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Impacts of Egg Diets on the Culture of *Clarias gariepinus* Fry in Indoor Hatchery

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ABSTRACT: The use of egg diets and fish meal as a starter diets for *Clarias gariepinus* fry after endogenous feeding was investigated for 42 days. The experiment was designed to determine the effects of egg diets on growth performance of *C. gariepinus*. The experimental diets were assigned into three treatments and control. The treatments were denoted T_1 (egg yolk), T_2 (egg yolk and albumen), T_3 (albumen) and control (fish meal). Growth parameters were monitored and calculated according to standard procedures. The data collected were analysed using analysis of variance (ANOVA) and Duncan's Multiple Range Test was used to separate the differences among the means. The crude protein (35.01%), crude fibre (0.78%) and ash contents (10.23%) were significantly higher $p<0.05$ in the control diet. Ammonia content was significantly higher $p<0.05$ in control than other treatments. Dissolved oxygen (DO) recorded was significantly higher $p<0.05$ in T2. The growth parameters showed that Mean Weight Gain (1.79g) (MWG), Specific Growth Rate (2.65) (SGR) and Survival Rate (77.78%) (SR) of T2 were significantly higher $p<0.05$ than other treatments. The findings of this study revealed that the combination of egg yolk and albumen (T2) had significant effect on growth performance of *C. gariepinus* fry.

Keywords: Egg Diets, Fish Meal, *Clarias gariepinus*, Water Quality Parameters, Growth

Introduction

Larviculture can be sustained by recruiting alternative protein supplements which can be used to substitute fish meal in fish diets. Globally, overfishing has led to the extinction of many fish species in natural water bodies and the only intervention is the massive propagation of fish seeds to meet fish demand. Artificial propagation with the use of hormones has helped to solve the problem of fish seeds collection from the wild. The decline in the supply of fingerlings is partly attributed to the lack of affordable fry diets as the available fry feeds are imported and expensive (Nabulime *et al*., 2015). Problems being faced from the inception of commercial production of fish fry are the unavailability of palatable and digestible diets required for their growth and survival.

In Nigeria, African catfish, *C. gariepinus* has been a major fish species recruited and cultured in ponds due to its ability to resist varied extreme of environmental conditions and diet variations. There is an urgent need to bridge the nutritional gap that has been causing a shortfall in the supply of fry of *C. gariepinus*.

In an attempt to boost aquaculture production, researcher had documented some feed ingredients which served as starter diets for survival and growth of livestock offspring and fish seeds in fish hatcheries. Touchette *et al.* (2003) investigated the use of alternative proteins to decrease the cost of milk replacers without negatively impacting the performance of the calf. The study affirmed that egg is an effective alternative protein source to milk protein in calf milk replacers when fed at levels up to 10% of the diet in a conventional feeding program. Engrola et al. (2007) reported substitution of expensive live food (Artemia metanauplii) at early developmental stages of Tor khudree with Artemia nauplii which provided an alternative weaning strategy for ensuring lower feed cost. Yakubu et al. (2015) showed in their study that Artemia salina had the best growth performance compared to other commercial diets fed fry of C. gariepinus. Eggs are livestock products that are produced majorly by poultry birds and other animals such as reptiles (alligators), amphibians (frogs), and fish. Eggs from poultry are major products consumed by people to meet their protein requirements. Nevertheless, there are risks associated with egg consumption in human being due to high level of cholesterol. Jafari et al. (2011) established a feeding regime and reported that the optimal diet for kutum larvae in the early life stage is egg yolk and Artemia nauplii that would be beneficial for larval rearing in terms of survival, growth and normal development. A study carried out by Mohammadi et al. (2015) revealed that 4-6% chicken egg lecithin can induce the growth performance of juvenile Mesopotamichthys sharpeyi. Akinola et al. (2020) reported that infertile egg without shell can be used up to 100% in place of fishmeal in broiler chicken diets to reduce feeding cost and improve health without affecting performance. This study was designed to investigate the effects of egg diets on the growth performance of C. gariepinus fry.

Materials and methods

Study area: The study was conducted in the Fisheries and Aquaculture Unit of Department of Animal and Fisheries Management, Bowen University Iwo, Osun State, Nigeria.
Propagation of fish fry: Artificial propagation with hormonal treatment was used to breed fish fry from matured male and female in the hatchery of Fisheries and Aquaculture Unit of Department of Animal Science and Fisheries Management, Bowen University, Iwo. The broodstocks were injected with ovaprim at 700 pm and stripped 12 h after injection. Eggs from female and milt from male were mixed together for sexual fertilization and later incubated inside hatching trough. The eggs hatched into fry between 20 and 22 h. The hatched fry was siphoned from the trough and transferred into nursery trough where they were nursed throughout the period of trial experiment.
Preparation of diet: Eggs were purchased from the Poultry Unit of Department Animal Science and Fisheries Management, Bowen University, Iwo. The eggs were broken and the contents (egg yolk and albumen) were oven dried at 75^{0}C in the laboratory. The oven dried egg yolk, albumen, egg yolk and albumen were grinded into powdery form using kitchen blender. The powdery form of the egg diets was stored at room temperature inside a tight container.
Experimental procedure: An average weight of 0.01g of C. gariepinus were stocked at thirty (30) fry per treatment and replicated thrice. The fish fry was stocked inside 50 liters experimental fish bowl. Four experimental diets were prepared and coded T_1 (egg yolk), T_2 (egg and albumen), T_3 (albumen) and control (Fish meal). The fish samples were fed at 5% body weight at 7am, 12 noon and 6pm daily. The weight of fish samples was weighed every week and the new weight was used to adjust the quantity of feed to be consumed by the fish.
Proximate composition of the fish diet: The proximate composition (Table 1) of the egg diets (egg yolk, albumen, egg yolk and albumen) and fish meal were determined according to the procedures described by AOAC, 2005.

Table 1: Proximate composition of the diets

Parameters	**Control**	**T_1**	**T_2**	**T_3**
Crude Protein	35.01^a±1.23	12.08^d±0.11	25.67^b±1.16	16.27^c±0.08
Crude Fibre	0.78^a±0.01	0.00	0.00	0.00
Crude Fat	4.23^c±0.67	10.01^a±1.02	5.88^b±0.12	2.03^d±0.13
Ash Content	10.23^a±1.25	1.87^b±1.24	0.42^c±0.33	1.03^{bc}±0.34
Moisture Content	70.12^d±1.28	82.49^c±1.34	91.17^b±1.45	95.68^a±1.32

Means along the same column with different superscripts differ significantly ($p<0.05$)

Monitoring of water quality parameters: The water medium used for nursing the fry after hatching was aerated using an electronic aerator of model PAI. Water samples were analysed weekly to determine water quality parameters (water temperature, dissolved oxygen, ammonia and pH). The pH of the water was determined using a digital pH meter Suntex (model TS-2). Water temperature was measured with mercury in glass thermometer. The reading was taken by dipping the thermometer in water to a depth of 0.5 m. Other water quality parameters were determined according to the procedures described by American Public Health Association (1992).

Growth parameters: The growth parameters of the fish samples were determined using the formula stated below:

(i) $MWG = W_2 - W_1$
where MWG is the mean weight gain during the experimental period
W_2 = Mean weight gain at the end of the experiment
W_1 = Mean weight at the commencement of the experiment

(ii) SGR (Specific Growth Rate) = $(LnW_2 - LnW_1) / T_2 - T_1 \times 100$
where Ln is the Logarithm natural
LnW_2 = Logarithm natural of mean final weight
LnW_1 = Logarithm natural of mean initial weight
T_2 = Final day of the experiment (experimental period)
T_1 = Initial day of the experiment

(iii) FCR (Feed Conversion Ratio) was calculated as determined by Hepher (1988)
where FCR = Mean total feed consumed (g) / Mean weight gain (g)

(iv) PER (Protein Efficiency Ratio) was determined according to the method of Zeiotoun *et al.*, (1973)
PER = Mean weight gain (g) / Mean protein intake

(v) SR (Survival Rate) = Total number of fish at the end of experiment / Total number of fish at the beginning of the experiment x 100

*Statistical analysis***:** The data collected were analysed using Statistical Package for Social Sciences (SPSS), Version 11 (2001) and Statistical Analysis Software (SAS), Version 8 (2001). Duncan's Multiple Range Test was used to compare the differences among the means. The significant level was set at 5%

Results

The proximate composition of the experimental diet is presented in Table 1. The results showed that crude protein of the egg diets (T_1 to T_3) ranged from 12.08% (T_1) to 25.67 (T_3), while control had a significant value $p<0.05$ of 35.01%. Crude fibre had a significant value $p<0.05$ of 0.78% in control diet, while no value was recorded for the egg diets (T_1 to T_3). Crude fat analysed in the diets showed that T_1 (10.01%) varied significantly $p<0.05$ among the egg diets (T_1 to T_3) and control. Ash content of the experimental diets revealed that control diet (10.23%) was significantly higher $p<0.05$ than the egg diets (T_1 to T_3). The moisture content recorded in this study showed that T_3 (95.68%) was significantly different $p<0.05$ from other treatments.

The water quality parameters of the water medium during the experimental period is shown in Table 2.

Table 2: Water quality parameters

Parameter	Control	T_1	T_2	T_3
pH	4.89^b+0.06	7.19^a+0.01	7.01^a+0.02	7.05^a+0.07
DO (mg/l)	5.43^a+0.14	8.32^a+0.09	8.45^a+0.14	8.40^a+0.06
NH_3 (mg/l)	1.45^a+0.04	0.01^b+0.12	0.01^b+0.09	0.01^b+0.08

Means along the same column with different superscripts differ significantly ($p<0.05$)

The pH values of egg diets (T_1 to T_3) were within the tolerable levels, while the control (4.89) was significantly higher $p<0.05$ than other treatments. Dissolved oxygen (DO) achieved a significant level of 8.45 mg/l in T_2, while the least value was attained at 5.45 mg/l (control). Ammonia value for control diet had a significant value $p<0.05$ of 1.45 mg/l compared to T_1 to T_3 which showed no level of significance.

Growth parameters of *C. gariepinus* fry is presented in Table 3. The mean weight gain (MWG) recorded in T_2 (1.79 g) was significantly higher $p<0.05$ compared to a lower value recorded in the control diet (0.09 g). Similarly, SGR had a significantly value $p<0.05$ in T_2 (2.65). FCR had the least value recorded in T_2 (2.52) and a higher value was recorded in control diet (4.11). SR values revealed that T_2 (98.13%) was significantly higher $p<0.05$ than other treatments.

Table 3: Growth performance of *C. gariepinus* fry fed egg diets

Parameter	Control	T_1	T_2	T_3
MIW(g)	0.01+0.01	0.01+0.01	0.01+0.01	0.01+0.01
MFW(g)	0.10^d+0.09	0.30^c+0.02	1.80^a+0.05	1.03^b+0.06
MWG(g)	0.09^d+0.04	0.29^c+0.03	1.79^a+0.12	1.02^b+0.11
SGR	0.53^d+0.10	0.89^c+0.02	2.65^a+0.03	1.67^b+0.11
FCR	4.11^a+0.02	3.01^b+0.04	2.52^d+0.11	2.85^c+0.03
SR (%)	45.56^d+0.14	61.11^c+0.02	77.78^a+0.03	68.89^b+0.12

Means along the same column with different superscripts differ significantly ($p<0.05$)

Discussion

Effects of different processed forms of egg diets on growth of *C. gariepinus* was investigated. The egg white is a hydrated medium, viscous, rich in protein and heat treatment would cause a distortion of its components, non-enzymatic browning and coagulation of proteins (Campbell *et al.*, 2003, Sanchez and Fremont, 2003). Akkouche *et al.,* (2012) reiterated in their study that the extent of temperature and duration of the treatment ranged from denaturation at the gelation or coagulation. Looking critically into the disparities in the crude protein of the egg diets and fish meal, it could be suggested that the crude proteins of the egg yolk and albumen might have been denatured during the heating process in the oven. Nabulime *et al.*, (2015) affirmed that quality of food protein ingredients used for feed formulation and method of feed processing improved availability of protein. Hoornyck (2000) further corroborated that heat treatment increased the chances of protein denaturation and decreased solubility of protein. The pH, DO and ammonia values recorded in control diet did not agree with the findings of Yakubu et al., (2015) who studied the impact of three different commercial feed on the growth and survival of *C. gariepinus* fry in aquaria glass tanks. The high levels of ammonia recorded in the control diet could be responsible for the acidic level of the water medium and low oxygen concentration.

The values recorded for SGR and FCR in this study did not fall within the range recorded by Singh *et al.,* (2012) in their study: Effect of feeding enriched formulated diet and live feed on growth, survival and fatty acid profile of Deccan Mahseer, Tor Khudree (Sykes) first feeding fry. Nutritionally, it would be expected that control diet which had the highest crude protein level would translate to best growth performance. Unfortunately, control diet (fish meal) was suspected to pollute the water medium, thereby increasing the ammonia level in water. This explained why the level of DO was drastically reduced to a level that could not support best growth performance *C. gariepinus* fry.

Conclusion

Larviculture requires alternative protein supplements to substitute expensive fish meal. It is evident from the findings of this study that egg yolk and albumen could sufficiently be used as starter feed after endogenous feeding. Nevertheless, precautions must be taken not to denature the crude protein in the egg diets during processing.

Conflict of Interest

There is no conflict of interest

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