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GROWTH PERFORMANCE AND SURVIVAL OF HYBRID AFRICAN CATFISH LARVAE (*CLARIAS GARIEPINUS X HETEROBRANCHUS BIDORSALIS*) FED ON DIFFERENT DIETS

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Abstract
The study evaluates the growth performance and survival of hybrid African catfish larvae (*Clarias gariepinus X. Heterobranchus bidorsalis*) fed different diets: live *Artemia nauplii,* decapsulated *Artemia* cysts, live *Ceriodaphnia sp* and commercial dry diet (50% crude protein). Catfish larvae of mean weight 10.01±0.01mg of mean length 9.05±0.09mm were fed from the onset of exogenous feeding for 28days in plastic aquaria tanks (10L capacity each). At the end of the feeding trial, the highest weight gain, 889.99±5.00mg was recorded for the larvae fed with decapsulated *Artemia* cysts followed by those fed with live *Ceriodaphnia* with mean weight gain of 442.66 ± 2.24mg. The least weight gain 60.42 ± 1.80mg was obtained in larvae fed with commercial diet. The best and the least specific growth rates (SGR), 16.07 ± 0.02 and 6.97 ± 0.01 were also obtained in larvae fed decapsulated *Artemia* cysts and commercial diet respectively. Statistically, all the results of the growth parameters obtained from the different diets were significantly different ($p<0.05$). The highest survival, 92.67±2.31% was obtained for larvae fed with decapsulated *Artemia* cysts while the lowest survival of 33.33±7.02% was recorded for the larvae fed with commercial diet. These results show that though decapsulated *Artemia* cysts is the best diet for the first feeding of hybrid African catfish larvae, *Ceriodaphnia* is also a suitable diet for the first feeding of the larval fish.

Introduction
The hybrid African catfish, (*Clarias gariepinus X Heterobranchus bidorsalis*) known among the fish culturists as 'Heteroclarias' is one of the popular fish cultured in Africa especially in Nigeria. This fish has a great market potential because of its fast growth rate, hardiness, high demand and excellent taste. Despite the popularity of this fish, the production of the fingerlings is still very low partly because of feed problem.

Over the years, *Artemia nauplii* have being the most common live food organism for feeding the larvae of catfishes. This is because of its size, motility and easy of digestion by larval fish. However, the drawback to the use of *Artemia nauplii* is the high cost which has increased the cost of production of fingerlings fish. In addition, the technicality of producing the *Artemia nauplii* is labour intensive and requires skilled personnel and specific facilities. Another constraint in feeding *Artemia nauplii* to the larvae of African catfishes, (freshwater species) is that *Artemia nauplii* can survive for only one hour in freshwater and thus the larvae fish need to be fed more frequently (Merchie *et al*., 1996) hence, the increased labour cost. In order to avoid these constraints, other diets that are easily accepted, readily ingested, efficiently digested and assimilated to support good growth at rates comparable to *Artemia nauplii* need to be developed.

The advantages on the use of decapsulated *Artemia* cysts in freshwater larviculture over *Artemia nauplii* have been documented (Lim *et al.,* 2002; Paulet 2003). Successful rearing of fish larvae using various species of zooplankton has been reported for milkfish *Chanos chanos* (Villegas, 1990); African catfish,

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Heterobranchus longifilis (Kerdchuen and Legendre 1994), the walking catfish *Clarias batrachus* (Hossain *et al*., 2006); Mekong catfish, *Pangasius bocourt*: (Hung *et al.*, 1999); and snakehead, Channa *striatus* (Kumar *et al.*, 2008). The successful rearing of some freshwater fish larvae exclusively on artificial diets from first feeding has been reported (Hecht, 1981; Appelbaum and Van Damme, 1988; Bergot *et al*., 1986 and Dabrowski *et al*., 1986).

This study compared the growth performance and survival of hybrid African catfish larvae fed live *Artemia nauphlii*, decapsulated *Artemia* cysts, live *Ceriodiaphia* and commercial dry diet (50% CP) as first feed under hatchery conditions.

Materials and methods

Larval source and experimental set up

Gravid catfish female *Clarias gariepinus* was cross bred with gravid male of *Heterobranchus bidorsalis* using synthetic ovaprim hormone at 0.5ml per kg body weight of fish. The overall procedure for the breeding, spawning and hatching of fertilized eggs was according to the methods of Viveen *et al.* (1985). Fertilized eggs hatched within 26-28h after fertilization. Three days after hatching, before the complete yolk sac absorption, the hybrid larvae were collected, weighed and distributed randomly into twelve plastic aquaria tanks each of 10L capacity at a density of 5 larvae per liter. Each of the aquarium tanks was therefore stocked with 50 larvae with a mean weight of 10.01±0.01mg. Three replicates were used for each treatment.

Experimental diets

Live *Artemia nauplii* (diet 1)

5g Artemia cysts (INVE Aquaculture Belgium) were incubated in hatching jar containing dechlorinated tapwater and 35g/Lof salt (Nacl) was dissolved in the water. The jar was aerated and faced a 60 watt light bulb directly to increase the water temperature to 30°C. After 27-32 hours of incubation, the Artemia cysts hatched and the newly Artemia nauplii at the bottom of the hatching jar were separated from the floated cyst shells by siphoning and fed to larval fish.

Decapsulated *Artemia* cysts (diet 2)

Dry decapsulated *Artemia* cysts (INVE Aquaculture Belgium) were used as one of the experimental diets. The composition of the diet was: protein 54%; lipid 9%; ash 4%; fibre 6% and moisture 5%.

Live *Ceriodaphnia* sp (diet 3)

Live *Ceriodaphnia* sp. were collected from a swamp very close to an abbatoir in Ojo, Lagos, Nigeria. The *Ceriodaphnia* were washed severally with bore hole water and inoculated into four concrete tanks which have been previously fertilized with cow dung manure at a rate of 250mg/L of water. There was population development in the tanks in about 7-9th day, the *Ceriodaphnia* were collected everyday and fed to the larval fish. Fertilization of water in the tanks was repeated every week using half of the initial amount of the cow dung (125mg of cow dung/L of water).

Commercial artificial dry diet (diet 4)

A commercial dry diet was purchased from a reputable local feed manufacturer ACT feeds, Agbara, Lagos State, Nigeria. The composition of the diet was 50% protein; 7% lipid, 3% fiber, 6% ash and 6.3% moisture.

Feeding trial

Hybrid catfish larvae were exposed to the four different dietary treatments, three replicates were used for each dietary treatment. Fish were fed to satiation with their allotted diet three times a day (08:00h, 13:00h and 18:00h). Feeding was done manually and satiation was determined based on visual observation of acceptance and refusal of diet. Fish behaviour was also observed during feeding. Every morning before feeding, all uneaten food and faeces were removed from the tanks by siphoning with a rubber pipe. Every week, ten larvae were randomly sampled from each aquarium, placed on paper filter to absorb water and weighed on an electronic balance to the nearest 0.01mg. The length of each sampled larva was also measured by measuring board to the nearest 0.01mm. The larvae were carefully returned back to their respective tanks. Dead larvae (if any) from each tank were removed, counted and recorded to estimate the percentage survival.

Water quality measurements

About 50% of water in each of the rearing tank was exchanged with fresh water daily before the first feeding was done. Aeration was provided in each tank using aquarium aerators through air stones. Water temperature, pH and dissolved oxygen were monitored daily while ammonia concentration was monitored once a week. Temperature was measured with a mercury glass-in- thermometer; pH with a pH meter (Jenway Model 9060) dissolved oxygen with an oxygen meter (Hanna Model H1-9142) while ammonia was determined by according to the methods of APHA 1985.

Calculations and statistical analysis

Data collected was used to calculate the following parameters.

Weight gain (WTG) = Final weight – Initial weight

Length gain (LTG) = Final length — Initial Length

$$\text{Specific growth rate (SGR)} = \frac{\text{Log}_e W_2 - \text{Log}_e W_1}{T} \times 100$$

Where W_2 = Final weight of fish

W_1 = Initial weight of fish

Log_e = Natural log to base e

T = Experimental period in days.

$$\text{Survival (\%)} = \frac{N_o - N_t}{N_o} \times 100$$

N_o = Initial total number of larvae

N_t = Total number of larvae at the end of feeding trial (28 days)

Statistical analysis

All data gathered after the feeding trial were analyzed by one-way analysis of variance (ANOVA), followed by Duncan's Multiple Range Test to test for significant differences among treatments. Analysis was performed using the SPSS Version 11. Significant level was chosen at p = 0.05. Values were expressed as means ± SD.

Results

Larvae appeared healthy, active and there was no incidence of disease outbreak. There was continuous movement of larvae up and down in the water column, and frequent surfacing activity was observed. Low cannibalistic and attacking behaviour were observed during the experimental period. Larvae were sluggish and laid at the bottom of the tank immediately after feeding for sometime.

The changes in weight of the hybrid larvae fed with the different diets are presented in Fig. 1. Fish fed with decapsulated *Artemia* cysts had the highest weight increase of 900±5.00 mg followed by live *Ceriodaphnia* and least with commercial diet with a value of 70.43±1.77mg. The results of growth performance of hybrid larvae fed with four different diets are presented in Table 1. The mean weight gains of fish were significantly different ($p < 0.05$) in all the test diets. Fish fed decapsulated *Artemia* cysts gave the best weight gain of 889.99+5.00mg followed by those fed live *Ceriodaphnia* with a weight gain of 442.66 ± 2.44mg and the least weight gain of 60.42±1.8mg was observed in larvae fed commercial dry diet. Larvae fed decapsulated *Artemia* cysts also had the best specific growth rate with a mean value of 16.07 ±

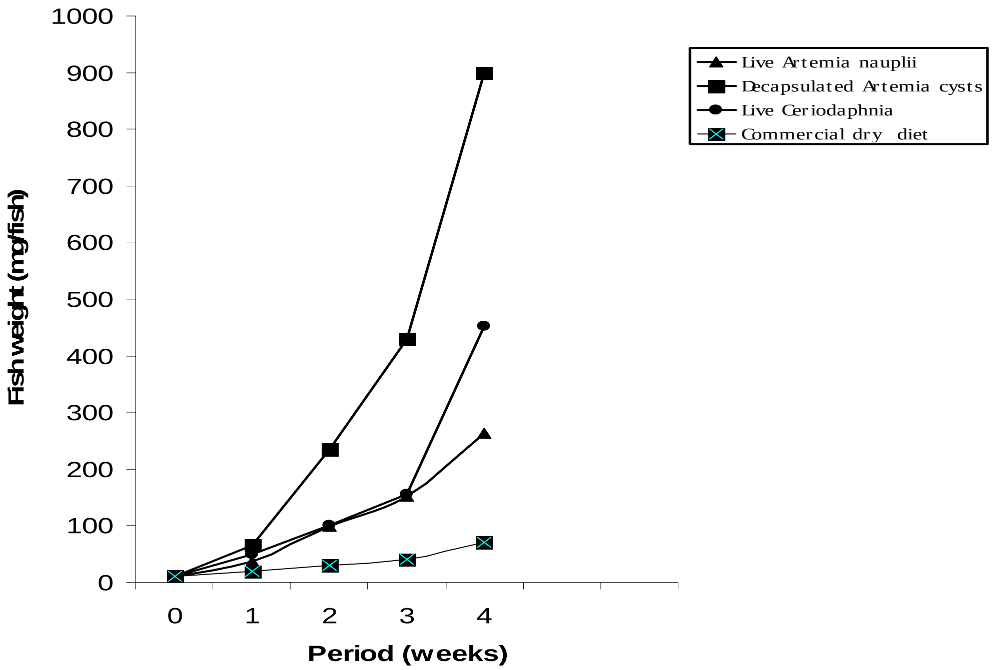

Fig. 1. Weight changes of African catfish hybrid (*Clarias gariepinus X. heterobranchus bidorsalis)* fed with experimental diets

Table 1. Growth performance and survival of African catfish hybrid of fed with the experimental diets

	Diet 1 **Live *Artemia nauplii***	**Diet 2** **Decapsulated *Artemia* cysts**	**Diet 3** **Live *Ceriodaphnia* sp.**	**Diet 4** **Commercial diet**
Initial weight (mg)	10.03±0.015	10.01±0.01	10.01±0.11	10.02±0.02
Initial length (mm)	9.03±0.6	9.01±0.1	9.07±0.12	9.05±0.09
Final weight (mg)	262.50±2.29[b]	900.00±5.00[d]	452.67±2.25[c]	70.43±1.77[a]
Final length (mm)	30.33±0.58[b]	51.67±0.58[d]	42.00±1.00[c]	18.17±0.27[a]
Weight gain (mg)	252.48±2.27[b]	889.99±5.00[d]	442.66±2.24[c]	60.42±1.8[a]
Length gain (mm)	21.30±0.61[b]	42.57±0.59[d]	32.93±1.00[c]	9.17±0.31[a]
Specific growth rate	11.66 ± 0.0[b]	16.07 ± 0.02[d]	13.61 ± 0.01[c]	6.97 ± 0.01[a]
Survival (%)	84.67 ± 2.31[b]	92.67 ± 2.31[c]	85.33 ± 2.31[b]	33.33 ± 7.02[a]

Figures in the same horizontal row with different superscript are significant ($p < 0.05$).
Figures in the same horizontal row without superscript are not significant ($p > 0.05$)

0.02%, this value was significantly ($p<0.05$) different from the other diets. The mean percentage survival of the larvae varied with different diets. The maximum survival (92.67±2.31%) was observed in larvae fed decapsulated *Artemia* cyst and the least survival, (33.33±7.02%) was observed in larvae fed commercial diet.

The mean water temperature ranged from 25.5 - 27.00°C; pH values from 6.5 - 7.2; dissolved oxygen level ranged from 5.00 - 6.25mg/L and while ammonia concentration ranged from 0.33 – 0.45mg/L.

Discussion

Growth of the larvae was significantly affected by different diets. Larvae on decapsulated *Artemia* cysts showed superior growth and survival over those on the other diets. This agrees with Qin *et al.* (1997) for larval *Channa striatus*, Lim *et al.* (2002) and Paulet (2003) for larval of goldfish, *Carassius auratus*. These workers found that the larvae fish grew best on decapsulated *Artemia* cysts than other first feed used in larvae culture. The advantages of *Artemia* cysts over *Artemia nauplii* as food for fish larvae have been reported. Qin *et al.* (1997) reported that the nutritional value of *Artemia* cysts is greater than newly hatched Artemia nauplii in terms of unsaturated fatty acids (HUFA's), amino acids and energy content. *Artemia* cysts can be stored in a refrigerator for years if dehydrated. They stay longer in freshwater than live nauplii (Paulet 2003) and do not leach nutrients (Vanhaecke *et al*., 1990; Dhert *et al.*, 1997, therefore, do not deteriorate water. The *Artemia* cyst size is suitable for most fish larvae (Verreth *et al.*, 1987). Direct feeding of decapsulated cysts would alleviate the work load in hatchery operation (Lim *et al.*, 2002), leading to labour saving.

The observation that larvae fed with live *Ceriodaphia* gave better growth than larvae fed with *Artemia nauphlii*, might be related to the fact that live *Artemia nauphlii* can only survive for one hour in freshwater (Merchie *et al.*, 1996) while *Ceriodaphia* being a fresh water zooplankton can survive for many hours. Adeyemo *et al*. (1994) similarly reported that *Heterobranchus bidorsalis* and *Clarias gariepinus* grew better when fed with *Moina dubia* (a freshwater zooplankton) than when fed with *Artemia nauplii.* On the contrary, Hung *et al*. (1999) reported that larvae of Mekong catfish, *Pangasius bocourti* exhibited lower growth performance when fed with *Moina sp.* compared with *Artemia nauplii.* Also, Kerdchuen and Legendre (1994) reported a better growth performance of *Heterobranchus longifilis* fed with *Artemia nauplii* than *Moina sp.* In this work, it was observed that percentage survival of larvae fed with *Artemia nauplii* and those fed with *Ceriodaphia* were similar indicating the feasibility of complete replacement of *Artemia nauplii* by *Ceriodaphia* for the rearing of hybrid catfish larvae. The poor growth of hybrid African catfish larvae fed artificial diet had also been reported for other catfishes: *Heterobranchus longifilis* (Kerdchuen and Legendre, (1994), *Claria gariepinus* (Hogendoorn, 1980; Msiska, 1981; Verreth and Tongeren, 1989; Adewolu and Ossai 2001), Mekong catfish, *P. bocorti* (Hung *et al.*, 1999) and *Chrysicthys nigrodigitatus* (Adewolu, 1998). The reason for the poor growth may be related to the texture of the dry feed, its digestibility and nutrient leach in water. In addition, may also be related to lack of functional stomach, particularly the absence of proteolytic enzymes during the first few days of exogenous feeding (Kerdchuen and Legendre, 1994; Mills *et al.* (1996). Dabrowski (1982) reported that many fish larvae do not have enzymes for digesting artificial diets and digestion in these fish larvae is carried out by enzymes present in their live diets.

Contrary to the present finding, some freshwater fish species were reared exclusively on artificial diets from the start of exogenous feeding as reported by Applebaum and Van Damme, (1988) in *C. gariepinus;* Legendre *et al.* (1995) in *H. longifilis.* Generally, cannibalism is one of the common problems in the culture of African catfish larvae. In the present study, there was very low incidence of cannibalism and fish attacks, which might be due to the uniform size of fish at stocking, low stocking density and feeding of fish to satiation. The results of water parameters measured during the rearing of the larvae fish are within the recommended range for catfish culture (Viveen, 1985).

In conclusion, this study has shown the superiority of decapsulated *Artemia* cysts over *Artemia nauplii,* live Ceriodaphnia and artificial diet, as first food for the hybrid African catfish larvae. Decapsulated *Artemia* cysts are imported and may be expensive for an average fish farmer, therefore *Ceriodaphnia* may be a better alternative to *Artemia nauplii* as this zooplankton is locally available in most freshwaters in Africa. In addition, the combination of decapsulated *Artemia* cysts with live *Ceriodaphania* is recommended but this needs further investigation.

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