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COMPARATIVE STUDY ON THE USE OF NATURAL AND ARTIFICIAL BASED FEEDS FOR THE CULTURE OF *Clarias gariepinus* FINGERLINGS

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ABSTRACT

In an effort to promote growth, increase survival and reduce cost associated with fish meal, a comparative study on the use of two diets (Maggot fortified with cultured zooplankton and Coppens unfortified with cultured zooplankton) were carried out on sixty specimens of *Clarias gariepinus* fingerlings. Initially, the specimens were fed twice daily on Coppens and allowed to acclimatize for two weeks. There after ten fingerlings from the general pool were randomly selected and distributed into each of three pairs of glass tanks (30cm x 15cm x 15cm), artificially aerated and observed under laboratory conditions for 56 days using the various treatments. There was a significant difference ($P<0.05$) in weight gain and total length increase for both treatments in comparison with the control experiment. The result of this study has shown that diet I, contained the richest nutrients which gave rise to the best growth and size increase desired in aquaculture. Fish mortality was nil for diet I; 30.0 % for diet II and 60.0 % for diet III. Diet I was the cheapest, more easily accessible, not competed for and most easily re-producible, hence its usage should be encouraged. In contrast, diet II which was the most expensive, beyond the reach of most fish farmers and which requires laborious water quality monitoring should be discouraged.

Keywords: fish feeds, mortality, aquaculture, maggot, *Clarias gariepinus* fingerlings, growth performance, treatment.

INTRODUCTION

Fish is most widely accepted as a nutrient-rich food source because it is palatable, tender, and of high nutritive value. The nutrients derived from fish include vitamins, calcium, phosphorus and unsaturated fat. These nutrients when provided naturally or artificially in aquaculture enable the fish to grow adequately for the enhancement of health in humans (Ayanda, 2003). Various fishes may not be free from cultural and religious taboos, but could be acceptable by people of all nations, tribes and religious affiliations (Ayodele and Fregene, 2003).

The inadequate supply of fish protein in the country has no doubt increased malnutrition especially among low income earners. These persons can hardly afford the high cost of meat products. The demand for fish has therefore been on the increase because the high cost of protein from livestock, and the general increase in human population, has resulted in increased demand for food, including fish. Fish like other animals require essential nutrients to grow adequately at all times. Such nutrients could be supplied from plankton, (Adigun, 2005) insect's larvae, worms/maggot, etc. (Ovie, 1996). When fishes are cultured in artificial environment, additional nutrients need to be supplied in form of supplementary diet (Eyo, 1996). Incorporation of planktons in the feed composition of these fishes could reduce the high cost associated with feeding, as well as improve water quality associated with artificial diet. Survival and increased availability of fries and fingerlings were better guaranteed in combination with plankton, than the result with artificial diet alone in the hatchery (Ovie, 1986, 1996).

High cost of fish feed has been a major problem to fish farmers in Nigeria. This high cost constitute 40-60% of the recurrent cost of most intensive fish farm ventures which negates the economic viability of the farm when cheaper alternatives are not available (Madu, *et al*., 2003). Artificial feed is usually expensive because the conventional feed ingredients compete for its consumption by human and livestock. There is need to identify, explore and utilize cheaper non-conventional feeds which are not only easily available but which attracts less competition. Based on affordable cost, ready availability and provision of crude protein content, maggot grown on poultry waste was reported to possess immense potential for fish feed production (Adesulu and Mustapha, 2000 and Ogunji *et al*., 2006). Fishes have used protein efficiently as energy source; hence they convert protein to energy better and faster than livestock. This gives fish a higher productive energy value, attributable to the efficient manner in which it excretes nitrogen (Falayi, 2003).

Compounded feeds for intensive fish culture have been developed in few industrialized countries where a preference for farmed fish has increased. To meet animal protein needs in developing countries, increased efforts are being made to develop aquaculture on an intensive scale (Falayi, 2003) where the cheapest but most nutritive feed ingredient will be used. For this reason growth and productivity of fish, has been focused on the provision of nutritionally adequate diets that will not only enhance their well being but which will enhance human growth.

The effect of natural feeds on the growth performance and survival rates of fingerlings has not been exhaustively investigated. For this reason, the present study will determine the best in terms of finance, easy accessibility, less competition and most easily re

producible of two diets for the growth and survival of *Clarias gariepinus* fingerlings.

MATERIALS AND METHODS

Four weeks old fingerlings of *Clarias gariepinus*, were obtained from the hatchery unit of DELSU Investment Limited, Delta State University, Asaba Campus. They were conveyed in plastic bucket to the Fisheries Laboratory of the Institution. During two weeks acclimation in habitat water contained in 75 liters capacity aquarium, they fed on Coppens *alibitium*, but starved for 24 hours before the application of dietary treatments. Ten specimens each were randomly selected from the pool and stocked into three glass tanks (30cm x 15cm x 15cm) in duplicate and artificially aerated. Each tank was filled with 20 liters of screened habitat water, maintained at 27^0C temperature, 7.2 mg/l dissolved oxygen and 6.84 units of Hydrogen-ion-concentration (pH).

Composition of the experimental diets is shown in Table-1. The first treatment, that is, maggot grown from poultry waste was produced as described (Eyo *et al*., 2006). The proximate analysis of the treatments revealed that maggot contained 44.5 % of crude protein, 10 % of ash and 24 % of lipid. The cultured zooplankton contained 60.8 % crude protein, 9.05 % ash and 13.4 % lipid, while Coppens contained 45.00 % of crude protein, 9.05 % of ash and 12 % of lipid. Each treatment was applied in duplicate. For instance, diet I coded as Ia and Ib contained, maggot meal fortified with cultured zooplankton whose biochemical composition is shown in Table-2. Diet II coded as IIa and IIb was composed of Coppens alone. Diet III whose code was IIIa and IIIb represented the control experiment. It contained cultured zooplankton alone. The culture of zooplankton in this study was as described by (Ovie, 1996). Zooplankton collections were screened through mosquito nettings to remove larvae, debris (Ovie, 1996) and predators (Wedemeyer, 2001). Samples of the cultured zooplankton, were mounted under a Binocular Microscope (Olympus CH) and identified according to Willoughby and Wetzel (1976), Table 1.

Table-1. Composition of experimental diets.

Dietary inclusion of the various treatments

INGREDIENTS	DIET 1	DIET 11	DIET 111
Maggot meal (Diet 1)	44.5	-	-
Coppens (Diet 11)	-	45.0	-
Zooplankton composition (Diet 111)	Zooplankton fortified	-	Zooplankton fortified
Yellow maize	24.00	24.00	24.00
Vegetable oil	1.00	1.00	1.00
Blood meal	4.60	4.60	4.60
Vitamin premix	0.50	0.50	0.50
Soyabean meal	54.00	54.00	54.00

Cultured zooplankton composition:
Rotifers: *Branchionus plicaticis, B. rubens, Asphachna* sp, and *Polyarthra* sp.
Cladocera: *Daphnia carinata*, *Moina* sp and *Daphamosoma* sp
Copepods: *Calanus plumchrus* and *Cyclops* sp.
Egg of crustaceans, naupli, copepoid and mosquito larvae.

Table-2. Biochemical composition of various zooplankton (%).

Zooplankton	MOIS	CP	CF	CHO	ASH	P	C
Daphnia sp	88.3	69.1	12.07	-	6.47	1.44	0.19
Daphnia carinata	91.3	52.9	7.00	25.9	11.4	1.09	-
Branchionus plicaticis	89.9	63.5	14.00	-	9.9	1.00	0.16
Calanus plumchrus	88.9	57.8	20.6	0.50	8.43	-	-
Average composition	89.6	60.8	13.4	13.2	9.05	1.17	0.18

MOIS= Moisture, CP=Crude protein, CF=Crude fiber, CHO= Carbohydrate= Phosphorus Carbon.

The fingerlings were fed twice daily for 56 days at 0900h and 1500h with feeding adjusted in accordance with their body weight. Batch measurement of body weight was taken with the aid of an electronic balance (LP 302A LARK), and recorded to the nearest (0.01g) at weekly intervals, while total length measurements were recorded to the nearest 0.1 mm with the aid of a measuring board each week. Depleted water was replaced with fresh one regularly while the entire experimental water was changed every other week. Water temperature, dissolved oxygen and pH values were observed routinely. Weight gain, size increment and survival of fingerlings were monitored for each treatment.

Data were subjected to one-way analysis of variance (ANOVA) at 5% level of significance. Duncan Multiple Range Test was used to determine the differences among means.

RESULTS AND DISCUSSIONS

Adequate water quality parameters (pH, temperature and dissolved oxygen) were maintained throughout the period of the study in the manner reported by Swingle (1969) and Boyd (1979). This observation was important based on the fact that water quality attributes are prime factors that influence all biological productions, fish survival and adequate growth performance (Adigun, 2005).

There was a significant difference ($P<0.05$) in the body weight of the fingerlings in comparison with the control treatment (Table-3). However, visual observation of the treatment combination in diet I (Maggot: 44.5 % crude protein, 24 % lipid and 10 % ash; Zooplankton: 60.8 % crude protein, 13.4 % crude fiber and 9.05 % ash) revealed that it was richer/higher than diet II in protein composition (Coppens: 45.0 % crude protein, 12.0 % lipid and 9.5 % ash). According to (Sogbesan, 1998) fingerlings are always able to convert the protein components in natural meals more efficiently than those found in artificial feed. This observation agree with that of the present study where maggot meal fortified with cultured zooplankton provided adequate protein, lipids, fatty-acids, minerals and enzymes for the fingerlings. Both combinations also enhanced better growth of fingerlings as revealed by (Holm and Moller, 1984; Ovie, 1996 and Kibria *et al*., 1997) as well as minimized problems associated with artificial diets (Eyo, 1996 and Ovie, 1996). Again, the present observations were corroborated with the findings of Ovie *et al*., 1986; Ajayi (1998); Adesulu and Mustapha (2000); Fasakin *et al*., (2003); and Ajani *et al*., (2004); who opined that the availability of natural organisms in large quantity and high quality at the right time guaranteed good performance of fry and fingerlings in aquaculture. Rimmer and Power (1978); Lan and Pan (1993) and Madu, *et al*., (2003) reported that the nutritive value of natural feed promotes better growth and higher yield in fish than that achieved from artificial feeds. This may have been the reason why diet I which was fortified with cultured zooplankton resulted in the best growth performance and fish survival. It is also for this reason that (Ayanda, 2003) concluded that the growth rate and survival of fish did not only depend on the amount of feed available, but also on its nutritive value. Although artificial feeds are specially made to meet the nutritional needs of fingerlings (FAO, 2008); their nutritional benefits were better realized when used in combination with zooplankton. Diet III gave rise to the highest recorded deaths. This is probably due to the fact that as the fingerlings advanced in age, the nutrient composition of the treatment became insufficient and could no longer sustain and satisfy the growing fingerings. This has often been the situation over time when fishes are grown singularly on natural feed (Ekokotu and Ekelemu, 1999).

There was a significant difference ($P<0.05$) in the total length increase of the fingerlings when compared with the control treatment (Table-4). According to Ajayi (1998); Sogbesan (1998); Adesulu and Mustapha (2000); Fasakin, *et al*., (2003) and Ajani *et al*., (2004) fishes reared on qualitative natural meals as that of diets I achieve adequate growth. This was because they utilized the nutrient from such feeds better and faster than those from artificial feed Coppens: diet II. In this regard, the reports of earlier researchers are in consonance with that of present study. The methods used for collecting, processing, drying, storing and administering of feeds by the previous and present researchers would have been same or almost similar. The crude protein value (44.5 %), ash content (10 %) and lipid concentration (24.0 %) of maggot used in the present study was comparable with those reported in literature. For instance, Ajayi (1998); Adesulu and Mustapha (2000); Fasakin, *et al*., (2003) and Ajani, *et al*., (2004), reported 61.4 % crude protein, 12.5 - 21 % lipid, and 0.93-11 % ash in maggot. The slight variation observed in the compositions of nutrients may have arisen from differences in the dung used for maggot production, rate and frequency of feed application.

An overall survival of 70.0 % was recorded at the end of this study. Fish mortality was nil in diet I; 30.0 % in diet II and 60.0 % in diet III (Table-5). For diet III where the fingerlings depended solely on cultured zooplankton during the study, resulted in the highest rate of fish mortality. This happening may have arisen because as the fingerlings advanced in size over time, the nutrient composition of diet III did not only become insufficient but also inadequate resulting in the weakness and subsequent death of the fingerlings. Again the quality and quantity of the zooplankton may have varied or became insufficient for fast growth and sustenance over time. Such observation agrees with the report of Wedemeyer, (2001). The mortality recorded for diet II may have emanated from depleted water quality arising from the use of artificial feed: Coppens. This report agrees with that of Eyo (1996). In addition, (Ovie, 1986) was of the opinion that the use of artificial diet alone without natural feed provided insufficient nutrients and could induce some effects which will result to fish mortality. The high survival rates of fingerlings used for this study could be compared with those of previous researchers. For instance, while (Sogbesan, 1998) reported 75.0 % survival using

artificial feed; the present study observed 70.0 % survival using the same artificial feed. Again, 95.0 % survival was reported for the use of natural feed whereas the present study recorded 100.0 %. The uniformity in the results obtained in both studies may have emanated from careful handling of fingerlings which minimized the degree of stress experienced during weekly fish measurement exercises by different researchers.

The study revealed that diet I proved to be the most conducive for rearing *Clarias gariepinus* juvenile in this study. It was the best alternative in comparison with diets II and III because it gave rise to the best growth rate and size increase. It was richer in crude protein, crude fiber and lipids necessary for adequate growth and survival of fingerlings. The diet was also not competed for; it was the cheapest to produce, easily accessible, more easily re-producible and economically viable. In contrast, the use of Coppens resulted in laborious water quality monitoring; it was less economically viable and not easily affordable to all fish farmers.

Table: 3. Weekly variation in body weight for all treatments (g): time in weeks

DIETS	1	2	3	4	5	6	7	8
Diet 1	3.46^{a}	5.34^{b}	7.74^{b}	7.78^{b}	9.90^{c}	11.65^{c}	12.28^{c}	14.02^{c}
Diet 11	3.43^{a}	4.04^{a}	5.05^{a}	6.02^{a}	7.14^{b}	8.34^{b}	9.00^{b}	9.71^{b}
Diet 111	3.41^{a}	3.52^{a}	4.65^{a}	5.67^{a}	5.88^{a}	6.59^{a}	6.79^{a}	7.48^{a}

Means with different superscripts are significantly different ($P<0.05$) using (DMRT).

Table: 4. Weekly variation in total length for all treatments (mm): time in weeks

DIETS	1	2	3	4	5	6	7	8
Diet 1	75.5^{a}	81.0^{b}	84.5^{b}	94.0^{c}	99.0^{c}	105.0^{c}	109.0^{c}	117.5^{c}
Diet 11	75.7^{a}	78.7^{a}	81.5^{a}	84.5^{b}	89.5^{b}	90.5^{b}	92.5^{b}	100.0^{b}
Diet 111	74.5^{a}	78.5^{a}	80.0^{a}	80.0^{a}	84.0^{a}	85.9^{a}	87.0^{a}	89.5^{a}

Means with the different superscripts are significantly different ($P<0.05$) using (DMRT).

Table: 5. Weekly variation of fish mortality for all treatments: time in weeks

DIETS	1	2	3	4	5	6	7	8	No of deaths	% Deaths/survival
Diet 1	-	-	-	-	-	-	-	-	-	100% survival
Diet 11	-	-	-	-	-	2	2	2	6	30% deaths
Diet 111	-	-	1	1	1	2	3	4	12	60% deaths

CONCLUSIONS

This study has shown that diet I was the best alternative for the rearing of *Clarias gariepinus* fingerlings. The diet resulted in the best growth/total length increase, as well as the highest fish survival. Again on the basis of easy availability, compatibility, affordability and less competition, diet I proved to be superior to diet II. It can be concluded from this study that the cost of fish production was greatly reduced, the growth rate of fish improved and survival of the fingerlings enhanced when maggot meal was fortified with cultured zooplankton.

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