

3 **NUTRITIONAL QUALITY DIFFERENTIAL, GROWTH AND ECONOMICS EFFICIENCY OF**
4 **SOME SELECTED COMMERCIAL FLOATING FISH FEEDS IN SAKI WEST OYO STATE**
5 **NIGERIA**
6

7 **Abstract**

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

11 *A 49 day-feeding trial was carried out to investigate nutritional quality differential, growth and economics*
12 *efficiency of some sampled commercially extruded floating feeds, based on frequency of usage among fish*
13 *farmers in the study area. The sample feeds were sourced from respective distributors covering the zone of*
14 *study. The feeds were designated as Fd₁, Fd₂, Fd₃, Fd₄, Fd₅ and Fd₆(control), with 3 replicates for each*
15 *treatment. The examined growth performance, feed utilization and economic efficiency of feeds followed*
16 *particular trend pattern and significantly different ($p < 0.05$) across the sampled feeds (FW, MWG, SGR,*
17 *TPI, PER and FCR). Finally, the control diet was least consumed, sustained positive allometry growth*
18 *pattern and concomitant marginal profits; than feed 1 and 2 which had sharp drops in the growth pattern*
19 *of fish after four(4) weeks.*

20
21 Key Words: Allometry growth, Economic efficiency, fish farming, feed utilization,
22 Differential, nutrition
23

24 **Introduction**

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

33 As aquaculture production become more and more intensive in Nigeria, fish feed will be a significant factor
34 in increasing the productivity and profitability of aquaculture (Akinrotimi, 2007). The need to intensify the
35 culture of the fish, so as to meet the ever increasing demand for fish has made it essential to develop
36 suitable diet either in supplementary form for ponds or as complete feed in tanks (Olakunle, 2000). The

37 contribution of fisheries to the national economy is very significant in term of employment, income
38 generation, poverty alleviation, food security, foreign exchange earnings and provision of raw materials for
39 the animal feed industry (Alatise *et al.*,2014). Catfish (*Clarias* sp) are the major commercially species in
40 Nigeria, for good market and culture (management) reasons (Anetekhai *et al.*, 2004).

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

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

54

55 **Materials and Methods**

56 **Study Area / Experimental Site**

57 35 practicing fish farmers in Saki – West L/Gvt. were sampled based on their preferred floating fish feeds
58 abound in the market. The experiment was carried out in the Fisheries Laboratory of Oyo State College of
59 Agriculture and Technology Igbo-ora, Oyo State, Nigeria.

60 **Experimental Feeds (Sampled Feeds)**

61 There are diverse of fish feeds which offer fish farmers' opportunity to choose out of the available floating
62 fish feeds in the market. In this experiment, only five types of fish feeds were chosen based on frequency of
63 usage by sampled fish farmers. They include, CF, AF, RF, VF, DF and CLF (Smoked fish waste meal)
64 designated as Fd₁, Fd₂, Fd₃, Fd₄, Fd₅ and Fd₆ (control). The control diet was formulated using smoked fish
65 waste (smoked fish waste meal) while other feed stuffs were purchased.

66 **Experimental Design**

67 The experimental design was in triplicates of eighteen plastic bowls for a period of 7 weeks, (April to June,
68 2018). Level of water in each bowl(60cm x 30cm x 15cm)was maintained at 30 litres and the renewal of
69 water was weekly (every seven days) at ratio 1:1 to avoid the shock as a result of the seemingly new
70 environment when the whole water is changed.

71 **Experimental procedure**

72 One hundred and eighty (180) African catfish (*Clarias gariepinus*) juveniles of average weight 38.8g, was
73 obtained from a reliable source. The fish were acclimatized for 2 days and were fed with control diet feed

74 (Fd₆) at 5% of their body weight twice daily; morning and evening. The fish were starved for 24 hours in
75 order to empty their stomach and prepared their appetite for the new feed trials. The feeding ration and diet
76 per meal were prepared at 5% body weight and two time feeding regimes. [Weekly adjustment of feeding](#)
77 [ration and diet were carried out throughout the experiment.](#)

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

79 Data on growth performance were collected weekly using the following nutrient utilization and growth
80 parameters:

81 Main Weight gain = Final weight – initial weight

82

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

84

85
86 Specific growth rate = $\frac{\ln \text{ final body weight} - \ln \text{ initial body weight}}{\text{Time (days)}} \times 100$

87

88
89 ADWG = MWG / Period of the experiment

90

91 %WG = MWG / Initial mean weight x 100

92

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

94

95
96 Total Protein Intake (TOi) = Total feed consumed x % CP in the feed

97

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

99

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

101

102

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

104

105

106

107

108

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

113

114 **Water quality Management**

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

118

119 **RESULTS AND DISCUSSION**120 **Differential nutritional quality, growth Response and economic efficiency**121 **Table 1: Average Mean Values Proximate Composition in Experimental Feeds**

122 PARAMETER	DT₁	DT₂	DT₃	DT₄	DT₅	DT₆	Mean	SD
123 Crude Protein	28.70	50.75	27.65	35.35	29.05	40.02	35.25	8.97
124 Ash	6.17	4.02	5.26	5.50	5.90	6.28	5.52	0.83
125 Crude Fibre	0.01	0.01	0.02	0.01	0.01	0.35	0.7	0.35
126 Lipid Either Extract	6.50	7.50	6.70	7.10	6.80	4.65	6.54	0.99
127 Moisture Dry Meter	91.99	92.67	92.39	91.70	92.15	93.76	92.44	0.73
128 NFE	58.62	37.72	60.37	52.04	58.24	48.7	52.62	8.55
129 Gross Energy	463.92	512.26	467.05	480.18	467.16	389.72	463.38	40.31
130 Digestible Energy (kcalg ⁻¹)	361.27	370.39	362.34	363.38	360.60	348.18	361.03	7.21
131 Energy/Protein ratio	12.6	7.3	13.1	10.3	12.4	8.7	10.73	2.37

133

134 Nitrogen Free Extract (NFE) = 100-(Crude Protein+Crude lipid+crude fibre+total ash). Gross energy:
 135 Caloric value of protein 5.65, NFE 4.1 and lipid 9.45 kcal g⁻¹, Digestible energy: caloric value of protein
 136 3.5, NFE 2.5 and lipid 8.1 kcal g⁻¹(Adedokun et al., 2017)

137

138 **Water quality parameters (WQP)**

139 The mean water quality of the plastic trough system at weekly intervals during the study is presented in
 140 **Table 2**. Throughout the feeding trials, the water quality was keenly monitored. The observed water quality
 141 parameters were within the acceptable ranges of APHA/AWWA/WPCF (1999), Ajani and Akinwale
 142 (2001).

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

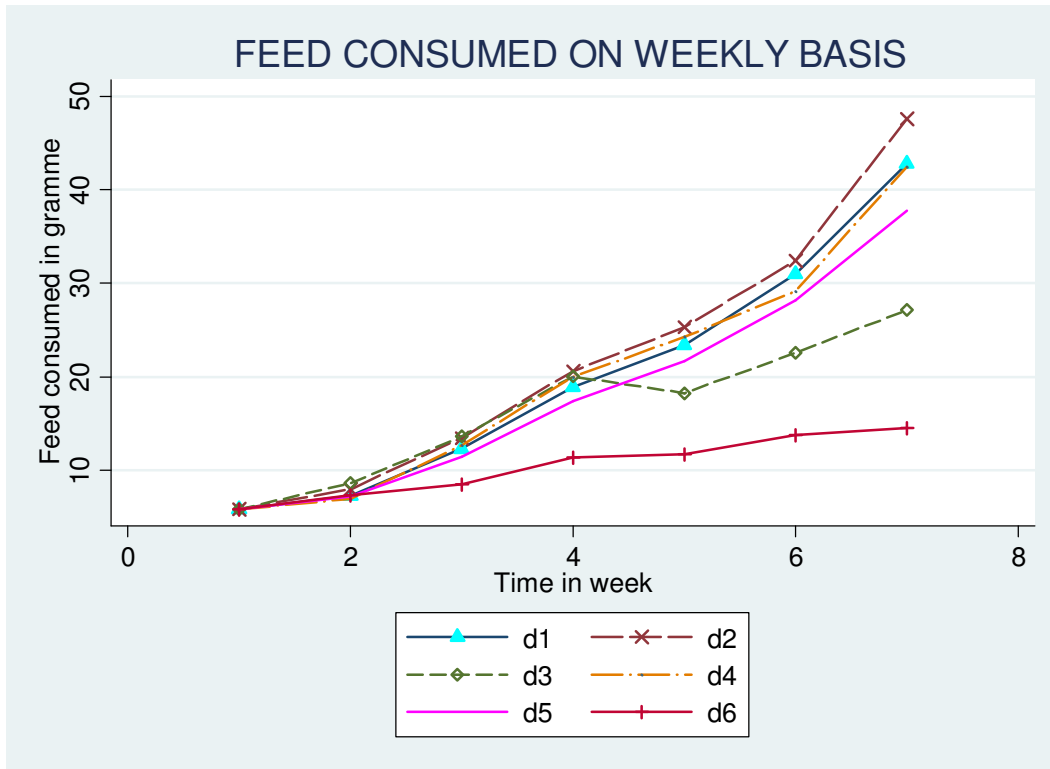
144 Parameters	Dietary Sampled Feeds							Mean	SD
	Fd₁	Fd₂	Fd₃	Fd₄	Fd₅	Fd₆			
Temperature	27.58	27.57	27.46	27.40	27.40	27.46	27.48	0.08	
DO (mg/l)	6.20	5.40	5.20	5.40	5.10	4.80	5.35	0.47	
p^H	6.40	6.80	6.70	6.60	6.60	6.60	6.62	0.13	
Conductivity (µm/cm³)	580	582	580	583	585	420	555	66.16	

144

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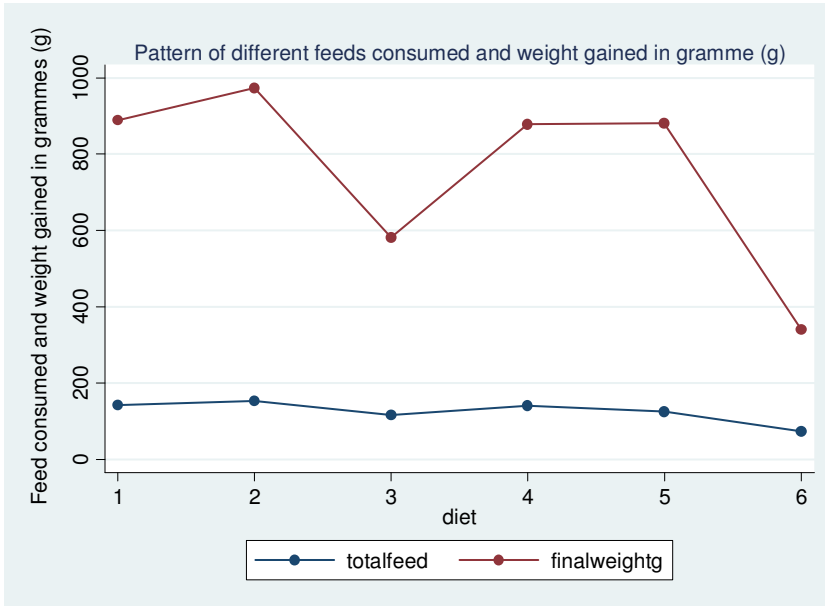
146 **Table 3: Growth Response Efficiency of *Clarias gariepinus* Juveniles**

147 Parameters	DT1	DT2	DT3	DT4	DT5	DT6	Mean	SD
148								
149 Total Feed	141.5	153.2	116.0	141.3	130.0	72.6	125.77	28.92
150 Final Weight	899.5	973.8	581.6	878.6	881	339.4	758.98	246.00
151 % Survival	80	86.6	66.6	86.6	86.6	90	82.80	8.55
152 % Mortality	20	13.3	33.3	13.3	13.3	10	17.20	8.54
153 Average Wt.	37.5	37.5	29.1	33.8	33.9	12.6	30.73	9.41
154 MWG	860.7	935	542.8	839.8	842.2	300.6	720.18	246.01
155 ADWG	17.6	19.1	11.1	17.1	17.2	6.1	14.70	5.03
156 % WG	2218.3	2409.8	1399	2164.4	2170.6	774.7	1856.13	634.05
157 SGR	17.6	19.1	11.1	17.1	17.2	6.1	14.70	5.03
158 TP Intake (TP1)	40.6	77.8	32.1	50.0	37.8	29.1	44.57	17.83
159 PER	22.2	12.5	18.1	17.6	23.3	11.7	17.57	4.79
160 Total Fish Produced	21.6	25.3	11.6	22.8	22.9	9.2	18.90	6.73
161 Feed CR	0.16	0.16	0.20	0.16	0.14	0.22	0.17	0.30
162								



163

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

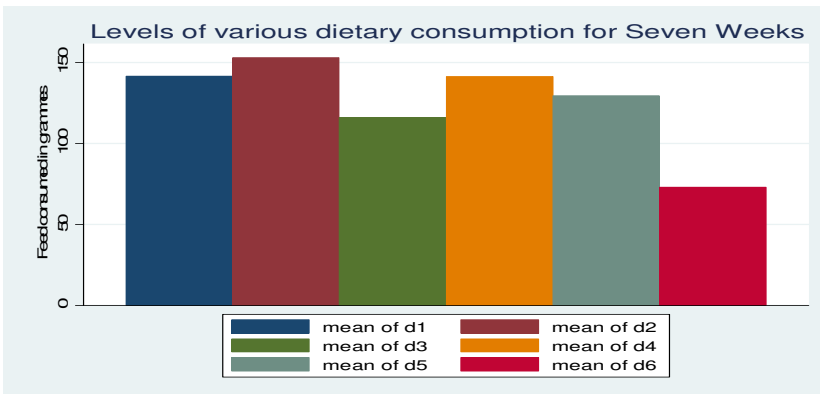


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166 **Figure 1b: Pattern of diff. feeds consumed and weight gained**

167 The amounts of sampled feeds consumed were compared with weight gained by the fish. The graph shows
 168 wide variation in the sampled feed consumed (fig. 1a) but relative little variation in the body weight gained
 169 (fig. 1c) by the fish sampled. The wide range between quantity of feed consumed and weight gained ratio is
 170 shown in figure 1(b).

171



172

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

174

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

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

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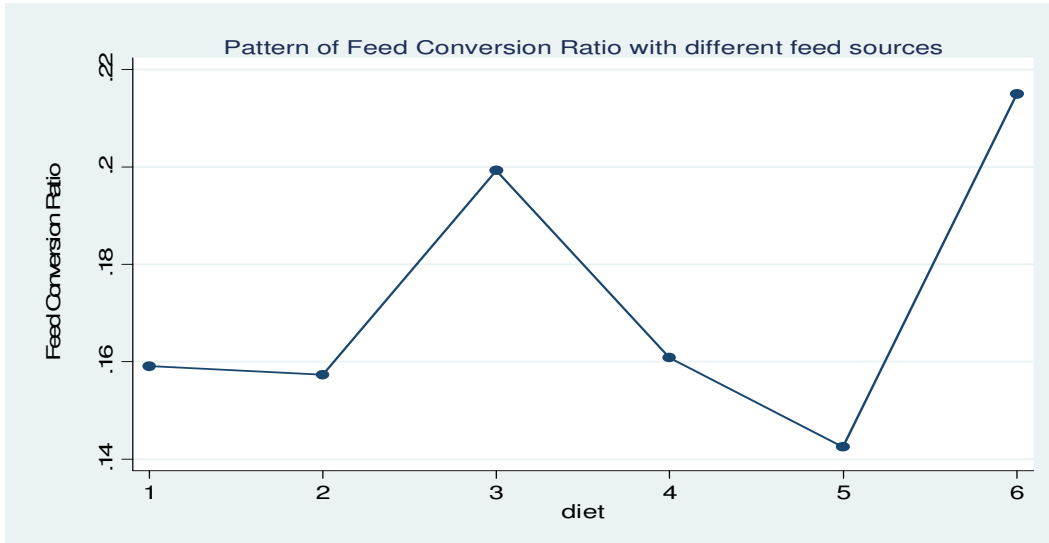
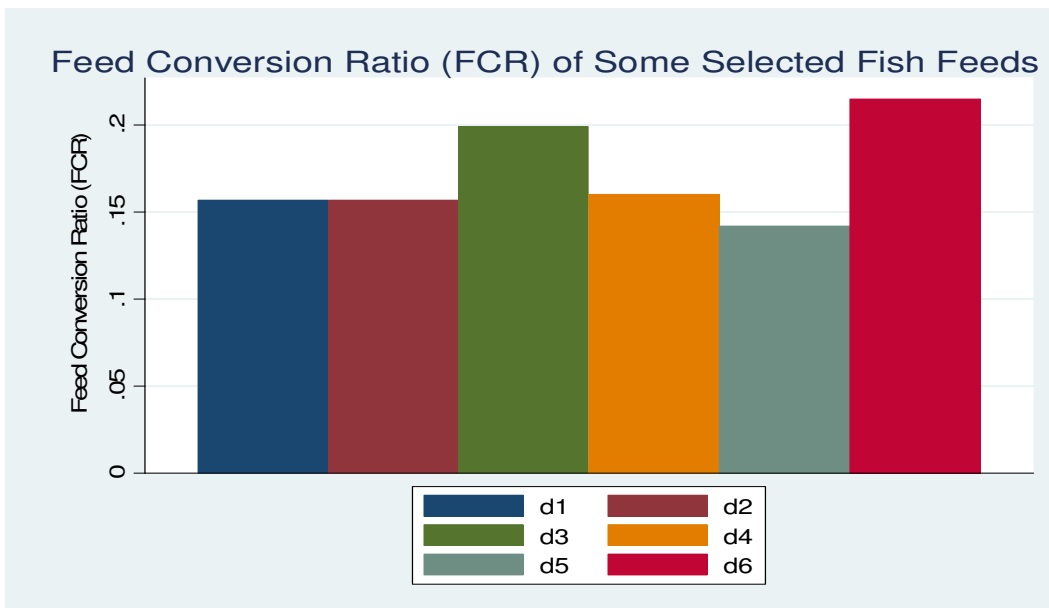


Figure 2a: Pattern of

179
180 **feed conversion ratio with diff. feeds sampled**

181



182

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

184

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

192 Figure 3 shows the length -weight relationship of the test organism in the experiment. It was obvious tha
 193 fish had relatibvely uniform and steady lengh-weight relationship in the first two weeks. After which there
 194 were sharp drops in the growth perttern of fish in floating types. The sinking type progressively sustained
 195 the positive allometry growth better than floating feeds. This may be attributed to the percentage crude
 196 protein content of each feed relative to the size of fish.

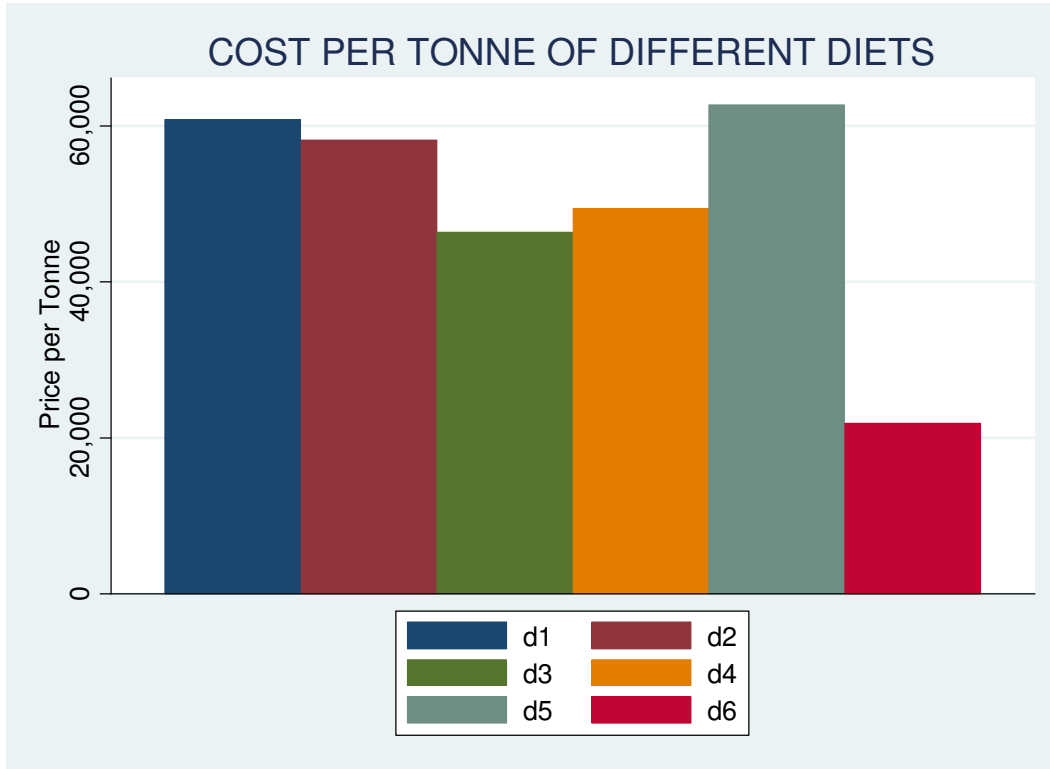


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198 **Figure 3: Length-weight relationships**

199 The analysis was also carried out on the cost per tonne of different feeds sampled. Fig. 4 showed that diet 6
 200 had the least cost per tonne while diet 5 had the highest cost. Relating the cost of individual diet with feed
 201 convesion ratio, it was discovered that diet 6 had the least cost and highest feed conversion ratio while diet
 202 5 had the highest cost with least feed conversion ratio. It could be deduced that diet 6 is most economical
 203 diet than other extruded floating types with concomitant marginal profits.

204



205

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

207 .

208 **Conclusion**

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

216 **Recommendation**

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

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