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Utilization of Compounded Ration and Maggot in the Diet of *Clarias gariepinus*

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Abstract: The study intends to promote the use and marketing of agricultural, animal waste products with special emphasis on the production of maggot from faecal poultry droppings. This study therefore aims to determine the best level of supplementation of maggot with compounded ration, the rate of growth and nutrient utilization by *Clarias gariepinus* and the economic viability of feeding *Clarias* with the combination of maggot and compounded ration.Forty juvenile *Clarias gariepinus* of weight ranges between 100-120 gm were randomly allocated to four treatments (each of 10 juvenile *Clarias gariepinus* per hapa of 1×1×1 m) in a nursery pond with over flow supplied with bottom springing clean water. They are treatment 1 (100%) compounded ration of 35% crude protein), Treatment 2 (50% compounded ration+ 50% maggot), Treatment 3 (25% compounded ration+75% maggot), Treatment 4 (100% maggot) were set up for 7week experimental period. Growth performance was significantly ($p<0.05$) different among the 4 diet treatments with Treatment 2 (50% compounded ration+50% maggot) recording the highest Mean Weight Gain (MWG) (119.65 gm). Specific Growth Rate, (SGR) (1.303), Protein Eufficiency Ratio (PER) (0.3860), Daily Rate of Growth (DRG) (0.2442) but lowest Food Conversion Ratio (FCR) (5.9410). Ranking second is Treatment 1, third is Treatment 3, while the least growth performance of MWG (58.15 g) SGR (0.416). PER (0.2890), DRG (0.1187)and highest FCR (16.54) was recorded for Treatment 4, as the poorest diet. However the Crude Protein (CP) from proximate composition shows Treatment 4 with the highest CP of (63.31%) > Treatment 3 (54.65)> Treatment 2 (48.36%) > Treatment 1 (34.75%). This implies feeding maggot alone with fish (Treatment 4) will not supply the required protein quality (balance diet) that will supply at least 10 essential indispensable amino acids that is required for optimum growth. Hence a combination of compounded ration and maggot (Treatment 2) will meet this requirement and this will also yield the highest economic gain by reducing the cost of feed by 40% of the proposed total cost when compared with Treatment 1 and 2. High yield in terms of weight of fish, over 200% yield (double profit) on harvesting (Treatment 2) when compared with treatment 4 (100% maggot diet).

Key words: *Clarias gariepinus*, compounded ration/maggot, balanced diet, protein quality (10 indispersable essential amino acids);nutrient utilization and fish growth

INTRODUCTION

This study intends to promote the use and marketing of agricultural animal waste products with special emphasis on the production of maggot for use as an alternative source of animal protein to supplement the rather expensive fish meal sold in the open markets and other costly fish feed ingredients when compounding fish feed rations. Most of our agricultural animal waste products such as animal and chicken offal could not only be packaged in frozen form (not to denature their protein) but could also be used to generate maggot to feed fish directly. The abundance of faecal waste product from poultry (which is a mixture of faeces and undigested food material) used in this study formed a very rich biome for the ready generation of maggot used in supplementing compounded feed in order to reduce cost.

Ita (1980) observed that *Clarias lazera (gariepinus)* is omnivorous and consumes natural food like insect larvae, gastropods, filamentous algae and plankton. Similarly Hogendoorn (1979) reported that they tend to feed on insect larvae, phytoplankton and zooplankton and in the Nigerian fish culture system *Clarias lazera (gariepinus)* is used to control tilapia populations.

The fact that catfishes are essentially omnivorous is probably suggestive that the fish could be raised successfully on artificial feeds at reasonable cost, since it will be practicable to select feed ingredients of both animal and plant origin Hogendoom (1980). Most artificial food stuffs eaten by fish also promotes the development of plankton, in fish ponds which contributes directly or indirectly to the growth of fish Bardach *et al.* (1972), Huet 1972. Their efficiency on fish growth is given by measuring the food quotient or conversion rate.

$$QN = \frac{\text{Weight of the food distributed}}{\text{Weight of fish harvested}}$$

The carrying capacity of ponds varies according to the species and rate of growth of fish. The rate of growth depends on three 3 factors rate of stocking rate of feeding and quality of feed

The proper rate of stocking may be estimated by dividing the carrying capacity by the required weight of fish (FAO, 1975).

The growth of fish in the ponds is directly related to the amount of food available in the pond (Chakroff, 1976). He also stated that almost anything can be used as a supplementary food depending on the fish species including bread crumbs, rice, fishmeal, groundnut cake, maize, left over animal food and some animal waste.

The fast growth rate of catfishes (*Clarias* in particular), ease of breeding, good taste and hardy bodies make them a good choice particularly for the first time fish farmers. However according to Huet (1972), the concept of *Clarias* culture should be geared towards both quantity and economic production. It is therefore the aim and objectives of this study to:

- Determine the rate of growth and nutrient utilization of *Clarias gariepinus* being fed with compounded ration and maggot.
- Determine the best level of maggot supplementation with compounded food rations to promote growth.
- Determine the economic viability of feeding *Clarias gariepinus* ration in combination with maggot.

MATERIALS AND METHODS

Experimental set up: The study was carried out at the Departmental fish farm for 7 weeks. Four hapas wereutilized for the project, each of the hapas is 1× 1×1 m. the hapas were sited in one of the ponds adequately supplied with water from underground seepage and the pond used also has an outlet which allows free flow of water out of the pond thus ensuring good water exchange.

Maggot production: The maggots were generated by the collection of poultry droppings containing maggots. They were placed in open containers and constantly wet with water to keep it moist always. This attracts flies that lay eggs which latter hatch into maggots (the larva stage of the housefly life cycle). Maggots were generated as from the third day to the fifth day. The poultry droppings were constantly being replenished as the volume drops in the open container. The maggots were sieved and washed with clean water to remove the poultry droppings before feeding the fish.

Experimental fish: A total of 40 juvenile *Clarias gariepinus* were used for the study. They were stocked at the rate of 10 juvenile *Clarias gariepinus* per hapa. The average weight of fish stocked ranged between 100-120 g. The fish were purchased from a private fish farm at Moniya, Ibadan.

Experimental feed:A 35% crude protein diet was formulated using the following ingredients for cost effectiveness and optimal grow out of fish (Table 1).

The feeds were pelletted to 2mm pellet size using pelleting machine and fish were fed to satiation in all the 4 treatments.

Experimental procedure: Though the use of both the compounded ration and maggot the following experimental treatments were designed.

Treatment 1 (Hapa 1)-100% compounded ration
Treatment 2 (Hapa 2)-50% compounded ration and 50% maggot
Treatment 3 (Hapa 3)-25% compounded ration and 75% maggot
Treatment 4 (Hapa 4)-100% maggot feeding

Feeding was done twice daily at 8.00 am and 4.00 pm. Sampling was done weekly throughout the 7week study period. Quantity of feed fed (compounded ration and maggot fed) were recorded daily and calculated on a weekly basis. The fish were also weighed weekly to monitor growth and nutrient utilization along with monitoring of water quality parameters daily.

Proximate analysis: Both initial and final proximate composition of fish samples were determined at the beginning as well as the end of the experiment according to AOAC (1990) methods.

Table 1: Composition of experimental feed

Ingredients	Composition (%)	Crude protein calculations(%)
Maize	10.00	1.10
Palm kernel cake	20.00	4.10
Groundnut cake	30.00	19.20
Soya beans	30.00	8.80
Fish meal	3.50	1.80
Palm oil	3.00	-
Bone meal	2.50	-
Oyster shell	0.50	-
Advit (mineral vitamins)	0.25	-
Industrial salt	0.25	-
	100%	35% Crude Protein(CP)

Water quality assessment: Clean springing water was constantly being supplied from the springing pond bottom in which the 4 hapas were fixed and excess constantly overflowing through the overflow pipe thus onstantly refreshing the water in the hapas. The temperature (°C), Dissolved Oxygen (DO) (mg/litre) and water transparency (turbidity) in cm were monitored and recorded daily.

Calculation of growth and nutrient utilization parameters

Specific growth rate: This is done in accordance with Brown (1957)

$$SGR = \frac{\text{loge } W_2 \text{ - loge } w_1}{T_2 \text{ - } T_1} \times 100$$

W_2 = Weight at time T_2 days
W_1 = Weight at time T_1 days

Protein Efficiency Ratio (PER): This was calculated from the relationship between the increment in the weight of fish (i.e., weight gain of fish) and protein consumed (Zeitoun *et al.*, 1973; 1976).

$$PER = \frac{\text{Mean weight gain}}{\text{Protein Intake}}$$

Feed Conversion Ratio (FCR):

$$FCR = \frac{\text{Feed intake}}{\text{Wet weight gain}}$$

Daily Rate of Feeding (DRF):

$$DRF = \frac{\text{Mean ration per day}}{\text{Body weight of fish}}$$

Daily Rate of Growth (DRG):

$$DRG = \frac{\text{Mean increase in weight per day}}{\text{Body weight of fish}}$$

Gross Efficiency of Food Conversion (GEFC):

$$GEFC = \frac{\text{Daily rate of growth}}{\text{Daily rate of Feeding}}$$

Mean Weight of Fish (MWOF):

$$MWOF = \frac{\text{Total weight of fish in hapa}}{\text{Number of fish in hapa}}$$

Feed per Fish per Day (FFD):

$$FFD = \frac{\text{Weekly feed per fish}}{7}$$

Mean Weight Gain per day (MWGD):

$$MWGD = \text{Final MWGD- Initial MWGD}$$

Statistical analysis: (ANOVA) Analysis of Variance to test the variability between the diet treatments in terms of growth performance according to Steel and Torrie (1960).

RESULTS

From Table 2, Treatment 4 (100% Maggot feed) had the highest crude protein, greater than in Treatment 3 (54.65%), followed by Treatment 2 (48.36%) and lastly Treatment 1 (100% Compounded ration) WITH 34.75% C.P. A diet is only balanced if it contains the right profile of essential amino acids. It is this (amino-acid profile in the correct amount) that determines the optimum growth pattern of the fish as reported by Halver (1972), Mertz (1972) and Cowey and Sergent (1979) who reported (10) essential (indispensable) amino acid in fish diet viz: (Arginine, histidine, isoleucine, leucine, lysine, Methionine, phenylalamine, threomine, tryptophan and valine). Hence optimum growth in fish is dependent on the quality of the protein fed. As a consequence of the foregoing although treatment 4 (100% Maggot feed) had the highest (C.P) crude protein (63.31%) it may not necessarily contain all the above listed 10 indispensable essential amino acid in their right profile. Hence it is

Table 2: Proximate composition of experimental feed and maggot

Treatments (nature of feed)	Moisture	ASH	FAT	Crude protein	Crude fibre	NFE
Treatment 1 (100% Compound Ration)	28.00	15.16	17.06	34.75	4.90	0.13
Treatment 2 (50% Comp. ration+50% Maggot)	18.55	15.26	10.36	48.36	5.18	2.29
Treatment 3 (25% Comp. ration+75% Maggot)	9.23	16.58	11.35	54.65	5.55	2.64
Treatment 4 (100% Maggot)	15.65	8.35	6.15	63.15	3.86	2.68

Table 3: Weekly Mean weight gain of *Clarias gariepinus* fed compounded ration/maggot (in GMS)

Weeks	Treatment 1 (100% compounded ration)	Treatment 2 (50%Compounded ration+50% maggot)	Treatment 3 (25% compounded ration + 75%)	Treatment 4 (100% Maggot)
Week o (initial mean weight)	105.55	110.63	108.25	112.65
Week 1	124.75	129.01	116.48	112.35
Week 2	141.96	148.04	133.56	131.65
Week 3	156.58	166.35	141.06	140.87
Week 4	171.05	184.63	149.65	148.23
Week 5	185.66	201.56	156.87	154.55
Week 6	193.58	218.85	170.96	161.36
Week 7 (final mean weight)	201.56	230.28	186.35	170.80
Mean weight Gain (MWG)	96.01	119.65	78.10	58.15

Table 4: Growth and nutrient utilization pattern of *Clarias gariepinus* fed compounded ration and maggot

Parameters	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Mean Weight Gain (MWG) (gm)	96.01	119.65	78.10	58.15
Total Feed Intake (TFP) (gm)	8,065.60	7,108.40	9,417.50	9,620.65
Mean Food Intake (MFI) (gm)	144.03	126.94	168.17	171.80
Special Growth Rate (SGR)	1.155	1.303	0.971	0.416
Protein Efficiency Ratio (PER)	0.3400	0.3860	0.2910	0.2890
Food Conversion Ratio (FCR)	8.4000	5.9410	12.0200	16.5400
Daily Rate of Growth (DRF)	0.1959	0.2442	0.1594	0.1187
Daily Rate of Feeding (DRF)	14.40	12.69	16.82	17.18
Gross Efficiency of Feed Conversion (GEFC)	0.0136	0.0192	0.0095	0.0069

Table 5:mean values/ranges of physico-chemical parameters during the 7 week experimental period

Parameter	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Mean temp (°C)	28.85	29.36	28.50	28.10
Range	28.50-29.20	28.80-29.92	28.00-29.00	28.20-28.00
Mean diss. Oxy (mg L^{-1})	5.20	2.15	4.90	5.05
Range	5.10-5.30	5.10-5.20	4.90-5.00	5.00-510
Mean pH	8.20	8.15	4.80	8.60
Range	8.20-8.40	7.80-8.50	8.00-8.80	8.20-8.60
Mean transparency (Turbidity) (cm)	20.00	24.00	25.50	28.25
Range	19.00-21.00	23.00-25.00	24.00-27.00	26.00-30.5

envisaged that feeding 100% maggot meal alone will not suffix except with the combination of compounded ration. The ratio of the combination of compounded ration/maggot is as determined in this study.

As shown in Table 3, the highest Mean Weight Gain (MWG) in the study was recorded in Treatment 2, with a mean weight gain of 119.65 gm in 7 weeks (for Treatment 2-50% compounded ration+50% maggot) followed by Treatment 1 (96.01 g) (for 100% compounded ration). The third best diet was Treatment 3, (78.10 g) (for 25% compounded ration+ 75% maggot). While the least mean weight gain of 58.15 g was recorded in Treatment 4 (100% maggot feed). As shown the mean weight gain of fish in Treatment 2 (50% compounded ration+50% maggot) far doubled that of Treatment 4 (100% maggot). This implies that Treatment 2 fish were fed the best balanced diet, with the best protein quality, in terms of the right profile and proportion of the indispensable 10 essential amino acids. Hence as shown clearly the protein quality of the 100% maggot diet (Treatment 4) does not surpass that of Treatment 2 which is even higher than in Treatment 1 (100% compounded rations).

Table 4 shows that diet treatment 2 (50% compounded diet+50% maggot) is the best in terms of mean weight gain (119.65 gm), highest specific growth rate (1.303), Protein Efficiency Ratio (PER) (0.3860), Daily rate of growth DRG (0.2442), but lowest Food Conversion Ratio (FCR) (5.9410). This is followed by treatment 1 (100% compounded ration) with MWG (96.01 gm), SGR (1.155) PER (0.3400), DRG (0.1959) and FCR (8.400). The third ranking treatment is Treatment 3 (25% compounded ration+75% maggot) while the least was Treatment 4 (10% maggot).

Table 5 shows that all the mean values of measured physico-chemical parameters fell within the acceptable ranges recommended by Boyd (1981). The mean dissolved oxygen levels which ranged from 4.90 mg L^{-1} (treatment 3) to 5.20 mg L^{-1} (treatment 1) were well above the minimum level of 3.0 mg L^{-1} recommended. However transparency (reduced turbidity) tend to increase with reduction in the use of compounded feed, with the highest transparency (least turbidity) recorded in treatment 4 (100% maggot). This is a clear indication that the maggot fed were thoroughly washed clean with water devord of poultry droppings or any of its residue, although there is a tendency towards the culture medium being more alkaline with treatment 4 (100% maggot) showing the highest alkalinity with the highest pH of 8.60

Table 6: Anova for growth performance between the 4 diet treatments

Source of variation	Degree of Freedom (DF)	Sum of Sequares (SS)	Mean Squares (MS)	F
Treatment error	3	284634.739	94878.246	
	28	28592.84	1021.173	92.9118
Total	31	313226.779		

the temperature range of 28.10 (treatment 4)-28.85 (treatment 1) fell within the temperature range for fish culture in warm waters.

$Fv_1\ v_2$

F_3, 28 Fcal = 2.92

- Fcal >Ftab significant at (0.05) = $p<0.05$

The growth performances in the diet treatment were significantly different from each other at $p<0.05$ (Table 6).

Economic viability of maggot supplementation with compounded fish ration: The cost of a standard cost effective and economically viable compounded fish feed (with all the essential feed ingredients including fish meal) as it is the case in the study is N 250.00 kg^{-1} feed. Whereas the labour cost of collecting poultry droppings to breed maggot is less than N50.00 kg^{-1}. Therefore from this study since the best level of supplementation is 50% compounded ration: 50% maggot feed. This implies for every 1 kg of maggot/compounded fish feed ration (i.e., precisely 1 kg cost of formulating diet treatment 2) is by calculation = N 125.00 (cost of 50% compounded ration)+N 25.00 (cost of 50% maggot) produced = N 150.00kg^{-1} (compounded ration/maggot) as against N 250.00 (for 100% compounded ration) as in Treatment 1.

Hence two main benefits arises from using diet treatment 2 which is the best diet as against other diets. Viz:

- High economic gain by reducing the cost of feed by 40% (N100.00 gain kg^{-1} feed) of the proposed total cost.
- High yield in terms of weight of fish on harvesting which is well over 200% yield (double profit) compared to using wholly 100% maggot diet as in Treatment 4.

DISCUSSION

The protein quality of feed fed the fish determines wether the feed material accepted by the fish (wether conventional or not) is balanced or not. For the feed material to be a balanced diet and of the right protein quality it must contain at least all the 10 essential indispensable amino-acids as reported in the studies conducted by Halver (1972) Mertz (1972) and Cowey and Sergent (1979). This assertion is true for the best diet treatment (Treatment 2) which gave the best growth performance in this study with a crude protein of 48.36% on proximate analysis (which is second to the least crude protein of 34.75% recorded for treatment 1-100% compounded ration). Whereas contrary to expectation diet treatment 4 (100% maggot meal) which had the highest crude protein (CP) of 63.31% on proximate analysis had the worst performance.

The foregoing is further confirmed with treatment 2 (50% compounded ration+50% maggot) having the highest mean weight gain (119.65 gm),SGR (1.303), PER (0.3860), DRG (0.2442), but lowest FCR (5.9410) compared to the worst diet treatment (Treatment 4-100% maggot) in this study with the least mean weight gain of (58.15 gm), SGR (0.416), PER (0.2890), DRG (0.1187), but highest FCR of (16.5400). Also Analysis of Variance (ANOVA) further confirms that growth performance were significantly different ($p<0.05$) among the four (4) diet treatments in the study (Table 6).

All the measured physico-chemical parameters temp (°C) (28.10-28.85) Dissolved oxygen (4.90-5.20 mg L^{-1}), pH (8.20-8.60) and transparency (turbidity) (20.00-28.25) were optimum values for warm water fish production as it is also reported by Boyd (1981) in his experiments on warm water fish culture. However there is a tendency towards transparency of the culture water medium as the level of compounded ration feed inclusion reduces, that is as maggot feeding tends towards 100% as it is the case with Diet 4 recording the highest transparency of 28.25. This observation also followed a similar pattern of increasing mean PH values from Diet1 (8.20) to Diet 4 (8.60). While also the temperature range (28.10-28.85) is optimum for warm water fish culture.

In terms of economic viability of maggot supplementation with compounded fish ration two main benefit arises from using Diet treatment 2 (50% compounded ration+50% maggot) as against other diets viz:-

- High economic gain by reducing the cost of feed by 40% (N100.00 gain per kg feed (compounded ration and maggots) of the proposed total cost.
- High yield in terms of weight of fish on harvesting which is well over 200% yield (double profit) compared to using wholly 100% maggot diet as in Treatment 4.

CONCLUSION

A combination of compounded ration and maggot at 50%: 50% ratios will yield the best growth performance and highest economic viability (profit) in terms of profit as it is the case with Diet treatment 2 (50% compounded ration and 50% maggot). This diet is least cost effective dropping 40% feed cost as against the use of Diet 1 (100% compounded ration) which is second to Treatment 1 in terms of yield and profit. While double profit and weight yield is guaranteed (200%) when Treatment 2 is used as against Treatment 4 (100% maggot).

The protein quality in terms of diet containing all the essential amino acid profile makes diet Treatment 2 the best over all the 3 other diets (1, 3 and 4) treatments.

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