Potentials of Sweet Potato *(Ipomoea batatas*) Leaf Meal as Dietary Ingredient for *Oreochromis niloticus* Fingerlings.

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***Abstract*: An 8-week feeding trial was conducted to evaluate the potential of sweet potatoe *(Ipomoea batatas*) leaf meal as dietary protein source in the diet of *Oreochromis niloticus* fingerlings. Five isonitrogenous diets of 35% crude protein were formulated to contain 0, 5, 10, 15 and 20% sweet potato leaf meal (Diets 1-5) to partially replace fishmeal ingredients in the tilapia diet. The diet containing 0% leaf meal served as the control. *Oreochromis niloticus* fingerlings were reared in plastic aquarium. Each dietary treatment was tested in triplicate groups of 10 fingerlings per aquarium. The results of the growth and nutrient utilization responses showed that there were no significant ($p>0.05$) differences among the fish fed diets 1-4 (0-15% sweet potato leaf meal) but were significantly ($p<0.05$) differences in the group diet 5 (20% sweet potato leaf meal) when compared with the control treatment. The present findings showed that sweet potato leaf meal has good potential for use as one of the protein sources in *Oreochromis niloticus* diet up to 15% level without compromising growth.**

***Keywords:* Sweet potato leaf meal, plant protein, feed utilization, growth, tilapia**

I. INTRODUCTION

One of the problems facing the aquaculture industry today is the high cost of fish feed. Nutritionist all over the world are constantly searching for the dietary protein sources in which fish will maximize growth and increase production within the shortest possible time and at lowest cost. Leaf meals are one of the cheapest sources of proteins that may reduce the high cost of fish feed. Many studies have been conducted using various sources of leaf meal proteins (Ng and Wee 1989, on cassava leaf meal, Yousif *et al.*, 1994 on Alfalfa, Reyes and Fermin, 2003 on *Carica papaya* and other leaf meal, Bairagi *et al.*, 2004 on *Leucaena leucocephala*). The sweet potato *(Ipomoea batatas*) belongs to the morning-glory family Convolvulaceae. It is cultivated in over 100 nations and ranks fifth among the most important food crops in the tropical areas (An, 2004). The leaves of this plant have been used in the tropics as a cheap protein sources in ruminant feeds. Studies have been conducted to determine the nutritive value of sweet potato leaf meal. According to Woolfe Idiroko (1992), Ali *et al*. (1999), Ishida *et al*. (2000), An (2004), Ekenyem and Madubuike (2006), the leaf meal has a high protein content of between 26 to 33%, with high amino acid score. It has good mineral profile and vitamins such as A, B, C and E. Aside from its nutritive values, sweet potato leaves can be harvested many times throughout the year (Hong *et al*., 2003) thereby making the leaf meal to be abundant. One major factor limiting the use of this leaf meal in fish feed is the presence of anti-nutritional factors. The anti- nutritional substances present in the sweet potato leaves, according to Oyenuga (1968), are the in-vertase and protease inhibitors. These substances can be inactivated by various processing methods such as oven or sun-drying, boiling or steaming and grinding prior to inclusion in fish feeds. Although, various leaf meals have been tested as potential fish feed ingredient to decrease diet cost, the use of sweet potato leaf meal has not been examined. It is against this background that the present study was designed, to evaluate the potentials of incorporating sweet potato leaf meal into the pelleted feed of *Oreochromis niloticus*, a widely culturable fish species in Africa. The objective of this work, therefore, was to determine the growth performance, feed utilization and carcass composition of *Oreochromis niloticus*, fingerlings fed on graded levels of sweet potato leaf meal.

II. MATERIALS AND METHODS

Collection and preparation of sweet potato leaf meal:

Fresh leaves of sweet potatoes were collected from New Bussa, Niger state, Nigeria. The collected samples were washed thoroughly with tap water to remove dirt and debris, drained properly and later air dried to a constant weight. The dried leaves were milled using a Hammer- mill.

Diet formulation and preparation:

Five diets were formulated to contain 35% crude protein. The sweet potato leaf meal was incorporated into each of these diets at 0, 5, 10, 15 and 20% to replace clupeid ingredients in the diets. The diet containing 0% leaf meal serves as the control. Feed ingredients were weighed according to the gross composition in Table 1. The ingredients were mixed together before the addition of micro-ingredients such as vitamin, premix, methionine and so on. The mixed ingredients then passed through a pelleting machine. The moist pellets were sun dried and kept in air tight containers.

Experimental design and feeding trials:

Fingerling of *Oreochromis niloticus* were purchased from the hatchery of NIFFR, New Bussa, Niger state, Nigeria. The fishes were allowed to acclimatized for two weeks, during this period, they were fed on commercial diet. Prior to the commencement of the experiment, all fish were starved for 24 hours. This practice was to eliminate variation in due to residue of food in the gut and also to prepare the gastro intestinal tract for the experimental diets, while at the same time to increase the appetite of the fish. The feeding trial was conducted in plastic aquaria and 150 fingerlings of initial mean weight of 60.10 ± 0.41g were randomly allotted at the rate of 10 fingerlings per aquarium into five dietary groups designated Diet 1, Diet 2, Diet 3, Diet 4 and Diet 5 and each group was fed on 0, 5, 10, 15 and 20% sweet potato leaf meal respectively. Fish were fed on allotted experimental diets at 3% of their total body weight per day. Feedings were generally done in the mornings and evening. All fishes were reweighed every fortnight and feed weight was adjusted accordingly to accommodate for weight changes. For statistical reasons, each of the dietary group was triplicated. The experiment lasted for 56 days.

Statistical analysis

Data obtained were subjected to the analysis of variance (ANOVA) using Microsoft software STATISTICA where significant difference was observed means were separated by Duncan's multiple range test (Duncan, 1955).

Table 1:Proximate Composition of Sweet Potato (*Ipomoea batatas*) leaf meal

Nutrient	Percentage composition
Moisture	5.12
Crude protein	30.00
Crude fat	4.27
Crude fiber	9.18
Total Ash	13.21
Nitrogen Free Extract (NFE)	51.43

Table 2:Percentage Composition of Experimental Diets

Ingredients	Control	5%	10%	15%	20%
Fishmeal	20.00	15.00	10.00	5.00	_
Potato leaf meal	_	5.00	10.00	15.00	20.00
Groundnut cake	19.79	23.79	25.79	28.79	33.79
Soybean	19.00	21.00	26.00	30.00	32.00
Maize bran	10.00	8.00	5.00	4.00	2.00
Wheat bran	25.00	21.00	17.00	11.00	6.00
Salt	0.25	00.25	0.25	0.25	0.25
Starch	2.00	2.00	2.00	2.00	2.00
Methionine	0.200	0.200	0.200	0.20	20.00
Premix	0.50	0.50	0..50	0.50	0.50
Vegetable oil	2.00	2.00	2.00	2.00	2.00
Vitamin c	0.03	0.03	0.03	0.03	0.03
B. Complex	0.02	0.02	0.02	0.02	0.02
Bone meal	1.00	1.00	1.00	1.00	1.00
Lysine	0.20	0.20	0.20	0.20	0.20
Enzyme	0.01	0.01	0.01	0.01	0.01

III. RESULTS

Table 3: Growth Response and Nutrient Utilization of *Oreochromis niloticus* Fingerlings fed Diet containing varied levels of sweet potatoes leaf for 56 days.

Parameters	DT1	DT2	DT3	DT4	DT5
Mean Initial Weight (g)	60.10 ± 0.41[a]	61.00 ± 0.47[a]	60.73 ± 0.66[a]	62.14 ± 0.13[a]	62.19 ± 0.42[a]
Mean Final Weight (g)	98.67 ±1.26[a]	98.21 ± 2.16[a]	98.04 ± 6.04[a]	90.85 ± 4.73[b]	88.85 ± 4.52[c]
Weight Gain (g)	38.55 ±1.21[a]	37.77±4.66[b]	37.51±2.26[b]	38.55±28.78[a]	26.51±2.02[c]
Feed Intake	185 ± 5.04[a]	204 ± 6,66[b]	130.62± 1.18[a]	98.4 ± 51.53[c]	189.98 ± 7.26[a]
Feed Conversion Ratio	3.38 ±2.58[a]	5.1 ± 0.66[b]	4.71± 0.86[b]	5.38 ± 1.72[b]	7.09 ± 1.29[c]
Specific Growth Rate (%)	0.38±0.03[a]	0.38±0.02[a]	0.36±0.02[a]	0.20±0.13[b]	0.29±0.02[a]
Protein Efficiency Ratio	1.26±0.26[a]	1.21±0.32[a]	1.19±0.21[b]	1.19±0.21[b]	0.82±0.12[c]
Survival %	100 ± 0.00[a]	100 ± 0.00[a]	96 ± 5.78[b]	86.67 ± 1.53[c]	96.67± 5.77[b]

Values in rows with the same superscripts are not significantly different (P>0.05) while those values with different superscript are significantly different.

Results of the analysis of variance indicated significant differences (P<0.05) in final weight feed intake, feed conversion rate (FCR), specific growth rate (SGR), protein efficiency ratio (PER) and survival values among the treatments

.Table 4: Proximate Analysis of Feed Samples

PARAMETERS	DT1	DT2	DT3	DT4	DT5
%Moisture	6.80 ± 0.05	8.02 ± 0.01	8.01 ± 0.01	8.00 ± 0.01	8.01 ± 0.01
%Ash	16.01 ± 0.01	16.01 ± 0.01	16.00 ± 0.01	14.56 ± 0.01	18.00 ± 0.01
%Crude fibre	12.00 ± 0.05	12.01 ± 0.01	12.00 ±0.01	12.00 ± 0.01	12.01 ± 0.01
%Crude protein	30.45 ± 0,02	30.63 ± 0.01	31.50 ± 0.04	31.67 ± 0.09	32.38 ± 0.01
%Crude fat/lipid	12.01 ± 0.01	12.20 ± .0.01	12.80 ± 0.01	11.20 ± 0.09	11.50 ± 0.05
%NFE	38.74±0.80	37.14 ± 1.67	36.49 ± 0.83	37.13 ± 0.84	36.10 ± 1.64

Table 5: Haematology of *Oreochromis niloticus* fed Diets containing Sweet Potato for 56 days.

PARAMETERS	DT1	DT2	DT3	DT4	DT5
WBC (×10^g/L	84.96	68.42	23.55	55.16	143.83
LYM %	94.65	91.11	84.85	97.43	95.20
RBC (×10^/l)	1.54	1.01	0.60	0.86	1.67
HGB (g/dl)	6.3	2.6	3.4	2.2	4.5
MCHC (g/dl)	28.85	22.87	52.89	18.68	23.75
MCH (pg)	40.88	25.70	56.47	25.70	26.94
MCV (fl)	141.68	112.30	106.77	137.57	113.44

The result of the proximate analysis of the sweet potato leaf meal is presented in Table 2. Sweet potato leaf meal had a crude protein level of 30.00%, crude fat 4.27%, crude fiber 9.18%, total ash, 13.21% and 51.43% for nitrogen free extract.

The growth performance and feed utilization efficiencies of *Oreochromis niloticus* fingerlings indicated significant difference (P<0.05) in terms of mean initial weight, mean final weight, weight gain, specific growth rate, feed conversion ratio, protein efficiency ratio, survival and are presented in Table 3. The mean final weight of the fish significantly increased (P<0.05) from the initial value in all the dietary treatments. *Oreochromis niloticus* fingerlings fed on Diet 1 had significant (P<0.05) highest weight gain while Diet 5 had the significant (P<0.05) poorest weight gain. The general trend was that significantly (P<0.05) decreasing growth rate was observed with increasing inclusion level of sweet potato leaf meal in the experimental diets. However, there were no significant differences (p>0.05) in the weight gain of fingerlings fed Diet 1 with those fed on Diets 2, 3 and 4. Fingerlings fed on Diet 5 had significant lower weight gain than the other diets (P<0.05).

IV. DISCUSSION

When alternative sources of feedstuff such as plant protein are used in fish diets, one of the common problems is the acceptability by fish and this has to do with the palatability of the diet (Rodriguez *et al.*, 1996). In the present investigation, all the experimental diets were accepted by *Oreochromis niloticus* fingerlings, indicating that the levels of incorporation of sweet potato leaf meal did not affect the palatability of the diets. This might be due to the processing technique employed in this study. The air drying and the grinding techniques might have reduced the anti-nutrient in the sweet potato leaf meal thereby increasing its palatability in *Oreochromis niloticus*. This observation is in support of the work of Siddhuraju and Becker (2003), Francis *et al.* (2001) and Fagbenro (1999). These workers reported that reduction in anti-nutrient by different processing techniques resulted in better palatability and growth in fish. The potentials of a feedstuff such as leaf meal in fish diets can be evaluated on the basis of its proximate chemical composition, which comprises the moisture content, crude protein, crude fibre, crude lipid, total ash and nitrogen-free extract. The proximate composition of sweet potato leaf meal in the present investigation revealed that the crude protein content was 30.00%, crude fibre 9.18% and ash 13.21%. These values were higher than the values reported by Woolfe (1992) and An (2004) for sweet potato leaf meal. These differences might be due to different environmental conditions such as soil type, harvesting time, local varieties and processing methods.

Although the nutritional quality of sweet potato leaf meal as determined by Tilapia body weight gain, specific growth rate, food conversion ratio and protein efficiency ratio were higher in fish fed the control diet (0% leaf meal) no significant (p>0.05) differences were observed in other experimental diets containing leaf meal up to 15% level. In this present investigation, inclusion of sweet potato leaf meal at 20% level reduced the growth rate and feed utilization of *Oreochromis niloticus* fingerlings.

The body moisture and crude protein content were similar in all the experimental groups, but there were reductions in the body lipid of fish fed on sweet potato leaf meal. The reason here might be due to the reduction of the level of fishmeal lipid as the level of sweet potato leaf meal increased in the diets. This is in agreement with the results of Siddhuraju and Becker (2001) and Afuang *et al*. (2003) who observed similar reductions in body lipid of fish fed on diets containing plant-based proteins. Ritcher *et al*. (2003) reported that Moringa oleifera leaf meal could replace 10% fish meal based dietary protein for Tilapia without causing any adverse effect on fish growth. However, Afuang *et al*. (2003) reported that solvent extracted moringa leaf meal could replace 30% of fish meal from Oreochromis niloticus diets. These various workers have shown that leaf meal protein at low levels of inclusion (less than 50%) in fish diets were able to support growth, therefore, supporting the results of this study. Base on the haematological parameter assessed in this study the inclusion of potato leaf meal up to 20% could be recommended in the diet of *oreochromis niloticus* fingerlings, since this inclusion level did not exhibit any negative effect on the fish health and all the values are within the reference values.

V. CONCLUSION

In conclusion, the results of this study show that sweet potato leaf meal could be included up to 15% level in diets of

Oreochromis niloticus without any negative effects on the growth and feed efficiency. Furthermore, sweet potato leaves are locally available in the tropics and can be obtained throughout the year.

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