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Study On The Performance Of Clarias Gariepinus Fed With Local Integrated Fish Feed

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Abstract: A study on the performance of Clarias gariepinus (fingerlings) fed with integrated fish meal as diet with two various level of formulations was carried out. The feed trial was for 77 days to compare the length-weight gain of fish reared with commercial diets and those reared with 50% and 100% integrated fish meal respectively, the control group were fish fed with commercially procured feed with no integration. The fishes were fed twice on day-to-day basis at 5% body weight for the experimental period. A random sampling of ten (10) fishes was done weekly to determine the growth performance of the fish. Results divulge significant difference ($p<0.05$) in the final mean body weight, mean body length and specific weight gain within experimental diets with the highest in fingerlings bred with 100% integrated fish meal. Even though, fish fingerlings fed with commercial livestock feed consumed more feed and attaining advanced feed conversion ratio values than those fed with integrated fish meal of 50% and 100% formulations respectively. The study therefore inveterate that integrating fish meal into percentages of between 50% and 100% formulations could act as a substantial replacement and supplementary feed for C. gariepienus fingerling; encouraging 46-50% growth with decrease mortalities.

I. Introduction

Fish to feed the world populace, is an essential resource with an estimate of 16% of high-quality animal protein consumed (FAO 1997). Its culture accounts for a significant measure in protein deficiency in any region in space and also are considered one of the speedy rising sectors in the world with an annual increase of about 10% reported (FAO, 1997). According to FAO estimates, about a billion of the world population rely on fish as animal protein source with less than 10% reportedly consumed in North America and Europe, 17% in Africa, 26% in Asia and 22% in China (FAO, 2000). It is reported in studies that the African catfish, *Clarias gariepinus*, requires about 40% crude protein in their diet and all African catfish species also requires 35-50% crude protein for high performance (Wilson and Moreau 1996; Adebayo and Quadri, 2005). The African catfish, *Clarias gariepinus*, has been recognized as a fish species with the greatest potential to contribute to the growth of aquaculture in Nigeria as it contributed about 35% of total production in 2003 (Udo and Umoren, 2011). To reach high level of fish production, there is need to redress the trials currently facing capture fish production. In the past, mass producing phytoplankton, zooplankton, insects, crustaceans, copepods and molluscs in culture media through fertilization was preponderant. The use of poultry droppings, cow dungs and many other organic fertilizers to fertilize pond for about five days before fish is introduced was reported (Sikiru et al, 2009; Faruque et al, 2010; Wurts, 2003). That fish farming accounts for more than half of production cost has been the major source of deterrence to prospective fish farming in Nigeria and urgent solutions are called upon for sustainability, attractiveness, and lucrativeness in farmed species (Madu et al., 2003). Fish farmed in intensive and semi-intensive systems consist of recurrent introduction of additional feed other than the recommended, which justifies for equal to 40 % and 60 % of production costs respectively and reported to sometimes regress the economic feasibility when the unsuitable feed are used (NRC 1993; Fagbenro et al., 2003). The utilization of locally available processed feedstuff as alternatives have the potentials of combating this estimated high cost of importing fish feeds and other challenges facing intensive fish farming as a sector (Jamu and Ayinla, 2003; Madu et al., 2003). Although, the imported fish meal tagged expensive is undoubtedly the best source of protein for artificial fish culture because its protein quality and palatability supports good fish growth (Miles and Chapman, 2012). Fish meal is the conservative source of animal protein in fish diet which has been valued for its stable amino acids, vitamin contents, palatability and growth factors (Tacon, 1983). The cost of purchasing a complete fish meal is a major identified barrier to capture fisheries and reducing this cost involves the use of locally available feed stuff especially by-products of agriculture (Fagbenro, 1999). Thus blood meal, a common abattoir waste is always readily available for use as cheaper alternative protein source. The development and addition of more sustainable aquaculture feed products to the existing is important to supplement as the available. This research is therefore, aimed at evaluating the length and weight gain as a requisite for growth criteria in *Clarias gariepinus* fed with local integrated fish feed as substitution to fish meal.

2. Methodology

The 50% and 100% integrated feed formulations were made using the raw feedstuffs stacked in categories in table 2.1 and the commercial livestock feed was obtained in a feed store in Abraka, Delta State. Waters of the pond cultures were changed every two days to reduce bacterial superinfection and fungal growth with spoiling feeds in pond waters. Water quality parameters such as temperature, dissolved oxygen and pH were measured twice weekly with digital YSI DO meter (YSI, Model 57) and electronic pH meter (metter Toledo, Model 320) respectively. Ten (10) fishes each were sampled at random from the control (livestock feed), two replicated 50% and 100 % integrated feed formulations weekly. Randomly sampled fishes were weighed and recorded for calculation of nutrient utilizations.

2.1. Feedstuff collection

Raw feedstuff stacked in categories were obtain all from the Abraka big market, Delta State while fresh cow blood, the main protein solvent for the integrated feed was obtained with a token from an abattoir close to the multi-cooperative fish farm in same city. The raw materials for the integrated feed preparation include 20 litres of fresh cow blood, raw soybeans, tilapia fish debris or other fish fragments or shrimp fragment is selected as sectioned in category A, Cassava flake or flour, cassava peel alone, wheat grain or yellow maize are selected in category B, Whole groundnut or locally made groundnut cake is selected in category C while cassava or water leaf is selected as leafy vegetables (table 2.1).

2.2. Integrated fish meal preparation

The selected raw feedstuffs except fresh cow blood were washed thoroughly and sundried at intervals to dryness. They were measured up and conjoined into fine particles. The preparation was carried out every two weeks throughout the study period. The measurement for a small scale integration include a 20 litres fresh cow blood, soy beans grain of 3-4kg, tilapia fish or any other fish fragment of at least 2 kg, Shrimp debris is optional where fish fragment exist but adding 0.5kg is permitted for category A, 0.5-1kg of cassava flake mixed in 0.3-0.5kg of cassava peel alone and 2kg of wheat grains for category B, a 3 kg of locally made groundnut cake is measured up in category C. All of the raw feedstuffs were milled category by category into fine particles after sun drying and properly mixed either with the bare hands, using a turner or electrified turning machine. After properly stirred, non-coagulated cow blood was let down gradually into the mixture and stirred continuously until a reddish semi-solid paste is formed. The paste was then measured up with a big spoon into a small cellophane and tied up. Each of the mixtures tied up are placed in a large cooking vessel where they are steamed for 1-2 hours depending on heat intensity. After cooking, it was allowed to cool and then untied with a dark brownish mould of cooked feed is formed. The untied cooked mould was then placed on a tray and further sundried for at least 2-3 hours to properly cake. The cooked dark-brown mould were then cut up into bit of sizes or pellets for fish and packing. Also, water leaf were blended and added fresh on the sliced pellets. Feed was prepared every week till the end of the feeding trial.

2.3. Experimental designs and feed formulation

Two hundred and fifty (250) fingerlings of *Clarias gariepinus* (7.81±0.09 g) bred in the Department of Animal and Environmental Biology from 0- 5 weeks were sorted and used for the integrated feed trials. The fingerlings were stocked in concrete pond (0.8 m x 0.5 m x 0.5 m) acclimatized and fed in two administrations using an industrial-based feed at the rate of 5% their body weight per day for two weeks. After acclimatization, the 250 fingerlings were partitioned into five labelled groups of 50 fingerlings each (11.36±0.10 g for control group and 10.94 ± 0.08g for treatment groups) for identification. Fishes were stocked in duplicates for integrated feed (50%= 25% cow blood, soybeans 15%, fish debris and/or shrimp waste 15%, cassava flour, cassava peel, and yellow maize grain 25%, locally made groundnut cake 15% and water leaf 5%) and cow blood meal alone (100%= 50% cow blood, soybeans 10%, fish debris and/or shrimp waste 10%, cassava flour, cassava peel, and yellow maize grain 15%, locally made groundnut cake 10% and water leaf 5%) formulations while a single group as control using commercial feed. The fishes for the feed trial were exempted from commercial feed for a day before feed trial commenced. The weight of the fingerlings were taken prior to the commencement of the feed trials. The feed were administered in the morning between the hours of 8.30 to 9.30 am and evening between 5.30 to 6.30 pm at 5% biomass daily for a period of 77 days. Each fish was weighed using Ohaus Scouth II digital weigh meter and total length measured using a meter rule both at end of week throughout experimental periods. The proximate analysis of raw feedstuffs were not carried out prior to integration because a comprehensive documentation of local available feedstuff for use in Nigeria exist as shown in table stacked in categories below.

Table 2.1. *Biochemical nutrient assay of some selected local feedstuffs obtainable in Nigeria*

S/n	Raw Feedstuff	Crude protein (%)	Fat content (%)	Fibre (%)	CHO (%)	Dry matter (%)	Mineral (%)
	Category A						
1.	Cow blood meal	86.0	0.7	2.1	6.5	92	5.0
2.	Tilapia fish meal	57.7	1.8	5.2	92	N.D	33.6
3.	Soy beans (raw)	40.7	22.0	6.3	16.6	90	6.4
4.	Soybean meal (slightly toasted)	46.2	24.8	4.7	17.2	90	7.9
5.	Soybean meal (really toasted)	48.1	23.9	4.1	20.7	90	7.9
6.	Shrimp waste meal	58.9	N.D	33.5	N.D	79.5	N.D
	Category B						
1.	Millet	9.0	5.0	0.7	83.2	90	2.3
2.	Cassava (flour)	1.6	0.5	1.7	83.3	N.D	N.D
3.	White maize	9.3	5.0	2.4	70.9	88.0	1.8
4.	Yellow maize	10.8	3.6	3.5	71.2	88	1.9
5.	Wheat grain	13.5	1.9	3	N.D	88	N.D
6.	Guinea corn	11.2	2.5	2.3	74.1	88	1.8
7.	Peeled cassava	2.6	0.5	0.4	94.1	88	2.4
8.	Cassava (Peels alone)	5.3	1.2	21.0	66.6	88	6.0
9.	Unpeeled Cassava	2.7	0.5	3.1	91.0	88	16.1
	Category C						
1.	Groundnut shells	4.0	1.0	46.7	46.3	N.D	N.D
2.	Groundnut Cake (Kuli-kuli)	40.6	23.4	6.0	19.0	93	6.2
3.	Industrial ground nut cake	48.0	13.2	8.1	18.9	93	6.3
	Category D						
1.	Water Leaf	21.1	1.5	10.3	87.4	N.D	4.6
2.	Cassava leaf	14.7	8.4	15.6	45.2	88	16.1

3.	Pawpaw leaf	32.6	0.8	17.2	18.38	N.D	N.D
4.	Sweet potato leaf	24.7	3.6	11.5	12.5	N.D	N.D

Source: Udo and Umoren (2011); Eyo et al (2004); Okanlawon and Oladipupo (2010); Gabriel et al (2007); Sikiru et al (2009); Agbebi et al (2009); Otubusin et al (2009) and Nwokocha and Nwokocha. (2013). N.D= no data

2.4. Data analysis

Performance of the fish was measure according to growth and nutrient utilization parameters. Growth parameters include length-weight gain, feed conversion ratio and protein efficiency ratio. All the data collected were subjected to Analysis of Variance, using the Duncan's multiple range F-test (Duncan, 1955) to determine significant differences in means among the feed trials at 5% level. The growth and nutrient utilization of fishes were calculated using the formula outlined below:

2.4.1. Mean weight gain (MWG)

$MWG = FMW(g) - IMW(g)$ (Pitcher and Hart, 1982)
Where, FMW= Final mean weight, IMW= initial mean weight

2.4.2. Daily weight gain (DWG)

DWG $= \frac{MWG\ x\ 100}{IMW}$ (Pitcher and Hart, 1982)

2.4.3. Feed conversion ratio (FCR)

$FCR = \frac{weight\ of\ feed\ gain\ (g)}{weight\ gain\ of\ fish\ (g)}$ (Wilson, 1989)

2.4.4. Specific weight gain (SWG)

$SWG = \frac{\log afw - \log aiw}{duration\ of\ feed\ exposure}$ (Brown, 1957)

Where, afw= average final weight, aiw= average initial weight, Log= the base of Natural Logarithm.

2.4.5. Protein efficiency ratio (PER)

$PER = \frac{Fish\ weight\ gain(g)}{protein\ intake\ (g)}$ (Burel et al., 2000)

2.4.6. Survival rate (SR)

$SR = \frac{number\ of\ survived\ fish}{total\ number\ of\ stocked\ fish}\ x\ \frac{100}{1}$ (Eyo and Ekanem, 2011b)

3. Results and discussion

Both livestock feed and the integrated feed meals were utilized by experimental fishes with little or no mortality as reported by feed utilization sections of Table 3. The daily weight gain for fishes fed with the control and integrated fish meals varied between 393.49±86.00% (livestock feed) and 457.86±47.5 % (100% integrated fish meal). There was no significantly different (P>0.05) between fishes fed with livestock feed from those fed with 50% integrated but a significant difference (P<0.05) exist for 100% integrated fish meal from those fed with livestock feed and 50% integrated feedstuff. It is linked that fishes fed with 100% integrated fish meal expended more compared to the livestock feed. Fish fed 50% integrated fish meal had the highest Protein Efficiency Ratio (PER) (0.85) than the livestock feed and 100% integrated feedstuffs with the lowest value (0.46). Although, fish fed with livestock feed had the highest feed conversion ratio than those reported for integrated fish meals; a low feed conversion value was recorded in fishes fed with 100% integrated fish meal (Table 3). Growth criteria of fishes (Table 3) divulged that fingerlings fed control diet had the lowest mean weight gain (44.70±0.86g) compared to those recorded in 50% and 100% integrated fish meal which was considerably higher and highest in 100% integrated. There was significant difference (P<0.05) between integrated feed meal and the livestock feed. Furthermore with respect to integrated fish meals, fish fingerlings fed with 100% integrated fish meal highest weight gain (50.09±0.38) than those fed with 50% integrated fish meal (45.84±1.69). Thus it is interpreted that mean weight gain is 50% of the initial weight for fish fed with 100% integrated fish meal and 46% of initial weight of those fed with 50% integrated fish meal. The mean final length of fish was highest in fish fed with 100% integrated fish meal and lowest in those fed with livestock feed (Table 3). There was also statistical significance (P<0.05) between the mean final length of fish fed with livestock feed and the integrated feedstuffs. The specific growth rate (SGR) was highest (1.77) in the fingerlings fed 100% integrated fish meal while those fed with livestock feed and 50% integrated fish meal recorded a slightly low value (1.74).

Table 3. *Growth performance and feed utilization of the Clarias gariepinus fed livestock feed and 50 and 100% integrated fish meal*

Growth parameter	Feed mixtures in percentages		
	Livestock feed (control)	Integrated fish meal (50%)	Integrated fish meal (100%)
Growth criteria			
Exposure days	77	77	77
Number of fish stocked	50	50 x 2 replicates	50 x 2 replicates
Initial mean weight (g)	11.36±0.10^{a}	10.94 ± 0.08g^{a}	10.94 ± 0.08g^{a}
Final mean weight (g)	56.06±0.96^{a}	56.78±1.77^{b}	61.03±0.46^{ab}
Mean weight gain (g)	44.70±0.86^{a}	45.84±1.69^{b}	50.09±0.38^{b}
Initial length (cm)	6.69±0.28^{a}	7.22±0.22^{a}	7.59±0.25^{a}
Final length (cm)	12.54±0.32^{a}	14.38±0.49^{b}	15.70±0.33^{ab}
Mean length gain (cm)	5.85±0.04^{a}	7.16±0.27^{b}	8.11±0.08^{ab}
Specific weight gain (%)	1.74	1.74	1.77
Feedstuff Utilization			
Daily weight gain (%)	393.49±86.00^{a}	419.01± 211.25^{a}	457.86±47.5^{b}

Feed conversion ratio	2.34	2.18	2.00
Protein efficiency ratio	0.64	0.85	0.46
Survival rate (%)	96	99	100

*Row means with the different superscript are significantly different (P<0.05) from each other.**

The integration of feedstuff into various percentages within 50-100% as replacement diet for *C. gariepinus* appear to support growth at considerable levels with those of commercial feed and even higher. The feed efficiency ratios, mean final length, specific weight gain, and daily weight gain reported in this study is high compared to those reported by Egesi and Ogbonna. (2016) in their study on blood meal integrated with methionine at various graded levels. On the contrary, mean weight gain for same study was reportedly higher than those reported in this study. The reduced mean weight reported for this study may be due to quantity of the feed introduced into the pond cultures at intervals. It is reported that fish meal can be replaced absolutely by blood meal with no resultant detrimental effect on growth, survival and feed conversion rate of *Clarias gariepinus* fingerlings (Agbebi et al., 2009). The result of this study from survival rate upholds similarities with that already reported which shows that integrated fish meal of 50-100% formulations can be substituted completely (100%) with little or no adverse effect on growth, survival and feed conversion ratio in African cat fish (*C. gariepinus*).

4. Conclusion

Integrating fish meal into percentages of between 50% and 100% formulations as a replacement and supplementary feed for *C. gariepienus* fingerling encouraged 46-50% growth and decrease mortalities. The study therefore inveterate that integrated fishmeal could thus be efficiently replaced with livestock feed meals up to 50% in *C. gariepinus* diets with reduced detrimental effects on growth. The local integration of feedstuffs as supplementary feed of *C. gariepinus* fingerlings will reduce the high cost of acquiring commercial feed for fish production and reducing the presence of waste substance such as cow blood which would have necessarily led to environmental pollution in abattoir sites.

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