PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 12 (5): 510-515, 2013
ISSN 1680-5194
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Growth Performance of *Clarias gariepinus* Fed Different Levels of *Agama agama* Meal Diets

L.O. Tiamiyu, G.A. Ataguba and J.O. Jimoh
Department of Fisheries and Aquaculture, University of Agriculture,
P.M.B. 2373, Makurdi, Benue State, Nigeria

Abstract: This study was investigated the utilization of agama lizard meat meal (*Agama agama*) as dietary protein source in the diets of *Clarias gariepinus* fingerlings (MW±SE = 33.48 g±0.13). The fingerlings were fed four Isonitrogenous and Isocaloric diets containing blends of agama lizard meal in percentages of 0 (Diet I), 10 (Diet II), 20 (Diet III) and 30% (Diet IV) respectively for 8 weeks at 5% body weight. Mean weight gain (MWG) ranged from 22.85g (Diet I) to 42.80g (Diet III) and Specific Growth Rate (SGR) ranged from 0.93% per day (Diet 1) to 1.46% per day (Diet III). Feed Conversion Ratio (FCR) was between 2.61 (Diet III) and 2.96 (Diet IV). There was however no significant differences (p>0.05) in these parameters for all the test diets. Proximate composition of carcass shows significant differences (p<0.05) in moisture and ash contents with no significant differences observed for all the other proximate composition parameters. From the foregoing, agama lizard meal can be included at any level but it is recommended that 20% inclusion level be used.

Key words: Protein, agama lizard, utilization, clarias gariepinus

INTRODUCTION

Proteins are major constituent of fish diet, knowledge of the protein requirement of fish is essential for the formulation of a well balanced artificial diet for economical fish feeding. Protein requirement is linked with the general energy requirement of the fish at a given water temperature and the ability of the fish to gain weight at its inherent capacity. It is also related to size, age and environmental stress such as stocking density, low dissolved oxygen supply and the presence of toxicants (Eyo, 2003). Fish, like other animals, synthesize body proteins from amino acids in the diet and from some other sources (Gatlin, 2010).

Protein requirement for maximum growth of any species is a logical step to the development of a cost-effective feed for fish and entails determining the maximum amount required to produce maximum growth and not to be used for energy (Sang-Min and Tae-Jun, 2005). Thus any substitution or addition of protein feed stuff in the diet of a fish which will not affect fish growth in a negative way will surely be welcome in aquaculture nutrition.

According to Gatlin (2010), meeting a fish's minimum dietary requirement for protein, or a balanced mixture of amino acids, is critical for adequate growth and health. Fish utilize both plant and animal proteins, although animal proteins are nutritionally better than plant proteins and it has been observed that fish require a higher percentage of protein in their diet than do warm blooded animals (Lovell, 1984). In view of this, a fish farmer or a feed formulator has to bear in mind the protein requirement of the fish for which they are formulating the feed.

The protein component of fish feed is very important because it is the most expensive dietary component and when provided in excess, is both economically and environmentally unsound (Gatlin, 2010). The major source of animal protein in a nutritionally balanced formulated feed of fish is high quality fish meal which is also the most expensive. Another thing about this fish meal is that it is in short supply in many countries and has to be imported (Pillay, 1994). Aquaculture is therefore constrained by the cost of fishmeal and according to Hoffman *et al*. (1997), the profitability of intensive aquaculture is closely related to the world supply and cost of feed protein.

Unconventional dietary animal protein sources have been experimented as substitutes for fishmeal with various levels of success. Abd Rahman Jabir *et al*. (2011) recently investigated the use of super worm meal as partial or total replacement for fishmeal in the diet of *Oreochromis niloticus*. They reported that up to 25% of fishmeal protein in fish diet can be replaced by super worm meal without any adverse effect on feed utilization and body composition of *O. niloticus*. Also, Sogbesan *et al*. (2006) and Ovie and Adejayan (2010), investigated the use of the garden snail in supplementing fishmeal in the diet of *Clarias gariepinus* and concluded that 25% of garden snail in the diet can be efficiently utilized. By-products from crustaceans such as shrimp head and crab meals are good candidates to replace fish meal in diets for cultured fish (Tibbetts *et al*. 2006 and Köprücü and Özdemir, 2005).

Corresponding Author: G.A. Ataguba, Department of Fisheries and Aquaculture, University of Agriculture, P.M.B. 2373, Makurdi, Benue State, Nigeria

The use of terrestrial animal by-products as substitute for fishmeal in fish diets has been widely reported. Poultry By-product Meal (PBM), Blood Meal (BM), Hydrolyzed Feather Meal (HFM) and Meat and Bone Meal (MBM) which have a good essential amino acid profile have been used as protein sources for tilapia (Tacon, 1993). The meat from Lizard (*Agama agama*) has been discovered to have high protein values and rich minerals with very low anti-nutrients (Abulude *et al*., 2007). According to the authors, the low fibre content makes the agama a good feed stuff for the feed of *Clarias gariepinus* and its availability in cheap quantity makes it worthy of being part of fish feed.

MATERIALS AND METHODS

Fingerlings were obtained from a fish hatchery in Makurdi, Benue state, Nigeria and the experiment was conducted at the Fisheries and Aquaculture Department Hatchery of the University of Agriculture, Makurdi. A static water culture medium was adopted with aeration. Plastic bowls (50L capacity) were used with the fingerlings distributed 20 per bowl. The mean weight of the fingerlings in each bowl was 33.48 g±0.13. To maintain good quality of water, the water was subjected to change every other day during which the uneaten feed was siphoned out.

The ingredients used in feed preparation were: agama meal, soybeans meal, maize meal (Yellow), rice bran, fish meal, vegetable oil, vitamin and mineral premix and salt. The Agama lizards used were sourced around the University of Agriculture, Makurdi premises while the other ingredients were sourced within Makurdi from a reliable livestock feed industry. Table 1 shows the level of crude protein content of the feed stuff used.

Feed processing: The soybean was toasted before milling to eliminate or reduce the effects of anti-nutritional factors and improve digestibility. Dirt and stones were removed from the maize before milling. Rice bran was also milled and sieved. The agama lizards were killed, gutted and oven dried at 80°C for six hrs before milling using a mini hammer mill.

Diet formulation and compounding: 40% crude protein diets were formulated for the fingerlings. The Pearson square method was used to calculate the percentage inclusion of each ingredient to be used in the diets but the percentage inclusion of the agama meal were varied at 0% [Diet I], 10% [Diet II], 20% [Diet III] and 30% [Diet IV]. The diets were pelleted using a pelleting machine after weighing and mixing of the ingredients. Table 2 shows the percentage inclusion of each ingredient in each diet formulated.

Table 1: Percentage Crude Protein in the ingredients used

Ingredients	Crude Protein (%)	Source
Maize meal	11.00	Ranjihan, 1980
Rice bran	9.80	Ranjihan, 1980
Soybeans Meal	44.00	Aduku,1993
Fish meal	70.00	Lim and Webster, 2006
Agama agama meal	51.63*	

*laboratory determined

Table 2: Percentage Inclusion of diets I, II, III and IV

Ingredient	Diet I (%)	Diet II (%)	Diet III (%)	Diet IV (%)
Soybean meal	22.00	24.00	20.00	17.00
Agama meal	0.00	10.00	20.00	30.00
Maize meal	35.00	32.00	29.00	29.00
Fish meal	36.00	28.00	26.00	19.00
Rice bran	5.00	4.00	3.00	3.00
Mineral premix	0.50	0.50	0.50	0.50
Vitamin premix	0.50	0.50	0.50	0.50
Oil	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00

Experimental set up and management: The plastic bowls were filled with de-chlorinated water up to the 20-litre mark and stocked at 20 fish per bowl. The fish were fed at 5% body weight twice daily. The mode of feeding was manual by simply dropping the feed into the baths. The faecal materials were siphoned and water completely changed every other day.

The fish were weighed at the beginning of the experiment and after every week for a period of 8 weeks. The quantity of feed was adjusted based on the new body weight of the fish in each bath. Mortalities were recorded accordingly. Water quality parameters: Temperature, Dissolved Oxygen and pH were determined using Thermometer, Dissolved Oxygen meter and pH meter respectively.

Data collection: The following parameters were determined:

Mean weight gain = Mean final weight-Mean initial weight

$$\text{Specific growth rate (\%/day)} = \frac{\text{Log}_e\ (\text{Wt}_2) - (\text{Log}_e\ \text{Wt}_1)}{t_2 - t_1} \times 100$$

where, Wt_1 = Initial weight of fish at time t_1, Wt_2 = Final weight of fish at time t_2, t_2-t_1 = Duration (in days) considered between Wt_2 and Wt_1 and e = natural logarithm.

Feed conversion ratio = dry feed intake / wet weight gain,

Protein Efficiency Ratio (PER) = wet weight gain / protein fed

where Protein fed = (% protein in diet x total weight of diet consumed) / 100 and:

$$\% \text{ Survival} = \frac{\text{Total number of fish} - \text{mortality}}{\text{Total number of fish}} \times 100$$

The data collected were subjected to statistical analysis using the students t-test, Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA). Differences of means were separated using Fisher's Least Square Difference (LSD).

Carcass analyses: At the beginning of the experiment, four fish were sacrificed and carcass analysis done. At the end of the experiment, fish from each of the treatments were also sacrificed for another set of carcass analyses all using the AOAC (2000) standard method.

RESULTS

Table 3 shows the proximate composition of the diets. The moisture contents varied from 3.00±0.87-7.40±0.87% with diet II having the highest while diet III had the lowest. The crude protein content varied from 38.69±0.29 to 39.56±0.29% with diet I having the lowest value while diet III had the highest value. Furthermore, the crude fibre, ether extract, ash and NFE varied from 7.24 ± 1.44 - 14.43 ± 1.44%; 5.82 ± 1.44 - 8.80 ± 1.44%; 3.56±0.87-5.34±0.87% and 27.06±0.29-40.39±2.60%, respectively with diets IV, II, II and I having the highest values for crude fibre, ether extract, ash and NFE respectively. The lowest values for Crude fibre, Ether extract and Ash were gotten in diet I but with diet IV having the lowest value of NFE.

Table 3: Proximate composition of the diets formulated

Parameter (%)	Diet I	Diet II	Diet III	Diet IV	SEM
Moisture	4.30^{b}	7.40^{a}	3.00^{b}	7.00^{a}	0.87
Crude protein	38.69	38.79	39.56	39.38	0.29
Crude fibre	7.24^{b}	12.72^{a}	10.20^{a}	14.43^{a}	1.44
Ether extract	5.82	8.80	7.40	7.40	1.44
Ash	3.56	5.34	5.01	4.73	0.87
NFE	40.39^{a}	27.55^{b}	34.83^{ab}	27.06^{b}	2.43

Values in the same row with the same superscripts are not significantly different (p>0.05)

The growth performance and utilization of *Clarias gariepinus* fed varying levels of *Agama agama* meals appears on Table 4. The noisy nature of data for the Final weight necessitated the use of Analysis of Covariance to determine if differences exist in the weight gain using final weight as covariate. The mean weight gain was found to vary from 22.85g±3.25 (Diet I) to 42.80g±5.90 (Diet III) with fish fed diet III having the highest weight gain but was not significantly different (p>0.05) for all the diets. Similarly, the Specific growth rate varied from 0.93±0.11% per day (Diet I) to 1.46±0.14% per day (Diet III) with diet III having the highest value. The Feed conversion ratio ranged from 2.61±0.80-2.96±0.13 with diet III having the lowest value while diet IV had the highest value. The highest value of Protein Efficiency Ratio (PER) was found to be 4.21 in diet III while the lowest was 3.07 in diet IV. Lastly the % Survival was highest in diet I fed fish with 97.50±2.50% and lowest in diet IV with 70.00%±5.00. No statistical significance (p>0.05) was observed for all the growth parameters for all treatments of feed used.

The carcass composition of the experimental fish as presented in Table 5 shows that the initial moisture level was similar across the diets but this varied significantly (p<0.05) after the feeding process. Also the ash content was found to follow the same pattern with significant differences (p<0.05) only being observed after the feeding trials (Table 3 and Table 5). No significant differences (p>0.05) were observed for all other proximate composition parameters for both initial and final carcass. Initial crude protein ranged from 19.33%±2.00 in diet I to 20.47%±1.44 in diet IV while the final carcass crude protein ranged from 18.08%±0.47 in diet III to 19.48%±0.89 in diet I. Initial carcass fat ranged from 16.43%±0.97 (diet IV) to 17.60%±1.50 (diet I) while the final carcass fat content ranged from 11.71%±0.42 in diet III to 13.75%±0.73 in diet I.

Analysis of data using student's t-test shows that there is no significant difference (p>0.05) between initial and final carcass values of ash, crude fibre and crude protein. However, there were significant differences (p<0.05) between the initial and final values of ether extract, Moisture and NFE.

Figure 1 shows the weekly weight increase of the experimental fish fed diets with varying inclusion levels of the Agama lizard meal. There was a uniform pattern of growth for diets II, III and IV for the first three weeks while diet I displayed a different pattern entirely. Fish fed diet III increased in weight above the other treatments between week three and week eight. This was followed closely by fish fed diet II. Fish fed diet IV lagged behind those of diet III and II after the third week.

DISCUSSION

The Mean Weight Gain (MWG) of *Clarias gariepinus* increased in response to higher inclusion level of agama lizard meal in combination with fish meal. The lack of significant difference in the Specific Growth Rate (SGR) and Feed Conversion Ratio (FCR) of the fish fed tends to suggest that *Agama agama* meal could be included up to 30% in the diet of C. gariepinus fingerlings. This is in line with the report of Ovie and Adejayan (2010), who reported that there were no significant differences in the various growth parameters for *C. gariepinus* fed varying levels of the garden snail *Limicolaria* Spp. Diet III with MWG of 42.80, SGR of 1.46% per day and FCR of 2.61 gave the best growth performance.

The FCR which ranged from 2.61-2.96 are quite higher than values of 0.35-1.12 reported by Nnaji and Okoye (2005) for *C. gariepinus* fed with varying levels of grasshopper meal (0, 10, 15, 20, 25 and 30%) as

Table 4: Growth Performance and Utilization of *Clarias gariepinus* fed different levels of *Agama agama* meals

Parameter	Diet I	Diet II	Diet III	Diet IV	SEM
Mean initial weight (g)	33.50	33.45	33.60	33.35	0.15
Mean final weight (g)	56.35	70.65	76.40	60.95	6.92
Mean Weight gain (g)	22.85	37.20	42.80	27.60	6.79
Specific growth rate (day^{-1}%)	0.93	1.32	1.46	1.08	0.17
Feed conversion ratio	2.84	2.69	2.61	2.96	0.12
Protein Efficiency Ratio (PER)	3.12	4.16	4.21	3.07	0.47
% Survival	97.50	87.50	80.00	70.00	5.86

No significant difference in all parameters for the Diets (p>0.05)

Table 5: Initial and Final Carcass Analysis of *Clarias gariepinus* fed different levels of *Agama agama* meals

Parameters		Final				
(%)	Initial	Diet I	Diet II	Diet III	Diet IV	SEM
Moisture	61.25	65.24^{b}	66.52^{ab}	68.21^{a}	66.94^{ab}	0.58
Crude protein	20.01	19.48	18.54	18.08	18.45	0.60
Crude fibre	0.05	0.04	0.03	0.03	0.04	0.01
Ether extract	16.82	13.75	13.54	11.71	12.45	0.63
Ash	1.40	0.95^{c}	1.05^{bc}	1.41^{ab}	1.47^{a}	0.12
NFE	0.29	0.42	0.32	0.42	0.45	0.05

Means in the same row of treatments with the same superscripts do not differ significantly (P>0.05)

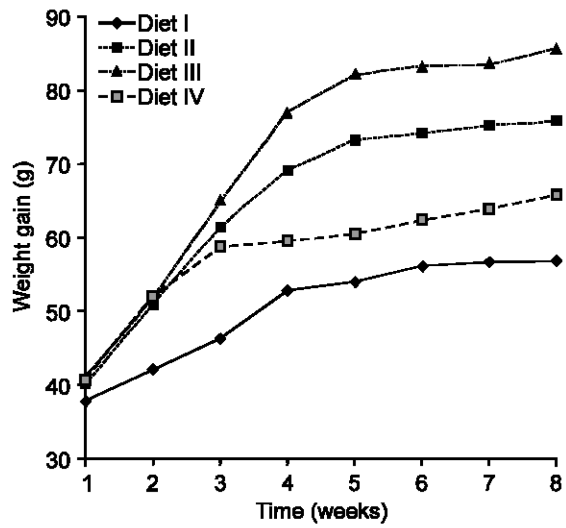

Fig. 1: Weekly weight gain of *Clarias gariepinus* fed diets with different inclusion levels of the Agama Lizard meal

substitute for fishmeal. Similarly, Ovie and Adejayan (2010) reported FCR values ranging between 1.10 and 1.23 for *C. gariepinus* fed varying levels (0-100%) of the garden snail (*Limicolaria* Spp.) as replacement for fishmeal which are also lower than those reported here. Furthermore, Sogbesan *et al.* (2006) reported FCR ranging from 1.21-1.44 for *C. gariepinus* fed garden snail (*Limicolaria aurora*) meal, as a replacement for fishmeal at levels of 0-100% at 25% intervals. In addition, Solomon *et al.* (2007), reported an FCR of 2.58 for *Heterobranchus* bidorsalis fingerlings fed with Wing Reproductive Termite Meal (WRTM) as a replacement for fish meal (FM) in the ratio of 25%WRTM:75%FM. Consequently, lizard meal is not efficiently utilized by *C. gariepinus* as an unconventional feedstuff to replace fishmeal when compared to grasshopper, wing reproductive termite and garden snail meals.

Okoye and Nnaji (2005) however reported an FCR of 2.75 for tilapia fed 25% inclusion level of grasshopper meal as replacement for fishmeal. This figure is close to the values reported for this present trial. Alatise *et al.* (2005), evaluated the freshwater mussel, *Aspatharia sinuata* as a dietary protein supplement in the diet of *Heterobranchus longifilis* fingerlings and reported FCR as low as 0.62 at 25% inclusion level and as high as 18.82 at 75% inclusion level. They concluded that complete replacement of fishmeal by freshwater mussel decreases growth rates and should not be used in *Heterobranchus longifilis* diets.

In terms of Specific Growth Rate (SGR), the values recorded for this trial (0.93-1.46) are lower than those reported by several authors. Solomon *et al.* (2007) reported a value of 2.13 for 25% inclusion of wing reproductive termite meal in the diet of *H. bidorsalis*. Nnaji and Okoye (2005) reported an SGR of 2.67 for 10% inclusion of grasshopper meal in the diet of *C. gariepinus* as the most efficient level of inclusion. However, Alatise *et al.* (2005) reported SGR values ranging from 0.04 to 1.62 for *H. longifilis* fed 0-75% inclusion of freshwater mussel. Sogbesan *et al.* (2006) reported an SGR of 0.71 for *C. gareipinus* at 25% inclusion level of the garden snail as the best performance. These results show that the agama lizard is better utilized by catfish than freshwater mussel but not wing reproductive termite and garden snail.

The final carcass composition of the fish *C. gariepinus* fed agama lizard meal shows that the moisture content is lower than those reported by Goda *et al.* (2007) for *C. gariepinus* fed various animal and plant protein sources in replacement of fishmeal with Soybean Meal (SBM) producing the lowest moisture content of 71.03% at 100% level of inclusion. Diet III from the present trial with moisture content of 68.21% is close to this value and also comparable with poultry by product meal value of 67.12% as reported by El-Sayed (1998) for carcass of Tilapia fed various animal protein sources. Carcass ash content which ranged from 0.95-1.47% is low when compared to values ranging from 2.97-4.87% reported for *C. gariepinus* by Goda *et al.* (2007) using various protein sources and El-Sayed (1998) who reported ash contents of tilapia carcass from 5.48-7.43% for diets of various protein sources. Carcass protein contents which ranged from 18.08% (Diet III) to 19.48% (Diet I) are higher than the values (9.42-16.46%) reported for *H. bidorsalis* fed wing reproductive termite meal by Solomon *et al.* (2007) and 14.10% (100% poultry by-product meal) to 18.10% (100% Soybean meal) for *C. gariepinus* by Goda *et al.* (2007).

Conclusively, diet III which contains agama lizard meal at 20% inclusion level is ideal for use since it produced the highest MWG and SGR as well as the lowest FCR. When compared with other alternative animal protein sources, the agama lizard meal performed less. This may be due to amino acid content hence the need for further investigation on the amino acid profile of the agama lizard meal. The carcass crude protein content of the test fish also shows that the fish produced is rich in nutrients when compared to results of previous works. The agama lizard meal is therefore a good candidate to replace fish meal in the diets of *C. gariepinus*.

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