ASSET Series A (2007) 7 (1): 160-166

ASSET
An International Journal

GROWTH RESPONSE, NUTRIENT UTILIZATION AND SURVIVAL OF NILE TILAPIA (*Oreochromis niloticus*) FED VARYING LEVELS OF CHAYA LEAF (*Cnidoscolus Chayamansa*) MEAL

OBASA S.O, FEMI, O. ADEOSUN, F.I. AND ODULATE, D.O.

Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta, Nigeria.

ABSTRACT

A feeding trial was designed and carried out to assess the growth response, nutrient utilization and survival of *Oreochromis niloticus* fed graded levels of Chaya leaf meal based diets. Two hundred and seventy (270) fingerlings of *O. niloticus* of average weight of 3.75 ± 0.14g were fed with six iso-nitrogenous diets containing 35% crude protein. The Chaya leaf meal (CLM) protein replaced soybean meal in the diets in the following proportions: Diet 1 (0% CLM), Diet II (20%CLM), Diet III (40% CLM), Diet IV (60% CLM), Diet V (80% CLM) and Diet VI (100%CLM). At the end of the trial, the mean weight gain of fish was highest in diet 1 with a value of 5.07g and lowest in diet VI with a value of 3.29g. There was no significant difference (P>0.05) in the mean weight gain (MWG) of fish fed diet 1 and fish fed diet II. Feed conversion ratio (FCR) was best in fish fed diet II (2.44) but not significantly different (P>0.05) from fish fed diet I (2.50). The highest specific growth rate (SGR) of 0.66%/day in fish fed diet I was significantly higher (P<0.05) than others except fish fed diet II with a value of 0.61%/day. The highest protein efficiency ratio (PER) was obtained for fish fed diet I with a value 0.98 while the lowest value was obtained for fish in diet VI with a value of 0.74. There was no significant difference (P>0.05) in MWG, FCR, SGR and PER between fish fed diet I and II. The highest net protein utilization (NPU) recorded was also significantly higher (P<0.05) in diet I which was 51.40% while the lowest value of 13.13% was recorded in diet VI which was 13.13%. Percentage survival was highest (100%) in fish fed diets V and VI, while fish fed diets I and II recorded 90% each. It was however observed that chaya leaf meal protein can favourably replace 20% of soybean meal protein in the diets of Nile tilapia, *O. niloticus.*

Keywords: Chaya leaf meal, Growth response, Nutrient utilization, Survival.

INTRODUCTION

One major constraint to achieving increased pond fish production in many developing countries of the world is the scarcity of cheap but balanced fish diets. This problem is further compounded by the soaring cost of some important ingredients like fishmeal and soybean which are in short supply, hence, the need for considering alternative cheap and affordable fish feedstuffs.

Of all the plant protein feed ingredients, soybean (*Glycine max*) is considered to be the most nutritious and it is used as a major protein source in most fish diets (Lovell 1988). However, the cost of soybean meal keeps increasing due to high demand both as food for humans as well as raw materials in livestock feed industry.

Several studies have been conducted to substitute fishmeal protein either wholly or partially with plant proteins in fish feeds (Carlos *et al.*, 1988, Balogun and Ologhobo 1989, Adeparusi, 1992; Webster *et al.,* 1995) while such that substituted the expensive soybean meal with some other less expensive plant protein sources are few (Fasakin and Balogun ,1998 and Obasa *et al.,* 2003).

Chaya (*Cnidoscolus)* is an ancient vegetable from Yucatan Peninsula of Mexico. It was introduced into Florida, USA where it became established as a rank shrub (Mc Vaughn, 1914). Under favourable condition, Chaya is a large shrub or small tree from 2-3 metres and at most reaching 5 metres in height. Basically, Chaya exists as two different species: *Cnidoscolus aconitifolis* and *Cnidoscolus Chayamansa.* They are closely related to jatropha. *C. Chayamansa* is the widely cultivated species while the other *C. aconitifolis* often grows as a wild variety. The Chaya plant is propagated by stem cutting. If well taken care of, almost all chaya cuttings will produce root. The cuttings can be established directly at the site where they are expected to grow. The soil should also be well drained and not too wet during early period of propagation (Martin and Ruberts,1973).

C. chayamansa leave has a high concentration of protein and balanced essential amino acids and similar to the body protein requirement of non-ruminants. (Donkoh *et al*.,1998), however, it contains large amount of hydrocyanic acid. The concentration of this acid is more in leaves, intermediate in the petioles and less at the tip of the stem. The hydrocyanic is heat labile and can be removed by heat between 50^o and 75^o C. It is also water soluble. On the above background this work was carried out, accessing the growth response, nutrient utilization and survival of *O. niloticus* fed varying levels of Chaya leaf meal based diets.

MATERIALS AND METHODS

Two hundred and seventy (270) fingerlings of *O. niloticus* of 3.75 ± 0.14g average weight were collected from a commercial fish farm in Ogun State, Nigeria. The fish were acclimatized for one week and starved for 24 hours before being placed on experimental diets. Eighteen (18) net hapa (1m×1m×1m) were set in a concrete tank (10m × 5m × 1.3m) at the Experimental Farm of the Department of Aquaculture and Fisheries Management, University of Agriculture, Abeokuta, Nigeria. Fish were distributed randomly at the stocking rate of 15 fish per hapa in triplicate per treatment. Water supply was from the University's water system, passed through pipes into the concrete tanks. Six iso-nitrogenous artificial diets containing 35% crude protein in which the soybean meal protein was replaced with boiled (at 100^o C) and sun-dried chaya leaf meal protein at 0, 20, 40, 60, 80 and 100% levels were formulated and compounded. The diets were fed to fish in triplicate treatments. Fish were fed twice daily at 5% body weight between the hours of 8:00 and 9:00 and 14:00 – 16:00 Hrs.

Fish were batched weighed weekly with a weighing balance (Metller 601 BD) and rations were adjusted accordingly. The pH was monitored with the pH meter (E520) Metrolin model, the dissolved oxygen (DO) was monitored by using the oxygen meter (JENWAY 1971) while the water

temperature was measured with mercury-in-glass thermometer.

Proximate analysis of triplicate samples of ingredients, diets and fish were carried out using the methods described by AOAC (1990). A sample of 10 fish of the initial stock as well as 5 samples of live fish from each treatment were removed and sacrificed at the expiration of the experiment for carcass analysis. Moisture was determined by oven drying at 85^{o}C to constant weight in a LEEC cabinet oven. Micro-Kjeldahl method was used to determine the level of crude protein (N x 6.25), crude lipid was determined by extraction with N-Hexane (60-80^{o}C) for 6 hours in a Soxhlet apparatus. Acid-base digestion was used to determine crude fibre cntent while ash was determined with a Gallenkamp (size 3) muffle furnace. Diet performance was evaluated on experimental fish according to Olivera- Nova *et al.* (1990). Data obtained were subjected to statistical analysis of variance (ANOVA) and correlation analysis system programme (SAS 1980).

RESULTS

The proximate composition of experimental diets (Table 2) showed that crude protein contents are between 34.45% in diet 6 and 34.68% in diet 2. Fat and ash contents increased as the Chaya leaf meal increased while the moisture did not assume any particular order. Carcass composition of *O. niloticus* before and after the growth trial (Table2) showed decrease in carcass proteins as the Chaya leaf meal increased while the carcass fat increased as the Chaya leaf meal increased.

Table 3 also shows the mean growth response, feed utilization and survival of Nile tilapia fed on experimental diets recorded throughout the eight weeks experimental period. The fish fed readily in all the treatments. Fish fed diets containing high levels of Chaya leaf meal exhibited reduction in feed consumption rate. Likewise, mean weight gain (MWG), feed conversion ratio (FCR) and specific growth rate (SGR) also showed gradual decrease as chaya leaf meal inclusion level increased. The highest specific growth rate with significant difference ($p< 0.05$) was recorded in fish fed diet 1 (0% chaya leaf meal) with the exception of fish fed diet II (20% Chaya leaf meal diet) ($p> 0.05$).

The nutrient utilization parameters such as the protein efficiency ratio (PER) and the apparent net protein utilization (App-NPU) also decreased as the Chaya leaf meal increased in diets but there was no significant difference ($p> 0.05$) between fish fed control diet 1 (0% Chaya leaf meal) and fish fed diet III (40% Chaya leaf meal). Percentage survival was highest in fish fed diets V and VI with the value of 100% while incidentally, fish fed diets I and II had lowest. Water physico-chemical parameters indicated that pH ranged from 6.11-6.23, dissolved oxygen (DO) between 5.50-6.60 mg/l and temperature, ranged between 25.6-26.7^{o} C.

DISCUSSION

This trial revealed that the growth and nutrient utilization of *O. niloticus* were influenced by levels of chaya leaf meal inclusion in diets. Diets were accepted by the fish during the first week of the experiment. This later decreased with increasing inclusion levels of chaya leaf meal with time. Diet 1 was most preferred and which

translated into superior growth performance and diet utilization (table 2). This result is not surprising since soy bean meal was described as a protein source with high nutritional value (Fagbenro and Davies 2001). Also, water quality parameters were all within tolerant range recommended for fresh water fish culture (Omoregie *et al.*, 1991). The significant difference ($p<0.05$) in the growth response and nutrient utilization within the replacement levels was probably an indication that those parameters were mainly influenced by the different replacement levels of soybean meal by chaya leaf meal. Also, the statistically significant depression ($p<0.05$) in final body weight of fish fed diet with higher chaya leaf meal inclusion levels could have resulted from reduced feed intake and also declined dietary protein quality of the diets. Similar results were observed by Appler and Jauncey (1993), Wee and Wang (1987) when Nile tilapia was fed high levels of plant protein sources. Also, Ipinjolu *et al.* (1989), feeding common carp *(Cyprinus carpio)* with palm kernel based diets and Carl *et al.* (1995), using soybean meal to partially replace fish meal in the diets for blue catfish (*Ictalurus furcatus).* Likewise, Absalom *et al*. (1999), recorded similar results while feeding the Nile tilapia with kidney bean meal and also Obasa *et al.* (2004) when soybean meal was replaced with mucuna seed meal in the diets of Nile tilapia *(Oreochromis niloticus).* Similar result was also recorded by Alegbeleye *et al.* (2004) while replacing groundnut cake with rubber seed cake in the diets for Nile tilapia. Proximate analysis of the fish tissue revealed no evidence of sharp decline in protein or excessive fat deposition in fish fed diets with high chaya leaf meal inclusion.

The high percentage survival, observed in fish fed diets with high level of chaya leaf meal may not mean that those diets were better than the lower inclusion levels as the mortality observed in these diets could be due to stress during stocking as they occurred in the first few days of the trial. This observation is consistent with Webster (1995) substituting fish meal with increasing levels of soybean meal in the diets for blue catfish *Ictalurus furcatatus* and found no significant differences in survival even when the soybean replaced all of the fish meal. Chaya leaf meal can therefore, favourably replace up to 20% of soybean meal in the diet of Nile tilapia, *O. niloticus.*

Table 1: Proximate composition of feed ingredients (Dry matter %)

Traits	Chaya leave meal	Soybean meal	Yellow maize	Groundnut cake	Fish meal
Crude protein	26.18	44.08	11.10	36.52	72.00
Moisture	11.43	5.66	11.00	7.08	8.00
Ether extract	3.70	19.10	4.40	8.80	8.00
Crude fibre	8.19	5.71	6.30	7.08	1.10
Ash	11.69	10.77	1.40	13.08	10.50
Nitrogen- free extract	43.91	26.05	65.70	30.21	10.40

Table 2. Ingredient composition of test diets fed to *O. niloticus* fingerlings (g/100g)

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6
Chaya leaf meal	0.00	8.70	18.38	29.20	41.39	55.20
Soybean	41.33	34.88	27.57	19.47	10.35	0.00
Yellow maize	27.55	24.27	20.62	16.54	11.95	6.75
Fish meal	20.67	21.76	22.98	24.34	25.87	27.60
Wheat offal	4.00	4.00	4.00	4.00	4.00	4.00
Vegetable Oil	2.00	2.00	2.00	2.00	2.00	2.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50
Oyster shell	0.50	0.50	0.50	0.50	0.50	0.50
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
*Vitamin Premix	1.00	1.00	1.00	1.00	1.00	1.00
Salt (NaCl)	0.25	0.25	0.25	0.25	0.25	0.25
Analyzed:						
% Crude protein	34.59	34.68	34.51	34.51	34.50	34.45
%fat	7.06	5.68	6.47	6.45	6.34	5.35
% crude fibre	5.12	6.32	7.12	7.35	7.71	8.21
% Ash	9.40	7.59	8.80	10.27	11.02	11.25
% moisture	13.36	12.69	13.13	12.78	14.22	13.49
Nitrogen free extract	32.18	33.04	29.97	30.64	26.91	27.54

RADAR VIT. PREMIX supplies per 100g diet. Palmitate (A) 10001U; Cholesterol (D) 10001U acetate (E) 1.1 mg;
Menadione (K) 0.2mg; Thiamine (B1) 0.63mg;Riboflavin (B2) 0.5mg; Panthothetic acid, 0.9mg; Pyridoxine (B6) 0.15mg; Cyanocobalamine (B12), 0.001mg: Nicotinic acid 3.0mg; Folic acid 0.1mg; Choline 31.3mg; Ascorbic acid (C), 2.5mg; Fe, 0.05mg; Cu 0.25mg; Mn 6.00mg; Co, 0.5mg; Zn, 5.0mg; I,0.2mg; S, 0.02mg.

Table 3. Growth Response Nutrient Utilization and survival of *O. niloticus* fed varying levels of chaya leaf meal based diets

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	SEM*
Initial mean weight (g)	3.74	3.79	3.78	3.80	3.79	3.77	0.01
Final mean weight (g)	8.81^{a}	8.34^{a}	8.11^{ab}	7.87^{c}	7.49^{d}	7.06^{e}	0.25
Mean weight gain (g)	5.07^{a}	4.55^{a}	4.33^{ab}	4.07^{b}	3.70^{c}	3.29^{cd}	0.26
Feed intake (g)	12.67	11.08	11.82	11.64	11.31	10.83	0.27
Feed conversion ratio	2.50^{c}	2.44^{c}	2.73^{bc}	2.86^{b}	3.06^{a}	3.29^{a}	0.13
Specific growth rate (%/day)	0.66^{a}	0.61^{ab}	0.59^{b}	0.56^{c}	0.53^{cd}	0.49^{d}	0.02
Protein efficiency ratio	0.98^{a}	0.93^{ab}	0.90^{b}	0.86^{b}	0.80^{c}	0.74^{d}	0.04
Net protein utilization (%)	51.40^{a}	44.65^{b}	38.75^{c}	32.00^{d}	20.06^{e}	13.13^{f}	5.97
Survival rate (%)	90^{ab}	90^{ab}	95^{a}	95^{a}	100^{a}	100^{a}	1.83
Carcass: Initial							
Moisture (%) 9.6510.22		9.88	9.79	9.66	9.14	8.78	0.18
Crude protein (%) 56.8770.53		70.03	68.97	68.47	62.56	58.68	2.16
Fat (%) 10.568.21		8.52	8.99	9.31	9.72	10.01	0.31

Values with common superscripts in horizontal rows are not significantly different ($p > 0.01$).
* Standard error of the mean.

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