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The Effects of Supplementing of Fish Meal With Maggots At Varying Levels in the Diet Of *Clarias gariepinus*

***[1]IDOWU E.O. [2] and AFOLAYAN E.B.**
*1,2 – Department of Zoology, Ekiti State University Ado Ekiti, Ekiti State, Nigeria
Corresponding Author- IDOWU E. O., E- Mail address idowunice@yahoo.com

ABSTRACT
Several feed ingredients have been investigated in an attempt to substitute fish meal in the diet of fish. These include both plant and animal protein sources (soya bean and maggot). The few studies on the utilization of maggot (magmeal) in replacing fish diet are inconclusive especially with particular reference to cat fish. Therefore more research work is carried out to find out cheaper alternative. In this study, 56 days (Nov. 2012-Feb. 2013) laboratory feeding trial was conducted to evaluate the growth of Clarias gariepinus juvenile with the average initial weight of 3.38g and average initial length of 9.0cm, using house fly larva (Musca domestica) maggot meal from poultry droppings as the protein source in place of fish meal in their diet. The diets were diet A control diet (0% maggot inclusion), B (10% maggot inclusion), C (20% maggot inclusion), D (30% maggot inclusion), E (40% maggot inclusion) and F (50% maggot inclusion). At the end of the 56 days, the juvenile fed with diet F 50% maggot inclusion recorded the highest mean weight (6.33g) and mean length (10.8cm). Diet 50% maggot inclusion has the highest specific growth rate (0.70) and protein efficiency ratio of (0.09) but the least value was recorded in diet C (20%) maggot inclusion (0.19) and (0.03) respectively. The highest value for food conversion ratio was recorded in 20% maggot inclusion diet (0.22) and 30% maggot inclusion has the highest survival rate. There was no significant difference (p>0.05) in all the parameters. Thus, maggot meal can be used successfully to replace fish meal in the diet of Clarias gariepinus for optimal growth and nutrient utilization.
KEYWORDS: *Supplementing fish meal, maggot meal, growth performance, feeding trials, Clarias gariepinus*

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INTRODUCTION

Fish contain about 60% protein and it is a very good source of protein which is cheaper compare to poultry product and it is affordable. As the world population grows, there is need for more protein; hence this results in the establishment of aquaculture at a minimum cost for the production of enough fish to meet up with the demand [1].

Feed is single most expensive factor in aquaculture production and the protein component of fish diet constitutes the highest cost. The proportion of protein in fish diets is higher than other cultured animals and this makes feed very exorbitant. Studies have shown that Africa catfish, *Clarias gariepinus,* require about 40% crude protein in their diet and best results have been achieved with crude protein value ranging from 35-50% for all African catfish species [2].

Proper growth of fish depends largely on good nutrition and this is more pronounced with fish in enclosure because they require adequate nutrition. This brought about a number of challenges facing this fish farmer. Firstly, the feed ingredient notable fishmeal which is used presently is very expensive ([3], [4]). Secondly, there is scarcity of fishmeal [5] coupled with consumption of fish by man and competition from other livestock industries leading to high cost of fishmeal [6].

In Nigeria, the feed ingredient (fish meal) used in fish feed by fish farmers is mostly imported and this result in the draining in foreign exchange. Thus there is need for sourcing of local alternative to reduce the dependency on imported materials. Scientists are investigating an alternative feed that is cheaper with comparable nutritional quality to supplement or replace fish meal totally without undermining the growth of the fish been cultured.

Maggot is a soft–bodied legless larva of a housefly that grows extensively on animal dung such as cow, goat, sheep and poultry droppings under favourable condition. Maggot has high potential that is, it is a good source of nutrient for livestock and fish as reflected from the proximate analysis of a well dried powdered maggot samples. Maggot has high quality with amino acid profile showing biological value that is probably superior to soya bean and groundnut cake [5]. Maggot has a good nutritional value, high

protein content and its inclusion in rearing of fish will enhance the avoidance of competition for human demand for fish population.

Many authors have worked on the replacement of fishmeal with maggot meal in the diet of *Clarias gariepinus* in Nigeria, these authors include, [2], [7], [8]'[9], [10] and others. These Authors all concluded that maggot meal is a good replacement of fish meal in fish diet at varying levels and successful results were gotten from the feeding trials.

The few studies on the utilization of maggot (magmeal) in replacing fish meal in fish diets are inconclusive, especially with particular reference to cat fish; more research works are to be carried out by scientists to identify a cheaper alternative to replace fish meal. Magmeal has been reported to be a possible alternative ([11] [12], [7]). *C. gariepinus,* African cat fish was chosen for this study because it is highly desired by fish consumers and it meets all necessary characteristics for aquaculture. There is high demand for *C. gariepinus* in Nigeria but unfortunately, due to high cost of feed, fish farmers have not been able to meet up with the growing demand for the product. There is need to boost the production of this highly demand cultured fish. The objectives of this study therefore are; to determine the best level of replacement of fish meal with maggot meal in the diet of *C. gariepinus* juvenile in order to reduce cost of feeding during culture and to evaluate the growth performance when fed with feed whose fish meal has been replaced with maggot meal at varying levels from a commercial model.

MATERIALS AND METHODS

Source of Feed Ingredient

Six experimental diets were formulated for the fish containing fish meal, maggot and other ingredients. The fish meal was purchased from metrovet feed mill in Ado-Ekiti, Ekiti- State, the maggots were gotten from poultry droppings of Agbowa poultry farm in Iwo, Osun State and poultry farm in Ile-Agbon farm in Ibadan, Oyo state. Fresh poultry dropping were collected and placed in a container and little water was added to it to make it moist and the odour attract flies which lay eggs on them. These eggs hatched into larvae called maggots which were harvested were oven dried using a laboratory oven model lab-tech sino-o.g 107. The dried maggots were grounded into powder form using a blending machine and taken alongside other ingredients that were purchased from Metrovet feed mill in Ado-Ekiti to Noble ventures in Ado-Ekiti, where they are compounded and pelleted into pellets, using a pelleter of hole size of 4.5mm and the feed ingredients were separately milled into various levels. The pelleted feed was sun dried and was packaged into non-porous polythene bags andt was used as the test diets as shown in table1. Proximate Analysis of feed stuff was determined using the method described in [13].

Feeding Trial

A total of one hundred and eighty (180) *C. gariepinus* juveniles of the same age were purchased from Adebayo's Fish Farm. The fish were divided into six groups with fifteen juveniles and its replicates; each group was placed in plastic bowl. The group (treatment) and its replicates were assigned to a dietary treatment and the bowls was covered with net hapas to avoid external predators. The bowls was labelled alongside with its replicate, *C. gariepinus* juveniles were acclimatized to experimental condition for one (1) week prior to the feeding trial on coppen and at the end of the acclimatization, the fishes were starved for 24 hours to empty their stomach and each group was weighed to know their initial weight and their length was measured to know their initial length.

The feeding trial begins after 24 hours starvation of the fish and the experimental diet was introduced to the fishes at varying level of maggot inclusion; 0%, 10%, 20%, 30%, 40% and 50%. The 0% diet contain no maggot but fish meal, 10% diet contain only 10% of maggot meal inclusion, 20% diet contain only 20% of maggot meal inclusion, 30% diet contain only 30% 0f maggot meal inclusion,40 % diet contain only 40% maggot meal inclusion and 50% diet contain only 50% maggot meal inclusion and 50% fishmeal. The fishes were fed twice daily at 5% of their body weight for a period of 8weeks and feed quantity was adjusted in accordance with their body weight. Each fish was weighed using an electric weighing balance model of Shanghai Jingtian J72101N and total length was also measured on weekly basis.

The growth and nutrient utilization was computed and the weight gained, length increased, mortality was observed and recorded and all data recorded was subjected to statistical analysis of variance (ANOVA) and samples of the experimental feed and the fish carcass was subjected to proximate analysis of [13].

At the end of the experiment, the growth and nutrient utilization parameters were computed for juvenile on each diet as follow;

$$\text{Specific growth rate} = \frac{Logw_f - Logw_i}{t} \times 100$$

Where W_i = Initial weight

W_f = final weight

Log = Natural logarithm

t = time taken

Food conversion ratio (FCR) = $\frac{total\ food\ supplied\ (g)}{total\ weight\ gained\ (g)}$

Protein efficiency ratio (PER) = $\frac{mean\ weight\ gain(g)}{Mean\ protein}$

Survival rate (%) = $\frac{F_2}{F_1} \times 100$

Where F_1 = Total numbers of fish used

F_2 = Number of fish alive at the end of the study

Table 1: Feed formulation of experimental diet

Diets / Ingredients	A (0%)	B (10%)	C (20%)	D (30%)	E (40%)	F (50%)
Maize	11.1	11.1	11.1	11.1	11.1	11.1
Rice bran	7.1	7.1	7.1	7.1	7.1	7.1
Fish meal	26.3	25.3	24.3	23.3	22.3	21.3
Maggot	-	1.7	3.3	5.0	6.7	8.3
Soya bean	15.2	15.2	15.2	15.2	15.2	15.2
Groundnut cake	38.4	38.4	38.4	38.4	38.4	38.4
Bone meal	1.0	1.0	1.0	1.0	1.0	1.0
Salt	0.2	0.2	0.2	0.2	0.2	0.2
Lysine	0.4	0.4	0.4	0.4	0.4	0.4
Methionine	0.01	0.01	0.01	0.01	0.01	0.01
Vitamin C	0.01	0.01	0.01	0.01	0.01	0.01
Fish Premix	0.01	0.01	0.01	0.01	0.01	0.01
Total	100	100	100	100	100	100

RESULT

The proximate analysis of nutritional composition of experimental diet is shown in table 2 and for fish carcass both before and after is shown in table 3.

The result of the proximate analysis composition of the experimental diet of all levels in table 2, shows the crude protein that is within 34.69 to 35.40, ash content of 9.59 to 11.10, moisture content from 9.87 to 11.78, fat content of 3.55 to 4.36 and crude fibre of 5.63 to 6.45 respectively. The result of the proximate composition of fish carcass before feeding in table 3, show crude protein, fat, ash and moisture that is high (61.25, 17.83, 8.74 and 7.41) compare to that of after feeding (44.04, 1.90, 4.43 and 6.84) respectively. The weekly mean weight increase and mean length increase is represented in figures 1and 2.

The values recorded for the growth parameters evaluated are presented in table 4. The initial mean weight ranges from 3.07(g) to 3.82(g), final mean weight ranges from 3.99(g) to 6.45(g). The initial and final mean length of fish ranges from 8.8 (cm) to 9.05 (cm) and 9.80 (cm) to 10.80 (cm). The specific growth rate and protein efficiency ratio was high in diet 50% maggot inclusion with the value of 0.70 and 0.09, the least value was recorded in diet 20% maggot inclusion with value 0.19 and 0.03. Diet 20% maggot inclusion recorded the highest value for food conversion ratio (0.22) and the lowest was recorded in diet 50% (0.11) and diet 30% (0.11).There is no significant difference in the growth parameters ($P > 0.05$) for all level of maggot inclusion.

Mortality recorded during the research work, were represented in appendix 3. Week two (2) has the highest mortality of 30 fishes and week five haven the least with no mortality during the study also mortality was recorded for other diets and weeks. Diet 0% maggot inclusion recorded the least survival rate of 37% with a total of 19 mortality, Diet 10% and 20% maggot inclusion recorded 70% with 9 mortality each, Diet 30% maggot inclusion has the highest survival rate with 93% and 2 mortality, Diet 40% recorded 73%survival rate with 8 mortality and diet 50% maggot inclusion haven 47% survival rate with 16 mortality.

Table 2: Proximate analysis of nutrient composition of experimental diet in percentage (%)

Diets Composition	A 0%	B 10%	C 20%	D 30%	E 40%	F 50%
Moisture content	10.23	11.78	10.94	11.01	11.11	9.87
Ash content	11.06	9.89	10.20	11.10	9.59	9.78
Crude protein	35.21	35.20	34.69	35.40	34.80	35.17
Fat content	4.36	4.25	3.76	3.79	3.55	4.04
Crude fibre	6.08	6.34	6.35	6.45	5.63	5.69

Table 3: Proximate analysis of fish carcass composition before and after feeding trial

	Before feeding trial	After feeding trial						Mean value
Diets								
Composition		0%	10%	20%	30%	40%	50%	
Moisture content	8.47	6.28	6.4	6.84	6.89	7.23	7.38	6.84
Fat content	17.84	1.3	1.37	1.4	2.41	2.42	2.51	1.9
Ash content	7.41	4.39	4.22	4.15	4.72	4.32	3.99	4.43
Crude protein	61.25	43.63	44.49	43.98	43.81	44.7	43.6	44.04

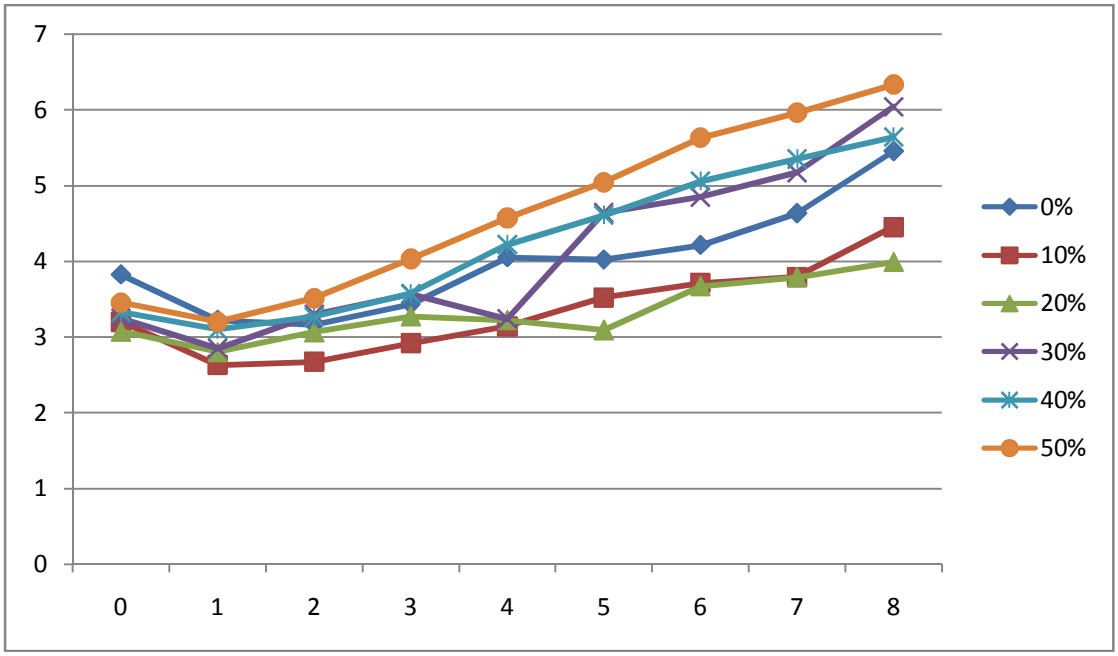

Figure 1: Weight increase of *C. gariepinus* fed on six (6) different diets with varying levels of fishmeal and maggot meal. Vertical line is the mean weight in gram (g) and the horizontal line is the periods (weeks).

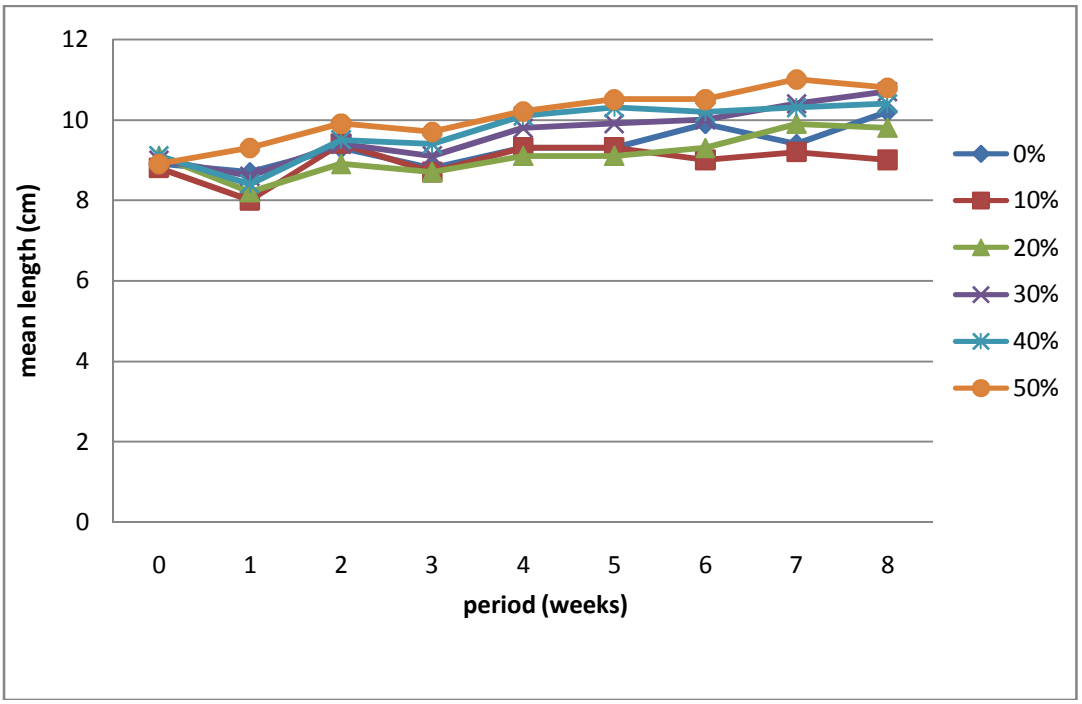

Figure 2: Length increase of *C. gariepinus* fed on six (6) different diets with varying levels of fish meal and maggot meal.

Table 4: Growth and Nutrient Utilization of *Clarias gariepinus* fed diet containing different levels of maggot inclusion.

Diets	A	B	C	D	E	F
Parameter	0%	10%	20%	30%	40%	50%
Initial weight	3.82 ± 0.60^{a}	3.20 ± 0.52^{a}	3.07 ± 0.33^{a}	3.25 ± 0.40^{a}	3.33 ± 0.41^{a}	3.45 ± 0.49^{a}
Final weight	5.45 ± 1.50^{ab}	4.45 ± 0.16^{ab}	3.99 ± 1.99^{b}	6.04 ± 0.49^{ab}	5.64 ± 0.05^{ab}	6.33 ± 0.18^{a}
Weight gain	1.64 ± 2.18^{a}	1.25 ± 0.37^{a}	0.93 ± 0.86^{a}	2.79 ± 0.89^{a}	2.31 ± 0.09^{a}	2.88 ± 0.67^{a}
Initial length	8.90 ± 0.28^{a}	8.80 ± 0.14^{a}	9.05 ± 0.21^{a}	9.00 ± 0.57^{a}	9.05 ± 0.07^{a}	8.90 ± 0.85^{a}
Final length	10.20 ± 1.27^{a}	9.00 ± 0.28^{a}	9.80 ± 0.71^{a}	10.70 ± 0.14^{a}	10.40 ± 0.99^{a}	10.80 ± 0.00^{a}
Length gain	1.30 ± 1.56^{a}	0.20 ± 0.14^{a}	0.80 ± 0.97^{a}	1.70 ± 0.71^{a}	1.35 ± 1.06^{a}	1.90 ± 0.85^{a}
SPR	0.27 ± 0.39^{a}	$0.26v0.10^{a}$	0.19 ± 0.16^{a}	0.48 ± 0.16^{a}	0.41 ± 0.03^{a}	0.70 ± 0.18^{a}
PER	0.05 ± 0.06^{a}	0.04 ± 0.01^{a}	0.03 ± 0.02^{a}	0.08 ± 0.03^{a}	0.07 ± 0.01^{a}	0.09 ± 0.02^{a}
FCR	0.17 ± 0.04^{a}	0.18 ± 0.01^{a}	0.22 ± 0.29^{a}	0.11 ± 0.04^{a}	0.12 ± 0.11^{a}	0.11 ± 0.08^{a}
Survival %	37%	70%	70%	93%	73%	47%

The values in this table with the same superscript letter are not significantly different (P>0.05) from each other.

DISSCUSION

This study revealed the possibility of utilising maggot meal to replace fish meal. The proximate composition of the feed and carcass 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 utilised by *C. greipinus* and this result in good fish performance in their weight and length. There was an increase in the lenght 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 six (6) experimental treatments imply that maggot meal can successfully replace fish meal in fish diets. Previous authors have proved from their works that maggot can improve the growth of cat fish *(C. gariepinus)*, considering the findings of [3], [4], [14], [15]. 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 utilised by fish ([16]. Reference [9] 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. Reference [17] attributed the reduction in growth performance of experimental fish fed full- fat maggot to low protein digestibility of the feed stuff among other reasons. Reference [18] reported magmeal crude protein content range (40% to 61.4%) and these differences may be due to processing, drying or storage method and also it may be related to the quality of poultry droppings used to produce maggot that was processed to magmeal. More work will be needed to standardise the method of magmeal production. The balanced amino acid of magmeal makes it better over other alternative of 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 magmeal is equivalent to that of whole fish meal [18]. This fact strengthened by the result obtain in the present study, 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 difference. The utilization of maggot meal will thus pave way for cheaper and nutritionally rich aqua feeds.

CONCLUSION AND RECOMMENDATION

The development of maggot meal, a high quality protein source in addition to 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 cat fish *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 cat fish. Though, there is a slight constraint in the commercial production of magmeal presently, but this can be overcome through more active researches.

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