International Journal of Innovative Agriculture & Biology Research 6(4):18-28, Oct.-Dec., 2018

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Preliminary Investigation of Processed Cassava Leaf (*Manihot esculenta)* Meal on the Growth and Survival of *Clarias gariepinus* Juveniles Fed with Varying Level of Inclusion in Sustainable Fish Production

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ABSTRACT
Cassava leaf (*Manihot esculenta*) meal was experimented for its ability and inclusions to partially replace fishmeal in the diet of *Clarias gariepinus* Juveniles under out-door culture system. The study was conducted Biological garden, fisheries unites Department of Biology Education, Federal College of Education (Tech) Bichi, Kano State, Nigeria (8-9^{0}E and 12-13^0 N). Four-dry diets formulated at 40% crude protein were fed to Juveniles (46g± 0.01) at 0%, 10%, 20%, 30% inclusion levels of Cassava leaf meal where the 0% served as control. The experiment, which was conducted for 91 days, measured among other parameters feed conversion ratio (FCR), specific growth rate (SGR) and survival rate (S) and stander length in the fish samples. The fish were fed at 5% body weight twice daily morning and evening. Although the three inclusion levels of Cassava leaf supported the growth of *C. gariepinus* Juveniles, growth performance and feed utilization was favored by low inclusion of Cassava leaf meal. From the result, 20% Cassava leaf meal inclusion gave the best final mean weight of 109.02g, mean weight gain (MWG) of 62.74g, feed conversion ratio (FCR) of 3.44, Specific growth rate of 0.47% and percentage survival of 90%. There was no significant difference (P>0.05) in the growth parameters between 20% inclusion level and the control diet.
Keywords: Growth, performance, survival, standard length of *C. gariepinus* Juveniles on the Concrete ponds

INTRODUCTION

Aquaculture shares the same challenges with Agriculture in increasing food supply and this brings about competition in the use of feeds for livestock and fish farming. Shortages of major feedstuff has been on the increase in recent times in Nigeria and with the poultry and livestock industry expanding, the aquaculture industry is finding it increasingly more difficult to source for critical feed ingredients (Agbola, 2004; Adewolu 2008).

For aquaculture to supply the population's growing demand for fish as food and to fill the gap in declining yield from capture fisheries, basic but critical information should be available especially regarding feed that are less competitive and of low cost value but with replaceable capacity for fish meals with the aim of making fish to attain table size at reduced culture time and minimum production cost (Adesina, Daddy, Mahammed & Uka *2004;* Abdullahi. 2009)

Utilization of non-conventional protein supplements of both animal and plants origin in practical fish diets has been a focused in Nigeria in recent times. It is imperative for such practical diet to contain optimum protein, required essential amino and fatty acids (F.A.O,2012)

Cassava leaf meal has been known for its high nutritive value with as much as 18-33% of crude protein depending on the culture system (Ayodeji, 2005, Ty, Saphararith, Preston & Maung, 2010). This experiment was conducted Biological garden, fisheries unites Department of Biology Education, Federal College of Education (Tech) Bichi, Kano State, Nigeria (8-9^{0}E and 12-13^0 N). To assess the suitability of Cassava leaf meal as a partial replacement for fish meal in the diet of *C.gariepinus* Juveniles (Cat fish*).*

Objectives; to investigate the possibility of including Cassava leaf meal in diet of *C. gariepinus*.

1. To determine the growth performance of *C. gariepinus* fed on diet containing processed Cassava leaf meal and the control.
2. To determine Nutrient Utilization *C. gariepinus* on the protein efficiency ratio.

Hypotheses

1. There is no significant difference between the growth performance *C. gariepinus* fed on diet containing processed Cassava leaf meal and the control.
2. There is no significant difference between the feed utilization of *C. gariepinus* fed with diets contain processed Cassava leaf meal and the control.

MATERIALS AND METHODS

Diet formation and preparation

Freshly harvested Cassava leaves from Biological garden of the Department of Biological sciences Ahmadu Bello University, Zaria Nigeria, was risen in water for ten minutes and allowed to drained further pounded, sun dried for three days and thereafter grounded into fine powder using the hammer mill. All the other feed ingredients were milled using locally fabricated hammer mill and sieved through a 595um sieve to remove stones and dirt as well as ensure homogeneous size profile before being analyzed for proximate composition. Four dry diets were prepared in which fish meal was replaced with Cassava leaf meal at 0%, 10%, 20% and 30% levels using the method of Ikeckwumere,. Ndubuisi, Amasi & Ekwere (2007) at 40% crude protein level. The diets were fortified with vitamin premix. They were thoroughly mixed in a bowl and pelletized in an improvised pelleting machine using 1% starch as binder see fig 1 and fig II below.

DIFFERENT FEED INGREDENTS

Fig I and Figure II below.

Table 1: Percentage Composition of experimental feed

Source and processing of the leaves, and Preparation of diets
(A) Grinding of cassava leaves using mortar
and pestle(B) Sun drying of grinded cassava leavesother Ingredients

Table 1. Percentage Compositions of Experimental Diets (40% C.P)

Diet ingredient	Diet I	Diet II	Diet III	Diet IV
Soya bean Meal	17.73	17.73	17.73	17.73
G. Nut Cake	21.33	21.33	21.33	21.33
Fish Meal	38.94	32.92	26.90	20.88
Cassava Leaves	0.00	6.02	12.04	18.06
Maize	25.00	25.00	25.00	25.00
Salt	0.50	0.50	0.50	0.50
Fish Premix	1.00	1.00	1.00	1.00
Binders	1.00	1.00	1.00	1.00
Oil	0.50	0.50	0.50	0.50
Total	100%	100%	100%	100%

EXPERIMENTAL SYSTEM AND FEEDING TRIAL

The Feeding trial was conducted in Concrete outdoor tanks (1.3x0.9x1m). Tanks were thoroughly washed and the Concrete ponds were scrubbed with agricultural lime ($CaCo_3$) which served as disinfectant. The ponds were then rinsed and drained after 24 hours to clear the ponds of the lime. Thereafter each Pond was filled with 150litres of water from reserved tank in Biological garden, federal College of Education (technical) Bichi, Kano with sources from Baguwe reservoir water. Each pond was label according on each feeds assigned to experimental groups. The twelve ponds were each stocked with twenty juveniles of *C. gariepinus* selected randomly. The water in each pond was changed fortnightly to remove the faeces and left over food. The experimental fish *C. gariepinus* Juveniles were collected from the Genetic Improvement Laboratory, Funtua hatchery units Nigeria. They were acclimatized for three days before the takeoff of the experiment, this was necessary to enable the juveniles empty their stomach content and to force them to adjust to the new diet**.**

Experimental Site

This experiment was conducted Biological garden, fisheries unites Department of Biology Education, Federal College of Education (Tech) Bichi, Kano State, Nigeria (8-9^{0}E and 12-13^0 N).

Fig III Measurement and Stocking of *C/gariepinus*

Figure IV Construction of pond pelleting feeds ingredient

Fig v Grinding feeds item Harvesting

EXPERIMENTAL PROCEDURE

The experimental fish were randomly distributed at a stocking density of 20 juveniles per tank in triplicates. They were fed at 5% body weight twice daily morning and evening at equal ration. Sampling was done weekly using a sensitive electronic balance (Soehnle - 2000g Model) to determine the average weight of the fish and adjust the feed accordingly.

The study was conducted for 91 days. All analyses for proximate composition including the carcass composition before and after the experiment were determined according to the methods of AOAC (2000) (Association for Official Analytical Chemist). Water temperature was monitored daily with a standardized mercury thermometer while dissolved oxygen and $_{P}$H were determined using Digital DO meter and Jenway Automatic $_{P}$H meter (Hannan HI98129) respectively**.**

Table 2: Proximate Composition of Experimental Feeds

Cassava leaves Sample	Crude Protein	Ether Extract	Ash	Moisture	Crude Fibre
0%	42.06	10.76	12.29	1.50	3.90
10%	41.35	13.02	11.30	1.00	4.08
20%	41.56	12.29	11.00	1.00	4.24
30%	41.87	11.83	10.90	3.00	5.00

Measurement of Growth Parameters

Food conversion ratio (FCR), Specific growth rate (SGR) and Percentage survival rate (PSR) were Determined as adopted by (Fagbenro, 1999).

Gross Protein Value (GPV): This is commonly used biological method for evaluating proteins. This was determined using Devendra (1988) method.

Protein Intake (PI)

This was determined following Sveier *et al.,* (2000) method using the formula: PI = Total feed intake x % crude protein in the diet.

Protein efficiency ratio (PER)

This index use growth as a measure of nutritive value of dietary protein. At was determined using Wilson (1989) as

$$\text{PER} = \text{Mean } \frac{\text{weight gain (g)}}{\text{Mean protein intake (mg)}}$$

Productive protein value (PPV)

This expresses the percentage of ingested protein that is retained by disposition in the carcass. It is usually calculated by the carcass analyses method of Fagbenro, (1999).

Statistical Analysis

The data collected was subjected to analysis of variance (ANOVA) and the means from the various treatments were compared for significant differences ($p<0.05$), using Duncan Multiple Range Test, (DMRT) to rank the means. System Analytic Statistical (SAS) computer package version nine (9) was used for the analysis.

ANOVA Percentage of Standard Length of Experimenter Fish

Source of variation	DF	SS	MS	F	Fcrit
Between Groups	3	46.652	15.351	1.75	0.255
Within Groups	6	53.260	8.87		
Total	11	167.37			

ANOVA Final Weight Gain of Experimenter Fish

Anova single Factor	DF	SS	MS	F	Fcrit
Between Groups	3	952.452	317.48	5.86	0.0324
Within Groups	6	325.238	54.20		
Total	11	1289.01			

Table 3 Growth Performance of C. gariepinus Juveniles Fed Experimental Diets.

Growth Parameter	Diets			
	0%	10%	20%	30%
Mean Initial Body Wt (g)	46.72	46.02	46.26	45.12
Mean Final Body Wt (g)	107.19^{ab}	93.11^{cb}	109.02^{a}	88.23^{c}
Mean Body Weight Gain (g)	60.17^{ab}	47.11^{cb}	62.74^{a}	43.11^{c}
Mean Body Weight Gain/week (g)	7.52^{ab}	5.88^{cb}	7.84^{a}	5.38^{c}
Mean Body Weight Gain/day (g)	0.66^{ab}	0.51^{cb}	0.68^{a}	0.47^{c}
Mean Initial Standard Length (cm)	17.22	16.97	17.99	17.20
Means Final Standard Length (cm)	22.93^{ab}	22.41^{b}	23.12^{a}	22.94^{ab}
Mean Standard Length Gain (cm)	5.71^{ab}	5.44^{a}	5.74^{a}	5.13^{a}
Specific Growth Rate (g/day)	0.44^{ab}	0.32^{ab}	0.47^{a}	0.29^{b}

Means with the same superscripts across the rows are not significantly different (p>0.05) Duncan's test. Superscript ^{a} stand for the highest value Foot note a Highly significant, ab significant, c not significant with a, ab, cb significant with c multiple range test in ranking them

Table 4. **Nutrient Utilization *C. gariepinus* Juveniles Fed with Experimental Diets.**

Growth Parameter	Diets			
	(0%)	10%	20%	30%
Protein Intake	3.73	3.62	3.61	3.54
Feed Conversion Ratio(FCR)	0.40^{a}	0.31^{a}	O.41^{a}	0,28^{a}
Protein Efficiency Ratio (FER)	1.50^{a}	1.13^{ab}	1.51^{a}	1.01^{ab}
Apparent Net (NPU (%)	41.67	44.22	46.93	48.52
Survival Rate (%)	94.83	93.17	95.66	81.66

Means with the same superscripts across the rows are not significantly different (p>0.05) Duncan's test. Superscript ^{a} stand for the highest value Foot note a Highly significant, ab significant, c not significant with a, ab, cb significant with c multiple range test in ranking them

RESULT AND DISCUSSION

The three-inclusion level of Cassava leaf meals in the experimental feed supported the growth for *C. gariepinus.* However, growth performance and feed utilization was favored by low inclusion level of Cassava leaf meal in the experimental feed. This result is similar to the report of several authors who have demonstrated the use of several species of leaves as a partial replacement for fishmeal in the diet of fish and other animals. Oduro, Ellis & Owusu, (2008) reported the use of duckweed *Spirodettla polyrrhiza* in the diet of the Nile Tilapia *(Oreochromis niloticus).* They stated that fish fed duckweed based diet had higher growth rates than fish fed diet containing water fern meals.

The authors indicated the possibility of partial replacement of fishmeal with Cassava leaf meal in the diet of C. *gariepinus*. Ty, *e tal*. (2010) reported that growth performance tilapia fed on prepared diet consisting of 30% soak Cassava leaf meal and *Moringa oleifera* Leaves; the weight gain, food conversion and energy use were equal to central diets (a standard Tilapia feed) the results of the studies was in agreement with Ty, *et-al*, (2010) because the prepared feeds support growth and development of the fish with the high body weight gain. Ahamad, Swapon; Yeasmin, Raham & Ali (2003) reported also the replacement of sesame oil cake by duckweed in broiler diet. They stated that partial replacement of the

costly oil seed by cheaper unconventional duckweed in broiler diet resulted in increased profitability. Which was similar to result obtain in these work Cassava leaf meals which are costly resulted in increased profit.

The protein efficiency ratio in the diets at 10 to 20% inclusive levels of Cassava leaf meal in the experimental diet showed no significant difference compared with the control diet .Olurin, Olujo & Olukoya, (2006) reported that 40% fermented Cassava incorporated in the diet of *C. gariepinus* gave the best performance in terms of growth response, food conversion ratio and protein efficiency. Contritely to results obtain in these work, 20% Cassava leaf meal diet had the best specific growth rate and food conversation ratio. Weight gain was well shown in diet two than other diets.

Ty *et al.,* (2010) reported that there was no significant difference in growth performance and nutrient utilization of fish fed on diets containing up to 20% Rice and Cassava leaf meal inclusion and the control. They however, stated that increase in dietary Cassava leaf meal inclusion resulted in progressively reduced growth performance and nutrients utilization of fish. This report is similar to the findings of this study; at 30% inclusion of Cassava leaf meal in the diet reduces the growth and feed utilization of the fish. Similar findings were reported by Hassan *et al*., (1994) and Garduno-lugo *et al*., (2008).

Anyanwu, Udebibie, Esonu and Ojuigwe (2008) reported no significant difference between the growth performance of fish that were fed diets containing up to 20% (*Microdesmis puberula*) leaf meal and fish that were fed the control diet, while carcass lipid and carcass protein also increased except for the diet with 15% (*Microdesmis puberula*) leaf meal in the *Heteroclarias (Heterobranchus bidorsalis* and *C. gariepinus*. These authors concluded that a diet containing up to 20% Cassava could be used as a complete replacement of fishmeal for commercial feed in the diet formulation for *C.gariepinus*. In the present investigation, all the experimental diets were accepted by *C. gariepinus* juveniles, indicating that the levels of incorporation of Cassava leaf meals did not affect the palatability of the diets. This portrays higher acceptability and utilization of the diets with additional advantage of being cheaper sources. This observation was supported by the work of Dongmeza, Steinbronn, Focken & Becker, (2008). These workers reported that reduction in anti-nutritional by different processing techniques resulted in better palatability and acceptability of the feed.

It was observed in this study that as temperature increased, pH increased and the DO value decreased. These parameters are within the range of culturing *C. gariepinus*. Auta (1993) reported Temperature range of 25-30°C, Dissolved oxygen of 5mg/l and a pH range of 6.7-9.0 in a similar experiment. It is also important to note that the period of higher growth, both in weight and length, in this study, coincided with the period of higher temperature, (September, 2010) in Zaria. One of the factors affecting metabolic rate of fish is temperature, (Bairagi *et a*l., 2004 and Burke, 2009). Weight gain and standard length increases are known to be the most important indices for measuring fish responses to experimental diets and very liable indicators of growth (Abdullahi, 2009). The study reveals that the specific growth rate per day of the fish was higher at 20% inclusions. This might be an indication that the nutrients were best converted to flesh by the fish fed on the 20% Cassava leaf meal inclusions, at 30% level reduced the growth rate and feed utilization, which might be due to high fiber content in the diets. Contrary to observation made by Adewole, (2008); Ochang, Fabenro & Adebayo, (2008), experimental diets containing 30% inclusion of *Leucaena leucocephala* leaf meal affected the growth of *Oreochromis niloticus* at 12.5% inclusion did not affect growth. The high values of performance indices (SGR and FCR) particularly in 20% 10% and 30% may be attributed to the high protein content of the diets (approximately 42% and above) which is within the recommended range of dietary requirements for proper growth of *Clarias gariepinus*. The findings of this study revealed increase in the carcass lipid similar to the report of these authors.

CONCLUSION

This study showed that Cassava *(Manihot esculenta)* meal, which is almost costless, could be used to partially replace the very expensive fishmeal in the diet of *C. gariepinus* Juveniles at regulated inclusion levels. This will no doubt reduce cost of production and thereby further boost aquaculture development in Nigeria. Furthermore, all the Null (Ho) hypotheses were rejected as there were significant difference

between the growth performance and feed utilization of *C. gariepinus* fed diets containing processed Cassava meal.

RECOMMENDATIONS

From the finding, the study hereby recommends.

1. Fish farmers could incorporate Cassava leaves meals at 20% of Crude Protein level to reduce the cost of purchasing expensive products from feed industries both within and outside the country.
2. Farmers in cassava producing areas could be encouraged to produces Cassava in abundances to cater for any increase fed supplement in the demand of the leaves by fish farmers
3. Exploring other simple technique and methods of improving the nutritional profile of ingredients such as removal of anti- nutritional factors as well as reducing fibre content using methods like ensiling to improve digestibility.
4. Further researches are encouraged for evaluating Cassava leaves and stem as potential to serve as novel ingredients in formulating and cost effective in fish diets.

Fig 1 Graphical Weekly Increase in Body Weight of *C. gariepinus Juveniles*

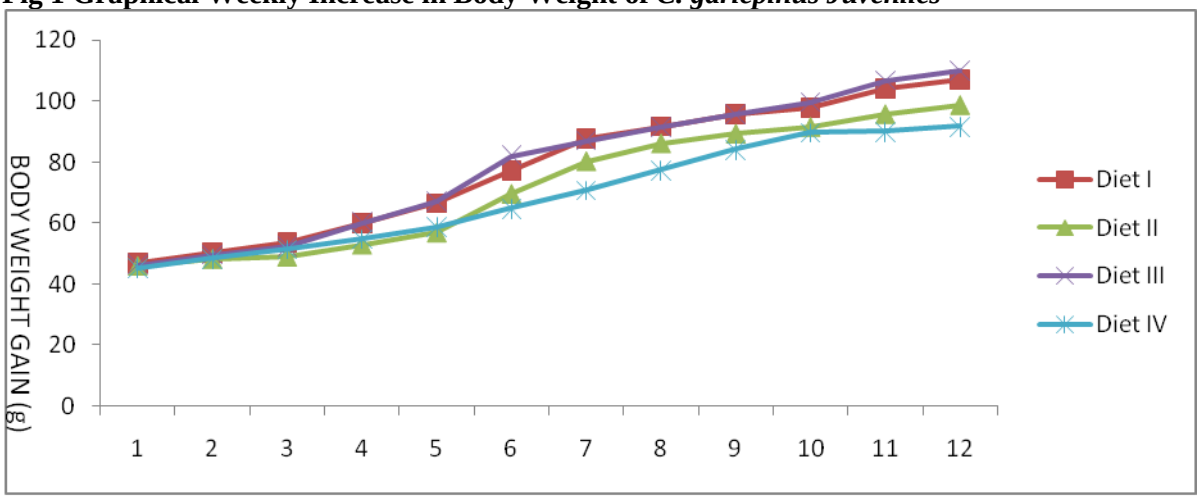
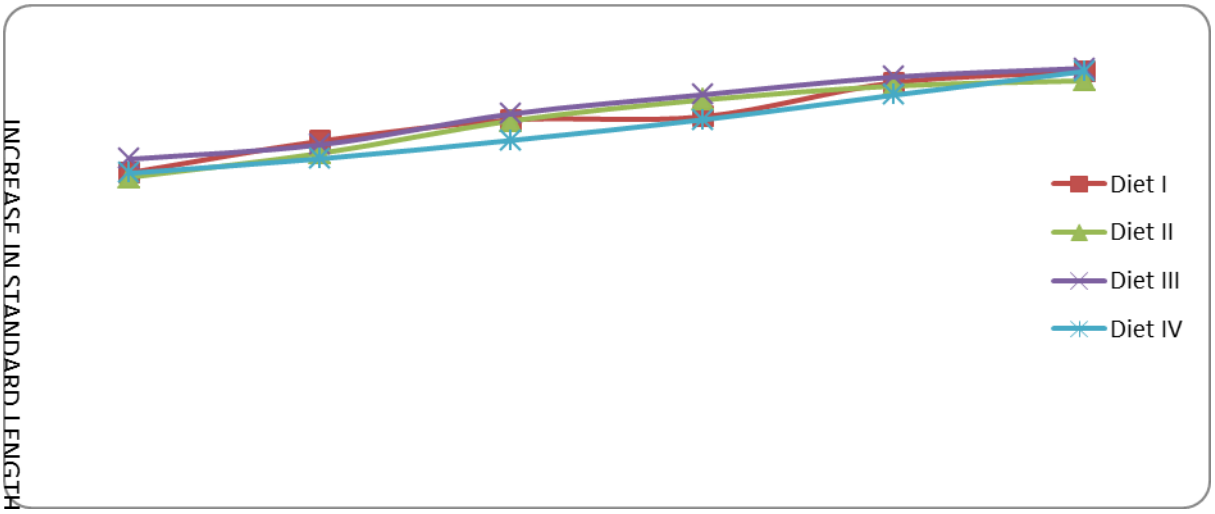


Fig 1I Graphical Bi-weekly increases Standard length *C. gariepinus Juveniles*



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