

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 (DT₁), Guinea corn (DT₂), millet (DT₃), and wheat (DT₄) on the growth performance and body composition of African sharptooth catfish (*Clarias gariepinus* Burchell) 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 1.62m², 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 (DT₁) has the highest growth rate followed by diet containing millet (DT₃), guinea corn (DT₂) and diet containing wheat (DT₄) had the lowest growth rate. This study, revealed that, among the energy feedstuffs evaluated maize (DT₁) 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

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

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

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

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

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55 **MATERIALS AND METHODS**

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57 The experiment was carried out at the Fish farm of the Institute of Oceanography, University of
58 Calabar, Calabar for 56 days. Two hundred and five (205) fingerlings of *Clarias gariepinus* with
59 mean weight of 4.68 ± 0.093 g were collected from the University of Calabar Fish Farm and
60 acclimatized for seven (7) days. Before stocking, the initial weight (g) and length (cm) of the

61 fingerlings were weighed to the nearest 0.1g using Metlar -200D electronic weighing balance and
62 nearest 0.1cm measuring board for length. Five fingerlings were randomly picked and taken to the
63 laboratory for proximate analysis prior to feeding trials. During the period of acclimatization, the fish
64 were fed with 1.5mm Coppem feed. The experiment in the ponds used a set of 2 hapas with mesh
65 size 2mm in each pond measuring 1.62m², therefore replicating the experiment 2 times in a
66 completely randomized design i.e 2 hapas in each of the four earthen ponds that were assigned for
67 the study. The fingerlings were randomly distributed in 25 numbers to all hapas unit. Feed
68 ingredients used for the feed formulation (maize, guinea corn, millet, wheat, soybeans, fish meal
69 and mineral premix) were purchased from Watt market Calabar, Nigeria. feed stuff/ingredient such
70 as soybeans was processed by toasting to improve their digestibility and eliminate anti-nutritional
71 factor that may be present in the feed.

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73 **Formulation of feed**

74 Pearson's square method was employed to formulate the four isonitrogenous and isoenergetic
75 experimental diets at 40% crude protein. Each of the diets contain only one of the test grains at
76 36.31%, 38. 26%, 37.09% and 40.05% level of inclusion (Table 1)

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

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80 Mean weight gain (MWG) = MFW – MIW

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

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

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$$87 \text{ SGR} = \frac{\log_e W_2 - \log_e W_1}{T} \times 100$$

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88 Where: W₁ = weight (g) at stocking, W₂ = weight (g) at the end of experiment, T = time duration (in
89 days) of the experiment and Log_e = natural logarithms

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

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$$94 \text{ FCR} = \frac{\text{Amount of fed given (g)}}{\text{Increase of fish weight (g)}}$$

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

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

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

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$$\text{ANPU} = \frac{\text{Protein gain}}{\text{protein intake}} \times 100$$

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104 **Proximate analysis**

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106 The proximate composition of the formulated diet and the proximate composition of the initial and
107 final carcass of the experimental fish were determined according to methods described by AOAC
108 [10].

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111 **Statistical analysis**

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

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120 RESULTS AND DISCUSSION

121 The proximate compositions of experimental diet and experimental fish are shown in Tables 2 and
122 3, respectively. From Table 2, it was observed that, the crude protein level of the four experimental
123 diets differs significantly (i.e. 42.11 ± 0.01 , 40.58 ± 0.01 , 41.72 ± 0.01 , and 40.24 ± 0.01
124 respectively). The ratio in Table 3 shows that the composition of the experimental fish feed and the
125 diets of various energy sources did not vary significantly at 5% level of significance. The growth
126 performance and nutrient utilization of the fish samples in table 3 indicated that diet 1 had the
127 highest weight gain (18.91g) and highest specific growth rate (2.76%) while diet 4 had the lowest
128 weight gain (11.16g) and lowest specific growth rate (2.54%). The protein efficiency ratio (PER)
129 values ranged between 0.16 ± 0.01 and 0.19 ± 0.02 . Diet3 (DT₃) composed of millet recorded the
130 highest protein efficiency ratio (0.19 ± 0.02) while Diet2 (DT₂) composed of guinea corn recorded the
131 lowest protein efficiency ratio (0.16 ± 0.01). The feed conversion ratio (FCR) values ranged between
132 13.57 ± 1.14 and 15.99 ± 0.56 . Diet2 (DT₂) recorded the highest feed conversion ratio (15.99 ± 0.56).
133 While, Diet3 (DT₃) recorded the lowest feed conversion ratio been 13.57 ± 1.14 . The feed conversion
134 efficiency (FCE) values ranged between 6.05 ± 0.00 and 7.45 ± 0.65 . Diet3 recorded the highest feed
135 conversion efficiency (7.45 ± 0.65) while, Diet2 (DT₂) recorded the lowest feed conversion
136 (6.05 ± 0.07).

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

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

152 Conclusion

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

158 **ETHICAL APPROVAL**

159 As per international standard or university standard ethical approval has been collected and
160 preserved by the authors.
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211 **Table 1.** Percentage composition of experimental diet using Pearson's Square method
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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

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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

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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

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

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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

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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.