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Growth Performance of *OreochromisNiloticus* Fingerlings Fed Varying Levels of Cassava Peel Meal as Replacement for Maize

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Abstract
Oreochromisniloticus fingerlings were fed diets containing 25, 50, 75, 100% levels of cassava peel meal as replacement for maize and a control, for eight weeks.O. niloticusfingerlings were stocked ten (10)for each tank. The fingerlings were fed twice daily by 8am and 4pm at 5% body weight. The fingerlings were weighed weekly to determine weight. Fish fed diet25% gained a mean weightof 1.79±0.02 for the period of the experiment. The poorest performance was from diet E (100%). The fingerlings fed diet E gained a mean weight of 1.26±0.01 during the experiment. The various growth indices of specific growth rate, feed conversion ratio and feed efficiency ratio show that diet 25% has SGR of 1.66±0.02, FCR of 3.04±0.04 and FCE of 32.93±0.48, diet 100% gave the SGR of 1.30±0.00, FCR 3.68±0.02 and FCE of 27.20±0.13. Water quality parameters of dissolved oxygen, pH, temperature, electrical conductivity and total dissolved solids were monitored.

Keywords: *Fish Feed, performance,Oreochromisniloticus, cassava peel*

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I. Introduction

Food production from aquaculture has continued to expand over the last decade with percentage contribution from aquaculture to total fish production rising from about 50million tonnes in 2007 to about 67million tonnes in 2012 (FAO 2014). However, the rapid growth comes at the expense of sustainability hence the challenge of combating disease, increasing growth rates, producing more efficient feed, improved larval rearing and finally a food product that meets nutritional and safety standards. Feed ingredient cost has remained a major problem in the aquaculture feed industry and by extension, aquaculture itself. Fish feed production is constrained by the cost of ingredient purchase which is about 80% of the production budget. Varied opinion show ever exists as to the percentage cost of feed as part of the variable cost in an aquaculture venture. A report (Price &Egna(2014) estimated the percentage cost of feed in aquaculture to be 80% but El-Sayed*et. al.,* (2015) estimated between 75-90%. On the lower side, Emerenciano*et. al.,* (2013) opined that feed costs account for about 50% of production cost with World Fish (2009) giving a range of 50-70%. At a more practical level, Hyuha*et. al.,* (2011) reported that about 85% of running cost on an aquaculture facility is spread between labour, feed and fish seed. Alternative ingredient sources for aquaculture feeds have focused mainly on the protein ingredients such as fishmeal and soybean meal. De Silva & Anderson (1994) defined unconventional feed stuff as ingredients that are capable of replacing fishmeal in the diets of aquaculture species. This definition obscures the need for sustainability given the fact that most of the ingredients apart from fishmeal are also being used in terrestrial animal husbandry as well as in human diets (Rana*et. al.,* 2009). The drive towards sustainability of aquaculture must be taken into tales against the partial drive that exist currently. Hertrampf*et. al.,* (2012) pointed out the thin line between a conventional and a non-conventional feed stuff hence the classification scheme can be in appropriate. The need for cheap animal protein nutrition for people in the developing countries has been stressed. To meet these goals therefore require a reduction in feed cost hence the need to discover alternatives. Fishes require higher levels of protein in their diets than land animals because of their low energy requirement which stems from the fact that they utilize little energy in movement and maintaining their position in water using buoyancy (Strand *et.al.,*2005; Barboza*et. al.,* 2008). The protein requirement varies between 25 and 65% crude protein depending on the species water temperature, salinity, trophic level and taxonomic phyla (Molina-Poveda 2016). Quantitative amino-acid requirements on the other hand are of great importance since they depend on age, culture environment and the physiological condition of the species. These factors are also the key determinants of energy needs of the fish (Conklin 2000). The energy component of fish diets is important because it spares protein and therefore creates room for effective utilization of protein for body tissue build-up hence increased growth to desirable sizes. However, the digestibility of the carbohydrate ingredient as well as the end result to fatty fish limits increased inclusion of carbohydrates and lipids in fish diets (Lin & Wu 2014)

Tilapia is an aquaculture fish with production at 4.8x107 tonnes valued at $8.25million in 2013 (FAO 2016). The production is expected to reach7.3x107 tonnes in 2030 (World Bank 2013). The species tolerate various environmental conditions hence their ability to thrive worldwide. Tilapia aquaculture has grown as a result of the development of new strains (Ng &Hanim 2007). The feeding habit of tilapia is also a key factor in its suitability for aquaculture (Shoko *et. al.,* 2016) with food consumption being at the primary level. Utilization of carbohydrate by tilapia is within a range of 35-40% of the digestible portion depending on certain factors such as the size of the fish, incidence of feeding, origin of the carbohydrate and presence of other ingredients (El-Sayed 2006).The objectives of this studies is to replace maize with cassava peel meal in diet of*Oreochromisniloticus* at various inclusion levelsandto determine the growth performance of *Oreochromisniloticus*fingerlings fed diet with varying levels of cassava peel meal in replacement of maize.

II. Materials And Methods

Experimental procedure

Cassava tuber was harvested from the farm at Ujam village Makurdi, the peels were removed and washed in water to remove soil particles. The peels were soaked in water for three days; cassava peel was spread on a clean flat cemented floor and sundried until completely dried (brittle). The dried peel were milled using a hammer mill to small particle size, package and store in a bag.

Maize was procured from Northbank market and sun dried. The maize grain was milled with the hammer mill and packaged in a cellophane bag.

Soybeans was procured from Northbank market, small pebbles, stalk, deformed seeds and other impurities were manually removed. The soyabeanwas toasted in a pot using fire wood for 30 minutes until the bean coat cracked without being burnt. The toasted bean was milled with hammer mill to small size and packaged in a bag for use later

Proximate Analysis for Moisture, Protein, Fat, Ash and Crude Fibre for cassava peel meal and the experimental diets.

The analysis for moisture, protein,fat,ash and crude fibre for cassava peel meal used for the experimental diets were done using standard methods as specify by AOAC, (2004) Association of Official analytical chemist.

Data analysis

The data was analysed using Analysis of variance (ANOVA) one way ANOVA for growth and the water quality parameters.

III. Results

3.1 Proximate composition of cassava peel meal

Table 1 contains the proximate composition of cassava peel meal (CPM) contents which include moisture, ash, crude protein, lipid fibre and the nitrogen free extract.

3.2 Proximate composition of experimental diet

Table 2 shows the proximate composition of experimental diet has shown that the percentage crude protein decreases as the level of cassava peel increases. The percentage crude fibre increases. This is probably due to the relatively low crude protein and high fibre content of cassava peel meal.

3.4 Growth performance of O. *niloticus*

Table 3 shows theGrowth performance of *O.niloticus* fingerlings fed varying levels of cassava peel meal through the duration of the experiment, as cassava peel meal inclusion increases the weight decreases.

3.5 A graph of weight of Oreochromis*niloticus*fingerlings

Figure 1 showsa graph of weight of *Oreochromisniloticus*fingerlings fed cassava peel meal for eight weeks showing the weights of the various levels of inclusions as inclusions increases from 25% to 100% weight of reduces.

Table 1 Proximate composition of cassava peel meals

Moisture	5.30
Ash	7.23
Crude protein	4.5
Fibre	14.6
Lipid	1.87
NFE	66.46

Table 2: Proximate composition of experimental feed containing varying levels of cassava peel diet used in feeding *Oreochromisniloticus*

Treatments	Moisture	Ash	Lipid	Fibre	Protein	NFE
0.0 CP	4.55±0.01[a]	5.66±0.01[a]	6.92±0.03[d]	4.80±0.00[a]	29.24±0.04[d]	48.85±0.00[b]
25.0 CP	4.63±0.01[b]	5.87±0.04[b]	6.86±0.01[c]	4.95±0.02[b]	29.20±0.06[cd]	48.52±0.10[a]
50.0 CP	4.65±0.00[c]	6.00±0.03[c]	6.83±0.01[c]	5.00±0.02[c]	29.09±0.02[bc]	48.45±0.03[a]

75.0 CP	4.74±0.01[d]	6.11±0.01[d]	6.58±0.02[b]	5.10±0.02[d]	29.07±0.03[b]	48.42±0.04a
100.0 CP	4.83±0.01[e]	6.14±0.01[d]	6.41±0.02[a]	5.15±0.01[e]	28.94±0.01[a]	48.54±0.04[a]
P-Value	0.000	0.000	0.000	0.000	0.007	0.010

Mean in the same row with different superscript differ Significant (P<0.05)

Table 3. Growth Performance of *Oreochromisniloticus* fed varying levels of cassava peel meal diet.

Treatment	0.0 CP	25.0 CP	50.0 CP	75.0 CP	100.0 CP	P-Value
MIW	1.18±0.00	1.17±0.01	1.18±0.00	1.17±0.00	1.17±0.00	0.737
MFW	2.80±0.02[d]	2.96±0.02[e]	2.62±0.02[c]	2.51±0.02[b]	2.43±0.01[a]	0.000
MWG	1.63±0.02[d]	1.79±0.02[e]	1.44±0.02[c]	1.34±0.02[b]	1.26±0.01[a]	0.000
MISL	3.43±0.03	3.50±0.06	3.43±0.03	3.43±0.03	3.47±0.03	0.690
MFSL	4.87±0.03[b]	4.97±0.03[b]	4.60±0.06[a]	4.50±0.06[a]	4.53±0.03[a]	0.000
MSLG	1.43±0.03[b]	1.47±0.03[b]	1.17±0.07[a]	1.07±0.03[a]	1.07±0.03[a]	0.000
GR	0.03±0.00	0.03±0.00	0.03±0.00	0.02±0.00	0.02±0.00	1.000
SGR	1.55±0.02[e]	1.66±0.02[d]	1.43±0.01[c]	1.36±0.01[b]	1.30±0.00[a]	0.000
FCE	31.03±0.61[c]	32.93±0.48[d]	28.61±0.23[b]	27.34±0.20[a]	27.20±0.13[a]	0.000
FCR	3.22±0.06[b]	3.04±0.04[a]	3.50±0.03[c]	3.66±0.03[d]	3.68±0.02[d]	0.000
PER	0.057±0.00[d]	0.064±0.00[e]	0.051±0.00[c]	0.048±0.00[b]	0.045±0.00[a]	0.000
%SUR	86.67±3.33	70.00±5.77	76.67±8.82	70.00±0.00	80.00±5.77	0.247

Mean in the same row with different superscript differ Significant (P<0.05)

KEY;

MIW=Mean initial weight, MFW=mean final weight, MWG=weight gain, MISL=Mean initial Standard length, MFSL=Mean final Standard length, MSLG=Mean Standard length gain GR=growth rate. SGR=specific growth rate, FCE=Feed conversion efficiency, FCR=Feed conversion ratio, PER= protein efficiency ratio.

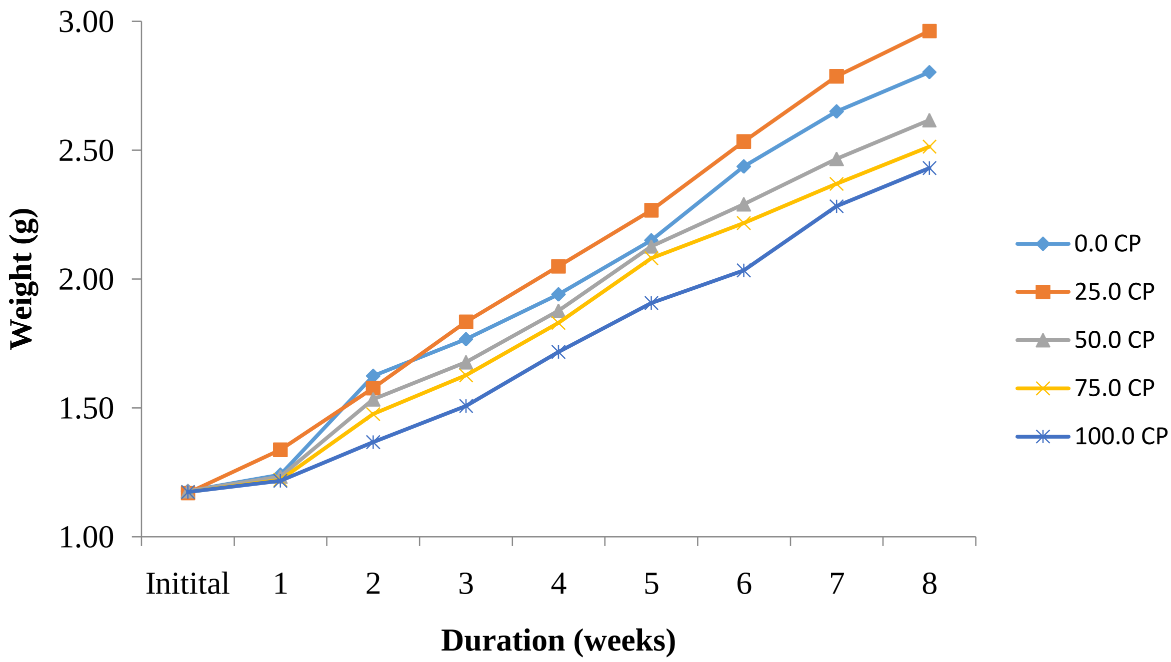

Figure 1; Weekly weight of *Oreochromisniloticus* fed varying levels of cassava peel diet

3.6 A graph of length of *Oreochromisniloticus*fingerlings

Figure 2 shows a graph of standard length of *Oreochromisniloticus* fingerlings fed cassava peel meal for eight weeks showing the weights of the various levels of inclusions.

3.7 Water quality parameter during the experiment

Table 4 shows that the water quality parameters during the experiment were not significantly different between treatments and were within the recommended range for the culture of *Oreochromisniloticus.*

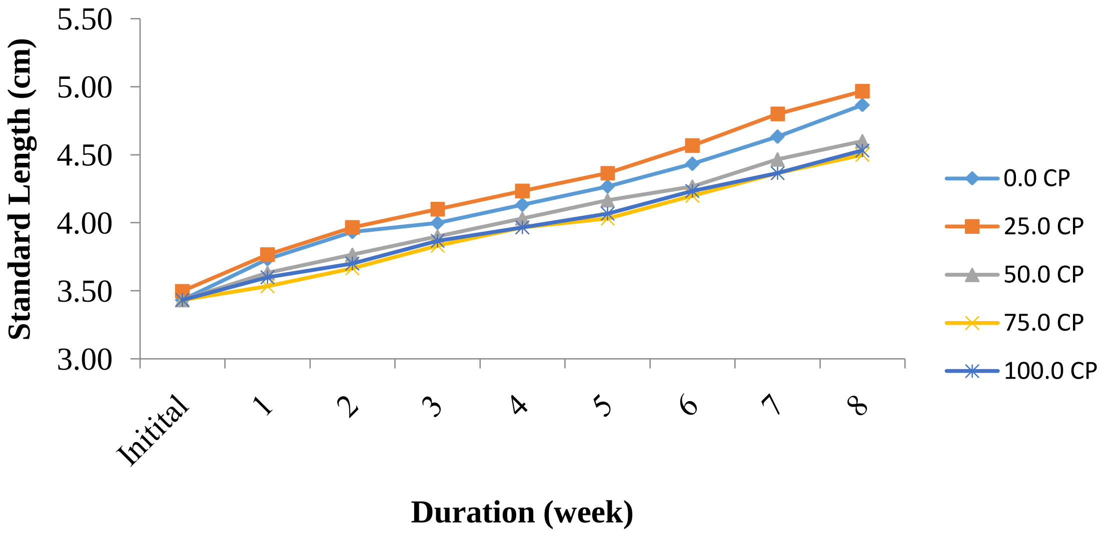

Figure 2; Weekly Standard length of *Oreochromisniloticus* fed varying levels of cassava peel diet

Table 4: Water quality parameter of the test media containing *Oreochromisniloticus* fed varying levels of cassava peel diet.

Treatments	pH	Temp (^{0}C)	TDS (ppm)	EC (µS)	DO (mg/L)
0.0 CP	7.42±0.01^a	27.23±0.01^a	162.33±1.45^a	324.67±2.91^a	4.23±0.02^d
25.0 CP	7.50±0.01^a	27.25±0.01^{ab}	164.33±0.33^a	328.67±0.67^a	4.14±0.01^c
50.0 CP	7.68±0.01^b	27.28±0.01^b	170.33±1.20^b	340.67±2.40^b	4.12±0.01^c
75.0 CP	7.92±0.02^c	27.27±0.01^b	185.00±0.58^c	370.00±1.54^c	4.05±0.03^b
100.0 CP	8.08±0.06^d	27.29±0.01^b	191.67±0.88^d	383.33±1.76^d	3.88±0.02^a
P-Value	0.000	0.032	0.000	0.000	0.000

Mean in the same row with different superscript differ Significantly (P<0.05)

IV. Discussion

4.1 Growth performance of*Oreochromisniloticus* fingerlings

The weight of fishes fed diet 25%, 50%, 75% and 100% differ significantly (p>0.05) similar result were obtained by Faturoti and Akinbote (1986) who observed that inclusion of cassava peel reduced body weight. According to the authors, 25 and 50 percent dietary inclusion of cassava peel meal did not reduce weight. The increasing poor performance from diet 75% and 100% is probably due to high fibre content of the diet. The growth recorded among fingerlings diet which contained 25% cassava peel while diet containing 0% cassava peel came next, Diet which contained 100% peels gave the poor performance. The specific growth rate (SGR) obtained for fishes fed with diet 25% and 0 differ significantly (p>0.05) from those fed diets 0%, 75%, and 100%. The specific growth rate (SGR) decreases with increasing level of cassava peel. However the trend is similar to that of the feed conversion ratio (FCR). This is because SGR expressed as percentage growth per day is independent on the FCR the decline in SGR is connected with the increased FCR of the diets. Similar reports of cassava peel meal in the range of inclusion as the one in the present study that was utilized with better growth are available (Oresegun&Alegbeleye 2001; Dada *et. al.*, 2015). Fish fed with diets where corn meal was totally replaced with cassava peel meal did not grow well.

The protein efficiency ratio (PER) recorded for fishes fed the three (0%, 50%, and 75%) diets were significantly different (p<0.05) from those fed diets 25% and 100%. The cassava peel meal inclusion at 25% and 50% enhances nutrient utilization which is reflected in improved weight gain, feed conversion ratio, protein efficiency ratio, feed conversion efficiency, apparent net protein utilization and specific growth rate. Crude protein levels of diets have an inverse relationship with PER (Bahnasawy 2009; Oishi*et. al.*, 2010). This implies that diets must have ingredients that do not interfere with protein utilization if the barest minimum of crude protein requirement is employed. An interesting discovery is the fact that 25% level inclusion of cassava peel meal boosted PER compared to diets with maximum substitution of cassava peel meal.

According to Tran-Duy*et.al.*, (2008), increasing starch content of tilapia diets leads to a decrease in digestible energy intake considering blood glucose levels and oxygen uptake under satiation.

4.2 Water quality parameters

The water quality parameter during the duration of the experiment did not change between treatments and were within the recommended range for the culture of *Oreochromisniloticus.*

V. Conclusion

Cassava peel inclusion as a substitute for maize in *Oreochromisniloticus*diet result in decrease in weight gain as the substitution level increases in the diet. However, the best performances among the test diets were obtained from diets substituted at 25% and 50% cassava peel respectively.

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