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Assessment of Growth Performance and Survival of *Clarias gariepinus* Larvae Fed with Live Feed (*Acartia tonsa*) and Commercial Feed (*Artemia*)

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Abstract

Investigation was done in the growth performance and survival of catfish larvae using five treatments at the hatchery unit of the Department of Fisheries, University of Port Harcourt. The treatments were T1 (50% *Acartia* and 50% *Artemia*) T2 (25 *Acartia* and 75 *Artemia*) T3 (75 *Acartia* and 25 *Artemia*), T4 (100% *Acartia*) and control (100% *Artemia*). They were applied in triplicate. 200 larvae were transferred to 15 experimental tanks after their exogenous feeding, and the application of treatments (feed) started 12 hours after stocking. Feeding was done three times a day at 7am, 1pm and 7pm. At the end of the experiment which lasted for 15 days, control (0.135g±0.173) and T2 had the highest weight gain (0.033g±0.0022) while T4 (0.022g±0.002) had the least. The highest in length gain was in T2 (1.0838cm±0.0578) while T4 (0.906^{a}cm±0.130) had the least. For survival rate control (75.50% ±2.2039) and T2 (75.40%^{a}±1·250) were the highest while T4 (39.625%^{a}±3·148) was the least the values for the specific growth rate shows that T2 had the best performance while control had the least· From the research findings Treatment two (25% *Acartia* and 75% *Artemia*) and treatment three (75 *Artemia* and 25 *Acartia*) gave the same level of performance with the control in terms of length gain, survival and growth.

Keywords: Catfish; Live Feed; Acartia; Artemia; Aquaculture

Abbreviations: DHA: Docosa Hexanaemic Acid; ANOVA: Analysis of Variance; WG: Weight Gain; SGR: Specific Growth Rate.

Introduction

Aquaculture in Nigerian has grown tremendously over the past decades [1,2]. Larviculture has been the most delicate part of aquaculture considering their survival and growth [3]. Most fish farmers deviated from culturing to buying of fingerlings because of the techniques involve in production of larva. Recently, increasing costs of aquaculture feed constitute one of the high operating expenditure in intensive practice. Also, culturing of larva which is one of the major sources of protein in fish culture has also drastically declined due to techniques involved [4]. In Nigeria, the highest accepted cultured fish is *Clarias gariepinus,* because of its hardy nature, high survival rate and fast growth rate

[5]. *Clarias gariepinus* also belong to group of fish where larvae absorb their yolk from day one of hatching to 3rd day of hatching. The digestive system is rudimentary, lacking a stomach and much of the protein digestion takes place in hindgut epithelial cell [6]. Such a digestive system seems at this point in capable of processing formulated diet in a manner that allows survival and growth.

Furthermore, in hatchery, an adequate supply of live food for first feeding fish larva is essential and nutritional quality of live food organism should be high [7]. Some researchers have investigated the effect of live food, Jeje CY, et al. [8], reported that the larvae of African catfish are small at hatching less or equal to 4mg and 7mm in weight and length respectively. The smaller sizes of this larva possibly thrive better on small Zooplankton especially *Acartia tonsa* which the female is 1.2 to 1.5mm body length, the male to 1.0 to 1.1mm body length compared to decysted *Artemia* cysts whose size range from 200 to 300 micron. The size of *Acartia tonsa* coupled with their relative mobility make it easier for them to be found and captured as food with lower energetic cost. Similar study conducted by Abaho I, et al. [9], showed that live food fed larvae were richer in essential fatty acids while those fed on combination of rotifer and *Artemia*, had improved growth rate. Similarly, work of other researcher indicate that live food confer better nutritional benefit to fish larvae since they are able to transfer fatty acids and other nutrient through the algae - rotifer -larvae food. Nutritionally, from the findings of Abaho I, et al. [9], the growth performance of live food fed Africa catfish larvae also corresponds with the high levels of Docosahexanaemic acid (DHA) in the live food diet. The larval fatty acid profile are always reflections of the diet profile Docosahexanaemic acid (DHA), an essential fatty acid that accumulate in the brain of fish during early development and functions to increase neural functions which can be easily incorporated in live food than *Artemia* due to catabolism of these fatty acid [10].

Nevertheless, the production of nutritionally adequate live starter feeds is a benchmark for successful fish seed production of African catfish [11]. However, the appropriate culture and adequate quantities of live feed for propagation of African catfish remain a challenge resulting in high larvae mortality at early life stages, hence low numbers of fish larvae obtained in hatcheries [11]. In Nigeria, the present practices among fish farmers (hatchery operator) is the use of decapsulated cyst of different *Artemia* strains following commencement of exogenous feeding and this has resulted in low survival rate in hatchery-based catfish seed production as low as 15% which is attributed mainly to poor larval nutrition [12]. It is documented that the nutritional quality of *Artemia* may vary considerably according to the geographical strain, processing batch and development stage as observed, the farmers are therefore not able to identify the best already packaged strain to use and yet not all strains of *Artemia* guarantee equal culture success in aquaculture hatcheries [13]. These factors together with the high cost and occasional scarcity of *Artemia* also make it unreachable for many commercial fish farmers [14]. There is a need therefore to explore alternative starter feeds (especially live feeds) to this *Artemia* to meet these challenges. Copepod especially *Acartia tonsa*, copepod have been viewed as potential alternative ration for *Artemia* as a live starter feed in African catfish larvae rearing because of their good morphological, behavioral and nutritional characteristics A partially bigger mouth in African catfish larvae than most cyprinid larvae permits newly hatched larval *Clarias gariepinus* to consume *Acartia* with sizes greater than 200 µm [15]. This study therefore compared the growth performance of African catfish larvae fed on different inclusion level of *Acartia* and *Artemia*.

Materials and Method

Description of Study Area

The experiment was carried out at University of Port Harcourt, Demonstration Fish Farm, Choba campus Rivers State, Nigeria,

Harvesting of Zooplankton

Zooplankton (*Acartia*) was harvested using a standard zooplankton net placed against the water current for 2-3 minutes and the filtrate at the zooplankton bottle is returned in a screen bowl. Zooplankton was harvested in Buguma every three days. The entire experiment lasted for 15days. Two major steps were involved in the experiment they include Harvesting of Zooplankton (*Acartia*) from Buguma and spawning of fish alongside with feeding trials.

Spawning of Fish

Spawning refer to the natural or artificial procedure the fish go through in other release their eggs. The brood stock used for the spawning was procured from Demonstration Farm, Choba, University of Port Harcourt. The sexes were kept separate to avoid indiscriminate spawning.

Brood Stock Selection

A male brookstock was selected based on the following criteria

- Aggressiveness to other males
- Extruding papilla that touches the base of the pectoral tin.
- Reddish pappilla
- Brood fish of 1.5 to 2kg and 13 to 16 months of age.

The female brood stocks were selected based on the following;

- Swollen soft abdomen
- Reddish or pinkish urinogenital organ
- Release of eggs on slight pressure to the abdomen

Administration of Hormone

The female fish were injected intramuscularly below the lateral line just below the dorsal fin at the rate of 0.5ml of hormone (Ovatide) to 1kg of body weight of fish. The male fish were not injected. All the broodstock were returned to solitary confinement for a latency period of nine hours.

Collection of Milt

The male fish were sacrificed by dissection to get the testis. The testis was dissected and the milt poured unto the stripped eggs.

Collection of Eggs

The female fish was injected intramuscularly with overtide at the rate of 0.5ml per kg body weight and left for 9hours of latency period in a covered container. They were stripped after nine hours (latency period) and at a time when the eggs were freely oozing out on a slight touch. The eggs were stripped into a clean bowl and care was taken while stripping to guide the eggs and the milt from coming in contact with water.

Fertilization

Milt solution was prepared by dissecting the gonad extracting the milt and mixing the extract with saline solution (0.09 percent). The milt solution was mixed with the eggs and mechanically shaken for 1 minute. A little water was added to the mixture. The eggs were then spread out on a hatching mat in the incubation tank.

Hatching

hatching is simply the mechanical enzymatic process of breaking the egg shells and release of the leaver. The hatching of eggs occurred in about 26 hours after fertilization and incubation. The hatchlings had egg sack attached to their abdomen. They were left for a period of three days to absorb their yoke and feeding trial started on the fourth day when they begin to swim as fry.

Experimental Design and Larvae Rearing

Complete Randomized Design was used in this research with four treatments and control. Three replicate for each treatment and control. Fifteen Dedi J, et al. (15) tanks were labeled used for the experiment, $T_1 R_1$, $T_1 R_2$, $T_1 R_3$, represents treatment one in three replicate. $T_2 R_1$, $T_2 R_2$, $T_3 R_3$, represent treatment two in three replicate. $T_4 R_1$, $T_4 R_2$, $T_4 R_3$, represent treatment four in three replicate while $C_1 R_1$, $C_1 R_2$, $C_1 R_3$, represent control.

Feeding was done three times daily, morning (7-8am) noon (1-2) and evening (6-7pm) with feeding adjusted in accordance with their body weight. *Acartia* was harvested two to three times a week maintaining the salinity and keeping them in brackish water until it exhausted. The standard plankton net was used, washed and screened through mosquito netting to eliminate larvae, debris and predators before using it to feed the fish. The uneaten feed in each experimental setup was siphoned off daily while the water was also removed by reducing and adding the same amount of water in each bowl in order to avoid accumulation of Ammonia which is harmful to fish.

Data Collection

The initial mean weight and total length of the Fry were taken using a sensitive analytical balance and a meter rule before commencement of feeding. Weight gain, specific growth rate, survival and mortality percentage were calculated on a fish fed three times a day and physico – chemical parameters were taken every other day.

Weight Determination

Sample to be weighed were randomly removed from each experimental tank and kept alive in a small plastic bowl and weight collected on weighing days. The fish were not fed until the whole exercise was completed. After the measurements, the fish were put in fresh water and then returned to the rearing tanks while subsequently weighing was done individual and the mean weight gain was determined according to Sogbesan AO, et al. [16].

$$Daily\,Weight\,Gain\,(DWG) = \frac{WF - W_I}{d}$$

Where W_f is the final weight,
W_1 is the initial weight.
d is the nursing period in days.

$$Specific\,Growth\,Rate\% = \frac{Log\ final\ weight - log\ initial\ weight \times 100}{Time}$$

Survival Percentage

At the end of the trial (15days), all the surviving fish were harvested, counted, divided by the total number stocked and multiplied by 100.

$$Percentage\ Survival = \frac{No\ of\ fish\ inceased \times 100}{No\ of\ fish\ stocked}$$

Determination of Physio-Chemical Parameter

Physio-chemical data collected during the study include temperature, dissolved oxygen (DO) and hydrogen concentration (pH) Ammonia (NH_3) using Hach Farm testing kit and hand held multi meter (pH, temperature).

Statistical Analysis

The measured values where analysed using two way ANOVA (Analysis of variance) at p>0.05 to test for significant difference in the growth performance and survival of *Clarias gariepinus* larvae fed commercial feed and live food (*Acartia tonsa*) using Duncan multiple range test was used to separate the means.

Results

Physico-chemical parameters recorded in Table 1 below indicate that the highest Dissolved Oxygen level (6.04^a±1.562) during the research was recorded in control, followed by treatment three (T_3) (5.00^a±1.106), treatment one (T_1)(4.80^a±1.010), treatment two (T_2) (4.66^a±1.020) and treatment four (T4) (4.34^a±0.613) in descending order. Recorded pH level during the research as shown in table 1 below was highest in treatment two (T_2) (7.9^a±1.464), followed by treatment four (T_4) (7.57^a±0.446), treatment one (T_1) (7.51^a±0.646), and the lowest observed in control (7.20^a±0.351). No significant different at (P<0.05) was observed between treatment. hough recorded temperature during the research as show the table1 below was highest in treatment two (T_2) (25.33^a±1.556) and treatment four (T_4) (25.33^a±1.756), followed by treatment one (T_1)(25.27^a±1.68), and lowest is control (24.90^a ±1.64). There was no significant difference at (P>0.05) across treatments. Ammonia (NH_3) level recorded during the research as shown in table 1 below was highest in treatment two (T_2) (1.03^a±0.767), followed by treatment four (T_4) (0.99^a±0.713), treatment one (0.96^a±0.690) the lowest is control (0.94^a±0.690) No significant difference (p>0.05) across the treatment.

Table 2 showed the mean production parameters of Treatment T_1 replicates (50% *Acartia* and 50% *Artemia*), it was observed that replicate 1 has the highest weight gain (0.0296^ag±0.006), replicate 2 (0.0252^ag±0.0012) and the lowest was recorded in replicate 3(0.0245^ag±0.0045). it also show the average mean length gain 3 replicate shows the highest length gain (1.070^acm±0.070) follow by the replicate 2 (1.05^acm±0.030cm) the lowest is 1(0.014^acm±0.012m) for the specific growth rate, the highest is replicate 3(4.9793^a%±0.590)followedbyreplicate1(4.619^a%±0.0190) and the lowest is replicate 2 (4.590^a±0.590) the highest survival is observed in replicate 3(47.500^a%±0.590) , followed by replicate 2 (46.500^a%±0.500), the lowest is 1(45.5^a%±0.500).

Table 3 showed the mean production parameter of three replicate of treatment two (T_2) 25% of *Acartia* and 75% *Artemia* in weight gain (WG). Replicate 1 had the highest mean weight gain (0.0349^ag±0.0013) followed by replicate 3(0.0345^ag±0.001) and lowest in replicate 2(0.0305^ag±0.030500). Length gain average was highest in replicate 1(1.119acm±0.0013) followed by replicate 2(1.093^acm±0.09300) and the lowest in replicate 3(1.051^acm±0.001). Specific growth rate was highest in replicate 2($7.380\%^a$±0.080) followed by the replicate 1($4.590\%^a$) and the lowest in replicate 3(4.565). While survival observed in the experiment was highest in replicate 1(76.50^a%±1.414), followed by replicate 2(75.50^a%±1.001) with the lowest in replicate 3(74.50^a%±1.0).No significant different observe across the treatment.

Table 4 showed the mean production parameters of treatment 3(T_3) (75% *Acartia* and 25% *Artemia*). Highest weight gain was recorded in replicate 1(0.0246^ag±0.001) while replicate 2(0.0235^ag±0.001) and 3(0.0235^ag±0.001) have same mean weight. The length gain was highest in replicate 1(1.072a±0.102) followed by 2(1.0607^acm±0.001) the lowest is replicate 3(1.042^acm±0.002), while the highest specific growth rate (SGR) was recorded in replicate 3(4.808^a%±0.010), followed by replicate 1(4.700^a%±0.99) and the lowest in replicate 2(4.613^a%±0.013). Survival observed, was highest in replicate 3(67.50^a%±1.00) followed by replicate 1(68.50^a%±1.414) and the lowest is replicate 2(65.50^a%±1.00). No significant different observed across the treatment.

Table 5, showed the mean production parameters of treatment four (T_4) (100% *Acartia tonsa*,) Highest weight gain was observed in replicate 1(0.0238^ag±0.001) followed by replicate 2(0.0221^ag±0.0021) the lowest in replicate 3(0.0215^ag±0.002). The length gain was highest in replicate 1(1.113^acm±1.414) followed by replicate 2(0.853^acm±0.032) the lowest in replicate 3(0.8370^acm±0.032) while specific growth rate was highest in replicate 3(5.316^a%±1.146) followed by replicate 1(4.610^a%±1.414) and the lowest in replicate 2 (4.596^a%±1.005). Highest survival was recorded in replicate 2(40.50^a%±1.00) followed by replicate 3(39.625^a%±3.14), and the lowest in survival is replicate 1(38.63^a ±7.78).

Table 6 showed the mean production of parameters of control replicates (100% *Artemia*). It was observed that replicate 1(0.0416_ag±0.0023) and replicate 2(0.0405_ag±0.001), while the lowest was in replicate 3(0.293_ag ±0.214). Length gain was highest in replicate 1(1.075_acm±0.106), followed by replicate 2(1.06_acm±0.020) and the lowest in 3(1.041_acm±0.030) while specific growth rate was highest in replicate 3(4.860_a%±0.007), followed by replicate 1(4.595_a%±0.085) and the lowest observed in replicate 2(4.587_a%±0.060). The highest survival was observed in replicate 3(76.50_a%±3.0) followed by replicate 1(75.50_a%±1.414) and lowest observed in replicate 2(74_a%±2.00).

Table 7 showed the mean production parameters of treatments and control at the end of the experiment. It was observed that the control (100% *Artemia*) had the highest weight gain (0.135^ag±0.173), followed by treatment two (T_2) (25 *Acartia* and 75 *Artemia*) T_2 (0.0333^ag±0'0022), treatment one (T_1) (50% *Acartia* and 50% *Artemia*) (0.0264^ag±0.0025), treatment three (T_3) (75% *Acartia* and 25 *Artemia*) (0.0238^ag±0.001) the lowest is treatment four (T_4) (0.0223^ag±0.002). The highest length gain was recorded in treatment two (T_2) (25% *Acartia* 75% *Artemia*) (1.0838^acm±0.0578), followed by treatment three (T_3) (75% *Artemia* and 25% *Acartia*) (1.0565^acm±0.0406), control (1.0565^acm ±0.047) and the lowest in treatment four (T_4) (100%)(0.939^acm ±0.130). The highest specific growth rate was observed in treatment two (T_2) (25% *Acartia* 75% *Artemia*) (5.627^a%± 0.455) followed by treatment three (T_3) (75% *Artemia* and 25% *Acartia*) (4.707^a%±0.385), treatment one (T_1) (50% *Acartia* and 50% *Artemia*) (4.729^a%± 0.455) and the lowest in treatment four (T_4) (4.691^a%±0.150). Fry survival was highest in treatment two (T_2) (25% *Acartia* and 75% *Artemia*) (75.40^a%±1.250) and control (100% *Artemia*) (75.40%±1.250), followed by treatment three (T_3) (75% *Artemia* and 25% *Acartia*) (67.00^a %±1.606), treatment 1 (50% *Acartia* and 50% *Artemia*) (46.5^a%±1.0607) and the lowest in treatment four (T_4) (100% *Acartia*) (39.625^a%±3.14).

Treatments	DO	PH	Temperature	NH3
T1	4.80^a±1.010	7.51^a±0.646	25.27^a±1.688	0.96^a±0.67
T2	4.66^a±1.020	7.9^a±1.464	25.33^a±1.556	1.10^a±0.802
T3	5.00^a±1.106	7.37^a±0.446	24.94^a±1.917	1.03^a±0.767
T4	4.34^a±0.613	7.57^a±0.446	25.33^a±1.756	0.94^a±0.713
CONTROL	6.04^a±1.562	7.20^a±0.351	24.90^a±1.64	0.94^a±0.690

*Values with same superscript on the same column have no significant difference.

Key: T1- 50% *Acartia* and 50% *Artemia*)
T2-25% *Acarta* and 75% *Artemia*
T3-75% *Acarta* and 25% *Artemia*
T4-100% *Acarta*
Control -100% *Artemia*

Table 1: Physico-Chemical Parameters of Treatment after 15 Days of Rearing.

Treatment (T1)	Replicate	WG (g)	LG (cm)	SGR(%)	S (%)
(50% *Acartia*)/(50% *Artemia*)	R1	0.02960^a±0.006	1.01400^a±0.0012	4.61900^a±0.010	45.50^a±0.500
	R2	0.02520^a±0.0022	1.0550^a±0.030	4.590^a±0.590	46.50^a±0.50
	R3	0.02446^a±0.0045	1.0700^a±0.070	4.9793^a±0.583	47.50^a±1.00

*Values with same superscript on the same column have no significant difference.

Key: WG (g)–Weight gain in gram
LG (cm)–length in centimeters
SGR (%)–Specific growth rate in percentage
S (%)–Survival in percentage
R-Replicate

Table 2: Mean production parameter of the three replicates in treatment one (50% *Acartia* and *Artemia*).

Treatment (T3)	Replicate	WG(g)	LG (cm)	SGR (%)	S(%)
(75% *Acartia*)/(25% *Artemia*)	R1	0.0246 ^{a}±0.001	1.0720^{a}±0.102	4.700^{a}±0.990	68.50^{a}±1.412
	R2	0.0235 ^{a}±0.001	1.0607^{a}±0.001	4.6130^{a}±0.013	65.50^{a}±1.00
	R3	0.0235^{a}±0.001	1.042^{a}±0.002	4.809^{a}±0.010	67.50^{a}±1.00

**Values with same superscript on the same column have no significant difference.

Key: WG (g)–Weight gain in gram
LG (cm)–Length in centimeters
SGR (%)–Specific growth rate in percentage
S (%)–Survival in percentage
R-Replicate

Table 3: Mean production parameter of the three replicates in treatment two (25% *Acartia* and *Artemia*).

Treatment (T4)	Replicate	WG(g)	LG (cm)	SGR (%)	S(%)
100% *Acartia*	R1	0.0238^{a}±0.001	1.1130^{a}±1.414	4.610^{a}±1.414	38.50^{a}±7.7782
	R2	0.022^{a}±0.0021	0.837^{a}±0.032	4.5887^{a}±1.005	40.50^{a}±1.00
	R3	0.0215^{a}±0.002	0.837^{a}±0.032	5.3160^{a}±1.1466	39.625^{a}±3.1481

*Values with same superscript on the same column have no significant difference

Key: WG (g)–Weight gain in gram
LG (cm –Length in centimeters
SGR (% –Specific growth rate in percentage
S (%)–Survival in percentage
R-Replicate

Table 4: Mean production of the three replicates in treatment three (75% *Acartia* and 25% *Artemia*).

Treatment (T4)	Replicate	WG(g)	LG (cm)	SGR (%)	S(%)
100% *Acartia*	R1	0.0238^{a}±0.001	1.1130^{a}±1.414	4.610^{a}±1.414	38.50^{a}±7.7782
	R2	0.022^{a}±0.0021	0.837^{a}±0.032	4.5887^{a}±1.005	40.50^{a}±1.00
	R3	0.0215^{a}±0.002	0.837^{a}±0.032	5.3160^{a}±1.1466	39.625^{a}±3.1481

*Values with same superscript on the same column have no significant difference

Key: WG (g)–Weight gain in gram
LG (cm)–Length in centimeters
SGR (%)–Specific growth rate in percentage
S (%)–Survival in percentage
R-Replicate

Table 5: Mean production parameters of the three replicates in treatment four (100% *Acartia*).

Treatment (Control)	Replicate	WG(g)	LG (cm)	SGR (%)	S(%)
100% *Artemia*	R1	0.0416^{a}±0.0023	1.075^{a}±0.1061	4.595^{a}±0.007	75.50^{a}±1.414
	R2	0.04050^{a}±0.001	1.060^{a}±0.020	4.587^{a}±0.085	74.50^{a}±2.0
	R3	0.293^{a}±0.214	1.0407^{a}±0.030	4.860 ^{a}±0.060	76.50^{a}±3.0

*Values with same superscript on the same column have no significant difference

Key: WG (g)–Weight gain in gram
LG (cm)–Length in centimeters
SGR (%)–Specific growth rate in percentage
S (%)–Survival in percentage.
R-Replicate

Table 6: Mean production parameter of the three replicates in control.

Treatment	WG(g)	LG (cm)	SGR (%)	S (%)
T1	0.026^{a}±0.0025	1.046^{a}±0.0460	4.729^{a}±0.455	46.500^{a}±1.0607
T2	0.03310^{a}±0.0022	1.0838^{a}±0.0578	5.627^{a}±1.477	75.40^{a}±1.250
T3	0.023775^{a}±0.001	1.056513^{a}±0.0406	4.709^{a}±0.385	67.00^{a}±1.6036
T4	0.02230^{a}±0.002	0.906^{a}±0.130	4.867^{a}±1.043	39.625^{a}±3.1481
Control	0.13538^{a}±0.173	1.0565^{a}±0.047	4.691^{a}±0.150	75.500^{a}±2.2039

*Values with same superscript on the same column have no significant difference

Key : T1-50% *Acartia* and 50% *Artemia*)

T2-25% *Acarta* and 75% *Artemia*

T3-75% *Acarta* and 25% *Artemia*

T4-100% *Acarta*

Control -100% *Artemia*

Table 7: Mean of means production parameter of treatments and control after 15 days of rearing period.

Discussion

Physico - chemical parameters taken were all within normal standard range. In the present study, growth performance and survival of *Clarias gariepinus* was influenced by both shell free *Artemia* and *Acartia tonsa*. The larvae performed better in treatment one (T_1) (50% *Acartia* and 50% *Artemia*) with weight gain (0.026g^{a}±0.0025), length gain (1.046cm^{a}±0.0460) specific growth rate (4.729%^{a}±0.455) and survival (46.500%^{a}±1.0607), treatment two (T_2) (25% *Acartia* and 75% *Artemia*) performed better with weight gain (0.03310g^{a}±0.0022), length gain (1.0838cm^{a}±0.0578), specific growth rate (5.627%^{a}±1.477) and survival (75.40%^{a}±1.250). treatment three (T_3) (75% *Acartia* and 25% *Artemia*) performance was weight gain (0.023775g^{a}±0.001), length gain (1.056513cm^{a}±0.0406) specific growth rate (4.709%^{a}±0.385) and survival (67.00%^{a}±1.6036) however, treatment four (T_4) (100% *Acartia*) had the lowest performance in weight gain (0.02230g^{a}±0.002), length gain (0.906cm^{a}±0.130), specific growth rate (4.867%^{a}±1.043) and survival (39.625%^{a}±3.1481). There was no significant difference at (P>0.05) between decapsulated *Artemia* which has been used as a good quality diet and freshly hatched zooplankton for larvae of marine shrimps and fresh water prawns [17]. Good result with decapsulated *Artemia* were obtained in larviculture of fresh water food fish species such as *Clarias gariepinus* [18], this agrees with our findings as control 100% *Artemia* had the highest weight gain (0.13538g^{a}±0.173), also performed better in length gain (1.0565cm^{a}±0.047) and specific growth rate (4.691%^{a}±0.150). These can be attributed to the fact that the higher dietary protein level in *Artemia* can meet the requirement of body protein synthesis in early stage and support fast growth of larvae. Watanabe T [19], Watanabe T, et al. [20], Watanab T, et al. [21] our finding also agreed with work of Li P, et al. [22] which shows that for both guppy fry and adult, the performance in terms of growth, survival and stress resistance of fish. Decapsulated *Artemia* is better than or comparable with those fed zooplankton. In this report finding shell free *Artemia* also recorded the highest survival percentage (75.500%^{a}±2.2039).

In this research, combination of *Acartia tonsa* and shell free *Artemia* also shows a good performance in treatment one (T_1) (50% *Acartia* and 50% *Artemia*) length gain (1.046cm^{a}±0.0460) treatment two (T_2) (25% *Acartia* 75% *Artemia*) (1.0838^{a}cm±0.0578), which is the highest length gain, treatment three (T_3) (75% *Acartia* and 25% *Artemia*) length gain (1.056513cm^{a}±0.0406)which is in line with work of Galloway TF, et al. [23]. This implies that the fry obtained their nutrition from both *Artemia* and *A. tonsa*. *Clarias gariepinus* larvae unable to access live food most have probably opted for *Artemia* for their food, this explained that treatment four (T_4) (100% *Acartia*) did not perform as well as treatment one (T_1) (50% *Acartia* and 50% *Artemia*) treatment two (T_2) (25% *Acartia* and 75% *Artemia*) and treatment three (T_3) (75% *Acartia* and 25% *Artemia*) which may have greatly contributed to the better growth and survival that was obtained in treatment two (T_2) (75.40%^{a}±1.250) since they were not starved. This work agrees with many other studies that has been carried out in *Clarias gariepinus*,. *Clarias Macrocephalus* Finn RN, Et al. [24], Folkword A [25], Durbin AG, et al. [26], *Claris Batrachus* Girri SS, et al. [27], *Platebagus falvidraco* [28]. This result is also similar to the works of Akbary P, et al. [29] who said that the growth benefit observed in combination of live food and artificial feed which resulted in true growth which was demonstrated by increase in length of fish. Treatment four (T_4) (100% *Acartia*) was also observed to have low survival rate. This may have raised as a result of larvae increases in size, the nutrient composition of live food did not only become insufficient but also inadequate resulting in weakness and subsequently death of the larvae. Again treatment four (T_4) (100% *Acartia*) having the lowest length gain (0.906cm^{a}±0.130), weight gain (0.02230g^{a}±0.002), this may be as a result of, a little motion required for fry to pick

live food (*Acartia*), this difficulty in picking live food may have led to the poor growth of larvae. This results is in line with the findings of Nwachi OF, et al. [30].

Conclusion and Recommendation

From the research findings Treatment two (25% *Acartia* and 75% *Artemia*) and treatment three (75 *Artemia* and 25 *Acartia*) gave the same level of performance with the control in terms of length gain, survival and growth. Treatment two (25% *Acartia* and75% *Artemia*) and treatment three (75% *Artemia* and 25% *Acartia*) should be used in culture of *C. gariepinus* larvae in place of sole shell free *Artemia*.

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