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Research Article

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Proximate composition of *Clarias gariepinus* fry fed with inert diet and *Artemia salina*

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Abstract The proximate composition of African catfish, *Clarias gariepinus,* fry raised with inert diet and *Artemia salina* were investigated for 42 days. Altogether 720 fries were divided into three Diets based on the different diet treatments for this study. Catfish fry in Diet 1 were fed with *Artemia,* catfish fry in Diet 2 were fed with inert diet and Diet 3 fry were fed with a combination of *Artemia* and inert diet. At the end of feeding trial, the fry were sacrificed and their proximate composition determined. The crude protein of the carcass was highest in Diet 3 (65.92) > Diet 1 (64.75) > Diet 2 (39.67) , the ash content ranked highest in Diet 3 (9.96) > Diet 1(9.90) >Diet 2 (9.84), the lipid content ranked highest in Diet 3(16.51) >Diet 1(14.54) > Diet 3(8.66), the Crude Fibre ranked highest in Diet 1(6.67%) > Diet 3 (5.44%) > Diet 2 (5.24%), while the Nitrogen Free Extract varied from 2.18 for Diet 3 to 35.06 for Diet 2. Significant difference ($P < 0.05$) was observed in the crude protein content and the NFE content of the fry carcass fed with the different diets. In conclusion, a diet combination of *Artemia* and inert diet had the highest (65.92) crude protein. Based on the proximate composition and growth performance of the fry after treatment with the various diets, it is therefore recommended that a combination of *Artemia* and inert diet is the most suitable diet for *Clarias gariepinus* fry.

Keywords *Clarias gariepinus, Artemia salina*

Introduction

In recent years, Nigerian fish culturists have made use of several materials to rear the larvae of *Clarias gariepinus* [1]. The availability of suitable diets that are readily consumed efficiently digested and provides the required nutrients to support good growth and health [2] leads to the success of larval rearing. One of the major obstacles causing an impediment to the development of aquaculture industry is availability of affordable and high-quality fish feed [3]. Survival rate and fish growth depends on the kind of feed, feeding frequency, feed intake and the fish's ability to absorb the nutrients. Starter feeds are important in the growth of African catfish (*C. gariepinus)* larvae. Live feeds such as *Artemia*, rotifers, copepods, *cladocerans* have been employed with successful outcomes in feeding most fry of *C. gariepinus* [4-5]. Although *Artemia nauplii* and decapsulated cysts have long been used successfully in starter feeds of most fish fry [5], their increasing cost and rise in adulterated *Artemia* is a major constraint to most fish farmer especially in West Africa. 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. Attempts have also been made to use inert diets solely or in combination with live food for fish larvae rearing [6]. Most studies using inert diets have not given satisfactory results [7]. Growth and survival data are powerful tools for understanding the effects of both live and manufactured diets on first-feeding fish larvae [8].

Materials and Methods

This study was conducted in the main laboratory of Faculty of Agriculture, University of Benin, Benin-city, Edo state, Nigeria, for forty-two (42) days. *Clarias gariepinus* larval were obtained through the hypophysation technique. On the fourth day after hatching, 720 healthy larvae were randomly selected from the hatchery and distributed into nine pre-prepared transparent plastic tanks holding 40L of water at a density of 80 larval per tank under natural photoperiod regime. At the onset of the experiments, the average initial weight of fish was taken per tank as follows: Diet 1, 0.0084g; Diet 2, (0.0067g); Diet 3, (0.0084g).

Preparation of Inert Diet

Fish crumb was purchased from the market and then sun-dried for two days to ensure that the moisture content was drastically reduced. After sun-drying, it was milled to fine particles with a milling machine. The fishmeal was then sieved with a small mesh filter to obtain a uniform and fine particle size fishmeal. In the preparation of inert diet, raw eggs were boiled for about 10 minutes after which the egg white was separated from the yolk. The egg white was then crushed to a very fine particle and then mixed with the fishmeal earlier prepared to serve as a binder

Experimental Diets and Treatments

Three (3) experimental diets were used viz- *A. salina* shell free (D1); the inert diet (D2) and a combination of *Artemia* and the inert diet (D3). Each experimental treatment was replicated three (3) times. *A. salina* shell free which has been used with various level of success for fry rearing was used as control diet. All diets were administered manually three times a day between 8:00 A.M. and 18:00 hr. The experiment was laid out in a complete randomized design. Proximate analysis of the experimental diet was performed at Faculty of Agriculture Main Laboratory.

Management Practice

The water was changed once every morning. Changing of the water was done prior to feeding in the morning. 15-20 minutes after each feeding in the morning and evening, the unconsumed feeds were removed by siphoning them out of the transparent plastic tanks into a drainage channel in the laboratory. Once every week, total changing of the water, washing of the tanks, weighing of the fry and determination of feed consumed was carried out. This helped to keep the water temperature, pH, dissolved oxygen, ammonia and nitrate under control.

Proximate Analysis of Experimental Diet

Proximate analyses of the experimental diet were carried out. Moisture content, nitrogen, ether extract, crude fibre and nitrogen-free extract (NFE) were determined according to the procedures of Association of Official Analytical Chemists (A.O.A.C., 2000). A factor of 6.25 was used to convert the total nitrogen content to protein.

Growth Parameters Determined

Growth parameters were determined using both length and weight.

1. Weight gain (g) = Final weight – initial weight,
2. Percentage weight gain (PWG) = $\frac{\text{weight gain}}{\text{initial weight}} \times 100$
3. Specific growth rate (g/day) = $\frac{100\times[\text{In}(\text{Final weight}) - \text{In}(\text{Initial weight})]}{\text{Rearing period in days}}$

   Where ''In'' represent natural logarithm.
4. Survival rate (SR %) = $\frac{\text{Total number of fish harvested}}{\text{Total number of fish stocked}} \times 100$
5. Performance index = $\frac{\text{survival rate} \times \text{weight gain}}{\text{culture duration in days}}$

Statistical Analysis

Data obtained were analysed using one way analysis of variance and differences in means were compared using Least Significance Difference at P=0.05. Analysis was done using a statistical software programme (GenStat version 12.5).

Results

Table 1: Growth performance and feed utilization of catfish fry fed with three different meals

Diets	WG (g)	SGR	PGR	Feed intake	FCR
Diet 1	0.42^b	13.55^a	383.40^a	0.35^{ab}	1.08^b
Diet 2	0.17^a	11.88^a	259.40^a	0.20^a	1.19^b
Diet 3	0.73^c	14.86^a	445.50^a	0.47^b	0.70^a
Standard error of mean	0.09	1.47	137.20	0.08	0.06

Means in the same column with similar superscript are not significantly different (P>0.5)

WG=Weight gain, **SGR**=Specific growth rate, **PGR** = Percentage growth Rate, **FCR** = Feed Conversion Ratio

The results showed that the weight gain was higher in Diet 3 with a mean weight gain of 0.7308g while the least was recorded in Diet 2 with a weight gain of 0.1654g. There was significant difference ($P<0.5$) in the weight gain. The specific growth rate in descending order ranked from Diet 3 (14.86) > Diet 1 (13.55) > Diet 2 (11.88). There was no significant difference ($P>0.5$) in the specific growth rate. As shown in Table 1, the PGR was higher in Diet 3 with a mean of 445.5 while the least was recorded in Diet 2 with a mean of 259.4. There was no significant difference ($P>0.5$) in the PGR.

The feed intake ranked higher in Diet 3 (0.4681) while it ranked lowest in Diet 2 (0.1950). There was no significant difference ($P>0.5$) in the feed intake. The Feed conversion ratio ranged from 0.6989 in Diet 3 to 1.1932 in Diet 2. There was significant difference ($P<0.5$) in the FCR.

Table 2: Proximate composition of different meals fed to catfish fry

Diets	Moisture	DM	Ash	Fat	CF	Protein	NFE
Diet 1	31.45	68.55	4.31	9.75	2.45	43.75	8.29
Diet 2	31.35	68.65	4.31	10.11	3.11	43.75	7.37
Diet 3	30.27	69.73	3.75	10.12	3.22	42.00	10.64

NFE = Nitrogen Free Extract, CF = Crude Fibre, DM = Dry matter

Table 3: Mean proximate composition of fry fed with different diets.

Diet	Moisture	Dry matter	Ash	Fat	Protein	NFE
Diet 1	6.65^b	93.35^a	9.90^a	14.54^b	64.75^b	4.06^a
Diet 2	5.24^a	94.76^a	9.84^a	8.66^a	39.67^a	35.60^b
Diet 3	5.44^a	94.56^a	9.96^a	16.51^c	65.92^b	2.18^a
S.E.M	0.37	0.99	0.33	0.38	1.07	1.22

NFE = Nitrogen Free Extract. Means in the same column with similar superscript are not significantly different (P>0.5).

From Table 2 above, it was observed that the crude protein of Diets 1 and 2 (43.75) varied with Diet 3 (42.00); however as shown in Table 3, the dry matter content of the fry carcass ranked from 93.35 for Diet 1 to 94.76 for Diet 2. There was no significant difference ($P > 0.05$) in the dry matter composition of the fry fed with the three diets.

As shown in Table 3, the ash content of the carcass varied from 9.84 in Diet 2 to 9.96 in Diet 3 while the fat content of the fry carcass for the various diets ranked from 8.66 in Diet 2 to 16.51 for Diet 3. There was no significant difference ($P > 0.05$) in the ash content of the carcass fed with the various diets while significant difference ($P < 0.05$) was observed in the fat content of the fry carcass for the various diets.

The crude protein of the carcass ranked highest in Diet 3 (65.92) > Diet 1 (64.75) > Diet 2 (39.67) while the Nitrogen Free Extract or carbohydrate content varied from 2.18 for Diet 3 to 35.06 for Diet 2 (Table 3). Significant difference ($P < 0.05$) was observed in the crude protein content and the NFE content of the fry carcass fed with the different diets.

Discussion

The present study was carried out to observe the effect of feed types on the proximate composition of catfish fry. The three diets used are *Artemia* (Diet 1), Inert diet (Fish meal and egg yolk) (Diet 2) and a mixture of *Artemia* and Inert diet (Diet 3). The crude protein of Diet 1 and Diet 2 (43.75%) ranked higher than the observed value of Diet 3 (42.00%). The observed crude protein content of *Artemia* of 43.75% was lower than the values observed by [5] (54%); [9] (54%) and [10] (57.28%). The fat content of Diet 2 and Diet 3 were slightly different (10.11%) and (10.12%) respectively and ranked higher than the observed value in Diet 1 (9.75%). The observed NFE values ranged from 7.37% for Diet 2 to 10.64% for Diet 3. Diet 1 had an intermediate NFE content of 8.29% which is lower than the value (27%) observed by [9]. The ash content values observed across the three diets ranged from 3.75% in Diet 3 to 4.31% in Diet 1 and Diet 2. The ash content value (4.31%) observed in *Artemia* (Diet 1) was higher than the value (4%) was observed [5,9].

From the study, it was observed that Diet 3 had the best protein content with a value of 65.92% as compared to the values observed in Diet 1 and Diet 2 (64.75% and 39.67% respectively). It was also observed that Diet 3 gave the best fat content value (16.51%) as compared to 14.54% for Diet 1 and 8.66% for Diet 2 while Diet 1 had ash content (9.90%) intermediate between the content in Diet 2 (9.84%) and Diet 3 (9.96%). The values observed for NFE in descending order ranked from Diet 2 (35.60%) > Diet 1 (4.06%) > Diet 3 (2.18%). It was noted that as body fat increased, the crude protein increased concomitantly. This is in contrast to the study by [11] on *Heterobranchus bidorsalis* and [12] on juvenile monosex Nile Tilapia.

The increase of whole body protein and decrease of lipid content with increasing dietary protein level may be attributed to the high carbohydrate and low protein content of diet 3 containing 42.00% protein levels. The excess carbohydrate in the diet may be converted into body fat for storage [12]. In addition, the biochemical composition showed that the highest lipid content was recorded for the larvae fed diets containing low protein levels (Diet 3). This observation agrees with other studies which reported that diets with high lipid content alter body composition of fish, by reducing their water content [11, 13]. The result of this study showed *Clarias gariepinus* fry had high protein, fat and ash content when fed with a combination of Diet 2 (egg yolk and fish meal) and *Artemia*. The yolk might have supplement some of nutritional deficiency of *Artemia* [14-15] while the endogenous enzymes in *Artemia* might help the digestion of egg yolk [16-17].

Artemia is still the most preferred and reliable live food in rearing fish and crustacean larvae [18]. However, *Artemia* is not cost-effective in most developing countries. Therefore, the use of *Artemia* is limited in aquaculture [19]. Attempts have also been made to use inert diets solely [20], or in combination with live foods for fish larval rearing [6]. Mouth size is a sure criterium to consider when feeding larval fish on either a natural or an inert compound diet. Most studies using inert diets have not given satisfactory results [7, 21].

Conclusion

In most species inert diets alone have a poor ability to sustain fish larvae growth and development. Furthermore, results of co-feeding inert diets and live prey are variable, which may be related to the effect of inert diets on digestive maturation and subsequently protein utilization. Proper selection and incorporation of local feed ingredients may be useful in the formulation of dry fry experimental feeds for weaning larval catfish. Knowledge gathered from the present study towards carcass quality when fed with the various diets suggests that the most suitable is a combination of *Artemia* and inert diet.

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