Original Research Article

The effect of different energy source on the growth performance of *Clarias gariepinus* fingerlings

ABSTRACT

This study was aimed to evaluate and compare the effects of different selected energy feed stuff namely; Maize (DT_1) Guinea corn (DT_2) millet (DT_3) and wheat (DT_4) on the growth performance and body composition of *Clarias gariepinus* fingerlings. This energy feedstuff in addition with other feed ingredients was used to formulate four (4) isonitrogenous and isoenergy diets at 40% crude protein. The energy feedstuffs were formulated at 36.31%, 38.26%, 37.09% and 40.05% level of inclusion respectively. The experiment in the ponds used a set of 2 hapas with mesh size 2mm in each pond measuring $1.62m^2$, therefore replicating the experiment 2 times in a completely randomized design The evaluation of the physical parameters revealed that there was no significant difference ($p>0.05$) in moisture, ash, lipid, fibre, protein and nitrogen free extract among the treatment (diets). The diet with maize (DT_1) has the highest growth rate followed by diet containing millet (DT_3), guinea corn (DT_2) and diet containing wheat (DT4) had the lowest growth rate. This study, revealed that, among the energy feedstuffs evaluated maize (DT_1) produced better growth parameters and could be recommended for on-farm aqua-feed.

Keywords: *Clarias gariepinus*, energy source, fingerlings, maize, Guinea corn, Millet, wheat.

INTRODUCTION

Every living organism including fish requires food for growth, reproduction and maintenance of tissues. To sustain fish under culture, supplemental diet must be provided to complement natural feed supply [1]. Feed stuffs used in aquaculture to provide basic nutrients such as protein, carbohydrate, minerals, water, vitamins and lipids are expensive because of their competitive uses by man and other animals [2]. Research has therefore focused on the need to provide alternative sources of these essential nutrients for use in aqua-feeds.

Aquaculture requires optimization of nutrition to efficiently raise fish for food production [3]. Nutrition have been reported by Adewolu and Adoti [4] to play a critical role in intensive aquaculture as it influences production cost as well as fish growth, health and waste production. Fish nutrition is the study of nutrients and energy sources essential for fish health, growth and reproduction [4]. Fish requires high quality nutritionally balanced diet for growth and for the attainment of market size within the shortest possible time [5]. Catfish farming has continued to attract private sector initiative compared to earlier public or government-sponsored programmes [6]. *Clarias gariepinus* is regarded as a good prospect for aquaculture due to its outstanding culture characteristics such as ability to adapt adverse environmental conditions, efficient utilization of various types of locally formulated fish feed, resistance to diseases, high economic potential and simple techniques in the propagation of their fingerlings [7].

Carbohydrate is a cheap source of dietary energy in domestic animals including fish [8]. Carbohydrates are important non-protein energy sources for fish and should be included in the diets at appropriate levels in order to maximize the use of dietary protein for growth. The amount of non-protein energy sources that can be incorporated into fish diets is not fully understood because certain fish species exhibit reduced growth rates when fed with carbohydrate free diets [9].

The purpose of this study is to determine the effect of different energy sources on the growth performance of *Clarias gariepinus* fingerlings.

MATERIALS AND METHODS

The experiment was carried out at the Fish farm of the Institute of Oceanography, University of Calabar, Calabar for 56 days. Two hundred and five (205) fingerlings of *Clarias gariepinus* with mean weight of 4.68± 0.093g were collected from the University of Calabar Fish Farm and acclimatized for seven (7) days. Before stocking, the initial weight (g) and length (cm) of the fingerlings were weighed to the nearest 0.1g using Metlar -200D electronic weighing balance and nearest 0.1cm measuring board for length. Five fingerlings were randomly picked and taken to the laboratory for proximate analysis prior to feeding trials. During the period of acclimatization, the fish were fed with 1.5mm Coppen feed. The experiment in the ponds used a set of 2 hapas with mesh size 2mm in each pond measuring 1.62m^2, therefore replicating the experiment 2 times in a completely randomized design i.e 2 hapas in each of the four earthen ponds that were assigned for the study. The fingerlings were randomly distributed in 25 numbers to all hapas unit. Feed ingredients used for the feed formulation (maize, guinea corn, millet, wheat, soybeans, fish meal and mineral premix) were purchased from Watt market Calabar, Nigeria. feed stuff/ingredient such as soybeans was processed by toasting to improve their digestibility and eliminate anti-nutritional factor that may be present in the feed.

Formulation of feed

Pearson's square method was employed to formulate the four isonitrogenous and isoenergetic experimental diets at 40% crude protein. Each of the diets contain only one of the test grains at 36.31%, 38. 26%, 37.09% and 40.05% level of inclusion (Table 1)

Fish were fed twice a day for eight weeks at 5% of their body weight; the amount of feed given was adjusted after the weekly measurement. The growth parameters were evaluated as given below.

Mean weight gain (MWG) = MFW – MIW

Where, MWG = Mean Weight Gain, MFW = Mean Final Weight and MIW = Mean Initial Weight

Specific growth rate (SGR): was established from the relationship of the differences in weight periods.

$$\text{SGR} = \frac{loge W_2 - loge\, W_1}{T}\ x\ 100$$

Where: W_1 = weight (g) at stocking, W_2 = weight (g) at the end of experiment, T = time duration (in days) of the experiment and Log_e = natural logarithms

Feed conversion ratio (FCR)**:** was determined from the relationship of feed intake and wet weight gain.

$$\mathrm{FCR} = \frac{\text{Amount of fed given (g)}}{\text{Increase of fish weight (g)}}$$

Protein Efficiency Ratio (PER): was determined from the relationship between weight gain and protein consumed.

$$\mathrm{PER} = \frac{\text{Increase of fish weight}}{\text{protein intake}}$$

Apparent Net Protein Utilization (ANPU): was determined as follows:

$$= \mathrm{ANPU} = \frac{\text{Protien gain}}{\text{protein intake}}\ \mathrm{x}100$$

Proximate analysis

The proximate composition of the formulated diet and the proximate composition of the initial and final carcass of the experimental fish were determined according to methods described by AOAC [10].

Statistical analysis

Data generated were analysed using One-way ANOVA to test for significance using PASW windows software (predictive analytical software) program (version 19.0). Effects with a probability of $P < 0.05$ were considered significant whereas the probability of $P > 0.05$ was not considered significant.

RESULTS AND DISCUSSION

The proximate compositions of experimental diet and experimental fish are shown in Tables 2 and 3 respectively. From Table 2, it was observed that, the crude protein level of the four experimental diets differs significantly (i.e. 42.11 ± 0.01, 40.58 ± 0.01, 41.72 ± 0.01, and 40.24 ± 0.01 respectively). The ratio in Table 3 shows that the composition of the experimental fish feed and the diets of various energy sources did not vary significantly at 5% level of significance. The growth performance and nutrient utilization of the fish samples in table 3 indicated that diet 1 had the highest weight gain (18.91g) and highest specific growth rate (2.76%) while diet 4 had the lowest weight gain (11.16g) and lowest specific growth rate (2.54%). The protein efficiency ratio (PER) values ranged between 0.16± 0.01 and 0.19±0.02. Diet3 (DT_3) composed of millet recorded the highest protein efficiency ratio (0.19± 0.02) while Diet2 (DT_2) composed of guinea corn recorded the lowest protein efficiency ratio (0.16± 0.01). The feed conversion ratio (FCR) values ranged between 13.57± 1.14 and 15.99± 0.56. Diet2 (DT_2) recorded the highest feed conversion ratio (15.99±0.56). While, Diet3 (DT_3) recorded the lowest feed conversion ratio been 13.57± 1.14. The feed conversion efficiency (FCE) values ranged between 6.05± 0.00 and 7.45± 0.65. Diet3 recorded the highest feed conversion efficiency (7.45± 0.65) while, Diet2 (DT_2) recorded the lowest feed conversion (6.05±0.07).

Carbohydrate, either of cereal or tuber in fish feed has been reported to acts as both structural and energy component [11], which have some influence on the rate of growth of fish provided all other physiological requirements are satisfied [12]. The isonitrogenous and isoenergetic experimental diets were formulated at 40% crude protein and 36.31%, 38.26%, 37.09% and 40.05% level of inclusion of maize, guinea corn, millet, wheat based on the fact that *Clarias gariepinus* is an omnivore, emphasizing animal source of food, therefore its feed contains less carbohydrates compare to plant based omnivore like “tilapia”.

In the research conducted by Al-Ogaily et al. [13] using maize, wheat, barley, rice and sorghum at 25% level of inclusion and approximately 41% crude protein, the diet containing sorghum gave the best performance at 5% level of significance (p<0.05), while there was no significant difference (p>0.05) in the performance of maize, wheat, and rice. The slight difference in the result of Al-Ogaily et al. [13] and the present study may be due to the different levels of inclusion of the grain. As the levels of inclusion of the grain increased, the digestibility of sorghum reduces at higher rate than that of maize. This is due to the presence of anti nutritive factor, tannin [14]; [15], in untreated sorghum and its influence on diet increase with increasing level of sorghum in the diet.

Conclusion

This study discovered the importance of maize, guinea corn, millet, wheat which can be utilized efficiently in *Clarias* diet to enhance growth and body composition quantity or quality. This study will help the researchers to identify the level of inclusion of different energy sources that many researchers were not able to explore. It is also recommended that for practical purpose, lower level of inclusion of grains than the 36.31%, 38.26%, 37.37% and 40.05% be used in *Clarias* diet.

ETHICAL APPROVAL

As per international standard or university standard ethical approval has been collected and preserved by the authors.

REFERENCES

1. Karapan, A. (2002). Studies to optimize poly unsaturated fatty acid composition of tilapia for human consumption in S.E. Asia. *Aquaculture News*.28:6-7.
2. Dunham, R.A., Majumdar, K., Hallerman, E., Bartly, D., Mair, G., Hulata, G., Liu, Z., Pongthan, N., Bakos, J., Penman, D., Gupta, M., Rothlisberg, P. & Hoerstgen-Schwark, G. (2001). Review of the status of aquaculture genetics. In: R. P. Subasinghe P, Bueno MJ, Philips C, Hough SE, Mc Gladdeny & JR Arthur (Eds). Aquaculture in the third millennium. Technical proceeding of the conference on aquaculture in the third millennium, Bangkok, Thailand, 20-25 February, 2000 PP137-166.NACA. Bangkok and FAO, Rome.
3. Hixson S.M. (2014). Fish nutrition and current issues in aquaculture: The balance in providing safe and nutritious seafood, in an environmentally sustainable manner. Journal of Aquaculture Research and Development.; 5(3):2-10. DOI:10.4172/2155-9546.1000234.
4. Adewolu M. A, Adoti A.J. (2010). Effect of mixed feeding schedules with varying dietary crude protein levels on the growth and feed utilization of *Clarias gariepinus* (Burchell, 1822) fingerlings. *Journal of Fisheries and Aquatic Sciences*.5:304-310. ISSN 1816-4927
5. Gabriel U U, Akinrotimi OA, Bekibele DO, Onunkwo DN, Anyanwu PE (2007). Locally produced fish feed: Potentials for aquaculture development in Sub-Saharan Africa. *African Journal of Agricultural Research*, 2(7):287-295.
6. Shiau SY, Huang S L (1992). Influence of varying energy levels with two protein concentrations in diets for hybrid tilapia (*Oreochromis niloticusx O. aureus)* reared in seawater. Aquaculture. 91:143-152. *doi*:10.1007/BF00004481

7. Owodeinde FG, Ndimele P.E. (2011). Survival, growth and feed utilization of two clariid catfish (*Clarias gariepinus*, Burchell, 1822 and *Heterobranchus bidorsalis*, Geoffrey, 1809) and their reciprocal hybrids. Journal of Applied Ichthyology. 27:1249-1253. https://doi.org/10.1111/j.1439-0426.2011.01804.x
8. Shiau SY, Lin YH (2001). Carbohydrate utilization and its protein-sparing effect in diets for grouper (Epinephelus malabaricus). Anim. Sci. 73:299-304.
9. Wilson RP (1994). Utilization of dietary carbohydrate by fish. Aquaculture 124:67-80. http//dx.doi.org/10.1016/0044-8486(94)90363-8.
10. AOAC (Association of Official Analytical Chemists) (2000). Official methods of analysis 16th edition, Arlington Virginia, USA.
11. Bruton MN (1979). The food and feeding behaviour of *Clariasgariepinus* (Pisces: Clariidae) in Lake Sibaya, South Africa, with emphasis on its role as a predator of cichlids. Trans.of the Zool. Soc. of Lon.35: 47-114.
12. Carter CG, Lewis T.E, Nicholas PD (2003).Comparison of cholesterol and sodium oxide as digestibility markers for lipid components in Atlantic salmon (*Salmon salar*) diets. Aqua., 225:341-351.
13. Al-Ogaily, S.M., N.A. Al-Asgah and A.Ali (1996). Effect of feeding different grain sources on the growth performance and body composition of tilapia , oreachromes nicoticus (L) Aquaculture Research, 1996. 27. 523 – 529. King Saudi University, Saudi Arabia.
14. Andrews, D.J., J.F. Rajasski, and K.A. Kumar, (1993). Pearl millet: New feed grain crop. P. 198-208 in J. Janick and J.E. Simon (eds). New crops, willey, New York.
15. Enwere, N.J. (1998). Food of plant origin, Afro-orbis pub.Ltd. Nsukka, Nigeria

Table 1. Percentage composition of experimental diet using Pearson's Square method

Ingredient (%)	**Diet 1**	**Diet 2**	**Diet 3**	**Diet 4**
Fish meal	31.85	30.87	31.46	29.98
Soya bean meal	29.85	28.87	29.46	27.98
Maize	36.31	-	-	-
Guinea corn	-	38.26	-	-
Millet	-	-	37.09	-
Wheat	-	-	-	40.05
Mineral premix	0.5	0.5	0.5	0.5
Vitamin premix	0.5	0.5	0.5	0.5
Salt	`1	1	1	1
Total	100	100	100	100

Table 2. Proximate composition of different energy feed stuffs.

Diets	Moisture	Ash	Lipid	Fibre	Protein	NFE
Diet 1	6.53 ± 0.01^{c}	9.81 ± 0.01	7.88 ± 0.01^{a}	8.35 ± 0.02^{d}	42.11 ± 0.01^{a}	25.99 ± 0.01
Diet 2	6.09 ± 0.01^{d}	8.76 ± 0.01	7.91 ± 0.01^{b}	10.32 ± 0.01^{a}	40.58 ± 0.01^{c}	27.06 ± 0.01
Diet 3	7.19 ± 0.01^{b}	8.72 ± 0.01	7.02 ± 0.01^{c}	9.21 ± 0.01^{c}	41.72 ± 0.01^{b}	26.16 ± 0.01
Diet 4	7.45 ± 0.01^{a}	9.44 ± 0.50	7.19 ± 0.01^{b}	9.23 ± 0.01^{b}	40.24 ± 0.01^{d}	26.46 ± 0.52

Mean in the same column of treatment followed by different superscripts differs significantly (p>0.05).

Table 3. Proximate composition of Carcass of *Clarias gariepinus* fed different energy feed stuffs.

Diets	Moisture	Ash	Lipid	Fibre	Protien	NFE
Initial	3.36 ± 0.01^{d}	7.14 ± 0.02^{d}	3.01 ± 0.01^{e}	3.42 ± 0.01^{e}	44.22 ± 0.01	38.87 ± 0.02
Diet 1	5.61 ± 0.01^{c}	11.33 ± 0.01^{c}	4.82 ± 0.01^{a}	5.13 ± 0.01^{d}	51.88 ± 0.01	21.24± 0.01^{b}
Diet 2	5.71 ± 0.01^{b}	15.22 ± 0.01^{b}	3.93 ± 0.01^{c}	6.72 ± 0.01^{a}	50.14 ± 0.01	18.26 ± 0.02^{c}
Diet 3	5.63 ± 0.00^{c}	15.14 ± 0.01^{a}	4.65 ± 0.01^{b}	6.26 ± 0.01^{b}	50.78 ± 0.01	17.78 ± 0.50^{c}
Diet 4	7.01 ± 0.01^{a}	7.14 ± 0.01^{d}	3.71 ± 0.01^{d}	6.12 ± 0.01^{c}	49.52 ± 0.01	17.81 ± 0.00^{c}

Mean in the same column of treatment followed by different superscripts differs significantly (p>0.05).

Table 4. Growth parameters different energy feed stuffs.

Diets	MIW	MFW	WT Gain	Daily WT Gain	SGR	PER	FCR	FCE	FE	FI	ANPU
Diet 1	4.68± 0.093g^{ab}	20.84 ± 0.39^{a}	18.91 ± 0.42^{a}	0.34 ± 0.01^{a}	2.76 ± 0.03^{a}	0.17 ± 0.00	14.65 ± 0.06	6.83 ± 0.03	0.07 ± 0.00	272.82 ± 7.16	7.03 ± 0.19
Diet 2	4.68± 0.093g^{a}	17.63 ± 0.61^{ab}	15.70 ± 0.63^{ab}	0.28 ± 0.01^{ab}	2.61 ± 0.03^{ab}	0.16± 0.01	15.99 ± 0.56	6.05 ± 0.00	0.06 ± 0.00	229.06 ± 2.01	6.47 ± 0.05
Diet 3	4.68± 0.093g^{bc}	18.77 ± 0.65^{a}	16.85 ± 0.69^{a}	0.30 ± 0.01^{a}	2.71 ± 0.08^{ab}	0.19 ± 0.02	13.57 ± 1.14	7.45 ± 0.65	0.08 ± 0.01	236.4 ± 29.1	7.05 ± 0.87
Diet 4	4.68± 0.093g^{c}	13.06 ± 0.45^{b}	11.16 ± 0.43^{b}	0.20 ± 0.01^{b}	2.54 ± 0.02^{b}	0.17 ± 0.01	15.19 ± 0.76	6.60 ± 0.33	0.07 ± 0.01	186.7 ± 15.8	7.15 ± 0.61

Mean in the same column of treatment followed by different superscripts differs significantly ($p>0.05$).
MIW = Mean Initial Weight, MFW = Mean Final Weight, WG = Weight gain, SGR = Specific Growth Rate, PER = Protein Efficiency Ratio, FCR = Feed Conversion Ratio, FCE = Feed Efficiency Ratio, FE = Feed Efficiency, FI = Feed Intake and ANPU = Apparent Net Protein Utilization.