NUTRITIONAL IMPACT OF HOUSEFLY MAGGOT MEAL ON GROWTH OF AFRICAN CATFISH (CLARIAS GARIEPINUS)

Abstract

In an attempt to successfully replace fish meal with Maggot meal in the diet of *Clarias gariepinus* for optimal growth and nutrient utilization, a 49 days (7 weeks) laboratory feeding trial was conducted to evaluate the growth of *Clarias gariepinus* fingerlings with the average initial weight of 5.36 ± 0.96 g and average initial length of 4.20 ± 0.05 cm, using housefly larva *(Musca domestica)* Maggot meal from cow dung as the protein source in place of fish meal in their diet. A total of 60 fingerlings were used. They were stocked 10 fingerlings in a 70 litre bowl. Each treatment was replicated twice. Treatment 1 (0% maggot inclusion), Treatment 2 (50% maggot inclusion) and Treatment 3 (53% maggot inclusion). At the end of the 49 days (7 weeks), the fingerlings fed with 53% maggot inclusion recorded the highest mean weight (7.93g) and mean length (12.01cm). Treatment 1 fish meal inclusion has the highest specific growth rate (12.9) but not significantly different and 53% maggot inclusion has the highest PER (1.63) but the least value was recorded in fish meal diet. The highest value for FCR was recorded in 53% maggot inclusion (0.83) while treatment 1 has the highest SGR and treatment 2 containing 50% maggot meal inclusion has the least survival rate while treatment 1 and 3 has the highest survival rate. There was no significant different ($P > 0.05$) in all the parameters. Conclusively maggot meal can be used successfully in place of fish meal in the diet of *Clarias gariepinus.*

Keywords: Maggot-meal, Treatment, Inclusion, Protein, Proximate

INTRODUCTION

The increasing cost of feed has been at alarming rate and this has been affecting the development and expansion of aquaculture in African countries particularly Nigeria (Sogbesan *et al.*, 2006). Fish meal been the major protein source in the fish diet constitutes the highest cost thereby making the price of the feed to rise exponentially. Therefore, several attempts have been made to substitute fish meal with other animal protein sources such as earth worm, shrimp waste, insect and plant protein sources such as sun flower, rape seed, soy

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Commented [er10]: Correct this to: being bean meal and cottonseed meal. However, they cannot replace fish meal wholly but partially due to the presence of chitin in their exoskeleton. In the same vein problem of anti-nutritional factor in tropical legumes have limited their usage and direct incorporation into animal feeds (Ogunji and Writh, 2001) Maggot meal is an animal protein source produced from waste, it has been reported to be highly nutritive with crude protein ranging between 43.9 and 62.4%, lipid 12.5 and 21%, and crude fibre 5.8 and 8.2% (Awoniyi *et al.*, 2003, Ajani et al., 2004). Maggot meal is also rich in phosphorus, trace elements and B complex, vitamins (Teotis and Milles, 1973). According to Fashina-Bombata and Balogun (1997), the cost of harvesting and processing one kilogram of maggot meal is smaller compared to the cost of 1kg of fish meal, thereby showing the cost effectiveness of using maggot meal in the diet of African catfish. This study therefore evaluates the nutritive value and growth performance *of Clarias gariepinus* fed with maggot meal.

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MATERIALS AND METHOD

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Experimental Fish Collection

The experimental fish, fingerlings of the catfish Clarias gariepinus were collected from Ejiamatu fish farm, Aguoye in Anambra State. The weight of the samples collected range between 5.36g. A total of sixty (60) fish were collected. The fish were transported to the Zoology hatchery unit in a plastic bucket with well oxygenated water. The fish samples were acclimated to laboratory conditions for seven days in big plastic tanks of 70 liters volume.

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Experimental Design

Six (6) bowls of 70litres volume were used. The bowls were of varying colors (blue and green) comprising of three (3) treatments and their replicates respectively. The experimental design is shown as follows: Compounded feed consisting of fishmeal, compounded feed containing 50% of maggot meal and compounded feed containing 53% of maggot meal.

The fish were stocked at the density of ten (10) fingerlings per plastic bowl and covered with nets to prevent the fish from jumping out. During the period of Acclimatization, the fish were fed Coppens at 5% body weight twice daily (Okoye et al., 2001) with the experimental diets of 40% crude protein. The main source of water used was well water located at the hatchery unit. The fish in each tank were selected at random and were fed at 5% of their body weight with the experimental diets. The fish were fed twice daily between 8.00am and 5.00pm.

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Cleaning of the Tank

Changing of water in all the treatments was done twice a week

Weighing and Measurement

All the fish in each group of feeding regime were weighed individually using water displacement method on an electronic sensitive scale (Labtech BL7501) at the beginning of the experiment and thereafter on a weekly basis to determine the growth rate of the fish. The water in each treatment was sieved using a sieve and the fingerlings were weighed individually using an electronic sensitive meter which gives the accurate weight of the fingerling when placed on the meter's plate-like surface after which they were measured using a meter rule and the length and weight were recorded respectively.

Water Quality

The following water quality parameters were measured carefully at the beginning and at the end of the experiment: Temperature, pH, Dissolved oxygen.

- Temperature: This was taken at the beginning and at the end of the experiment using mercury in-glass thermometer.
- pH: pH was measured using pH meter.

Maggot production

A 25 kg of fresh cattle dung, 5 kg of spent grain and saw dust were mixed together to a thickness of 5 cm to constitute substrate. The mixture was spread in a box of 1.4 m by 1.4 m screened with plastic net with one end open. The dung product were left to ferment for 48 h and the odour released attracted flies to perch on the mixture, then the open side was closed the second day. The eggs laid by the female flies on the substrate hatched into larvae within two days, after which the larval matured and was harvested. The whole process took five days. The larvae were harvested and oven dried to a constant weight, after which the dried maggots were milled into a meal and kept in an air tight container at room temperature.

Experimental Diets

Feed ingredients were purchased from a feed ingredient store in a container of plastics. The major feed ingredients used were yellow maize, wheat bran, groundnut cake (GNC), fishmeal, vitamins, mineral premix, oyster shell three isonitrogenous diets of 40% crude protein were formulated: Treatment 1 (Trt 1) contained 0% of maggot meal (control), Trt 2 (50%maggot meal, Trt 3 (53.% maggot meal), with these ratios of maggot meal to fish meal 0, 1:1, 1:2 respectively. The feed were made into pellets with the use of pelletizing machine; pellets were sun dried for three days to reduce the moisture content and to prevent deterioration. The feeds were packed and stored in air tight container at room temperature

Proximate Analysis of the On-Farm Feed

The proximate analysis of the on-farm feed was carried out at Springboard Research Laboratory located at Udoka Estate, Awka in Anambra state.

Experimental diet (On-farm feed) was analyzed for proximate composition according to AOAC (1990 and 1995).

Determination of moisture content

Moisture content in feed sample was calculated by using Association of the Official Analytical Chemists (AOAC 1990) procedure via the sample drying method in an oven at

135°C temperatures for 2 hours till constant weight. The moisture content was calculated as follows:

$$\text{Moisture content (\%) = } = \frac{\text{Weight of dried sample}}{\text{original wet weight}} x100$$

3.4.2 Determination of Ash content

Ash content in feed samples was calculated by using Association of the Official Analytical Chemists (AOAC 1990) method at 600° for 2 hours. Percentage of ash content was measured by the resulting inorganic residue. Weight of ash obtained in percentage as follows:

$$\text{Ash (\%) = } \frac{\text{Weight of ash}}{\text{original wet weight}} x100$$

$$\text{Crude Fiber (\%) = } \frac{\text{Loss in weight}}{\text{Weight of sample}} x100$$

Determination of crude fat

The crude fat from the feed sample was extracted by Soxhlet using Association of the Official Analytical Chemists (AOAC 1990) methods for 4 hours at condensation rate of 5-6 drops/ second, dry extract for 30 minutes at 100 °C cool. Crude protein contents was determined gravimetrically and stored at 4 C until analysis.

Nitrogen free extract

NFE was determined by subtracting % crude protein, % crude fibre, %moisture, %Ash and %Ether extract from 100 using the formula:

NFE = 100 - (%moisture ± % crude protein ± % Ether extract ± %crude fibre ± % Ash).

Metabolizable energy

Metabolizable energy was calculated based on the standard physiological values of 4.5 kcal/g protein, 3.3 kcal/g carbohydrates and 8 kcal/g fat (Brett & Groves 1979).

Growth and Food Evaluation Data

i. Specific Growth Rate

$$SGR\% = \frac{\ln W_2 - \ln W_1 \times 100}{T-t}$$

Where; W_1, is the initial weight (gram at time t).

W_2, is the final weight (gram at time T)

t= initial time

T= final time

The food conversion ratio was calculated thus:

$$\text{ii. F.C.R} = \frac{\text{Feed intake}}{\text{Fish weight gain}}$$

The study lasted for a period of seven weeks.

iii. Protein Efficiency Ratio (P.E.R):

This was determined using the formula;

$$PER = \frac{\text{Weight gain}}{\text{Weight of Protein intake}} x100$$

Percentage survival rate:

$$\text{Percentage survival rate} = \frac{\text{Final number of fish}}{\text{Initial number of fish}} X \frac{100}{1}$$

Statistical Analysis of Data

The data obtained from the experiment were subjected to Two-way Analysis of Variance tests.

RESULTS

Table 1: Proximate Composition of Experimental Diets

Parameters	**Treatment 1**	**Treatment 2**	**Treatment 3**
CP	44.20[a]	43.50 [a]	44.23[a]

CF	3.74 [b]	3.76 [b]	3.74 [b]
EE	4.76 [a]	4.60[a]	4.50 [a]
ASH	13.37 [b]	12.77 [b]	13.11 [b]
DM	9.95[a]	8.90 [a]	9.90 [a]
NFE	23.98 [b]	25.47 [b]	24.52 [b]

CP=Crude protein, CF=Crude fatty acid, EE-Crude fiber, ASH=Ash, DM=Moisture, NFE=Nitrogen free extract.

- Values on the same row with the same superscript are not significantly different (P>0.05)
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Table 2 weekly mean weight increase and analysis of variance of *Clarias gariepinus* fingerlings fed on different combination of fishmeal diet and maggot meal feeds for seven (7 weeks) is presented below

Week	**Treatment 1**	**Treatment 2**	**Treatment3**
Initial	5.36±0.95	6.25±0.45	7.37 ± 0.06
1.	10.86 ±0.36	12.50± 0.50	14.40± 0.80
2.	23.65±0.65	23.75±0.55	29.50±0.90
3.	34.00±2.79	35.30±1.90	40.10±2.55
4.	43.30±1.30	43.40±0.35	49.20±3.75
5.	53.20±40.40	55.20±1.50	58.20±4.55
6.	60.50±40.50	63.40±0.40	71.20±42.40
7.	72.45±40.65	73.90±0.90	79.25±0.45

From the result presented in the table 2 above, it can be deduced that there is a successive increase in the weight of the experimental fish fed different inclusion of maggot meal than those obtain from fishmeal diet. These data is higher than the result obtained before the experimental research. But from the statistical analysis, there was no significant different among the experimental groups fed the two diets (fishmeal and maggot meal) (P>0.05)

Table 3: Weekly mean length increase of *Clarias gariepinus* fed with varied inclusion of maggot meal

Week	**Treatment 1**	**Treatment 2**	**Treatment3**
Initial	4.20±10.05	4.16±0.17	4.15±0.04
1	5.25±0.07	5.41±10.01	5.33±0.05
2	6.22±0.20	6.30±10.04	6.42±0.02
3	7.13±40.06	7.3940.05	7.51±0.01
4	8.05±0.05	8.35±0.05	8.56±10.04
5	9.25±0.06	9.46±0.05	9.65±0.05
6	10.05±0.05	10.53±10.10	10.89±10.05
7	11.10±10.11	11.74±10.11	12.01±10.01

From the result presented in the table of above, it can be deduced that there was a recorded increase in the weekly mean length among the experimental group but the result was subjected to statistical analysis which show that there was no significant difference among the experimental group as (P>0.05).

Table.4: Specific growth rate (SGR), protein efficiency ratio (PER) and food conversion ratio (FCR) of *Clarias gariepinus* fingerlings feed on different combinations of fish meal and maggot feeds for seven (7 weeks).

Growth indices	Treatment 1	Treatment 2	Treatment 3
Food conversion ratio	0.82±0.05	0.73±0.01	0.83±0.01
Protein efficiency Ratio	1.52±0.01	1.56±0.02	1.63±0.02
Specific growth rate	12.94±2.34	10.87±0.72	9.76±0.14

From the experimental result presented above on table 3, treatment 3 consumed more feed made of maggot meal, followed by treatment 1 that was fed with fishmeal diet. Treatment 2 has the least food consumption and as a result has the least food conversion ratio. From the result presented above also, it can be deduced that the feed made with maggot meal has the highest protein efficiency treatment 1 seems to have a high SGR but from the statistical analysis, it has deduced that there was no significant difference in the growth indices of the fish feed the experimental diets as (P>0.05).

Table 5: Percentage survival rate of *Clarias gariepinus* fingerlings feed on two experimental feed (fishmeal and maggot meal for 49days).

Growth indices	Treatment 1	Treatment 2	Treatment 3
No of fish in each replicates	10	10	10
Replicates			
No of fish that survived	7.50	7.00	7.50
Survival rate (%)	75	70	75

Table 5 above shows the result of the percentage survival rate of *Clarias gariepinus* fingerlings fed on two different diets (fishmeal and maggot meal) from the table, it can be deduced that *Clarias gariepinus* fingerlings fed on fishmeal feed and 53% maggot meal inclusion had the highest percentage survival rate (75%). Those fed 50% maggot meal feed has the least percentage survival rate (70 %.) There is no significant difference (P>0.05).

DISCUSSION

This study revealed the possibility of utilizing maggot meal to replace fishmeal. The proximate composition of the feed and showed the different protein composition at varying levels. Other feed sources like fat also contributed essential fatty acids which are needed for fish growth and survival. Maggot meal was well utilized by *C. gariepinus* and this result in good fish performance in their weight and length. There was an increase in the length and weight of fish fed all the experimental diets. There was no significant difference in the weight of all the diet used. The non-significant difference of the evaluated parameters of growth and nutrient utilization among the three (3) experimental treatments imply that maggot meal can successfully replace fish meal in fish diets. Previous authors reported that maggot can improve the growth of catfish (C. gariepinus), (Akinwande, 2005, Dada, 2005, Sogbesan et al., 2005, Sogbesan, 2006). The non-significant difference in the growth and nutrient utilization parameter at varying levels, thus support the study of previous result that maggot meal like other animal protein source was accepted and utilized by fish (Idowu et al., 2003). Omoruwou and Ogunremi, (2011) reported that the biological value of protein is close to those of groundnut cake and soya bean meal, thus maggot combination with them in partial replacement of fish meal is reasonable. Fasakin et al., (2000) attributed the reduction in growth performance of experimental fish fed full- fat maggot to low protein digestibility of the feed stuff among other reasons. (Ajani et al., 2004) reported maggot meal crude protein content range of 40% to 61.4% according to them, the value could be attributed to the

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Processing, drying or storage method as well as the quality of poultry droppings used to produce maggot. More work will be needed to standardize the method of maggot meal production. The balanced amino acid content of maggot meal makes it better than other alternative protein source especially plant protein. The non-significant difference in the value of food conversion ratio of the treatment diets is a possibly indicative that both protein source compared favourably in the feed to flesh conversion. It has been reported that the biological value of maggot meal is equivalent to that of whole fish meal (Ajani et al., 2004). This fact is in accordance to the result obtained in the present study where protein efficiency ratio values were not significantly different. The percentage survival showed that there were mortality recorded during the period of study and this might be as a result of stress, water quality differences. The utilization of maggot meal will thus pave way for cheaper and nutritionally rich aqua feeds.

5.1 Conclusion and Recommendation

The development of maggot meal, a high quality protein source as a good replacement of fish meal will reduces the cost of fish feed and aquaculture industry will also benefit from the wide availability of this local and inexpensive aqua feed which is a key to a productive and sustainable aquaculture development in developing countries. Based on production cost, availability growth and nutrient utilization, maggot is a viable alternative protein source to fish meal in catfish *C. gariepinus* diet especially in a developing country like Nigeria where fish meal is imported at exorbitant cost. Therefore, this study has shown that maggot meal can be used to replace fish meal in the diet of *C. gariepinus* juvenile Up to 50% of maggot would give an optimum growth and nutrient utilization of catfish. Though, there is a slight constraint in the commercial production of maggot meal presently, but this can be overcome through more active researches.

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