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2 **Original Research Article**

3 **NUTRITIONAL QUALITY DIFFERENTIAL, GROWTH AND ECONOMICS**  
4 **EFFICIENCY OF SOME SELECTED COMMERCIAL FLOATING FISH FEEDS**  
5 **IN SAKI WEST OYO STATE NIGERIA**

**Comment [FE1]:** Recast. You must not state all the variables in your title

6

7

8 **Abstract**

9 *Nothing is more important than quality nutrition and adequate feeding of fish in captivity. Undernourished fish in terms of nutrient deficiency, cannot maintain its health for proportionate growth regardless the intense of feeding and quality of the environment.*

12 *A 49 day-feeding trial was carried out to investigate nutritional quality differential, growth and economics efficiency of some sampled commercially extruded floating feeds, based on frequency of usage among fish farmers in the study area. The sample feeds were sourced from respective distributors covering the zone of study. The feeds were designated as  $Fd_1$ ,  $Fd_2$ ,  $Fd_3$ ,  $Fd_4$ ,  $Fd_5$  and  $Fd_6$  (control). The examined growth performance, feed utilization and economic efficiency of feeds followed particular trend pattern and significantly different ( $p < 0.05$ ) across the sampled feeds (FW, MWG, SGR, TPI, PER and FCR). Finally, the control diet was least consumed, sustained positive allometry growth pattern and concomitant marginal profits; than feed 1 and 2 which had sharp drops in the growth pattern of fish after four (4) weeks.*

**Comment [FE2]:** With replicates?

22

23 Key Words: Allometry growth, Economic efficiency, fish farming, feed utilization,  
24 Differential, nutrition

25

26 **Introduction**

27 Aquaculture is one of the fastest animal based food producing sectors, particularly in  
28 developing countries. However, success in aquaculture depends on the ability of a farmer  
29 to cost effectively meet the nutritional demand of the cultured fish species. This is  
30 because feed type as well as feed quality may have consequences on both growth  
31 efficiency and feed utilization (Tsevis *et al.*, 2000). Good nutrition in animal production  
32 system is essential to economically produce a healthy and high quality product. In fish  
33 farming, nutrition is critical because feed represents 50-60% of the production costs,  
34 Jamiu and Ayinla (2003). The development of new species, specific diet support the  
35 aquaculture (fish farming) industry as it expands to satisfy increasing demand for  
36 affordable, safe and high quality fish.

37 As aquaculture production become more and more intensive in Nigeria, fish feed will be a  
38 significant factor in increasing the productivity and profitability of aquaculture  
39 (Akinrotimi, 2007). The need to intensify the culture of the fish, so as to meet the ever  
40 increasing demand for fish has made it essential to develop suitable diet either in  
41 supplementary form for ponds or as complete feed in tanks (Olakunle, 2000). The  
42 contribution of fisheries to the national economy is very significant in term of  
43 employment, income generation, poverty alleviation, food security, foreign exchange  
44 earnings and provision of raw materials for the animal feed industry (Alatise *et al.*,2014 ).  
45 Catfish (*Clarias* sp) are the major commercially species in Nigeria, for good market and  
46 culture (management) reasons (Anetekhai *et al.*, 2004).

47 Since 2000 there has been a rapid expansion in urban aquaculture and a significant  
48 development in high density catfish culture. As a result of this intensification in catfish  
49 culture, the aqua feed industry has grown and concerted effort has been focusing on  
50 research in fish nutrition and fish diet which start at Nigeria Institute for Oceanography  
51 and Marine Research (NIOMR). Laboratory size pellet mill and about 12 commercial  
52 aqua feed producers were established in Nigeria to complement companies that import  
53 high quality floating feed (Hect, 2007; Ayinla, 2007). As such, there is currently in the  
54 market assortment of both imported and locally manufactured pelleted floating catfish  
55 feed brands.

56 Feed trial studies have been carried out on *Clarias gariepinus* to evaluate their growth  
57 response to different readily available protein sources (Ayinla and Akande, 1988;  
58 Achionye- Nzeh *et al.*, 2002; Fagbenro and Arowosoge, 2002; Otubusin *et al.*, 2009;  
59 Amisah *et al.*, 2009; Sotolu, 2009 and Sotolu, 2010;). The submission of their findings  
60 were not conclusive and the variations in conclusion of these afore-listed authors is a  
61 source motivation to further expand the body of knowledge regarding the nutritional  
62 quality differential, growth and economics efficiency of some selected floating feeds.

63

## 64 **Materials and Methods**

### 65 **Study Area / Experimental Site**

66 35 practicing fish farmers in Saki – West L/Gvt. were sampled based on their preferred  
67 floating fish feeds abound in the market. The experiment was carried out in the Fisheries  
68 Laboratory of Oyo State College of Agriculture and Technology Igbo-ora, Oyo State,  
69 Nigeria.

### 70 **Experimental Feeds (Sampled Feeds)**

71 There are diverse of fish feeds which offer fish farmers' opportunity to choose out of the  
72 available floating fish feeds in the market. In this experiment, only five types of fish feeds  
73 were chosen based on frequency of usage by sampled fish farmers. They include, CF, AF,  
74 RF, VF, DF and CLF (Smoked fish waste meal) designated as Fd<sub>1</sub>, Fd<sub>2</sub>, Fd<sub>3</sub>, Fd<sub>4</sub>, Fd<sub>5</sub> and  
75 Fd<sub>6</sub> (control). The control diet was formulated using smoked fish waste (smoked fish  
76 waste meal) while other feed stuffs were purchased.

77 **Experimental Design**

78 The experimental design was in triplicates of eighteen plastic bowls for a period of 7  
79 weeks, (April to June, 2018). Level of water in each bowl was maintained at 30 litres and  
80 the renewal of water was weekly (every seven days) at ratio 1:1 to avoid the shock as a  
81 result of the seemingly new environment when the whole water is changed.

Comment [FE3]: State also the size of the bowl

82 **Experimental procedure**

83 One hundred and eighty (180) African catfish (*Clarias gariepinus*) juveniles of average  
84 weight 38.8g, was obtained from a reliable source. The fish were acclimatized for 2 days  
85 and were fed with control diet feed (Fd<sub>6</sub>) at 5% of their body weight twice daily; morning  
86 and evening. The fish were starved for 24 hours in order to empty their stomach and  
87 prepared their appetite for the new feed trials. The feeding ration and diet per meal were  
88 prepared at 5% body weight and two time feeding regimes.

89 **Growth performance parameters of test organism juveniles fed different Feeds**

90 Data on growth performance were collected weekly using the following nutrient  
91 utilization and growth parameters:

92 Main Weight gain = Final weight – initial weight

93

94 Average weight =  $\frac{\text{Total weight}}{\text{No of fish}}$

95

96  
97 Specific growth rate =  $\frac{\ln \text{ final body weight} - \ln \text{ initial body weight}}{\text{Time (days)}} \times 100$

98

99

100 ADWG = MWG / Period of the experiment

101

102 %WG = MWG / Initial mean weight x 100

103

104 Protein Gain =  $\frac{\text{MTPI g}}{\text{Culture Time (days)}}$

105

106

107 Total Protein Intake (TOi) = Total feed consumed x % CP in the feed

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109 PER =  $\frac{\text{Net weight gain (g)}}{\text{Amount of protein fed (g)}}$

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111 Feed conversion ratio (FCR) =  $\frac{\text{Total feed intake}}{\text{Total wet weight gain}}$

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**Statistical analysis of Data**

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120 One-way analysis of variance (ANOVA) was used to determine the effects of diets on  
121 growth and nutrient utilization indices using 16,0 version of SPSS (1999) statistical  
122 package. Significant differences between individual means were identified using the  
123 Duncan's multiple range test (Duncan, 1955). Mean differences were considered  
124 significant at  $p < 0.05$ .

125

### 126 **Water quality Management**

127 The water quality variables such as Temperature, Hydrogen- Ion Concentration (pH) were  
128 measured with a combined digital pen-type daily meter, while dissolved oxygen (mg/l)  
129 was measured using Winkler's method and conductivity by a digit conductivity meter  
130 (APHA/ AWWA/ WPCF, 1999).

131

## 132 **RESULTS AND DISCUSSION**

### 133 **Differential nutritional quality, growth Response and economic efficiency**

134 **Table 1: Average Mean Values Proximate Composition in Experimental Feeds**

135 <b>PARAMETER</b>	<b>DT<sub>1</sub></b>	<b>DT<sub>2</sub></b>	<b>DT<sub>3</sub></b>	<b>DT<sub>4</sub></b>	<b>DT<sub>5</sub></b>	<b>DT<sub>6</sub></b>
136 Crude Protein	28.70	50.75	27.65	35.35	29.05	40.02
137 Ash	6.17	4.02	5.26	5.50	5.90	6.28
138 Crude Fibre	0.01	0.01	0.02	0.01	0.01	0.35
139 Lipid Either Extract	6.50	7.50	6.70	7.10	6.80	4.65
140 Moisture Dry Meter	91.99	92.67	92.39	91.70	92.15	93.76
141 NFE	58.62	37.72	60.37	52.04	58.24	48.7
142 Gross Energy	463.92	512.26	467.05	480.18	467.16	389.72
143 Digestible Energy 144 (kcalg <sup>-1</sup> )	361.27	370.39	362.34	363.38	360.60	348.18
145 Energy/Protein ratio	12.6	7.3	13.1	10.3	12.4	8.7

146

147 Nitrogen Free Extract (NFE) = 100-(Crude Protein+Crude lipid+crude fibre+total ash).  
148 Gross energy: Caloric value of protein 5.65, NFE 4.1 and lipid 9.45 kcal g<sup>-1</sup>, Digestible  
149 energy: caloric value of protein 3.5, NFE 2.5 and lipid 8.1 kcal g<sup>-1</sup>( Adedokun et al., 2017)

150

### 151 **Water quality parameters (WQP)**

152 The mean water quality of the plastic trough system at weekly intervals during the study  
153 is presented in **Table 2**. Throughout the feeding trials, the water quality was keenly

154 monitored. The observed water quality parameters were within the acceptable ranges of  
 155 APHA/AWWA/WPCF (1999), Ajani and Akinwole (2001).

156 **Table 2:** Water quality parameters of the Experiment

Parameters	Dietary Sampled Feeds					
	Fd <sub>1</sub>	Fd <sub>2</sub>	Fd <sub>3</sub>	Fd <sub>4</sub>	Fd <sub>5</sub>	Fd <sub>6</sub>
Temperature	27.58	27.57	27.46	27.40	27.40	27.46
DO (mg/l)	6.20	5.40	5.20	5.40	5.10	4.80
P <sup>H</sup>	6.40	6.80	6.70	6.60	6.60	6.60
Conductivity (µhom/cm <sup>3</sup> )	580	582	580	583	585	420

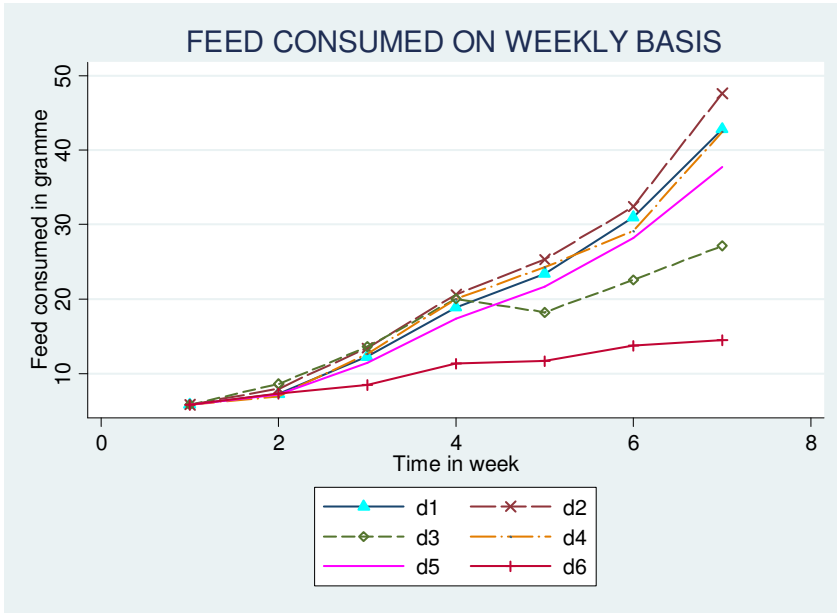
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159 **Table 3: Growth Response Efficiency of *Clarias gariepinus* Juveniles**

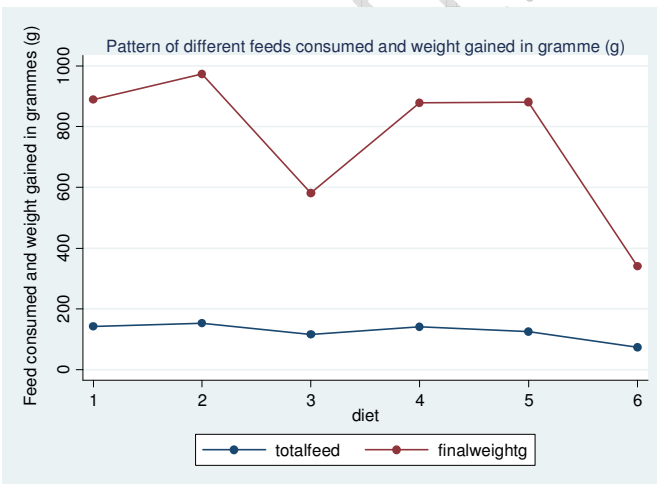
Parameters	DT1	DT2	DT3	DT4	DT5	DT6
Total Feed	141.5	153.2	116.0	141.3	130.0	72.6
Final Weight	899.5	973.8	581.6	878.6	881	339.4
% Survival	80%	86.6%	66.6%	86.6%	86.6%	90
% Mortality	20%	13.3%	33.3%	13.3%	13.3%	10
Average Wt.	37.5	37.5	29.1	33.8	33.9	12.6
MWG	860.7	935	542.8	839.8	842.2	300.6
ADWG	17.6	19.1	11.1	17.1	17.2	6.1
% WG	2218.3	2409.8	1399	2164.4	2170.6	774.7
SGR	17.6	19.1	11.1	17.1	17.2	6.1
TP Intake (TP1)	40.6	77.8	32.1	50.0	37.8	29.1
PER	22.2	12.5	18.1	17.6	23.3	11.7
Total Fish Produced	21.6	25.3	11.6	22.8	22.9	9.2
Feed CR	0.16	0.16	0.20	0.16	0.14	0.22

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176

177 **Figure 1a: Weekly Feeds sampled consumed**



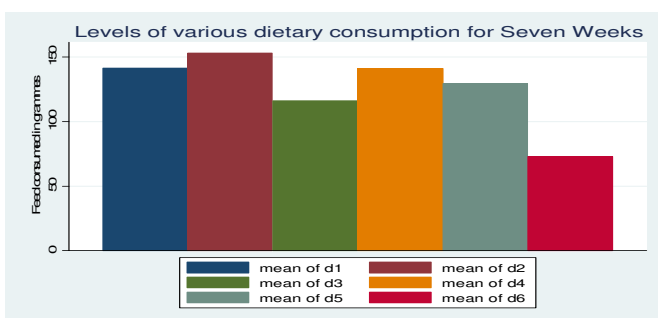
178

179 **Figure 1b: Pattern of diff. feeds consumed and weight gained**

180 The amounts of sampled feeds consumed were compared with weight gained by the fish.  
 181 The graph shows wide variation in the sampled feed consumed (fig. 1a) but relative little

182 variation in the body weight gained (fig. 1c) by the fish sampled. The wide range between  
183 quantity of feed consumed and weight gained ratio is shown in figure 1(b).

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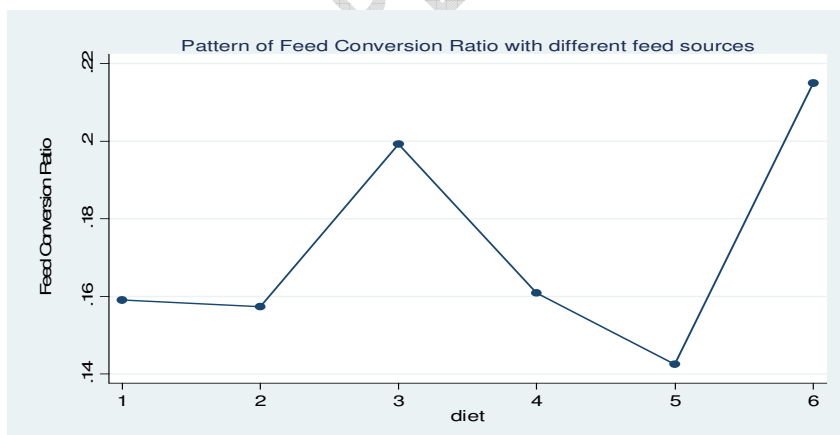
186 **Figure 1c: Level of sampled feeds consumed**

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188 Acceptability and palatability of feed is a function of the processing methods.

189 The feed conversion ratio (FCR) depends on many factors such as feed palatability, fish  
190 breed and species, energy content, level of fibre inclusion, crude protein content,  
191 mineralization etc.

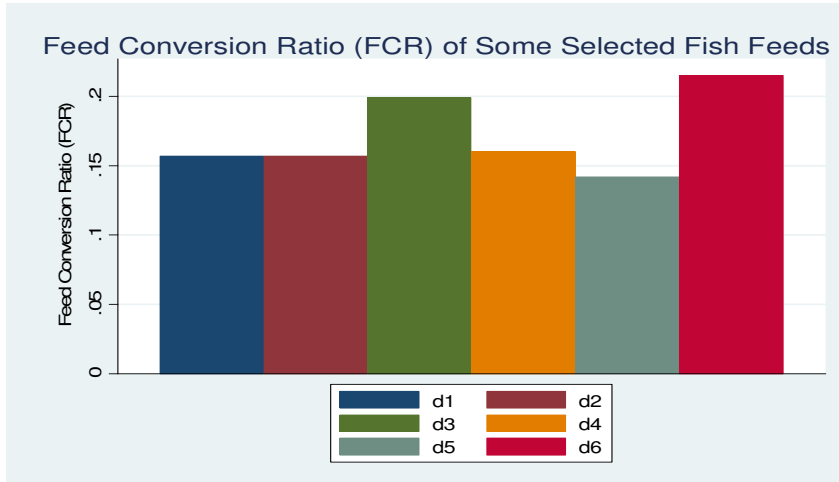
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194 **Figure 2a: Pattern of feed conversion ratio with diff. feeds sampled**

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197 **Figure 2b: Feed conversion ratio of sampled fish feeds**

198

199 Figures 2a and 2b show the pattern of feed conversion ratio with different feeds sampled.  
 200 The descriptive analysis revealed that diet 6 has highest feed conversion ratio (FCR)  
 201 though less than 0.5 of total dry feed consumed divided by the wet weight of fish  
 202 harvested. While diet 5 had the lowest feed conversion ratio. Theoretically, among other  
 203 factors that affect utilization nutrient include digestible protein content of the feed,  
 204 energy-protein ratio, mineral and vitamin. Moreover, it was observed that the fish  
 205 consumed less quantity of diet 6 due to easy disintegration and sinking tendency of the feed  
 206 sample. But the little quantity of diet 6 consumed was well utilized.

207 Figure 3 shows the length -weight relationship of the test organism in the experiment. It  
 208 was obvious that the fish had relatively uniform and steady length-weight relationship in the  
 209 first two weeks. After which there were sharp drops in the growth pattern of fish in  
 210 floating types. The sinking type progressively sustained the positive allometry growth  
 211 better than floating feeds. This may be attributed to the percentage crude protein content  
 212 of each feed relative to the size of fish.

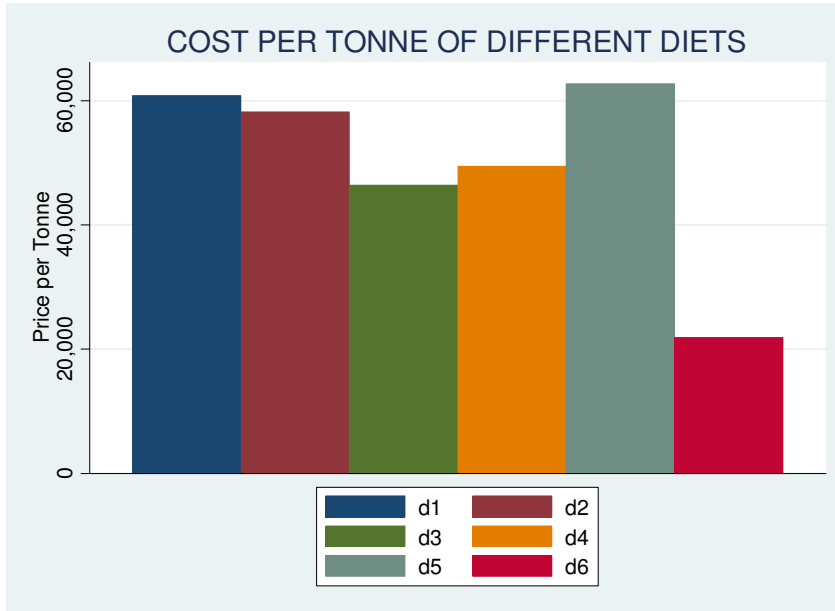


213

214 **Figure 3: Length-weight relationships**

215 The analysis was also carried out on the cost per tonne of different feeds sampled. Fig. 4  
 216 showed that diet 6 had the least cost per tonne while diet 5 had the highest cost. Relating  
 217 the cost of individual diet with feed conversion ratio, it was discovered that diet 6 had the  
 218 least cost and highest feed conversion ratio while diet 5 had the highest cost with least  
 219 feed conversion ratio. It could be deduced that diet 6 is most economical diet than other  
 220 extruded floating types with concomitant marginal profits.

221



222

223 **Figure 4: Cost per tonne of different feeds**

224 .

225 **Conclusion**

226 The results of this study had shown that there are falsifications in crude protein  
 227 percentages. The actual crude protein percentage in each feed was established through  
 228 proximate analysis, response of fish growth and feed utilization efficiency. Generally,  
 229 floating feeds performed excellently well in terms of weight gained and length-weight  
 230 relationships for the first two weeks as evidenced in the experiment. However, the body  
 231 weight gained dropped sharply and did not commensurate with the total feeds consumed  
 232 over time. The control diet (DT<sub>6</sub>) was least consumed with steady body weight gained and  
 233 positive weight length-weight relationship and had best feed conversion ratio.

234 **Recommendation**

235 According to the experiment conducted, it revealed that floating feeds specifically (DT<sub>1</sub>)  
 236 and (DT<sub>2</sub>) are good and preferable to be used in early 2-4 weeks after which compounded  
 237 feed is recommended for least feed consumption, steady body weight-gained and for high  
 238 cost effectiveness.

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