DIGESTIBILITY AND NUTRIENT UTILIZATION OF SOYBEAN MILK CONCENTRATE BASED DIETS IN OREOCHROMIS NILOTICUS

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ABSTRACT

The digestibility and utilisation of two fresh soybean milk concentrate based diets, two stale soybean milk concentrate based diets and two Fishman based diets serving as control, at optimal (30%) and suboptimal (20%) protein levels were evaluated. They were Diet I (Control) - fishmeal based diet at 30% crude protein Diet II (Control) Fishman based diet at 20% crude protein, Diet III - fresh soybean milk concentrate rased diet at 30% crude protein, Diet IV - fresh soybean milk concentrate based diet at 20%. Diet V- stale soybean milk concentrate based diet at 30%crude protein, Diet VI-stale soybean milk concentrate based diet at 20% Dry matter digestibility differed insignificantly with variation in diets (P:0.05). There was significant variation in the protein, lipid and ash digestibility. Protein was more digestible at optimum than sub optimum level. Ash digestibility was lowest of all the nutrients. Variations in the utilisation of the diets in terms of weight gain, specific growth rate, food conversion ration, protein efficiency ration and apparent netprotein utilization were insignificant (P: 0.05). All diets compared favourably with the standard control diet - Diet I. This suggests the suitability of SBMC utilisation as protein supplements in the diets of late fry O. Niloticus.

Indexing Keywords: Digestibility, nutrient utilisation, Soybean Slurry Residue, Diets, Oreochromis Niloticus.

INTRODUCTION

Soybean (Glycine max) is the most valuable oil seed legume with starling nutritional qualities and now internationally acclaimed as the miracle crop, the cow of China, the Cinderella crop of the West and the Pearls of the Orient (Osho, 1991) It has high utilisation potential in human, animal and fish nutrition.

Soybean meal constitutes 50% of the diet of channel catfish in the United States - as replacer of fishmeal (Mohsen and Lovell, 1993) Utilisation of soybean fractions such as soybean bran, milk and milk products are feed in aquaculture has been an age long practice in Asia. Chen and Yi (1991) successfully utilised unicellular algae and soybean milk in the rearing of zoaea larvae of Paenaeus penicillatus. The larvae of Mytilus edulis were reared on four species of unicellular algae. They started ingesting these food materials when they still had some yolk in the body (Nie and Ji, 1980). In Africa, soybean fractions production and utilisation have been popuparised through soybean production and utilisation projects of the international institute of tropical Agriculture (IITA, 1990) to address the problem of human malnutrition in Africa. Several whole and fraction soybean products are now common household dietary sources in Nigeria. Extension services on the utilisation of soybean to other West African countries of Ghana and Cote d''Ivoire were expedited (Okoruwa and Dashiell 1997).

Ironically, most of these fractions of great nutritional potential are highly perishable materials and are therefore potential sources of wastes into the environment. A planned industrial scale production of these fractions should be backed up with a well planned waste management strategy, particularly in the Third world Countries with inadequate preservation and processing technologies. Bio-transformation of these materials into first class animal protein when fed as feed to fish appears to be a very effective biological method of management that converts wastes into wealth.

One of such wastes is the soybean milk concentrate resulting from fractionating soybean in the course of soyamilk production. This investigation is aimed at studying the suitability of soybean milk concentrate in the diets of late fry of Oreochromis niloticus in its fresh and stale state as protein supplements. In its stale form, it has undergone partial hydrolysis microbiologically. The use of animal wastes hydrolysate have been reported. Hardy (1991) investigated the suitability of fish hydrolysate utilization in the diets of Onycorhychus my kiss and observed that partially hydrolysed fish silage was better than fully hydrolysed fish silage. utilisation of plant wastes in fish diet has been rarely reported. It is in this vein that the fresh and partially hydrolysed SBMC were incorporated into the fish feed.

MATERIALS AND METHODS

The standard methods of the International Institute of Tropical Agriculture (IITA) was employed to produce the soybean milk. Further concentration of the milk was effected using calcium hydrogen sulphate (IITA, 1990). SBMC was divided into two equal parts. One half was oven dried at 80°C afterwards to arrest further action of microbes. This was tagged stale soybean milk concentrate (SBMC-S). These products were then incorporated into the tilapia grower diets. Six isocaloric (4.0 Kcal/g) diets at suboptimal and optimal protein levels of 20% and 30% containing SBMC-F and SBMC-S were prepared, with fish meal based diets serving as control (Table 1) 3mm pellets were prepared using a modified Bohr mill with a mounted pelleting die. They were subsequently solar-dried and kept in a dry place at room temperature. Pellets for dispensation to fish were further micronised into crumb acceptable to the late fry.

The feeding trial experiment was a completely randomised block designee with six diets in duplicate. late fry of O.niloticus were stocked at 10 per 20L tank in 12 tanks in a recirculatory system at an average weight of 0.24g. They were fed at 5% body weight twice daily for 8 weeks. Wastes accumulating from the system were siphoned twice in a week. Water quality parameters were monitored at pH, 6-7; temperature, 30-35°C; DO, 5-6.0 mg. I; NH_3-N, 0.5-1.0; NO_3-N, 10-20 and NO_2-N, 0.4mg/l. Water flow rate was maintained at 1L/min.

Chemical analysis of the feedstuffs, diets and carcass (initial and final) were performed according to A.O.A.C. (1990). 10 specimens of late fry O. Niloticus were taken for initial carcass analysis while 5 from each tank for final carcass analysis. Acid insoluble ash was measured as inert material in the diets and faecal matter according to (Cockerell *et al*, 1987). Water quality parameter were analysed according to APHA(1980).
Biological parameters monitored were specific growth rate (SGR), food conversion ration (FCR) protein efficiency ratio (PER) apparent net protein utilization (ANPU) and survival (S) (Steffens, 1989) Gross energy was calculated by using the following multiplier factors; carbohydrate, 4.1kcal/g; protein, 5.4 kcal.g and lipid, 9.5 kcal./g (Jobling, (983) Digestibility was determined by the substitution of percentages of acid insoluble ash as nutrient in faeces and diets into the apparent digestibility coefficient equation of Maynard *et al* (1979).

Analysis of variance was used to evaluate variability in the utilisation of the four diets as treatments. Multiple range analysis was used to compare means of the utilisation parameters according to Turkey (Steele and Torries, 1960). Percentage, version 3.0 was used for the statistical analysis while cricket graph package, version 1.3.1 was used for the presentation of the fish growth response to the diets.

RESULTS AND DISCUSSION

Digestibility of Diets

Table 2 shows that there was insignificant variation in the dry matter digestibility of the diets (P:0.05). Protein, lipped and ash digestibility values varied significantly with the diets (P:0.05). On the whole, the highest digestibility values were observed in diet III containing SBMC-F. Lipid had a lower digestibility values than protein in all the diets. This negates the record of higher lipid digestibility in Tilapia that was attributed to high Lepas activity (Sargent et al. 1989). Ash digestibility was lowest in Diets I, IV and V (Table 3). Acid digestion of ash have been reported in fish except stomach less one. Lovell (1991) reported fish which do not have acidic stomach do not utilise mineral sources of low solubility and conversely. Digestibility of ash expected to be high in tilapia was generally low. This could be due to mineral composition of the feed being of low solubility and the physiological state of the fish as latfry.

Utilisation of Soybean Milk Concentrate (SBMC) Based diets in O. Niloticus.

Six SBMC diets (Diets I-VI) were fed to late fry of O.niloticus with an average weight of 0.25g for a period of eight weeks at 5% body weight per day (Table 1) All the parameters measured varied insignificantly with the diets (Table 3) depicting equal nutrient utilisation amongst the six diets including the control. The insignificant variation in the MFW, SGE, FCR, PER and Anpu depicts a favourable comparison of the SBMC based diets and Diet I. Fig 1 shows the growth response of O.niloticus to the diets. Growth was highly exponential from the beginning till week 4 when it goes into the Plateau phase in line with the growth pattern of fish (Huxley, 1932). The growth rate and percentage survival of O.niloticus fed these SBSR based diets were above 85% of the control diet. A good experimental diet is that diet that gives at least 85% growth and survival rate of an acceptable standard - the fish meal based control diet (Akiyama, 1991). These are attestations to their suitability for inclusion in the diets of O. niloticus - late fry, as protein supplements.

Carcass Composition of O.niloticus fed Soybean Milk (SBMC) Based Diets

Carcass analysis showed no significant variation in the carcass composition of O. niloticus fed SBMC based diets and when compared with the control diet - FM based diets (P:0.05 except for ash where fishes fed Diet III had the highest ash and the least carcass ash was in fishes fed Diet I. Lack of variation in carcass lipid depicts no relationship between moisture and lipid and this negates the already established inverse relationship between carcass moisture and lipid in fish (Vlieg. 1985) It could therefore be said that the SBMC inclusion had altered this balance. Similarly the lack of variation in carcass protein with the diets negates the postulation that a direct relationship exists between amino acid profile in the diet and the carcass, and consequently their protein (Janucey *et al.* 1984) This could be due to the difference in the metabolic pathway of nutrients and the physiological state of the fish.

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Table 1: Level of Inclusion of ingredients in Soybean Milk Concentrate (SBMC) Based Diets and their Proximate Composition

	Diets					
Ingredients	I	II	III	IV	V	VI
SBMC-F	-	-	33.52	18.03	-	-
SBMC-S	-	-	-	-	34.15	18.07
FM	51.22	36.33	33.52	18.03	34.15	18.07
MM	43.78	58.48	27.97	58.93	13.51	58.85
*V/M Premix	5.00	5.00	5.00	5.00	5.00	5.00
% Proximate Composition						
Moisture	8.48	8.75	9.50	9.50	9.21	10.04
Protein	28.50	22.62	28.50	19.18	27.34	19.00
Lipid	9.8	8.37	9.78	7.45	14.34	10.17
Ash	17.00	14.60	13.83	11.50	13.74	11.69
Energy(kcal/g)	3.96	3.89	4.04	4.02	4.28	4.01

* Vitamin-mineral/kg premix: Vit. A, 4 000 000 I.U; Vit. D3 800 00 I.U; Vit. E, 10 000mg; Vit. B1, 800mg; Vit. B2, 2 00mg; Vit B6, 1200mg; Calcium D-pantotenate, 4 000mg; Vit. H, 20mg; Vit. K3

Table 2: Digestibility of Soybean Milk Concentrate (SBMC) Based Diets in Late Fry O. Niloticus

	Diets					
ADC(%)	I	II	III	IV	V	VI
Dry Matter	96.60a	97.69a	97.86a	97.98a	97.32a	97.66a
Protein	70.24b	51.36a	70.24c	63.55b	70.19c	63.55b
Lipid	51.11a	62.71b	62,71b	55.75ab	62.71b	55.75ab
Ash	12.68a	27.87b	34.84c	12.68a	12.68a	27,87b

Data on the same row carrying the same letter differ insignificantly from each other(P>0.05).

Table 3: Utilisation of Soybean Milk Consent rate 9SBMC) Based Diets by Late fry O. niloticus

	Diets					
Parameter	I	II	III	IV	V	VI
MIW(g)	0.21a	0.23a	0.25a	0.24a	0.28a	0.26a
MFW(g)	0.79a	0.51a	0.62a	0.62a	0.78a	0.55a
SGR (% Day)	2.08a	1.74a	1.66a	1.30a	1.43a	1.36a
FCR	0.30a	0.32a	0.26a	0.28a	0.25aa	0.28a
PER	12.59a	13.45a	13.66a	14.93a	14.21a	13.76a
ANPU(%)	357.69	217.50	241.81a	248.81a	190.00a	208.04a
SURV(%)	80a	80a	85.00a	75a	90.00a	80a

Date on the same row carrying different letters differ significantly from each other(P>0.05).

Table 4: Carcass Composition of Late fry O. niloticus fed Soybean Milk Concentrate (SBME) Based Diets

	Diets					
Proximate Composition	I	II	III	IV	V	VI
Moisture	51.84a	60.39a	49.79a	46.79a	46.33a	3.20a
Protein	15.54a	14.79a	16.37a	15.44a	13.22a	11.80a
Lipid	7.10a	6.98a	7.64a	10.06a	6.71a	7.40
Ash	5.33a	5.81ab	9.55b	6.03ab	6.30ab	7.40ab

Date on the same row carrying different letters differ significantly from each other(P>0.05).

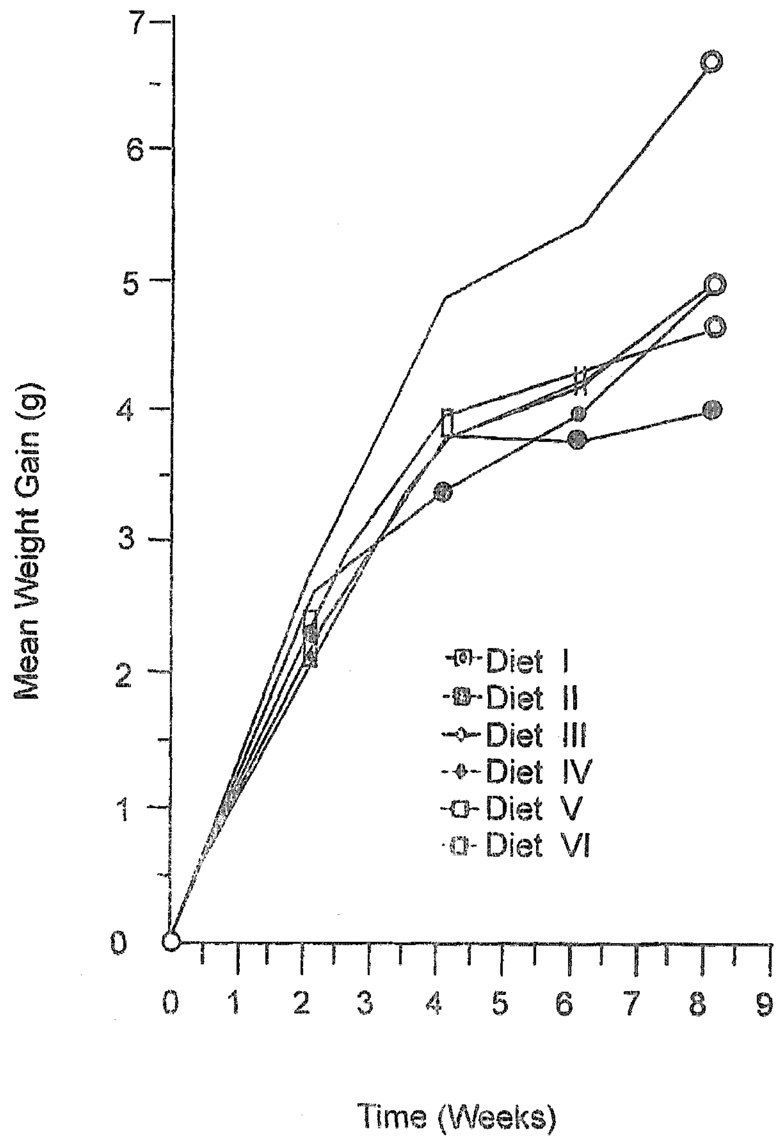

Fig. 1: Growth response of 0.niloticus fed soybean protein concentrate based diets for eight weeks