding [6, 10]. The discrepancy in growth could also be attributed to the differences in the contents of essential nutrients available in the diets. Zooplankton is a living food capsule from which the young growing fish hatchlings derive both macro and micro nutrients, especially the essential amino acids, vitamins, enzymes, and in some cases antibiotics [10].

Furthermore, [11] extensively reviewed the literature on the feeding of larvae, and assumed 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 Artemia [12] and probably in the naturally cultured zooplankton species.

The success of fish hatchery operation, all over the world, is thus intricately linked to the ready availability and supply of natural feed, notably zooplankton organisms. This result readily agree with [5], who reported that within the first weeks of life, the food of mudfish fry are predominantly zooplankton such as *Moina*, *Brachionus*, *Daphnia* and *Ceriodaphnia* while [13] reported that the quality of the nutrient composition of freshwater zooplankton is important to the growth and survival of freshwater fish fry.

It can therefore be concluded that the success of weaning of fish larvae depends largely on the nutritional quality of the diets. However, [14] maintained that high quality performance of fish fed Artemia napluii could not be tagged exclusively to the presence of nutritional factors present in the zooplankton, but that there could be an interplay of other factors.

CONCLUSION

Live *M. micrura* treatment (D2) had the best overall performance (growth and survival) in the feeding of *Clarias gariepinus* fry. Even though the condition factor and specific growth rate were not significantly different ($p<0.05$) from the other diets, the percentage weight gain and survival were significantly different ($p>0.05$). The use of *M. micrura* is highly recommended as live food in the hatchery production of the *Clarias gariepinus* fish, since the zooplankton is easily cultivable in freshwater, the bio-nutrients are readily available/utilizable by the fry and the procurement is highly economical. This technology also reuses of livestock wastes for production thus contributing towards climate change mitigation and making aquaculture sustainable.

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