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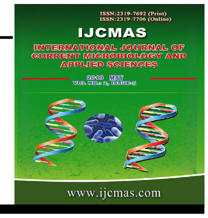

Original Research Article

Evaluation of growth response of *Clarias gariepinus* fingerling fed dried maggot as protein source

Ajonina A. Samuel[1]* and R.E. Nyambi[2]

[1]Department of Environmental Science, University of Buea, Cameroon
[2]Chair of Environmental Land Planning, Brandenburg University of Technology, Cottbus, Germany
*****Corresponding author e-mail: saajonina@yahoo.com*

Keywords

Growth response; nutrient utilization; *Clarias gariepinus*; dried poultry maggot; protein.

A B S T R A C T

A feeding trial was conducted at the aquaculture unit of Cameroon Society for Sustainable Development of Natural Resources and Environmental Protection (CASSDNREP) for 13 weeks to evaluate the growth response *Clarias gariepinus* fingerlings obtained from the Ndongo stream in Buea using dried maggots generated from poultry droppings as protein source in place of fish meal. Five experimental diets (40% crude protein) were formulated, four of these diets contained dried maggot meal at varying levels of (25%), (50%), (75%) and (100%) while the diet with fish meal served as control. Fish fingerlings were fed weekly at (5%) body weight. It was discovered that the percentage weight gain was not significantly different ($p<0.05$) among the controlled diet and the experimental diets; specific growth rates were also not significantly different ($p<0.05$) among the controlled diet, diets A and B but different in diets C and D with diet D (100% of dried maggots) having the highest value. The highest weight gain was recorded in diet D containing (100%) dried maggots (23.05g) while the least at (50%) inclusion (14.03g). Fish protein increased with increasing maggot substitution. Based on the observations from the result of this study we conclude that *Clarias gariepinus* fingerlings harvested from the wild could tolerate (100%) inclusion of dried maggot meal in the diet in place of fishmeal.

Introduction

Studies in the fish feed technology have revealed that there is a potential for big time investment into fish feed production and marketing in view of the growing awareness of fish farming in Cameroon. In fish farming, nutrition is one of the most critical factors because fish feed represents (50-60%) of the total production costs. promote optimal fish growth and health. The development of new species-specific diet formulations is vital for sustainable aquaculture venture i.e. fish farming industry as it expands to satisfy increasing demand for affordable and high quality fish. Aquaculture is the rational rearing of fish and other aquatic organisms in man-made ponds. As previously reported by

World Fish Center (2005) one of the areas which the fisheries potential of Cameroon could be exploited is through aquaculture, the development and expansion of which would however, depend mainly on many factors. These include the availability of good quality and relatively inexpensive feed ingredients for the formulation of compounded food since supplement feed brings greater yields in ponds than if the fish were left to depend on natural (aquatic) food. According to Miles and Chapman, (2006), various feeds are used in culturing fishes to enhance adequate fish growth, reproduction and survival. Tacon and Barg, (1998) reported that fishmeal which serves as the main protein source for fish feed because of its high quality protein content, is not only expensive but also usually unavailable, particularly in developing countries. Fagbenro and Davies (2003) reported the efforts to replace fishmeal with vegetable protein from more sustainable sources by many workers. Local plant and animal protein ingredients have been extensively studied for use in fish feed formulations for aquaculture Gatlin *et al*., (2007); Gallagher, (1994), these include various pulses and lupins in carnivorous fishes such as rainbow trout, blood meal, feather meal and earth worms etc. Earlier reports of Cook *et al.,* (2000) and Lockeett *et al*., (2000) showed that maggot meal is an animal ingredient with an outstanding protein quality and its protein and amino acid composition has been reported. The most conventional protein sources used in fish feed such as soya bean, fish meal etc are becoming expensive especially to small scale fish farmers in Cameroon. Also, the competing demand for fish feed stuff such as corn, soybean, cotton seed cake, rice brand and groundnut cake has made feed production expensive (Anant *et al*., 2002; Bureau *et al*., 2000; Kikuchi *et al*., 1997; and Gallagher, 1994). This high demand for these feed stuffs by man and consequently the high prices has made other means such as "dried maggots and dried earth worms" inevitable. Since the primary objective of fish nutrition work is geared towards reducing protein cost in fish feed, it is of interest to investigate and utilize the suitable abundant conventional and non-conventional feed resources available in Cameroon for feed formulation. This work is therefore intended to evaluate the effects of dried maggot meal as a substitute of fish meal in the feed of *Clarias gariepinus* fingerlings as a protein source.

Materials and Methods

Fish feed stuff that are protein based were computed in diet formulation using the popular Pearson square method as applied by Wagner and Stanton (2010) to determine the proper dietary proportion of feed stuff bearing about the protein requirement of the fish. After preparing the ingredients, they were weighed and mixed in appropriate proportions to give the desired protein level required by the fish. Four experimental feeds were formulated at varying percentage inclusion of dried maggot meal (A-25%, B-50%, C-75% & D-100%) and a control diet having fishmeal solely as the source of protein. Dried maggots are commonly generated from decaying poultry droppings, cow dung, goat dropping, and other decaying animal materials waste found in large quantities in the South, Littoral Western and North West Regions of Cameroon. There is however, no negative economic impact on the use of maggots in aquaculture in Cameroon. The proximate analyses of the feed stuffs and experimental diets were carried out using the (AOAC, 1990). Gross composition of all diets is shown in Table 1

Table.1 Gross Composition Of Experimental Diets

Ingredient	Control	Diet A 25%	Diet B 50%	Diet C 75%	Diet D 100%
Fish meal	24.72	18.54	12.36	6.18	/
Maize bran	21.85	21.85	21.85	21.85	21.85
Dried maggot		6.18	12.36	18.54	24.72
Groundnut cake	24.72	24.72	24.72	24.72	24.72
Soya beans cake	24.72	24.72	24.72	24.72	24.72
Oil	1.0	1.0	1.0	1.0	1.0
Bone meal	1.0	1.0	1.0	1.0	1.0
Premix	1.0	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5	0.5
Starch	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100

The experimental tanks used for the research were 40l capacity plastic tanks filled with water. The fingerlings of *C. gariepinus* were procured from the Ndongo stream in Buea and stocked at the rate of 25 fingerlings per tank. The initial mean weights of the fingerlings were control (14.82g), treatment diet A (17.28g), diet B (13.39g), diet C (11.41g) and diet D (12.98g). The fingerlings were fed at (5%) body weight twice daily at 8am and 4pm except on sampling days. Feeding trial lasted for 13 weeks. Weights of specimens were taken weekly with a sensitive weighing balance (Metler P200) to the nearest gram. Water quality parameters measured during feeding trials included temperature determination using a standard laboratory thermometer (Jenway 9071); dissolved oxygen was measured using oxygen meter calibrated in mgl-1 (Jenway 9071) and pH determined using a digital pH meter (Teledo 320). Biological evaluations carried out include:

Weight gain = final weight–initial weight.

Percentage weight gain = Initial weight divided by Final weight X 100

Specific Growth Rate: (SGR) =Log eW2 – Log e W1 divided by T X 100.

Where W2 is the final weight of the fish; W1 is the initial weight of fish; T is the period of experiment in days; e is the base of natural logarithm.

Statistical analysis

Data collected were subjected to a One-way and two way analysis of variance (ANOVA) using the SPSS (statistical package computer software version 17), the means from the various treatments were compared for significant differences (P<0.05) using Duncan’s multiple range test (Duncan, 1955).

Results and Discussion

Table 2 shows the proximate composition of the experimental diets. The crude protein was slightly higher in diet D (40.06%) than the control diet while (%) fat was higher in the control diet (3.54%) than all the experimental diets. The (%) moisture was highest in diet A (10.57%) and least in diet B (10.09%). The (%)

crude fibre was highest in diet D (10.07%) and least in control diet (9.42%). The (%) ash was highest in diet C (11.10%) and least in control diet (10.09%). Carbohydrate was highest in treatment diet A (24.81%) and least in control (24.06%).

Growth performance of *Clarias gariepinus* fingerlings fed experimental diets as shown in Table 3 above revealed that weight gain (WG), percentage weight gain (% WG) and specific growth rate (SGR) of the fish specimens were not significantly different ($p<0.05$) i.e. the fish showed good appetite in all the treatment diets as attested to by the increased weight and length. However, the highest weight increase was in diet D-(100%), (18.05g) and least in diet B-(50%), (10.10g).

Table 4 shows the results of the carcass analysis of *C. gariepinus* fingerlings fed experimental diet after 13 week experiment. Control diet has the highest moisture content (10.06%) and least in diet C (6.28%). The highest crude protein was obtained in diet D (66.19%) while control diet had the lowest crude protein (62.37%). The ash content was highest in diet C (13.49%) and least in control diet (10.43%). The highest (%) fat was in diet A (14.95%) while the least was in diet D (12.33%). Carbohydrate content was least in the control diet with (0.21%) while diet D has the highest percentage of (0.54%). The average dissolved oxygen in the culture water ranged between 8.06-8.16 mgl-1, pH value ranged from 6.5-7.8 and temperature ranged between 25.7- 27^{o}C. These ranges fall within acceptable limit in aquaculture (Boyd, 1979).

This study reveals the possibility of utilizing dried maggots in the diet of fish such as *Clarias gariepinus*. From the analysis carried out, proximate composition of the carcass of the fish fed experimental diets agrees with the findings of Webster *et al*., (1997), Webster *et al*., (1999) who observed the best growth performance, food conversion and survival rate in sunshine bass fed fish meal free diets containing meat and bone meal (1-3g body wt.) when dried maggot meal was fed as supplemental food (maggot + artificial feed).

The increase in lipid deposits in the carcass of fish fed experimental diet of dried maggot meal may be responsible for the better growth in terms of weight rather than the crude protein. It has also been reported that dried maggot is rich in essential amino acids necessary for growth and development. Results from this study are similar to those obtained by Gallagher and LaDouceur, (1995), who observed the highest growth response of juvenile palmetto bass at a blood meal and poultry waste inclusion of (25%). Also present are other amino acids such as arginine and histidine as previously reported by (Griffin *et al*., 1994b).

Protein requirement is given high priority in any nutritional study because it is the single nutrient that is required in the largest quantity for growth and development and also the most expensive ingredient in diet formulation (Lovell, 1989; NRC, 1993). Dietary lipids function as a ready source of energy for fish and also provide essential fatty acids which are needed for fish growth and survival. Fish generally require omega-3 fatty acids rather than omega-6 fatty acids in contrast to terrestrial animals which require omega-6 fatty acids (Kanazawa, 2000). Previous work of El-Sayed (1998); identified meat

Table.2 Proximate composition of experimental diets.

Components (%)	**Control Diet (0%)**	**Diet A (25%)**	**Diet B (50%)**	**Diet C (75%)**	**Diet D (100%)**
Crude Protein	40.04	39.94	40.02	40.01	40.06
Moisture	10.24	10.57	10.09	10.35	10.53
Fat	3.54	3.37	3.07	3.06	2.98
Crude fibre	9.42	9.87	10.04	9.78	10.07
Ash	10.09	10.49	10.57	11.10	11.00
CHO	24.06	24.81	24.34	24.68	24.43

Table.3 Growth evaluation of *Clarias gariepinus* fingerlings fed experimental diets for 13 weeks.

Parameters	**Control Diet (0%)**	**Diet A 25%**	**Diet B 50%**	**Diet C 75%**	**Diet D 100%**
Initial mean	16.68± ^{b}	15.63± ^{bc}	11.47± ^{a}	12.20± ^{ab}	13.78± ^{ab}
Weight(g)	1.02	2.30	0.78	1.37	2.10
Final mean	21.44 ±^{c}	18.62 ± ^{b}	15.76 ± ^{a}	17.01± ^{a}	21.06± ^{c}
weight (g)	7.10	4.88	3.72	5.89	8.20
Weight	16.28 ± ^{a}	11.16 ± ^{ab}	10.10 ± ^{ab}	16.26±^{a}	18.05± ^{a}
Gain	8.50	9.41	16.37	6.35	18.28
%Weight	51.63 ± ^{a}	57.83 ± ^{a}	56.02 ± ^{a}	44.25 ± ^{a}	46.56± ^{a}
Gain	8.51	9.41	16.37	6.35	18.29
Specific	25. 60 ± ^{a}	28.10 ± ^{a}	26.24 ± ^{a}	36.84 ± ^{ab}	35.68 ± ^{ab}
Growth rate	3.30	7.66	2.04	5.26	19.51

Means on the same row with different superscripts are significantly different ($p<0.05$)

Table.4 Carcass composition of flesh of *Clarias gariepinus* fingerlings fed with experimental diets after the experiment.

Components (%)	**Control Diet (0%)**	**Diet A (25%)**	**Diet B (50%)**	**Diet C (75%)**	**Diet D (100%)**
Crude protein	62.37	64.19	64.66	64.79	66.19
Moisture	10.06	7.59	6.69	6.28	6.86
Fat	12.59	14.95	13.61	13.48	12.33
Crude fibre	0.06	0.05	0.06	0.06	0.05
Ash	10.43	13.67	13.27	13.49	13.43
CHO	0.21	0.38	0.34	0.44	0.54

and bone meal as an appropriate ingredient in diets fed to Nile tilapia (*Oreochromis niloticus*). The replacement of fishmeal by alternate sources of protein has met with varied degree of success, depending on the nature and composition of ingredients, inclusion level and method of processing. This study agrees with the findings of Webster *et al*., (1999) who had similar result from a study on the effect of substituting fishmeal diets with varying quantities of feather meal on the growth responses and food utilization of the hybrid striped bass. The findings from this study also agree very closely with those of Olukunle *et al*., (2002) who observed the best growth performance, hematology and serum enzyme activity at a blood meal concentration of (25%) on hybrid catfish fingerlings.

Based on the findings of this study, it is inferred that dried maggot meal is rich in protein and essential amino acids. It can also be inferred that inclusion of dried maggot meal in the diet of fish will improve growth yield of *Clarias gariepinus*. Though the dried maggot meal can be included up to (100%), since the fish showed good appetite for all the treatment diets, the results of this study recommends the inclusion of dried maggot meal is best at (25%). It is also recommended that maggots which are not competing with any other feed ingredient for animal feed formulation are available in large quantity and are rich in valuable protein. Therefore, the diet of fish can include a combination of dried maggots and fish meal as protein sources which will be considerably cheaper than using solely fishmeal. Results from this study will go a long way to contribute towards aquaculture feed technology in Cameroon and also improve on aquaculture development in the sub-region. Despite this finding, there is need for further research in this area.

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