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RESEARCH ARTICLE

Comparative Studies on the Effects of Four Different Types of Diets on the Growth Performance and Survival Rate of *Clarias gariepinus* Hatchlings (Burchell, 1822)

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ABSTRACT

A research was carried out on the hatchlings of *Clarias gariepinus* under a nursing tank system. Hatchlings were fed from 4th-30th day with different food items as treatment A, B, C, and D respectively, known as follows, A (Water fertilized with 30% Poultry droppings and 70% Cow dung), B (Fertilized water and finely grinded Crayfish 52% Crude Protein (CP), C (Fertilized water and Egg yolk mixed with Ladha powder milk at the ratio of 1:1), and D (Fertilized water and formulated fish feed of 40% (CP). Larvae fed with fertilized water only could not live beyond the 9th day. Hatchlings fed with treatment B (fertilized water and finely grinded Crayfish), lives were sustained, with dark skin, stunted growth and a Percentage Survival (PS) of 37.6%. Hatchlings fed with treatment C (fertilized water and egg yolk mixed with Ladha powder milk at the ratio of 1:1), had a Percentage Survival of 27.8%, with the highest Percentage Growth Rate (PGR) in length of 93.5. Treatment D (fertilized water and formulated fish feed of 40% CP), recorded 47% survival and 77.7% growth rate. The experiment showed that there is a significant difference in treatments A, B, C and D ($P<0.5$). The Least Significant Difference (LSD) is 1.74, and the difference between the mean value of treatments A and B is 8.24 ($P<0.5$), C and B is 3.30 ($P<0.5$), C and D is 1.35 ($P>0.5$). There is no significant difference between Treatments C and D because the mean difference between Treatments. C and D is less than the LSD. Treatment D. feed, fed to hatchlings recorded the highest number of survivors of 237 and second best PGR in length of 77.7. Also treatment C. feed, fed to hatchlings recorded 139 survivors of PS of 27.8 and the highest PGR in length of 93.5. Therefore, treatments D and C can be used to feed hatchlings provided the feeds have the right texture and particle size and reared under right physico-chemical parameters.

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INTRODUCTION

The future and sustainability of the fishery industry hinge greatly on aquaculture production. This is as a result of enormous interest and potentials that are bound in it. In the face of so many vagaries of nature like global warming, water pollution, erosion, landslides, tsunami, flooding, siltation, these had made the survival of aquatic organisms difficult and greatly depleted aquatic resources

The majority of world populations are fish eaters. Fish food, constitute a major food item in the diet of an average person. And with the increase in world population, the demand for fish has continued to increase. Again, fish is an important component of total human food and to a lesser degree of animal feed. Nutritionally, it is equivalent to meat in protein with a good amino acid profile, high in essential minerals and low in saturated fatty acid. Thus, the culture of fish has become an innovative technology aimed at producing large quantity of food fish for the ever-increasing population in Nigeria and the world in general (Idoniboye and Ayinla, 1991). For instance, Nigeria needs approximately 1.5 million tons of fish annually to satisfy her fish demand, but her annual domestic production is less than 0.45 million tons (Ayinla, 1991 and Adekoya, 2001).

The great success recorded in the area of artificial propagation of fish, has so many feeding and management constraints. Feeding and management of larva in the first

thirty days of hatching is very critical to the survival of hatchlings (larvae). The delicate nature of larva to the physico-chemical changes in Temperature (T^o), pH, Salinity, turbidity, Dissolve Oxygen (DO) and feed availability has made survival very difficult in the early life of larvae (fish). Great care is required to rear the larva to fry and to fingerling stage. To achieve this, the type of food fed the larvae becomes very vital, in addition to good quality rearing water and tank or intermediate rearing race ways and outdoor rearing facilities (nursery ponds) (Ugwu *et al.* 2006 and Nwuba and Onuoha, 2006).

Because of the importance of these stages (larval to fingerling) in fish seed production, it is pertinent that the right type of quality and quantity of food are fed to the larvae.

The larva is known to undergo two types of feeding at this stage: the endogenous and exogenous feeding. The yolk-sac carried by the larva, contains nutrients which serves as food to the larva in the first 3-4 days of hatching. Appelbaum (1976) observed that larva feeding behavior, does not depend on any optical or other stimuli and larvae will start to feed on live or artificial feed if they are available.

The early food of larva has been determined by early workers and the suitability of natural plankton organisms was established (Lopez *et al.*2005). However, while the fry of herbivorous fish like *Tilapia spp.* prefer phytoplankton, those of predatory or omnivorous species, like *Clarias geriepinus* prefer zooplankton. In many hatcheries all over the world, the brine shrimp-*Artemia salina* has been used as first food of fish fry in nursery tanks and troughs. Also, the *Cladoceran spp., Moina mucura* has equally been used for the same purpose, both in the hatchery of African Regional Aquaculture Centre (ARAC) Aluu, Port-Harcourt, Nigeria and in many Asian countries (Nwadukwe, 1991).

Fry must be adequately fed with suitable food, since it is believed that lack of suitable food is the main cause of fry mortality apart from cannibalism. Nwadukwe (1991) stated that the quantity and quality of artificial feed are of great importance, if satisfactory growth and high percentage of fry survival are to be achieved.

As a result of the popularity of *Clarias gariepinus* among fish culturist and farmers, it became pertinent to search for other early food of larvae other than life food *Artemia salina*, *Moina spp*., *Cladoceran spp*. and others. These alternative larval feed, must be locally available in quantity, quality and must have the ability to promote fast growth and high survival of hatchlings.

MATERIALS AND METHODS

The *Clarias gariepinus* hatchlings used in this research were obtained from Okey's Fish Farm, Agulu Lake, Anaoha Local Government Area of Anambra State, Nigeria. The rearing site was located under a shade where there was no direct impact of the solar energy.The location was screened to eliminate predators and poachers. The source of clean water was very near and was obtained by pumping.

One 2,000 liter plastic tank was used for water fertilization. 20 plastic bowls of 30 liter capacity each, was used for each replicate. Therefore, each of the four treatments was replicated five times. Treatments (A, B, C and D), each was stocked with 500 hatchlings (fry), with each replicate stocking density of 100 fry as shown in Table 1.

Each of the 30 plastic bowls was filled with 20 liter of fertilized water. The fertilized water was changed every other day from the fertilized water plastic tank. The fries were subjected to four different types of diets, tagged treatment A, B, C and D.

1. **Treatment A:** Fries under this treatment were feed with Fertilized water only
2. **Treatment B:** These Fries were fed with Fertilized water and finely grinded Crayfish of 52% Crude Protein level (CP)
3. **Treatment C:** Fed with Fertilized water and egg yolk mixed with ladha powder milk at a ratio of 1:1
4. **Treatment D:** Fertilized water and Compounded formulated diet of 40% Crude Protein (CP)

Treatment A: fertilized water

The 2,000 liter plastic tank was sited where it can have direct impact of the sun. This will help the primary producer to multiple faster, by so doing make planktons (zoo and phyto) available for the fry to feed on. The inoculants were poultry droppings and cow dung mixed at the ratio of 30% to 70% respectively. Poultry droppings and Cow dung that had cured were mixed in the above ratio, and put in a jute bag. The mouth of the bag was tied. The bag was immersed inside the tank. Organic nutrient dripped out from the bag and generated microbial activities. The primary producers; Algae (phytoplankton) in the presence of the sunlight was manufactured. The tank water turned greenish after seven days. From this tank the fertilized water used for all the treatments were obtained. The tank was filled back after every usage.

Treatment B: Fertilized water and grinded Crayfish (52%) Crude Protein (CP)

The crayfish was procured from the local market. It was processed to remove trashes and bones. The Crayfish was grinded to the finest of particles. It was spread for one day to dry further. This was again grinded to obtain the final product. This was fed to the hatchlings together in the fertilized water.

Treatment C: Fertilized water and egg yolk mixed with ladha powder milk at a ratio of 1:1

The eggs used in this research were obtained from a poultry farm in the locality. Fifteen good eggs were boiled for 10 minutes. The eggs were de-shelled after cooking. The albumen (whitish) coats were removed to expose the yolk. The yolks were reduced to tiny beats and dried under a mild sun. After drying, it was grinded into powder. The Ladha powder milk was procured from the local market. The two ingredients were mixed at a ratio of 1:1. The feed was stored in a well ventilated store to avoid growing mould. This was used to feeding fingerlings in treatment C.

Treatment D: Fertilized water and compounded formulated diet of 40% crude protein

All the feed stuffs used in the formulation and compounding of the feed, were procured from the local markets. The feed items were further processed to

Table 1: Experimental set-up for feeding *Clarias gariepinus* hatchlings on four diets

Replicates	TRT. A	TRT. B	TRT. C	TRT. D
	Fertilized Water (30% poultry droppings and 70% Cow Dung)	Fertilized Water and Cray fish 52% Crude Protein (CD)	Fertilized Water and Egg yolk mixed with powdered Ladha Milk ratio 1:1	Fertilized Water and Standard formulated Feed 40% (CP)
R_1	100	100	100	100
R_2	100	100	100	100
R_3	100	100	100	100
R_4	100	100	100	100
R_5	100	100	100	100
Total	500	500	500	500

Table 2: Shows the Percentage Ingredient Composition of all the Feed Stuff Used to formulate a 40% Crude Protein Feed

Ingredients	Composition (Kg)
Soya bean	21.13
Groundnut Cake	21.13
Corn meal	15.49
Crayfish	21.13
Fish meal	21.13
Vitamin premix	0.30
Salt	0.15
Groundnut oil	0.15
Ampicilin	0.10
Multivite	0.10
Starch (binder)	0.50
Total	100

The grinded feed ingredients were mixed beginning with those in small quantity. The starch binder was used to hold every ingredient. The paste was sun dried. The dried feed pellets were grinded severally to obtain a powdery feed. It is important to grind the feed thoroughly because of the size of fish to be fed with it.

Measurement

The experimental fingerlings were fed five times daily, at 5% body weight for the first 13 days and reduced to three times daily for the rest part of the experiment. The uneaten feeds were removed with a siphoning tube. Care was taken not to siphon the experimental fish in the process. Fertilized water of all the nursing tanks was changed every day (24 hrs). This process is very important in the rearing of hatchlings, because they are very fragile and highly susceptible to fungal disease, which occur when water is polluted.

The following morphological measurements and development were recorded throughout the duration of the experiment.

i) Growth: Measurement was taken every other day in (cm). The length of each of the ten (10) fry selected randomly from each replicates, where measured with a 15cm ruler. The measurement was from the tip of the snout to the end of the caudal tail. The mean measurement was obtained by summing the length of the 10 fingerlings and divided by the number of specimen measured. The total mean growth in length of treatments A, B, C and D were determined using the formula $\frac{\Sigma(x)}{N}$ ..... (1)

Total Mean of Treatment A = r1+r2+r3+r4 / 5

Where $\sum x$ = Summation of length of replicates N = No of items (Replicates in this case) Source: (Utene, 1979).

ii) Percentage Growth in Length (%): The % Growth Rate in length of hatchlings (fingerlings) of all the treatments was calculated using the formula.

$$\% \text{ Growth Rate (length)} = \frac{F_2 - F_1}{F_2} \times \frac{100}{1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where: % GR = Percentage Growth Rate (length)
F_1 = Initial length; F_2 = Final length; Source: (Utene, 1979).

iii) Survival and Mortality: These were recorded every day, by physically counting the number of dead fingerlings in each replicates of each treatment (A, B, C and D).

Therefore, to obtain the numbers of survivors in the replicates of each treatment, the number of dead fingerlings in each replicate is subtracted from the initial or remaining stocking density.

iv) Percentage Survival (%): To obtain the % survival, the total number of mortality in each treatment's replicates is subtracted from the total stocking density and is calculated thus:

$$\% \text{ Percentage Survival (PS)} = \frac{S_2}{S_1} \times \frac{100}{1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where PS= Percentage Survival
S_1 = No. of stocking density; S_2 = No. of survivor
Source: (Utene, 1979)

Statistical evaluation: The data collected from treatments A, B, C and D, were subjected to Analysis of Variance (ANOVA) for Significant Difference Probability. The Least Significant Difference (LSD) of treatments A, B, C and D were also calculated. The graphical distribution of survivors was also represented.

RESULTS

Table 3: Shows that the head to yolk sac length varied between 0.80mm and 1.00mm and with a mean value of 0.93mm. The diameter of yolk-sac varied between 0.90mm and 1.05mm, the yolk sac to tail length varied between 1.05mm and 1.20mm, with a mean of 1.11mm and total fish length varied between 2.8mm and 3.15mm with a mean of 3.00mm.

Treatment A

Table 4: Shows the mean body measurement of *Clarias gariepinus* replicated five times for the ten specimen

Table 3: Measurement of 10 randomly sampled larva of *Clarias gariepinus* at stocking

S/ NO	Head to yolk SAC (mm)	Diameter of yolk SAC (mm)	Yolk SAC to tail (mm)	Mouth Gap (mm)	Total Lengt-h (mm)	Age in day	Mortality
1.	0.80	0.90	1.10	0.00	2.80	4^{th}	Nil
2.	1.00	0.90	1.20	0.00	3.10	4^{th}	Nil
3.	0.90	1.00	1.10	0.00	3.00	4^{th}	Nil
4.	0.80	1.00	1.20	0.00	3.00	4^{th}	Nil
5.	1.00	1.05	1.11	0.00	3.15	4^{th}	Nil
6.	1.00	1.00	1.05	0.00	3.15	4^{th}	Nil
7.	0.90	1.00	1.05	0.00	2.95	4^{th}	Nil
8.	1.00	0.90	1.10	0.00	2.85	4^{th}	Nil
9.	1.00	1.00	1.05	0.00	3.00	4^{th}	Nil
10.	0.90	1.00	1.10	0.00	3.05	4^{th}	Nil
Total Mean	9.3	9.75	11.06		30.05		
$\frac{\sum N}{N}$	0.93	0.98	1.11	0.00	3.01	Nil	Nil

Table 4: Mean measurement of yolk-sac, body length and survival of *Clarias gariepinus* fries from 4^{th}-30^{th} days of treatment.

No. of Reading (DAY)	Mean Head Yolk SAC of 10 Specimen (mm)	Mean Total Body Length of 10 Specimen (mm)	No. of Survivals
4	0.98	3.00	500
5	0.82	3.05	498
6	0.95	3.08	300
7	1.10	3.10	100
9	1.10	3.11	50
11	Nil	Nil	Nil

TABLE 5: Mean measurement of yolk-sac, body Length and survival of *Clarias geriepinus* hatchlings from 4^{th} – 30^{th}.

No. of reading in (DAY)	Mean Head Yolk SAC of 10 Specimen (mm)	Mean Total Growth in Body Length for 10 Specimen (mm)	Total No. of Mortality
4	0.90	3.20	500
5	0.85	3.35	498
7	2.85	4.95	498
9	2.65	5.45	447
11	2.65	5.00	373
13	2.72	5.20	317
15	2.82	5.90	260
17	2.75	7.15	218
19	2.74	7.20	208
21	2.86	7.60	195
23	2.97	8.10	191
25	2.95	9.00	191
27	2.92	9.80	190
29	3.00	11.35	188
Growth Rate (GR) in length (1)		73.5%	188

samples of fries randomly selected from 1-3 day old. The mean total body growth in length varied from 3.00mm and 3.11mm. The mean yolk Sac length varied from 0.82mm and 1.10mm.

Mortality was first recorded on the fourth day and increased as the experiment progressed. Total mortality of the five replicates (500 fries) was recorded on the 11^{th} day.

Treatment B: Feeding hatchlings of *Clarias gariepinus* with fertilized water and grinded crayfish 52% (CP).

Table 5: Shows the mean body measurements of *Clarias gariepinus* fingerlings in five replicates, for ten specimen samples randomly selected. The mean yolk-sac measurement varied from 0.85mm to 3.00mm. The mean body length measurement varied from 3.00mm to 11.35mm with a Percentage Growth Rate in length of 73.50%.

A total count of one hundred and eighty eight (188) survivors was recorded from 4^{th}-30^{th} days of the experiment in treatment B.

Treatment C: Feeding fries of *Clarias gariepinus* with fertilized water and egg-yolk mixed with ladha powder milk at the ratio of 1:1 as shown on Table 6.

Table 6: Shows the mean body measurement or vital statistics of *Clarias gariepinus* hatchlings in five replicates, for the ten specimen samples, selected randomly from 4^{th} – 30^{th} day. The mean head yolk-sac measurement varied from 0.80mm to 3.85mm. The mean total body length measurement varied from 3.00mm to 14.65mm. Percentage Growth Rate (PGR) in length is 93.5%. A count of one hundred and thirty-nine (139) survivors was recorded from 4^{th}-30^{th} day of the experiment in treatment C.

Treatment D: Feeding hatchlings of *Clarias gariepinus* with fertilized water and formulated feed of 40% Crude Protein (CP). Table 7: mean measurement of yolk-sac body length.

TABLE 7: Shows the mean body measurement or vital statistics of *Clarias gariepinus* hatchlings, in five replicates, for ten specimen samples, randomly selected from 4^{th}-30^{th} days. The mean head Yolk-sac measurement varied from 0.95mm to 3.75mm. The mean total body length measurement varied from 3.50 to 13.50mm. The Percentage Growth Rate (FGR) in length is 77.7%.

Total counts of two hundred and thirty-seven (237) survivors were recorded from 4^{th}-30^{th}day of the fingerlings in treatment D.

Table 7: Shows survival and Percentage Survival (PS) of *Clarias gariepinus* hatchlings fed with different feeds. **Treatment A:** On the 11^{th} day of the experiment, treatment A recorded 100% mortality or 0% survival. **Treatment B:** Recorded 188 survivors, and percentage survival of 37.6%. The bulk of the mortality was recorded

Table 6: Mean measurement of *Clarias gariepinus* Fries (yolk-sac. body length and survival from 4^{th} -30^{th} days).

No. of Reading in (DAY)	Mean Head Yolk SAC for 10 Specimen (mm)	Mean Total Body Length for 10 Specimen (mm)	Survival Count
4	0.86	3.40	499
5	0.80	3.80	489
7	2.90	4.45	473
9	2.88	6.20	438
11	2.95	8.10	389
13	3.00	9.10	317
15	2.96	10.10	254
17	3.05	11.15	209
19	3.16	11.86	184
21	3.35	12.05	162
23	3.62	13.10	154
25	3.70	13.90	142
27	3.84	14.05	140
29	3.85	14.65	139
Growth Rate (GR) in Length …….. (2)		93.5%	139 Survivors

Table 7: Mean measurement of yolk-sac, body length and survival of *Clarias gariepinus* hatchlings from 4^{th} -30^{th} day

No. of Reading in (DAY)	Mean Head Yolk SAC for 10 Specimen (mm)	Mean Total Growth in Body Length for 10 Specimen (mm)	Total No. of Survival
4	0.95	3.50	500
5	0.86	4.30	498
7	2.85	7.80	492
9	2.90	8.20	482
11	2.95	8.90	452
13	2.95	9.30	411
15	3.00	9.70	360
17	3.10	10.45	332
19	3.05	10.70	282
21	3.05	11.25	251
23	3.35	11.85	245
25	3.65	1220	241
27	3.45	12.90	241
29	3.75	13.50	237
Final Man Length F_2		13.50	237 Survivors
% Growth Rate (PGR) in Length …….. (2)		77.7%	

Table 8: Effects of Different Feeds on the Survival of Hatchlings of *Clarias gariepinus* from 4^{th} – 30^{th}

No of Reading (Days)	Treat. A	Treat. B	Treat. C	Treat. D
4	500	500	500	500
5	498	498	499	498
7	300	492	489	492
9	100	447	473	482
11	50	373	438	452
13	Nil	317	389	411
15	Nil	260	317	332
17	Nil	218	254	282
19	Nil	202	209	260
21	Nil	195	184	251
23	Nil	191	162	245
25	Nil	191	142	241
27	Nil	190	140	241
29	Nil	188	139	237
Total Survival	0	188	139	237
% Survival	0%	37.6%	27.8%	47%

between 9^{th} and 19^{th} day; **Treatment C:** This recorded 139 survivors and a Percentage Survival of 27.8%. The bulk of mortality was recorded between the 5^{th} and 25^{th} day; **Treatment D:** This recorded 237 survivors and a Percentage Survival of 47%. The bulk of mortality was recorded between 9^{th} and 23^{rd} day.

Statistical analysis

The Analysis of Variance (ANOVA) of growth in length showed that there is Significant Difference in treatment A, B, C and D ($P<0.5$).The treatments pair comparison, using Least Significant Difference (LSD) was calculated to be 1.74 and the difference between the mean values of treatment A and B is 8.24 and is greater than LSD of 1.74. Which means that feed used in treatment B., has significant effect on the growth of fish specimens than feed used in treatment A.

The difference in the mean values of treatment C and B is 3.30. The difference is greater than the LSD which is 1.74, which means that the feed fed to the *Clarias gariepinus* hatchlings in treatment C has significant effects on the hatchlings than feed given to treatment B.

The difference between the mean values of treatment C and D is 1.35. The mean value difference is less than the LSD of 1.74. This shows that the feed fed to fingerlings in treatment C has no significant difference ($P>0.5$) than feeds fed in treatment D.

The difference between the mean values of treatment D and B is 1.95. This is greater than the LSD which is 1.74. This shows that the feed fed to treatment D is significantly more effective than feed fed to treatment B.

DISCUSSION

The hatchlings (fries) fed with only fertilized water treatment A., showed signs of weakness at the 5^{th} day and this sign increased by the day. Also, mortality increased by the day. By the 11^{th} day, all the hatchlings had died, thereby recording 0% survival. This agrees with the argument of Huisman (1976) who wrote that fish food organism such as rotifer, *Cladoceran spp* as single diet do not sustain hatchlings. Ayinla (1991) stated that about 80% of the yolk is absorbed after 3-4 days of hatching. That once the yolk is fully absorbed, the fry must find it own food both in quality and quantity, otherwise, the fry becomes weakened beyond recovery and cannibalism is stimulated.

Feeding with fertilized water only in this study, has shown that phytoplankton and zooplankton, when not is large quantity and quality cannot sustain life of *Clariasgariepinus* hatchlings.

In *Clariasgariepinus* (hatchlings) fed with various diets or formulated feed, recorded the highest survivors. As observed in treatment B, the feed lacked enough feed components like carbohydrates, fats and minerals. The percentage survival from 4^{th} – 30^{th} day was 37.6% in treatment B and second in terms of number of survivor in the experiment. Mortality was witnesses between 6^{th} and 26^{th} day. The growth rate of 11.35mm of hatchlings in treatment B was the least in this study. The percentage growth rate (PGR) was 73.5.

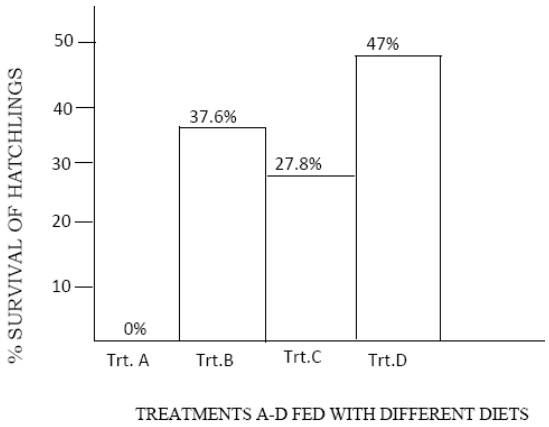

Fig. 1: The percentage survival of clarias gariepinus hatchlings fed with different types of diets for 29th day

The *Clarias gariepinus* hatchlings in treatment C., fed with fertilized water mixed with egg yolk and Ladha powder milk at the ratio of 1.1. The percentage survival (PS) from 4th - 30th day was 27.8%. This recorded the second highest number of mortality of 361 after treatment A that recorded 100% mortality. Mortality was recorded between 5th and 25th day. The growth rate in length of 14.65mm was the highest in the experiment and the PGR of 93.5%.

Clarias gariepinus hatchlings in treatment D, recorded the highest number of survivors of 237, with PS of 47%. Mortality started from the 7th to 21st day. The high percentage survival maybe attributed to the fact that the feed contained essential ingredients required for effective growth is fish (protein, carbohydrates, fats and oil, vitamins and mineral). Treatment D equally recorded a growth in length of 13.50mm and a PGR of 77.7%.

Madu *et al.,* (1990), formulated aqua feed with which they successfully fed *Clarias anguillaris* hatchlings. Their aqua feed was made up of ingredients such as zooplanktons *Moina spp.* And *Cladocerans spp*.Sin mixture of artificially blended agricultural products such as corn mill, cassava flour and animal products or by products such as fish meal, blood meal, grind crayfish and soon. These and other additives like vitamin premix gave a high quality aqua feed.

Recommendation

- It is recommended that fingerlings fish feed should be available in quantity and quality, size and texture before embarking on artificial "fish seed" propagation.
- That standard formulated feed of 40% Crude Protein (CP) when prepared to have correct texture, particle sizes, can be used to feed hatchlings in the absence of (live feed) *Artemiasalina* or *Mornaspp* in the first 30 days of hatching.
- Also, egg yolk mixed with ladhapowder milk mixed at the ratio of 1:1 can also be used in feeding fingerlings in the first 4th-30th day.

Provided that the water is changed regularly and debris and feaces are removed constantly to avoid the water from being polluted.

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