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Evaluation of Maggot Meal (Muscadomestica) and Single Cell Protein (Mushroom) in the Diet of *Clarias gariepinus* Fingerlings (Burchell, 1822)

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Abstract

The growth performance of Clarias gariepinus fingerlings (mean weight 0.9 g) fed diets of maggot meal and single cell protein supplemented diet were investigated for 56 days. Nine diet of 40% FM and 30% FM, 10%MM and 20% FM, 10%MM, 10%SCP and 10%FM, 20%MM, 10%SCP and 30%MM, 10%SCP and 40%MM and 10MM, 30% SCP and 10%FM, 10%MM, 20%SCP and 40%SCP. The result of the experiment showed that fingerlings on the diet of 30%FM and 10% MM plus dry pelleted feed (T2) has the best specific growth rate (1.22%), food conversion (2.14) indicating that feed with maggot in combination with other supplemented diet formed better balance diet for the fingerlings. Feed with 30% fish meal and 10% maggot meal is recommended by this study.

Keywords: *Clarias gariepinus*; Maggot; Single cell protein; Feed utilization; Cost benefits

Introduction

In fisheries feed constitute one of the major inputs in intensive and semi intensive fish farming and can reduce the economic viability of a farm if suitable feeds are not used. The use of commercial pelleted fish feeds is so expensive that it accounts for about 40% to 60% of the recurrent cost of fish farming venture [1-3].

Fish feed is highly affected by the cost of feed ingredients used in formulation of the feed [1]. The major component in fish feed formulation is the fish meal (that constitute about 50-70% by weight), which use to be limited by high cost, non-availability and competition from poultry and livestock sectors. The high price of fish meal and other ingredients such as soybean, groundnut cake and maize has led to the need for investigating into other alternate cheap sources of fish feed ingredients that will provide the requited for the fish at cheaper cost so as to increase production from aquaculture sector and bridge the gap between fish demand and supply in Nigeria.

Poultry manure and abattoir wastes impose threat of disposal to the poultry and cattle slaughtering industries and as well as a serious pollution problem to the incumbent environment and man's health, hence an efficient and effective means of poultry waste disposal becomes imperative.

Maggot, the larval form of housefly (Muscadomestica) is not being competed for as animal protein source by man. The production of Maggot from waste materials either from plants or animal origin dung and food waste where it digests then to odour free "scum" with high nutrient value.

Maggot is readily available and has been accredited for its quality protein with amino acids profile showing its biological value to be superior to soybean and groundnut cake [4,5]. Maggot and single cell protein (mould) could be a cheap source of protein ingredients in fish diet.

Single cell proteins from organisms such as bacteria and fungi have been considered as possible substitutes for fish meal in diets for Clarias. The use of petroleum yeasts in combination with other proteins (SCP), especially alkane grown yeasts and methanol fermenting bacteria provided that they are supplemented by the limiting amino acids, can serve as a high quality source [6]. They are rich in crude protein content (55-80%) as well as amino acid profile as potential feedstuffs in *Clarias* nutrition.

Hike in the price of fishmeal and consequently fish feed has led to the need for investigating into other alternative cheap sources of fish at cheaper cost if production from aquaculture sector and bridge the gap between fish demand and supply in Nigeria. Hence, partial or total replacement of fish meal protein with alternative source of protein could be considerable economic advantage especially of the ingredients in association with moderate reduction in feed efficiency.

The aim of this study is to evaluate the use of organic matter to produce usable protein for fish feed so as to prepare a cost efficient feed for fish, in search for a better disposal means and conversion of wastes to useful nutrients for fish. And also to evaluate the efficiency of maggot harvesting techniques as well as the economics and production capacity of feeding *clarias gariepinus* with maggots and supplemented diets.

Materials and Methods

Culture of maggot and single cells

Maggots used for this experiment were cultured from chicken manure using sack method as described by Madu and Ufodike [7]. The collection was done as described by Adejinmi [4,5] and Sogbesan et al. using screens. The maggots are photonegative, so in attempts to escape from the traces of sunlight they passed through the 3 mm mesh size net and is collected in a basin under the net. Maggots collected were weighted, oven dried and grounded into powdery form using blending machine. The Single cells were harvested from the wild.

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Proximate analysis of the experimental diets

The single cell protein, maggot and all the formulated diets were analysed for the proximate composition following Association of Analytical Chemist Methods AOAC, 2000.

Fish feed ingredients

Fish meal, maize, soybean, groundnut cake, salt, vitamins/mineral premix, palm oil, starch, dicalcium phosphate. The fish meals are substituted with single cell protein/maggot meal in the diet (Table 1).

Experimental site

The experiment was conducted at the fisheries experimental farm of the ModibboAdama University of Technology, Yola, Adamawa State.

Experimental fish

The experimental fish *C. gariepinus* fingerlings total 100 were randomly sorted, weighted, stocked at 10 fingerlings per each plastic bow and starved overnight before the commencement of the feeding trial. The fish *C. gariepinus* fingerling were fed at 5% body weight, twice a day between 8 am and 4 pm. The fish were monitored for mortality daily. Dead fish were removed, counted and recorded for determination of survival rate (Table 2).

Sampling

The initial length and weight of fish (fingerlings) before stocking and the final length and weight of the fish were taken. Weekly sampling of the fish was done, i.e. 5 fingerlings were sampled. The weekly weight-

Experimental diet	I	II	III	IV	V	VI	VII	VIII	IX
Fish meal %	40.00	30.00	20.00	10.00	-	-	-	10.00	-
Maggot meal %	-	10.00	10.00	20.00	30.00	40.00	10.00	10.00	-
Single cell protein	-	-	10.00	10.00	10.00	-	30.00	20.00	40.00
Maize	37.03	40.00	44.50	44.50	40.00	37.03	40.00	44.50	37.03
Groundnut cake	17.97	15.00	10.50	10.50	15.00	17.97	15.00	10.50	17.97
Palm oil	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Cassava starch	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
DicalciumPhosphate salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin/Mineral	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Premix	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 1: Dry matter composition of experimental diets at 40% crude protein.

Parameters	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Initial mean weight (g)	0.9	0.98	1.04	1.0	0.96	1.0	1.0	0.96	1.10
Final mean weight (g)	4.15	4.75	4.33	4.25	3.69	4.50	4.37	3.95	3.83
Weight gain (g)	3.25b	3.77d	3.29bc	3.25b	2.71a	3.50c	3.37c	2.99ab	2.93ab
Initial length (cm)	4.60	4.56	4.10	3.50	4.10	4.40	3.86	3.28	3.80
Final length(cm	7.80	7.55	7.65	7.43	7.25	8.13	7.0	7.15	7.15
Relative weight Gain (%)	361.a	384.6a	316.d	325.c	282.3	350.b	337.0b	311.e	248.2f
Specific Growth Rate (%/day)	1.185b	1.224a	1.106	1.122	1.039	1.166	1.143	1.09	0.967
Feed intake (g)	8.07	8.07	7.93	7.59	6.44	7.64	7.57	8.13	7.36
Feed conversion Ratio	2.48b	2.14d	2.41b	2.34b	2.38b	2.18d	2.25c	2.27c	2.70a
K_l K_2	0.924 0.874	1.075 1.103	1.508 0.967	2.332 1.036	1.392 0.963	1.173 0.837	1.738 1.274	2.72 1.08	2.004 1.048
Protein Efficiency Rate	0.081	0.0943	0.082	0.081	0678	0.087	0.843	0.74	0.068

Data with dissimilar alphabets are significantly different ($p<0.05$).

Table 2: Growth performances of *Clarias gariepinus* fed maggot and single cell supplemented diets.

T_1		T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Cost of feed (₦)	218.1	170.6	96.2	126.9	119.4	128.6	113.0	124.5	115.8
Cost of Feeding(₦)	17.50	13.77	7.63	9.63	7.69	9.83	8.55	10.12	8.52
Cost of fingerlings (₦ Fish)	40	40	40	40	40	40	40	40	40
Miscellaneous	100	100	100	100	100	100	100	100	100
Expenditure (₦)	157.50	153.77	147.63	149.63	147.69	149.83	148.55	150.12	148.52
Value of fish (₦)	184.00	193.87	166.54	170.00	152.92	180.00	174.80	164.58	139.27
Net profit (₦)	26.50	40.10	18.91	2037	5.23	30.17	26.25	14.46	9.25
Incidence of cost	67.10	45.25	29.24	39.04	44.05	36.74	33.53	41.63	42.41
Profit index	10.51	14.07	21.83	17.65	19.88	18.31	17.78	16.26	16.34
Cost Benefit ratio	1.168	1.260	1.128	1.136	1.035	1.201	1.176	1.096	0.937

Table 3: Cost benefits analysis of *Clarias gariepinus* fed maggot and single cell supplemented diets.

length of fish recorded was used to determine the growth performance of the fish. The feed supplied were used to determine the feed utilization or nutrient parameter following the methods of Burelet [8].

Water sampling

Water temperature was taken with graduated mercury-in-glass thermometer while dissolved oxygen, ammonia and pH were determined using the methods described by Boyd [8].

Growth, feed and cost-benefits parameters

At the end of the culture and feeding trials, the growth rates, condition factor, survival rate and nutrient utilization were computed and analysed according to zaid and sogbesan, [9] (Table 3).

The production cost in naira of the experimental diets was calculated following the method of Faturoti and Lawal [10] based on the current market price of the ingredients used for formulating the diets. Economic evaluation was determined according to New Faturoti and Lawal and Mazid et al. [9,11,12] based on the following.

(i) Weight gain of fish fed each experimental diet.

(ii) Similar number of days of the experiment for all the treatments.

(iii) Survival of the experimental fish stocked.

(iv) Cost of ingredients processing and of formulated feeds using the non-conventional animal feedstuffs.

(v) Cost of stocked and cropped fish before and after the feeding trials respectively.

Statistical analysis

Data generated from the experiment were subjected to Analysis Of Variance (ANOVA), correlation, and graphical representation. Duncan Analysis (Duncan, 1984) was used to compare the mean differences.

Results

The total highest weight gain of 3.77 g was recorded in fish fed (30%) fishmeal and 10% maggot meal) followed by 3.50 g from 40% maggot, 2.71 g was computed from fish fed 30% maggot and 10% single cell protein supplemented diet.

The best specific growth rate of 1.22% /day was recorded from fish fed 30% fish meal, 10% maggot meal and 20% single cell 2.14 from diet containing 30% fish meal and 10% maggot meal supplemented diets.

The highest feed intake recorded goes to fish fed 10% fishmeal, 10% maggot meal and 20% single cell protein with total feed intake of 8.13 g.

When you compare k1, and k2 in Figure 1, k1, has 2.7 as the highest condition factor when fed 10% fishmeal, 10% maggot meal and 20% single cell protein and lowest condition factor 0.92 when fed 40% fishmeal while k2 has highest condition factor 1.27 when fed 10% maggot meal and 30% single cell protein and lowest condition factor 0.84 when fed 40% maggot meal supplement.

The results on the survival rate indicated that the feeding of *C. gariepinus* fingerlings on maggot diets resulted into high survival rate. This can't be connected to the high acceptability of this meal which was observed during the study and also in accordance to the earlier report of Babatude [13] (Tables 4 and 5).

The best net profit of N40.10 and Cost - Benefit Ratio of 1.260 was recorded from fish fed 30% fish meal and 10% maggot meal supplemented diets followed by diet supplemented 40% maggot meal with N36.74 incidence of cost, N26.25 Net profit and N1.176 Cost - Benefit Ratio and the least 40% single cell protein supplemented diet with N42, 41 incidence of cost, 9.25 Net profit and 0.937 Cost –Benefit Ratio (Figure 2).

Discussion

The high growth performance of fingerlings fed maggot in combination with other supplemented diet in this experiment have formed a better balance diet for the fingerling catfish. A similar observation was made by Ugwumba and Abumoye [14] who obtained the best growth performance, food conversion and survival of *C. gariepinus* fingerlings (1-3 g body weight) when maggot was fed as supplemented food (maggot artificial feed).

The best feed conversion ratio with diet Viii (10% FM, 10% MM, 20% SCP) followed by diet ix (single cell alone) goes to suggest that the diets containing maggot were better utilized by the fingerlings. According to Jhimgram maggots are easily digested by fish.

The control diet would have been expected to show the best growth performance especially in terms of weight gain since it contains fish which has high level of protein that has been known as the best feed ingredient for fish [15,16] but this was not so, However, Lovell [15]

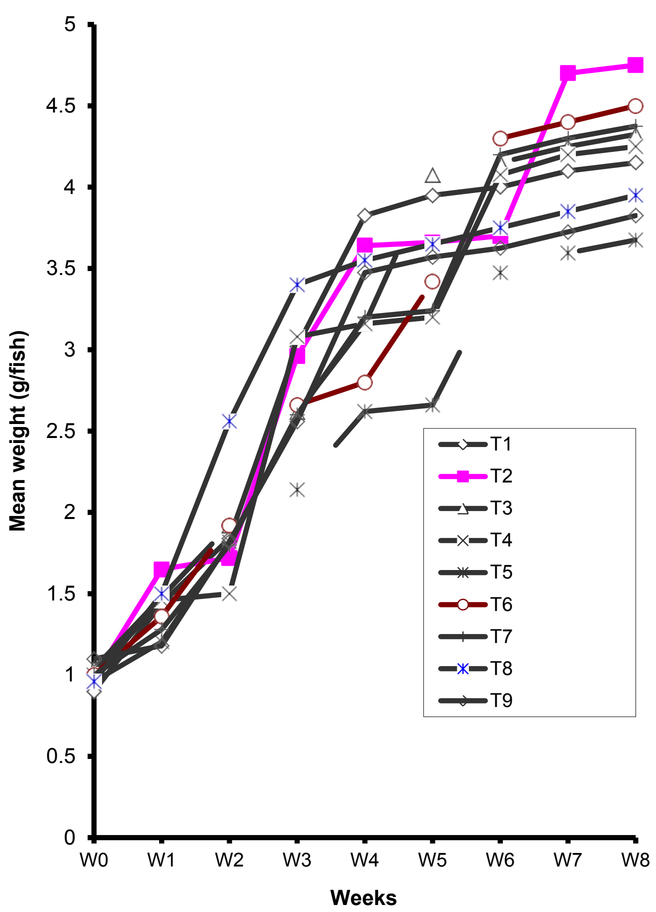

Figure 1: Weekly changes in mean weight of *Clarias gariepinus* fed maggot and single cell supplemented diets.

	Cost of feed (N)	Cost of Feeding(N)	Value of fish (N)	Net profit (N)	Incidence of cost	Profit index	Cost Benefit Ratio
Cost of feed (N)	1						
Cost of Feeding(N)	**0.983737**	1					
Value of fish (N)	0.592602	0.654475	1				
Net profit (N)	-0.07186	-0.07492	0.02516	1			
Incidence of cost	0.915516	0.858921	0.237713	-0.10587	1		
Profit index	-0.9115	-0.91817	-0.43038	0.072316	-0.86746	1	
Cost Benefit ratio	0.420056	0.487747	0.979202	0.05278	0.044476	-0.25036	1

Table 4: Correlation of the Cost benefits indices of using maggot and single cell supplemented diets.

	T1	T2	T3	T4	T5	T6	T7	T8	T9
T1	1								
T2	0.984943	1							
T3	0.972739	0.990114	1						
T4	-0.09986	-0.00029	-0.09661	1					
T5	0.985324	0.975228	0.98697	-0.20547	1				
T6	0.980632	0.997826	0.997131	-0.03968	0.982206	1			
T7	0.979054	0.996493	0.998318	-0.05437	0.98364	0.999811	1		
T8	0.989882	0.989922	0.994515	-0.13741	0.996432	0.993851	0.994482	1	
T9	0.991275	0.981061	0.9872	-0.17581	**0.999188**	0.985458	0.986151	0.997838	1

Table 5: Correlation of the experimental diets economy.

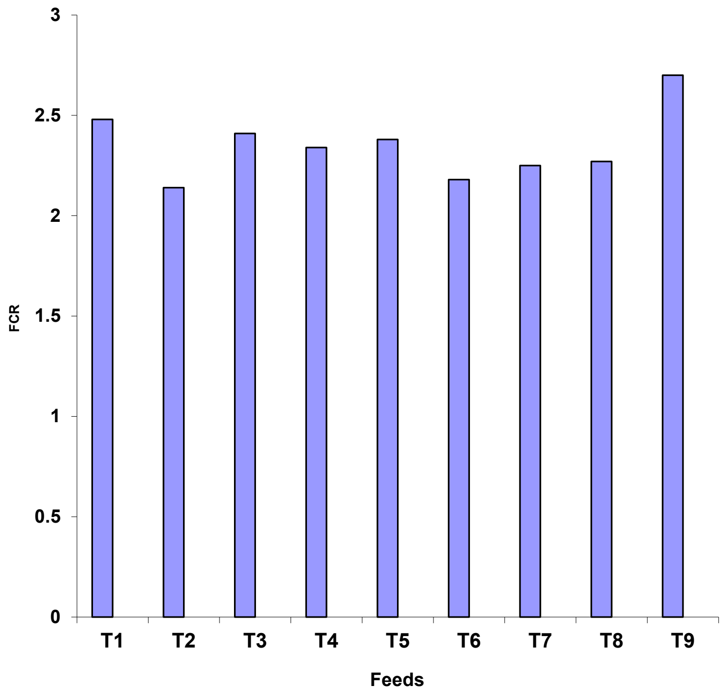

Figure 2: Barchart of the feed conversion ratio of the fish fed the experimental diet.

reported that the biological value of protein source does not only depend on its amino acid profile but also on its digestibility as indicated by digestibility energy which increased with maggot meal inclusion. Fibre content of feed has been documented to enhance growth performance in fish [17].

The optimum aim of every agricultural investor is to make profit at the end of the cultural season. This same phenomenon is as well applicable to fisheries, Since cost of feed has been one of the major constrain to the development of aquaculture sector, provision of an alternative ingredient that will be able to reduce certain percentage of the incurred overhead cost as a result of feeding should be embraced.

The actual feed product cost and harvest of maggot [5] is confounded by and associated benefit to livestock – poultry producers gain from manure management since fishmeal production requires labour, Fuel and equipment, one could assume that the equipment used to collect poultry manure, culture and harvest live maggot and process dried maggot meal might cost the same amount as reported by Newton et al. [18] but the cost of feed production did not agree with their report. The cost benefit report in this study also justifies the growth performance finding. Based on these results, the use of maggot to substitute the costly fishmeal to about 75% inclusion level is recommended to fish farmers and feed industry though there is a need to appraise large scale production of maggot. And the higher growth performance observed in combined feeding can explain by the synergetic effect of combining two biological compounds to have a single and superior effect than when individually applied. This observation is in agreement with suggestions by previous authors, that combined protein source is better than single protein source for fish diets [19-22].

The water quality parameters were within tolerates ranges throughout the period of the experiment. Temperature ranged between 28-32°C, Dissolved oxygen was between 4.5-5.8 ml while pH fluctuates between 7-8. The values of physico-chemical parameters observed in the culture system were within the range recommended for fresh water fish [19,20].

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