An Evaluation of Three Fish Diets Formulated from Locally Generated Agricultural By-products for Catfish (*Heterobranchus bidorsalis*: Geoffroy St. Hilaire, 1809) culture

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ABSTRACT

The growth rate, economic benefits and other yield characteristics of *Heterobranchus bidorsalis* (Geoffroy St. Hilaire, 1809) fed with three diets formulated from locally generated low-cost agricultural by-products were evaluated in an experiment that was carried out for a period of 56 weeks. The best growth and profitability were obtained in T₁ (Fish meal soybean meal and yellow maize followed by T₂ (cow blood, soybeans meal and yellow maize) and T₃ (cassava peels, soybean meal and yellow maize). Evaluation of growth parameter and food utilization of the fish fed on the three experimental diets was based on Mean Weight Gain (M.W.G.), Food Conversion Ratio (F.C.R.), and Survival Rate. There was significant difference ($p < 0.05$) in M.W.G., M.F.W., F.C.R and Net Revenue realized from the sale of fish produced from the three treatments (T₁, T₂ and T₃). Fish fed T₁ had the highest M.W.G. (2,353.30 g) and conversely the least F.C.R. (1.80) while fish fed T₂ had a M.W.G. of 2,030.40g and F.C.R. of 2.80 while fish fed T₃ had a M.W.G. of 1,261.15g and F.C.R. of 3.85. However, there was no significant difference ($p > 0.05$) in survival rate. The economy of food conversion was best in T₁. Net Revenue realized from the sale of fish was highest in T₁ (N105, 764.50) followed by T₂ (N74,440.50) and T₃ (N39,438.50).

Original Research Article

Received: 22nd Nov., 2017

Accepted: 14th Jan., 2018

Published: 14th Mar., 2018

Keywords:

Agricultural by-products

Catfish culture

Economic benefits.

Heterobranchus bidorsalis

1. INTRODUCTION

Aquaculture accounts for less than 10% of total fish production in Nigeria (Egwui, 1986; Aguigwo, 1993; Absalon and Omenaihe, 2000; Adekoya, 2001; Nwosu *et al.*, 2002; Nwosu *et al.*, 2009). Various workers (Huisman, 1986; Middendorp, 1993; Chidobem and Anibeze, 1994; Eze *et al.*, 2000; Nwosu *et al.*, 2002 and Nwosu *et al.*, 2009) have advocated that aquaculture could bridge the gap and demand supply of fish in Nigeria. One major constraint to the development of aquaculture, however including other constraints (Okeke *et al.*, 2016) is the prohibitive high cost of extruded fish feeds in the country. Some resource poor farmers often resort to the use of fish feeds of doubtful quality which often results in low yield. Recent studies (Nwosu *et al.*, 2009; Okeke *et al.*, 2016) showed that *Clarias garipinus* (Burchell: 1822) and *Heterobranchus* spp. are preferred in Nigeria because they are hardy, grow fast and resistant to diseases. Adequate knowledge of these species and their

nutritional requirements etc. is therefore, necessary in order to sustain, their continuous production.

Various research work (Alfred-Ockiya *et al.*, 1995; Eze *et al.*, 2000; Nwosu *et al.*, 2002; Jamabo and Alfred-Ockiya, 2008; Nwosu *et al.*, 2009 and Okeke *et al.*, 2016) have aptly demonstrated the growth response of cat fishes to agricultural by-products such as proteins sources. This, therefore, formed the pivot of the present research work viz: to evaluate three fish diets formulated from locally generated agricultural by-products for catfish culture.

2. MATERIALS AND METHODS

The research work was carried out for a period of 56 weeks. There were three treatments namely: T₁ (fish meal, soybean meal and yellow maize), T₂ (cow blood meal, soybean meal and yellow maize), T₃ (cassava peels, soybean meal and yellow maize) and the experimental fish.

Each treatment was replicated 4 times, collection and stocking of fish fingerlings. A total of 1440 fingerlings of *Heterobranchus bidorsalis* with an initial mean weight of 4.50 ± 0.02 g and mean standard length of $7.30 \text{ cm} \pm 0.04$ cm were stocked at the rate 120 fingerlings in 12 homestead concrete fish ponds 60m^3 owned by Anambra State Agricultural Development (ADP) contact farmers in the four Agricultural Zones viz: Aguata, Onitsha, Anambra and Awka (Fig. 1). The fingerlings were prior to stocking conditioned and acclimatized by introducing small quantities of the pond water into the plastic container holding the fish fingerlings for a period of 30 minutes. The fish ponds were prepared for stocking with fish fingerlings using methods adopted by Nwosu *et al.* (2009). The ponds were each fertilized with a

1:1 mixture of poultry dropping and cow dung at the rate of 9kg per pond to generate phytoplankton and zooplankton.

2.1 Pond water parameters

Pond water parameters (Table 1) were taken fortnightly by measuring pH, temperature and turbidity. Surface water temperature was measured with the aid of mercury in glass bulb thermometer at a depth of 25mm. pH was measured with the aid of a battery operated field pH meter while turbidity was measured with the aid of a 25cm Secchi Disc as stipulated by AOAC (1990) and Nwosu *et al.* (2009), while nitrate-nitrogen concentration was determined spectrophotometrically. Dissolved oxygen was determined using the Winkler method

Fig. 1: Map of the Study Area

2.2 Preparation of fish feed

The three fish feeds were compounded to contain 35% crude protein and the fish were fed 5% of their body weight. The level of hydrocyanic acid (HCN) in the cassava peels was reduced following methods adopted by Tewe (1982) and Nwosu *et al.* (2009): by sun-drying before being incorporated into the fish feed. The compounded fish feeds were supplemented with palm oil to ensure that they were 150-caloric (Tewe, 1982; Nwosu *et al.*, 2009). The experimental fish were fed twice daily (7am and 6pm) and sampling was done fortnightly to monitor fish growth.

The growth performance and food utilization parameters of *H. bidorsales* (Table 2) were calculated using methods presented in Nwosu *et al.* (2009) and Okeke *et al.* (2016).

1. Food conversion ratio – This was determined as the ratio of food consumed by fish to the weight gain by fish and expressed as

$$F.C.R. = \frac{\text{Food consumed by fish (kg)}}{\text{Total weight gain by fish (kg)}}$$

2. Mean weight gain (M.W.G.) this was also determined as final weight gain minus initial weight of fish $Wt.F = Wt - f$
Where WF = Final mean weight of fish W.F. = initial mean weight of fish
3. Percentage survival (PS) was determined as the ratio of number of fish harvested to the number of fish stocked and expressed as

$$PS = \frac{\text{Number of fish harvested}}{\text{Number of fish stocked}} \times 100$$

2.3 Economic Analysis

Cost-benefit Analysis (Table 3) was based on methods adopted by Nwosu *et al.* (2002) and Okeke *et al.* (2016). The following parameters were analysed.

1. Cost/kg feed (N) = properties of each ingredient in the diet × cost/kg of the increment.
2. Cost of total feed consumed per fish (N) = total feed consumed × cost/kg feed.
3. Cost/kg weight gain = cost/kg × feed conversion
4. Revenue (total cost or net cost) cost/kg fish × mean weight gain
5. Gross margin = revenues – cost of total feed consumed.

2.4 Statistical Analysis

The growth performance of *H. bidorsalis* as affected by the three feeds were computed at the end of the research work and subjected to one-way Analysis of Variance (ANOVA) and least significant difference (LSD) test at 5% level of significance.

3. RESULTS AND DISCUSSION

The growth performance and food utilization parameters of *H. bidorsalis* fed three diets viz, T₁, T₂ and T₃ are presented in Table 1. The highest growth response (mean weight gain) of 2,352.30g was attained in T₁ followed by T₂ (2,025.90 g) and T₃ (1,261.15 g) which varied significantly (p<0.05). Mean final weight (2,356.80 g, in T₁, 2,030.40 g in T₂ and 1,266.00 g in T₃) also varied significantly (p<0.05). Total fish yield (94.27 kg in T₁; 69.03 in T₂ and 40.51 in T₃) also varied significantly (p<0.05).

The economy of feed conversion consistently was most efficient (1.80) in T₁ (Fish meal and yellow maize followed by T₂ (cow blood, soybean meal and yellow maize with a food conversion ratio (F.C.R.) of 2.80 and 3.85 in T₃. The difference in growth performance and food utilization of *H. bidorsalis* fed with three experimental diets (T₁, T₂ and T₃) could be attributed to the different sources of protein in the diets. Work done elsewhere (Eze *et al.*, 2000; Nwosu *et al.*, 2002; Nwosu *et al.*, 2009) demonstrated that fish growth is proportional to the amount of protein in the diet. It is noteworthy also that although all three fish diets used contained protein only T₁ contained fish protein which is a high grade protein (Egwui, 1986; Ockiya *et al.*, 1995; Eze *et al.*, 2000; Nwosu *et al.*, 2002 and Okeke *et al.*, 2016).

The lowest growth response was obtained in T₃ which included cassava peels, soybean meal and yellow maize. Work done elsewhere (Nwosu *et al.*, 2009) has shown that as in the case of poultry and other monogastric animals certain precautionary measures need to be taken to guarantee

satisfactory performance of the fish stock fed on cassava meal. It has been demonstrated for instance that cassava can affect mineral imbalance in monogastric animals such as pigs (Tewe, 1982). This condition however, can be prevented by including zinc salts in the diets (Maust *et al.*, 1972 and Nwosu *et al.*, 2009).

3.1 Percentage Survival

Percentage survival of the experimental fish was generally high although not significantly different (p>0.05) for all the treatments (95.83%, 94.60% and 92.25%) in T₁, T₂ and T₃ respectively. The high survival rate of *H. bidorsalis* recorded in the present work may be attributed to the high ecological tolerance of the clariid and proper pond management.

3.2 Economic Analysis

A simple cost-benefit analysis (Table 2) obtained from total weight of fish produced, gross revenue, total cost of product and net revenue showed that net profit from T₁ was N105,764.50; N74,440.50 from T₂ and N39,438.50 from T₃.

3.3 Pond Water Parameters

Pond water quality (Table 3) was not adversely affected in the course of the research work. The mean values of water quality parameters did not vary significantly (p>0.05) and fell within the acceptable range for fish culture in the tropics (AOAC, 1990).

4. CONCLUSION

The results of this research work showed that both fish yield and net profit were higher in T₁ followed by T₂ and T₃. The high level of fish production in T₁ tends to suggest that the inclusion of fish meal and soybean meal in fish diets enhances food utilization, growth and weight gain in culture fish.

The lowest value of fish production obtained in T₃ may be attributed to the incorporation of cassava peels which may alter nutrient balance in fish feeds. This result tends to suggest an optimum, minimum and maximum inclusion/substitution levels for cassava in fish feed formulation. These observations notwithstanding the beneficial effects of cassava peels and the other two agricultural by-products used in the present research work cannot be underestimated in the quest to reduce cost of cat fish production in the country.

Table 1: Growth performance and food utilization parameters of *H. bidorsalis*

Treatment	Initial weight (g)	Mean weight (g)	final weight (g)	Mean weight gain (g)	Total fish yield (kg)	F.C.R.	Percentage survival (%)
T ₁	4.50	2,356.80 ^a		2352.30 ^a	94.27 ^a	1.80 ^a	95.83 ^c
T ₂	4.50	2,030.40 ^a		2025.90 ^a	69.03 ^b	2.80 ^b	94.60 ^c
T ₃	4.50	1,266.00 ^b		1261.15 ^b	40.51 ^c	3.85 ^c	92.25 ^c
		LSD (p = 0.05)		LSD (p = 0.05)	LSD (p = 0.05)	LSD (p = 0.05)	LSD (p = 0.05)
		= 1010.00		= 1090.40	= 20.25	= 2.16	= 5.50

Means followed by different letters are significantly different (p<0.05)

Table 2: Cost-Benefit Analysis

Treatment	Total fish production (kg)	Unit price (N)	Gross Revenue (N)	Total Cost of production (N)	Net Revenue
T ₁	94.27	1,350	127,264.50	21,500	105,768.50
T ₂	69.03	1,350	93,190.50	18,750	74,440.50
T ₃	40.51	1,350	54,688.50	15,250	39,438.50

Table 3: Pond water parameters

Parameter	Min.	Max.	Mean	SD
Temperature (°C)	26.10	27.00	25.00	±0.03
pH	7.00	8.00	7.50	±0.01
Dissolved oxygen (mg/l)	6.50	7.50	6.50	±0.03
Free CO ₂	3.00	4.00	3.50	±0.01
Nitrate-nitrogen concentration (mg/l)	2.01	2.05	1.25	±0.05
Alkalinity (ppm)	5.00	5.50	5.00	±0.02

SD = Standard Deviation

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How to cite this article

Nwosu M.C. (2018). An Evaluation of Three Fish Diets Formulated from Locally Generated Agricultural By-products for Catfish (*Heterobranchius bidorsalis*: Geoffroy St. Hilaire, 1809) culture. *Tropical Journal of Applied Natural Sciences*, 2(2): 10-14. Doi: <https://doi.org/10.25240/TJANS.2018.2.2.02>.

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