

1

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**

6

7

8 **Abstract**

9 *Nothing is more important than quality nutrition and adequate feeding of fish in captivity.*
10 *Undernourished fish in terms of nutrient deficiency, cannot maintain its health for*
11 *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,*
13 *growth and economics efficiency of some sampled commercially extruded floating feeds,*
14 *based on frequency of usage among fish farmers in the study area. The sample feeds were*
15 *sourced from respective distributors covering the zone of study. The feeds were*
16 *designated as Fd₁, Fd₂, Fd₃, Fd₄, Fd₅ and Fd₆(control), with 3 replicates for each*
17 *treatment. The examined growth performance, feed utilization and economic efficiency of*
18 *feeds followed particular trend pattern and significantly different ($p < 0.05$) across the*
19 *sampled feeds (FW, MWG, SGR, TPI, PER and FCR). Finally, the control diet was least*
20 *consumed, sustained positive allometry growth pattern and concomitant marginal*
21 *profits; than feed 1 and 2 which had sharp drops in the growth pattern of fish after four(*
22 *4) weeks.*

23

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

26

27 **Introduction**

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

36 aquaculture (fish farming) industry as it expands to satisfy increasing demand for
37 affordable, safe and high quality fish.

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

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

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

64

65 **Materials and Methods**

66 **Study Area / Experimental Site**

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

71 **Experimental Feeds (Sampled Feeds)**

72 There are diverse of fish feeds which offer fish farmers' opportunity to choose out of the
73 available floating fish feeds in the market. In this experiment, only five types of fish feeds
74 were chosen based on frequency of usage by sampled fish farmers. They include, CF, AF,
75 RF, VF, DF and CLF (Smoked fish waste meal) designated as Fd₁, Fd₂, Fd₃, Fd₄, Fd₅ and

76 Fd₆ (control). The control diet was formulated using smoked fish waste (smoked fish
77 waste meal) while other feed stuffs were purchased.

78 **Experimental Design**

79 The experimental design was in triplicates of eighteen plastic bowls for a period of 7
80 weeks, (April to June, 2018). Level of water in each bowl(60cm x 30cm x 15cm)was
81 maintained at 30 litres and the renewal of water was weekly (every seven days) at ratio
82 1:1 to avoid the shock as a result of the seemingly new environment when the whole
83 water is changed.

84 **Experimental procedure**

85 One hundred and eighty (180) African catfish (*Clarias gariepinus*) juveniles of average
86 weight 38.8g, was obtained from a reliable source. The fish were acclimatized for 2 days
87 and were fed with control diet feed (Fd₆) at 5% of their body weight twice daily; morning
88 and evening. The fish were starved for 24 hours in order to empty their stomach and
89 prepared their appetite for the new feed trials. The feeding ration and diet per meal were
90 prepared at 5% body weight and two time feeding regimes. [Weekly adjustment of feeding
91 ration and diet were carried out throughout the experiment.](#)

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

93 Data on growth performance were collected weekly using the following nutrient
94 utilization and growth parameters:

95 Main Weight gain = Final weight – initial weight

96

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

98

99
100 Specific growth rate = $\frac{\ln \text{ final body weight} - \ln \text{ initial body weight}}{\text{Time (days)}} \times 100$

101

102

103 ADWG = MWG / Period of the experiment

104

105 %WG = MWG / Initial mean weight x 100

106

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

108

109

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

111

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

113

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

115

116

117 Total fish production: $\frac{\text{Final weight g} \times \text{Survival rate}}{1000}$
 118

119
 120

121 **Statistical analysis of Data**

122

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

128

129 **Water quality Management**

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

134

135 **RESULTS AND DISCUSSION**

136 **Differential nutritional quality, growth Response and economic efficiency**

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

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

149

150 Nitrogen Free Extract (NFE) = 100-(Crude Protein+Crude lipid+crude fibre+total ash).
 151 Gross energy: Caloric value of protein 5.65, NFE 4.1 and lipid 9.45 kcal g⁻¹, Digestible
 152 energy: caloric value of protein 3.5, NFE 2.5 and lipid 8.1 kcal g⁻¹(Adedokun et al., 2017)

153

154 **Water quality parameters (WQP)**

155 The mean water quality of the plastic trough system at weekly intervals during the study
 156 is presented in **Table 2**. Throughout the feeding trials, the water quality was keenly
 157 monitored. The observed water quality parameters were within the acceptable ranges of
 158 APHA/AWWA/WPCF (1999), Ajani and Akinwole (2001).

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

Parameters	Dietary Sampled Feeds					
	Fd ₁	Fd ₂	Fd ₃	Fd ₄	Fd ₅	Fd ₆
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 ^H	6.40	6.80	6.70	6.60	6.60	6.60
Conductivity (µmoh/cm ³)	580	582	580	583	585	420

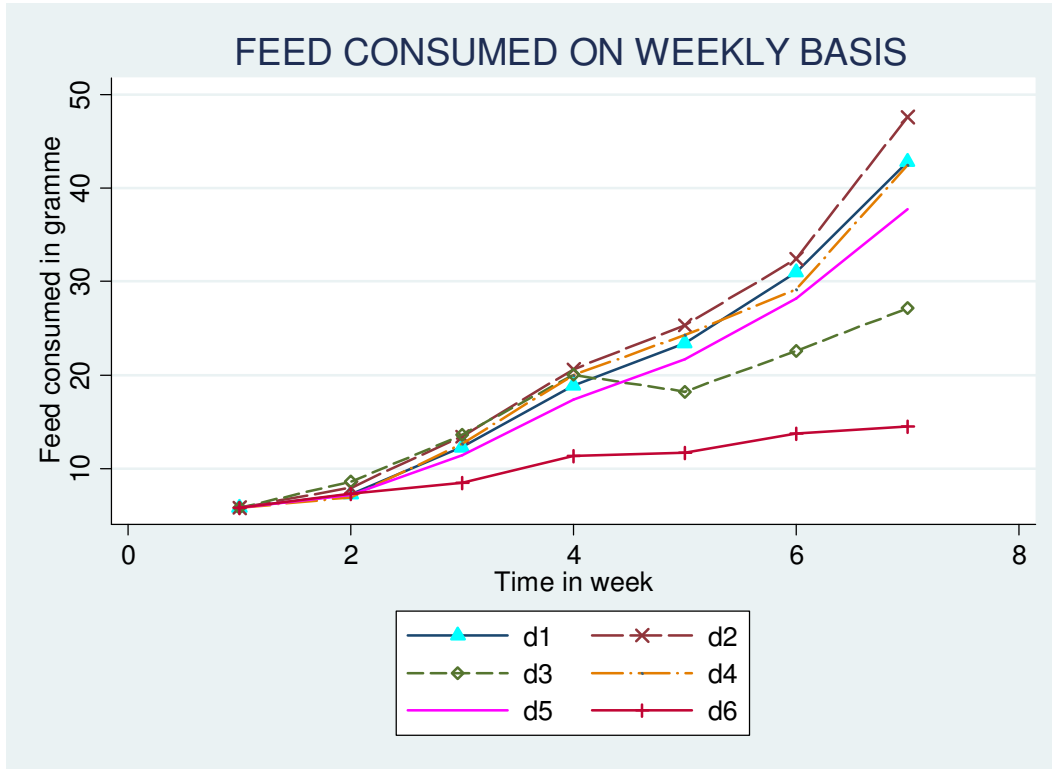
160

161

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

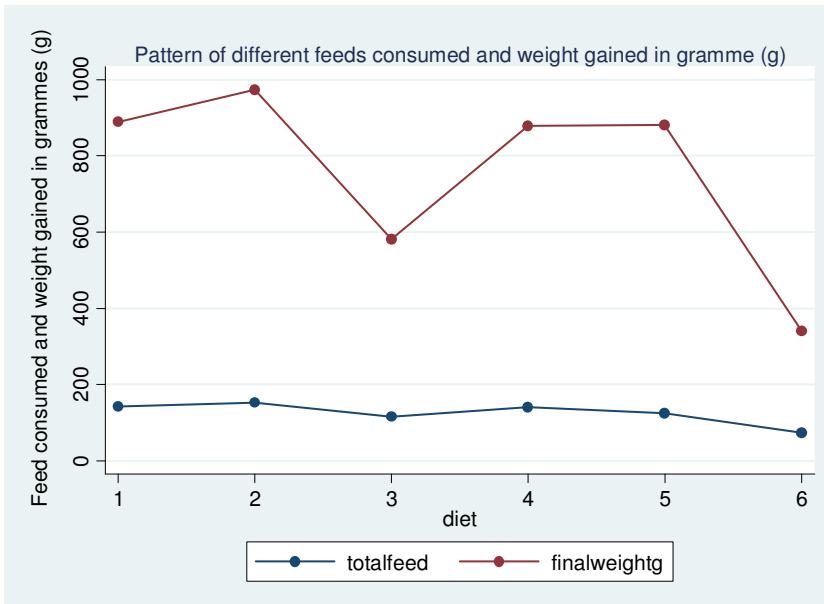
Parameters	DT1	DT2	DT3	DT4	DT5	DT6
Total Feed	141.5	153.2	116.0	141.3	130.0	72.6
Final Weight	899.5	973.8	581.6	878.6	881	339.4
% Survival	80%	86.6%	66.6%	86.6%	86.6%	90
% Mortality	20%	13.3%	33.3%	13.3%	13.3%	10
Average Wt.	37.5	37.5	29.1	33.8	33.9	12.6
MWG	860.7	935	542.8	839.8	842.2	300.6
ADWG	17.6	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

178



179

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



181

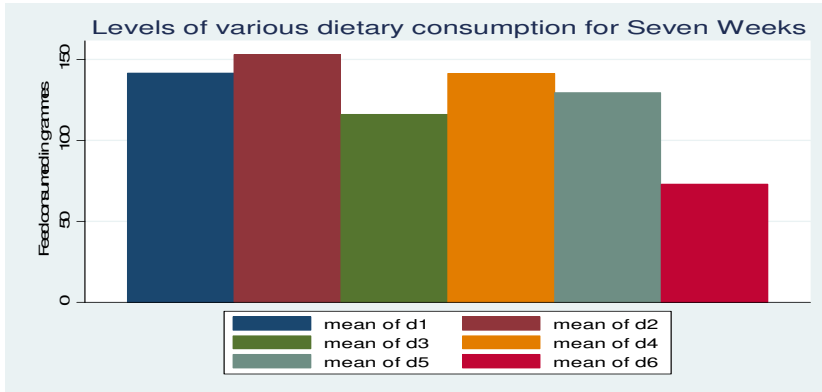
182 **Figure 1b: Pattern of diff. feeds consumed and weight gained**

183 The amounts of sampled feeds consumed were compared with weight gained by the fish.

184 The graph shows wide variation in the sampled feed consumed (fig. 1a) but relative little

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

187



188

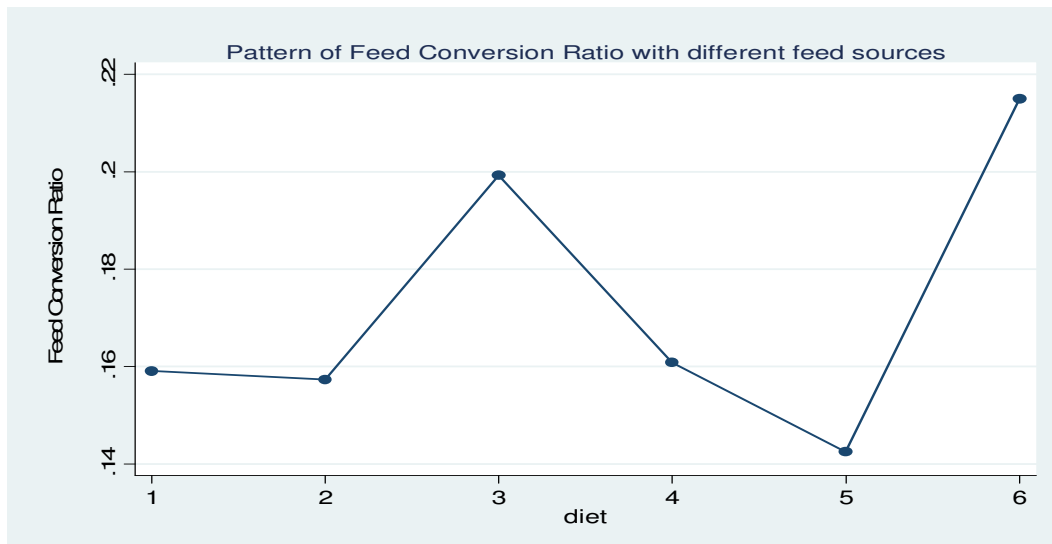
189 **Figure 1c: Level of sampled feeds consumed**

190

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

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

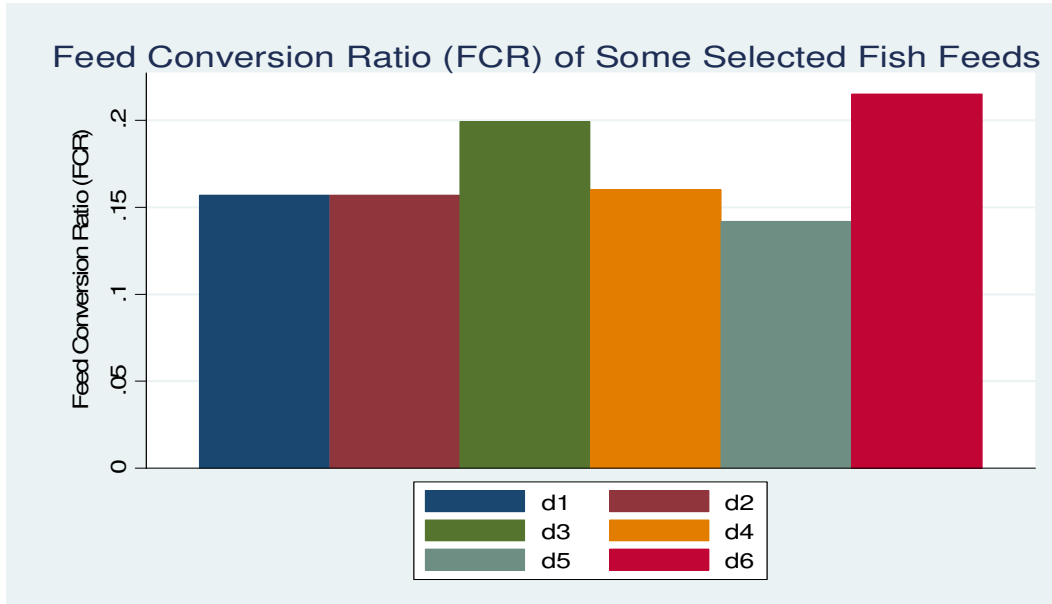
195



196

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

198



199

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

201

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

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

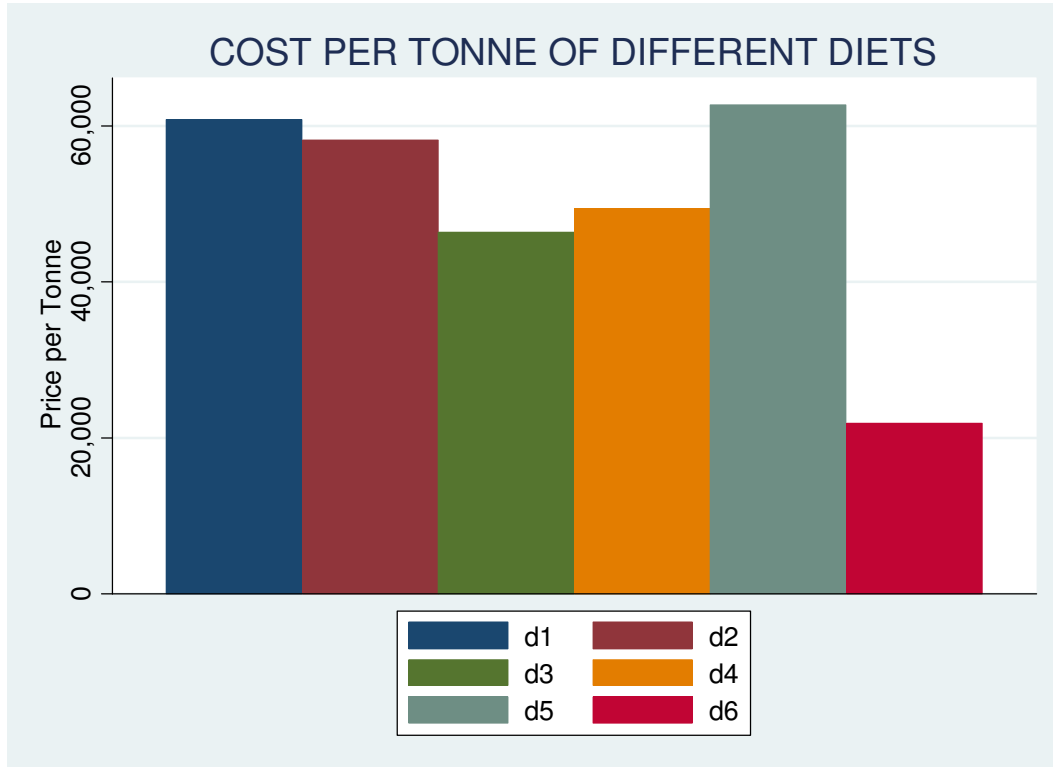


216

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

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

224



225

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

227 .

228 **Conclusion**

229 The results of this study had shown that there are falsifications in crude protein
 230 percentages. The actual crude protein percentage in each feed was established through
 231 proximate analysis, response of fish growth and feed utilization efficiency. Generally,
 232 floating feeds performed excellently well in terms of weight gained and length-weight
 233 relationships for the first two weeks as evidenced in the experiment. However, the body
 234 weight gained dropped sharply and did not commensurate with the total feeds consumed
 235 over time. The control diet (DT₆) was least consumed with steady body weight gained and
 236 positive weight length-weight relationship and had best feed conversion ratio.

237 **Recommendation**

238 According to the experiment conducted, it revealed that floating feeds specifically (DT1)
 239 and (DT2) are good and preferable to be used in early 2-4 weeks after which compounded
 240 feed is recommended for least feed consumption, steady body weight-gained and for high
 241 cost effectiveness.

242

243

244

245 **References**

- 246 Achionye –Nzeh C.G; Qgidiolu, O., Salmi S, (2002). Growth response of juveniles of *Clariasanguilaiesto*
247 diet formulated, Ciriunaforda within laboratory. *Nigerian journal of pure and Applied Sciences*, 17,
248 1253-1256
- 249 Adedokun, M. A., Tairu, H. M., Adeosun, O. and Ajibola, O. (2017). Assessment of the Optimal
250 Replacement Levels of Maize with Water Lettuce Leaf (*Pistia stratiotes*) based Diets for *Clarias*
251 *gariiepinus*. *Jour. Of Fisheries Sciences.com* 11 (2): 028-035.
- 252 Ajani, E. K. and Akinwole, O. A. (2001). Recommended water quality for warm water Fishes in Fish
253 Farming. University of Ibadan. *Agric Res. 3, 19-23*
- 254 Akinrotimi, (2007). Locally produced fish feed, potentials for aquaculture development in sub-
255 sharan *African Journal of Agricultural Resources* vol: 297
- 256 Alatise, S. P., Adedokun, M. A., Adelodun, O. B., and Ajiboye. G. E. (2014). Effects of Boiled Jatropha
257 Kernel Meal as a Substitute for Soyabeans Meal in Diet of African Mud Catfish (*Clarias*
258 *gariiepinus*). *Jour. Of Fisheries and Aquatic Scien.* ISSN 1816-4927 / DOI: 10, 3923/jfas.
- 259 Amisah, S. Oteng, M.A and Ofori, J.K. (2009) Growth performance of the African Catfish *Clarias garipinus*
260 Fed varying inclusion level of *Leavcaena leaucocephala* leaf meal. *Journal of applied science and*
261 *environmental management* 13(1), 21-26)
- 262 Anetekhai, M.A., Akin-Oriola, G.A, Aderinola, O.J and Akintola S.L(2004). Steps ahead for aquaculture
263 development in sub-saharan Africa-the case of Nigeria. *Aquaculture*, 239, 237-248.
- 264 APHA/AWWA/WPCF(1999). Standard methods for the examination of water and wastewaters. The 20th
265 Edition. American Public Health Association American Water works. Association and water
266 Pollution Control Federation; Washington Inc, 460-472.
- 267 Ayinla, O.A. and Akande, G. R. (1988). Growth response of *Clarias gariiepinus*
268 (Burchell, 1822) on silage base diets. NIOMR. Technical Paper, 37, 19.
- 269 Ayinla, O. A. (2007). Analysis of feeds and fertilizer for sustainable aquaculture development in Nigeria. In
270 M. R Hassan, T, Hecht S. S De Silua and A. G. J. Tacon (eds) Study and analysis of feed and
271 fertilizer for sustainable Aquaculture development. FAO Fisheries Technical paper No. 497. Rome.
272 FAO, 453-470.
- 273 Fagbenro, O.A. and I.A. Arowosoge, (2002). Replacement value of some household wastes as energy
274 substitute in low rearing catfish, in south-western Nigeria. *Bioresource Technol* 37:197-203.
- 275 Hect, T.(2007) . Review of feed and fertilizer for sustainable Aquaculture in Sub-saharan Africa. In M.R.
276 Hasan, T Hecht, S.S De Silva and A.G.J Tacon (eds). Study and analysis of feed and fertilizer for
277 sustainable Aquaculture development. FAO Fisheries Technical Paper No/ 497 Rome FAO. 77-109
- 278 Jamiu D.M Ayinla O.A (2003). Potential for the development of aquaculture in Africa. *NAGA*, 26 (3), 6-13.
- 279 Olakunle, O. (2000). Homestead Pond Management, Department of Wild Life and Fisheries Management
280 University of Ibadan, Oyo State, Nigeria.
- 281 Otubusin S.O; Ogunleye F.O and Agbebi, O.I (2009). Feeding trials using local protein sources to replace
282 fish meal in pelleted feed in catfish *Clarias gariiepinus* (Burchell, 1822) culture. *European journal*
283 *of scientific research*, 31(1), 142-174
- 284 Sotolu A.A (2009) Comparative utilization of fish waste meal with imported fish meal by Africa cat fish
285 (*Clarias gariiepinus*) *American Europeans journal of scientific research* 4(4): 225-289
- 286 Sotolu A.O (2010) feed utilization and biochemical characteristic of *Clarias gariiepinus* (Qurchz//, 1% 22)
287 finger ling fed diet containing fish oil and vegetable oil as a total replacement. *World Journal of*
288 *fish and marine science*, 2 (2), 93-98.
- 289 SPSS (1999). Software Program of Statistical Analysis. Version 8.0, SPSS Inc., Chicago, IL., USA
- 290 Tsevis A.A. and Azzaydi T.A (2000): Effect of feeding regime on selected species of fish Article
291 Publicaiton of FISON, Fed, 20000 Agora site.
- 292