THE EFFECT OF DIET WITH DIFFERENT INCLUSION LEVEL OF CASSAVA LEAF MEAL (CLM) *MANIHOT UTILISSIMA* ON THE GROWTH PERFORMANCE OF *HETEROCLARIAS* FINGERLINGS

[1*]Ekanem, A.P., [2]Eyo, V.O. and [3]Ndome C.B.
[1]Department of Fisheries and Aquaculture, University of Calabar, Nigeria*
[2]Department of Fisheries and Aquaculture, University of Calabar, Nigeria
[3]Department of Zoology and Environmental Biology, University of Calabar, Nigeria

ABSTRACT
A feeding trial was conducted to asses the growth performance of *Heteroclarias* fed diets containing cassava leaf meal (CLM) at difference inclusion levels, in an attempt to reduce the cost of fish feed as well as add value to cassava leaves which are wasted after harvest. Four experimental diet A, B, C and D containing 0%, 15%, 25% and 40% inclusion levels of cassava leaf meal (CLM) respectively were fed to Heteroclarias fingerlings in glass aquaria (96cm 50 cm x 29cm) for 70 days. Evaluation of the growth performance indices and food utilization indices was based on weight gain, growth rate (GR), specific growth rate (SGR), mean growth rate (MGR), percentage weight gain, protein efficiency ratio (PER), food conversion ratio (FCR) and food conversion efficiency (FCE). The best growth performance was obtained in diet A (control) containing 0% CLM which was significantly different ($P<0.05$) in their growth performance and food utilization indices from fish fed diets B, C and D with 15, 25 and 40% CLM respectively. The results led to the conclusion that inclusion of 15% CLM in diet for Heteroclarias would enhance excellent growth performance at a reduced cost.
Keyword: Cassava leaf meal, Growth Performance, Heteroclaris.

INTRODUCTION
Aquaculture has been the world's fastest growing food production system over the past decade. The average growth rate for aquaculture has been 8.9% per year since 1970, compared to only 1.2% for capture fisheries and 2.8% for terrestrially farmed meat-production over the same period (Brink, 2001). In 2002 the total contribution of aquaculture towards total world fish requirements was 29.9% (FAO, 2004). Although aquaculture tends to grow in Africa, One of the major hindrances to the development of this industry is high cost of protein source for the production of high quality fish feed. This is attributed to the fact that trash fish which is the best source of protein for fish feed is highly competed for by humans and livestock. To eliminate this problem, fish nutritionists in the continent are constantly searching for cheaper protein sources from plant and animal-based ingredients that will maximize fish growth and increase production within the shortest possible time. To reduce the inclusion level of fish meal in fish feed, requires research into locally available raw materials which may be cheaper or not in competitive demand. Leaf meals are one of the cheapest sources of protein that may reduce the high cost of fish feed. A number of plants continue to be investigated for their potential in supplementing or even replacing fish meal. Many studies have been conducted using various sources of leaf meal protein. Ng and Wee, 1989 worked on the inclusion of cassava leaf meal in pelleted feed for nile tilapia; Yousif et al., meal; Yosif et al, 1994 on Alfalfa in tilapia diet; Reyes and Fermin, 2003 on Carica papaya for farmed

abalone Haliotis asinine; Bairagi et al, 2004 on nutritive value of leucaena leucocyshala and other leaf meals.

Cassava (*Manihot esculenta*) is a staple food in the tropics and its leaves also serve as forage for animals due to its palatability and high protein content (Ravidran,1991). In some parts of Nigeria, where cassava is highly cultivated, the leaves are allowed to waste away on the farmlands after harvest. These wasted cassava leaves on farmlands could be completely utilized by incorporating them into fish feed (Felaye,1992) which is attributed to its high crude protein of 25% and its richness in lysine (Sylvester,1989). when non-conventional feed stuff such as cassava leaf meal (CLM) are used as protein source in fish diets, one of the major problems is the acceptability by fish as a result of poor palatability of the diet (Rodriquitz et al, 1996). Generally, leaf meals are found to contain anti-nutritional factors such as tannins, cyanide coumarine which reduces its palatability (Karda et al.,1996). Moreover, different processing techniques leads to reduction in anti-nutritional factors resulting in better growth performance in fish (Siddhuraju and Becker, 2003; Francis et al., 2006 and Fagbenro, 1999).

Heteroclarias is a hybrid of two African catfish species *Clarias gariepinus* and *Heterobranchus longifilis.* This hybrid fish species exhibits some qualities which qualifies it for commercial culture. Such qualities include hardiness, high yield potential, high fecundity, high market value, air breathing characteristics, fast growth rate, disease resistant etc. For artificial feed to be deemed successful in fish culture such as *Heteroclarias*, it must meet the requirements for survival and growth of the fish and consequently, must contain approximate combinations of nutrients which are effectively and efficiently utilized (Ajah, 2007).

The aims of the study is to investigate the use of cassava leaf meal (CLM) in fish feed formulation at its optimum inclusion level to replace highly competitive feed ingredients such as fish meal in the diet of Heteroclarias.

MATERIALS AND METHODS

Experimental Design

The 10 weeks experiment was carried out in the University of Calabar fish farm hatchery complex where 8 aquaria measuring 96 x 50x 29 cm^3 were randomly stocked with 80 *Heteroclarias* fingerlings (10 fish in each aquarium) after being acclimatized for three days. The average initial body weights of the fingerlings were taken with an electronic weighing balance to the nearest gram. Four different kinds of fish feed were formulated with different inclusion levels of cassava leaf meal (CLM) and labeled A (0%) (Control), B (15%), C (25%) and D (40%). The animals were fed twice daily at 4% of their body weights. The dissolved oxygen (DO) and pH level of each of the experimental tank was monitored using an oxygen and pH meters respectively. The water in the experimental tanks was replaced daily about 3 hours after feeding and the unconsumed food particles collected, dried and measured with the balance to determine their weight. The weight and length of the experimental fish and their controls were measured bi-weekly for the determination of their growth performance. The experiment was replicated two times with controls and their replicates under the same conditions.

EXPERIMENTAL DIET COMPOSITION

Experimental diet was composed of cassava leaf meal (CLM), groundnut meal (GNM), wheat offal (WO), Vitamin C, Bone ash, wheat flour, vitamin premix, palm oil, sodium chloride (NaCl), and lysine.

PREPARATION OF CASSAVA LEAF MEAL (CLM)

Cassava leaf meal was prepared by obtaining cassava leaves of the species *Manihot utilissima.* The leaves were sun dried for 7 to 8 hours depending on the intensity of sun light and finally oven dried in a hot-air oven for three hours at 65^{o}C. Dried leaves were crushed to powder with a manual blender to obtain the cassava leaf meal (CLM) which was used to formulate the feed as shown in table 1. Feed A (control) contained no CLM, Feed B contained 160g of CLM, Feed C contained 250g of CLM and Feed D contained 400g of CLM as shown in table 2.

DIET FORMULATION AND PREPARATION

Four isonitrogenous (35% crude protein) diets were formulated using trial and error method (Felaye, 1992) with different inclusion level of cassava leaf meal (CLM) as shown in table 1. The different ingredients were mixed according to their percentages. After mixing, the feeds were pelleted using a pelletizer then sun dried to prevent growth of mould. Table 2 shows the Crude protein contribution (%) of the basal ingredients in the experimental diet.

FEED INGREDIENT	**WEIGHT IN GRAMS PER KILOGRAM**			
	FEED A	**FEED B**	**FEED C**	**FEED D**
Cas s Cassava leaf meal (CLM)	---	150g	250g	400g
Fish Meal	250	200	150	100
Groundnut Meal	260	320	360	390
Wheat offal	450	260	180	50
Vitamin C	5	5	5	5
Bone Ash/Calcium	10	10	10	10
Wheat Flour	10	10	10	10
Palm oil	5	5	5	5
Vitamin premix	15	15	15	15
	5	5	5	5

Sodium Chloride				
Lysine	10	10	10	10
Total weight In g/kg	**1 Kg**	**1Kg**	**1 Kg**	**1Kg**

Table 1: weight of the ingredients in grams per kilogram:

Table 2: Crude protein contribution (%) of the basal ingredients in the experimental diet

FEED INGREDIENT	**PROTEIN CONTRIBUTION**			
	FEED A	**FEED B**	**FEED C**	**FEED D**
Cassava leaf meal (CLM)	-	3.75	6.25	10.00
Fish Meal (FM)	16.25	13.00	9.75	6.50
Groundnut Meal (GM)	12.60	14.35	16.30	17.55
Wheat Offal (WO)	6.15	3.90	2.70	0.95
Total Crude Protein	35.00	35.00	35.00	35.00

Statistical Analysis: Data obtained from the experiment were analyzed statistically using the analysis of variance (ANOVA).

RESULTS

MEAN GROWTH PERFORMANCE INDICES

Growth indices examined in this experiments include weight gain (g), growth rate (G.R), specific growth rate (S.G.R), mean growth rate (M.G.R) and percentage weight gain (table 3). These were calculated from the weekly growth performance of the catfish hybrid, *Heteroclarias*.

Table 3:- Mean growth performance indices of *Heteroclarias* fed with diet containing different inclusion levels of cassava leaf meal for five weeks.

Growth Indices	Diet A	Diet B	Diet C	Diet D
Initial WT(g)	15.00± 0.11	15.02±0.05	15.00±0.59	15.03±0.01
Final WT (g)	78.00±2.00	62.95±1.55	54.10±2.40	45.10±0.70
Weight Gain	63.00±1.89	47.93±1.50	39.10±1.81	30.09±0.71
Growth Rate	0.90±0.30	0.69±0.02	0.56±0.02	0.43±0.01
SGR	2.36±0.02	2.05±0.03	1.84±0.01	1.57+0.02
MGR	19.35±0.14	17.56±0.19	16.17±0.05	14.30±0.17
% weight Gain	80.76±0.35	76.13±0.50	72.27±0.14	66.70±0.53

FUI	A	B	C	D
Food Consumed (g)	140.06±7.66	109.58±1.12	96.10±2.80	87.25±1.52
Food Conversion Ratio (FCR)	2.23±0.06	2.29±0.05	2.46±0.04	2.90±0.02
Food Conversion Efficiency (FCE)	45.05±1.12	43.73±0.92	40.67±0.70	34.48±0.21

Table 4: Mean food utilization indices of *Heteroclarias* fed with diet containing different inclusion level of cassava leaf meal for five weeks.

The maximum weight gain was obtained in fish fed diet A (control) (63.00 ± 1.89g) followed by fish fed diet B (47. 93 ± 1.50g). Fish fed diet C gained (39.10 ± 1.81g) of weight while fish fed diet D showed the least weight gain (30.09± 0.71). Growth rate (G.R) was highest in fishes fed diet A (0.90± 0.30) while the least value was obtained in fishes fed diet D (0.43 ± 0.01). Fish fed diet A also showed the highest specific growth rate (2.36 ± 0.02) while the least specific growth rate was obtained in fish fed diet D (1.57±0.02). Mean growth rate (MGR) and percentage weight gain were equally highest in fish fed A and least in fish fed diet D. Thus fish fed diet A (control) containing 0% inclusion level of cassava leaf meal showed the best performance in all the examined mean growth performance indices.

FOOD UTILIZATION INDICES

Experimental feed utilization was measured by the following indices: food consumed (g), food conversion ratio (FCR) and food conversion efficiency (FCE) shown in table 4. Food consumed (g) was highest for fish fed diet A (140.06 + 7.66) and least in fish fed diet D (87.25 ± 1.52). Food conversion efficiency (FCE) was highest in fish fed diet A (45.05 ± 1.12) and least in fish fed diet D (34.48 ± 0.21). Fishes fed diet A showed the least food

conversion ratio (2.23 ± 0.06) while fish fed diet D showed the highest value (2.90 ± 0.02).

DISCUSSION

The experimental fish fed diet A (0% CLM and 35% CP) responded more positively in their growth performance as indicated by the weight (63.00 ± 1.89g) gained which was the highest in the series of fish fed different levels of CLM in compounded feed followed by fish fed diet B (15% CLM inclusion level; 35% CP) with 47.93± 1.50g . This was significantly different ($P < 0.05$) from fish fed diet B (15% CLM inclusion level; 35% CP), Diet C (25% CLM inclusion level; 35% CP) and diet D (40% CLM inclusion level; 35% CP) respectively. In all the growth parameters (FCR, FCE, PER, SGR, MGR etc) estimated, the overall best performance was observed in experimental diet A. The organisms in this study were fed daily at 4% of their body weight. This rate of feeding is similar to that recommended by Ghosh et al (1984); Salim and Sheri (1999) who reported significant growth of *Labeo rohita* on 4% level of feeding.

Growth rate (0.90± 0.30) was highest in fish fed diet A, followed by fish fed diet B (0.69±0.02) and lowest in fish fed diet (0.43 ± 0.01). Also the highest specific growth rate (SGR) was obtained in diet A (2.36 ± 0.02) and the least SGR in diet D (1.57±0.02). According to Rodriquitz *et al*., (1996) acceptability of feed by fish as a result of poor palatability of the diet is one of the major problems when plant protein like cassava leaf meal are used in fish diets.

In the present study, all the experimental diets were accepted by experimental fish indicating that the incorporation of cassava leaf meal in fish diets did not have much effect on the palatability of experimental diets. This might be attributed to the processing technique employed in the study. This finding agrees with Siddhuraju and Becker (2003), Francis et al. (2006) and Fagbenro (1999) who reported that reduction in antinutrient by different processing techniques resulted in better palatability and growth in fish.

Also, increase in the inclusion level of cassava leaf meal (CLM) in fish diet resulted in reduced growth performance of experimental fish showed decreasing weight gain, growth rate, SGR, MGR and % weight gain. This is attributed to poor FCR and FCE recorded in diet C and diet D (25 and 40% inclusion level of CLM) with higher inclusion of cassava leaf meal (CLM). However, lower food conversion ratio (FCR) in fish fed diet A and diet B (0 and 15% CLM) means that the fish were able to utilize diet A without CLM and feed B(15% CLM) than diet C and D containing higher inclusion level of cassava leaf meal (25 and 40% CLM) . The highest FCR was observed in Diet C and D containing (25 and 40% CLM) is an indication of poor diet utilization which may be attributed to high inclusion level of CLM in the diet. This could as attributed to high fiber content which is a major problem when leaf meals are used in fish diets which can impair fish growth through poor food utilization. The availability of suitable diets that are effectively digested and provide the required nutrient for optimum growth is a key component of fish nutrition (Mokolensang *et al*., 2003). The growth and feed conversion ration of a fish is remarkable tool to compute the acceptability of artificial feed. The feed conversion ratio (FCR) of various fish have been estimated by many workers ((Jhingran, 1991; Shabbir *et al.,* 2003; Jabeen *et al*., 2004; Ali and Salim, 2004; Saeed *et al*., 2005; Inayat and Salim, 2005; Gull

et al., 2005). According to their reports, proper understanding of FCR help the farmer to feed the fish to satiation, and when fish are fed exactly the quantity of feed required, they are not stressed and they provide high quality meat for human consumption. The results obtained in the present study shows some similarities with that of other workers in the use of CLM in fish formulated diet. Chhay et al 2010 obtained excellent growth in *O. niloticus* fed diet with cassava leaf meal; the nutritive value of cassava leaf meal (CLM) in pelleted feed for Nile tilapia was also confirmed by Wing and Kok (1989).

The four experiment diets were formulated to be isonitrogenous (35% CP) using trial and error method. In this method of feed formulation, as the inclusion level of cassava leaf meal increases from 15% to 40%, the highly competitive fish meal inclusion level reduces from 250g to 100g which indicates reduction of the feed production cost. Our results have also demonstrated that cassava leaf meal (CLM) could be safely incorporated into feed concentrates of fish meal without any fear of cyanide toxicity. There was no mortality of test fish throughout the experimental period, an indication of high level of safety in the use of CLM as feed component for fish (Felaye, 1992). Cassava leaf meal is found to be a good supplement to highly competitive fish meal due to its high protein level (25%) and its richness in lysine, Sylvester (1989). Also, comparing diet B, C, and D which contained different inclusion level of cassava leaf meal, diet D containing the highest level of cassava leaf meal gave the poorest result. This is a reflection of poor diet utilization by fish caused by poor binding ability of the feed due to high fibre content of CLM which caused it to scatter in water. Optimal water quality condition was maintained during the experiment. The pH range was 6.5 – 8.5, temperature 24 – 28^{o}C and dissolved oxygen (DO) was maintained at saturation level (5mg/l). These are recommended values for warm water fish culture (Balarin and Halton, 1979). The high cost of protein source in fish diet which has been a problem to fish culturists is addressed in the present study in the use of cassava leaf meal in fish compounded feed. Utilization of such material (cassava leaf) which is rich in protein could help the fish farmer to reduce the cost of feed and may enhance increase production. Cassava leaves which are wasted after harvest have proved to be efficacious in animal feed preparation. In addition to increase fish production and increase revenue for fish farmers, the value of cassava farming stands to increase with the added values to its post-harvest waste (leaves) which is hereby confirmed to be a rich source of protein in animal feed preparation. The use of cassava leaf meal (CLM) to replace highly competitive sources of protein in fish compounded diet is hereby recommended at a moderate inclusion level of 15%.

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