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GROWTH RESPONSE OF *HETEROBRANCHUS LONGIFILIS* FINGERLINGS TO *MUCUNA PRURIENS* SEED MEAL BASED DIETS

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ABSTRACT
Laboratory studies on the growth responses of Heterobranchus longifilis fingerlings, mean weight 3.21 ± 0.37g to Mucuna pruriens seed meals based diets were conducted for 70 days at the Federal College of Agriculture, Ishiagu in Ebonyi State, Nigeria. Mucuna pruriens seed meals were processed as either boiled or toasted and included at 0%, 6%, 12%, 18% and 24% in place of soybean in the entire diets. The experimental design was Randomized Complete Block Design (RCBD) with two processing methods of Mucuna seed meals (MSM) at five levels of inclusion, each with ten fingerlings replicated thrice and diets were fed at 5% fish body weight. The effects of processed MSM on Heterobranchus longifilis fingerlings (cumulative weight gain) were significant (P<0.05) from 4th to 8th week with boiled Mucuna seed meal (BMSM) being better than toasted Mucuna seed meal (TMSM) but did not differ significantly (P>0.05). Growth generally decreased with increase in MSM in the diets. However, Heterobranchus longifilis fingerlings fed 24% TMSM (zero soybean) recorded mean weight gain/day (MWG/D) of 0.170 ± 0.16g as against the control 0.197 ± 0.25g; specific growth rate (SGR) 2.07 ± 0.11against 2.31 ± 0.09; protein efficient ratio (PER) 1.11 ± 0.08 against 1.18 ± 0.15; crude protein of 59.46 ± 0.83% against 61.89 ± 1.9% ; increased FCR of 2.31 ± 0.17 against 2.03 ± 0.06 ; and percentage mortality of 23.3 ± 20.8% against 10.0 ± 10%. The inclusion of 12% processed boiled Mucuna seed meal is therefore recommended for partial replacement of soybean meal to reduce the cost of fish production without adverse affect.

Key words: *Mucuna* seeds, protein source, processed, *Heterobranchus longifilis*, growth.

INTRODUCTION
Aquaculture in Nigeria covers an estimated 60,000 hectares and produces some 25,000 to 30,000 metric tons (mt) of fish per year. Nigeria, according to Food and Agricultural Organization, FAO (2002) is a protein deficient country thus making fish production viable means of meeting this deficiency. According to estimates, Nigeria requires about 2.1 million metric tons (mt) of fish/year but only produces 0.65 mt which is far less than the FAOs recommended minimum fish consumption rate of 12.5 kilograms per head yearly, to satisfy basic protein need. Fish feed is responsible for 60-80% of production cost in aquaculture industry (New, 1993; Eyo, 2001). The high cost of fish feed has led to food insecurity to most Nigerians due to low income. Since diets generally represent the largest single cost item of most fish farm operations, it follows that the selection of feed ingredients for use within diets will play a major role in dictating the ultimate nutritional and economic success for farmed fish. Fish meal which serves as the main protein source for fish feeds due to its high quality protein is very expensive and usually unavailable particularly in developing countries (Tacon and Barg, 1998). Efforts to replace soybean with plant protein have been researched upon by various workers (Fagbenro and Davies, 2001; Fagbenro and Davies, 2003; Ogunji and Wirth, 2001; Osuigwe *et al*, 2002,).

Mucuna, a tropical legume is widely cultivated as cover crop and the seeds which have relatively high protein content is hardly consumed by man. *Mucuna pruriens* commonly known as velvet beans contain high amount of carbohydrate and rich source of macro- and micro – elements. The plant is used as food and herbal medicine (Siddhuraju *et al*., 1996). The presence of prurienine, and prurienidine

compounds in the seeds has been reported (Ahmad *et al*., 2008). The nutritive value of *M. pruriens* seeds is similar to the highly priced soybean. It compares well with other legume crops such as jack bean (*Canavalia ensiformis*), yam bean (*Sphenostylis stenocapa*), kidney bean (*Phaseolus lunatus*), pigeon pea (*Cajanus cajan*), and bambara nut (*Voandzeia subterranean*), (Ologhobo, 1992; Ukachukwu and Obioha, 1997). However despite its nutritional advantages, *Mucuna* contains numerous ant-nutritional factors: tannins, lectins, phytic acid, cyanogens, trypsin inhibitors and 3-4 dihydroxyl-L-phenylalanine (L-Dopa) which is prominent among these factors (Ravindran and Ravindran, 1988; Siddhuraju *et al*, 2000). The effects of these anti-nutritional factors include dizziness, diarrhoea, pathologic changes in organs, growth decrease and death (Ene-Obong and Carnovale, 1992).Bressani (1993) reported inhibition of protein and carbohydrate digestibility, inhibition of a number of enzymes and nutrients, making them unavailable. Osuigwe and Ojike (1999) observed inverse performance with increase levels of raw *Mucuna* seed meal fed to *Oreochromis niloticus* fingerlings. Siddhuraju and Becker, (2001) reported that fish (*Cyprinus carpio*) fed higher levels (>13%) of raw *Mucuna* seed meal had significantly higher carcass moisture, lower levels of crude protein and lipid contents.

Previous studies showed however that heat treatment could drastically reduce the toxicity of *Mucuna pruriens* seeds (Ukachukwu and Szabo, 2003; Nyirenda *et al*, 2003). This work is an effort to evaluate the effect of processing methods of *Mucuna pruriens* seed meal and its utilization as an alternative feedstuff to soybean in the growth of *Heterobranchus longifilis,* a commonly cultured catfish in Nigeria.

MATERIALS AND METHODS

Dried mature seeds of *Mucuna pruriens* var *cochinchiensis* were obtained from the National Root crops Research Institute (NRCRI), Umudike farm. The seeds were divided into two groups. One group of 10kg of *Mucuna* seeds was subjected to wet boiling for 60 minutes as described by (Egounlety 2002). The boiled meal was thereafter sun dried and ground into powder using electric grinder and stored in an airtight container as Boiled *Mucuna* seed meal (BMSM). Another 10kg *Mucuna* seeds were toasted over fire as toasted *Mucuna* seed meal (TMSM) in a frying pan for 20 minutes until the shiny seed coats became dull. The toasted seeds were also ground into powder as above and stored as Toasted *Mucuna* Seed Meal (TMSM). The processed MSM and other feed ingredients procured from feed store in Umuahia market were ground into fine particles. 40% crude protein diets were formulated with MSM replacing soybean meal (SBM) at 0%, 6%, 12%, 18%, and 24%, the control had no MSM, (Table 1).

Heterobranchus longifilis fingerlings were procured from Okwy Fish Farm, Enugu Ngwo in Enugu State and transported to the Federal College of Agriculture Ishiagu, Ebonyi State where the experiment was carried out using battery operated aerators to supply oxygen in transit. The fingerlings were acclimatized for two weeks in plastic bowls fed with 1.0 mm commercial fish feed and water changed every other day. The experimental design consisted of two processing methods of *Mucuna* seed meals (MSM) and five levels of inclusion in the diets in a Randomized Complete Block Design (RCBD) with three replications. Each *Heterobranchus longifilis* fingerlings were procured from Okwy Fish Farm, Enugu Ngwo in Enugu State and transported to the Federal College of Agriculture Ishiagu, Ebonyi State where the experiment was carried out using battery operated aerators to supply oxygen in transit.

Table 1: Composition of Experimental Diets

	Control	Toasted *Mucuna* Seed Meal				Boiled *Mucuna* Seed Meal			
Ingredients	0%	6%	12%	18%	24%	6%	12%	18%	24%
Fish meal	16	16	16	16	16	16	16	16	16
Blood meal	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
Groundnut cake	9	9	9	9	9	9	9	9	9
Soybean meal	24	18	12	6	0	18	12	6	0
Mucuna bean meal	0	6	12	18	24	6	12	18	24
Maize (white)	30	30	30	30	30	30	30	30	30
Vit/Mineral Premix*	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Common salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Bone meal	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100	100	100

*Vit./mineral premix (Agricare-Mix, Pfizer production Plc, Lagos, Nigeria) contained per 1000g: Vitamin A 12,000,000 IU ;Vitamin D_3 2,000,000 IU ; Vitamin E 7,000 IU ; Vitamin B_2 4000mg ; Nicotinic acid 15,000 mg; Calcium d-pentothenate 8,000 mg; Biotin 40 mg; Vitamin B_{12} 10 mg; Mn 20,000mg; Fe 50,000 mg; Zn 100,000 mg; Cu 10,000 mg; Iodine 750 mg; Co 3,000 mg

The fingerlings were acclimatized for two weeks in plastic bowls fed with 1.0 mm commercial fish feed and water changed every other day. The experimental design consisted of two processing methods of *Mucuna* seed meals (MSM) and five levels of inclusion in the diets in a Randomized Complete Block Design (RCBD) with three replications. Each experimental unit consisted of ten *Heterobranchus longifilis* fingerlings (3.21 $\pm$ 0.37g) stocked in circular plastic tanks measuring 22.7cm radius by 33cm depth. Fish were weighed with Ravens court digital Mettler weighing balance weekly and adjustment in feeding made based on the new fish weight at 5% body weight. Fish were fed twice daily; morning and evening and water quality monitored. The experimentation lasted seventy days. The data were analyzed with General Linear Model of SPSS statistics 17.0 package and Tukey HSD used to compare mean.

RESULTS

The growth response of *Heterobranchus longifilis* fish fed boiled and toasted MSM diets for 70 days is shown in fig. 1.

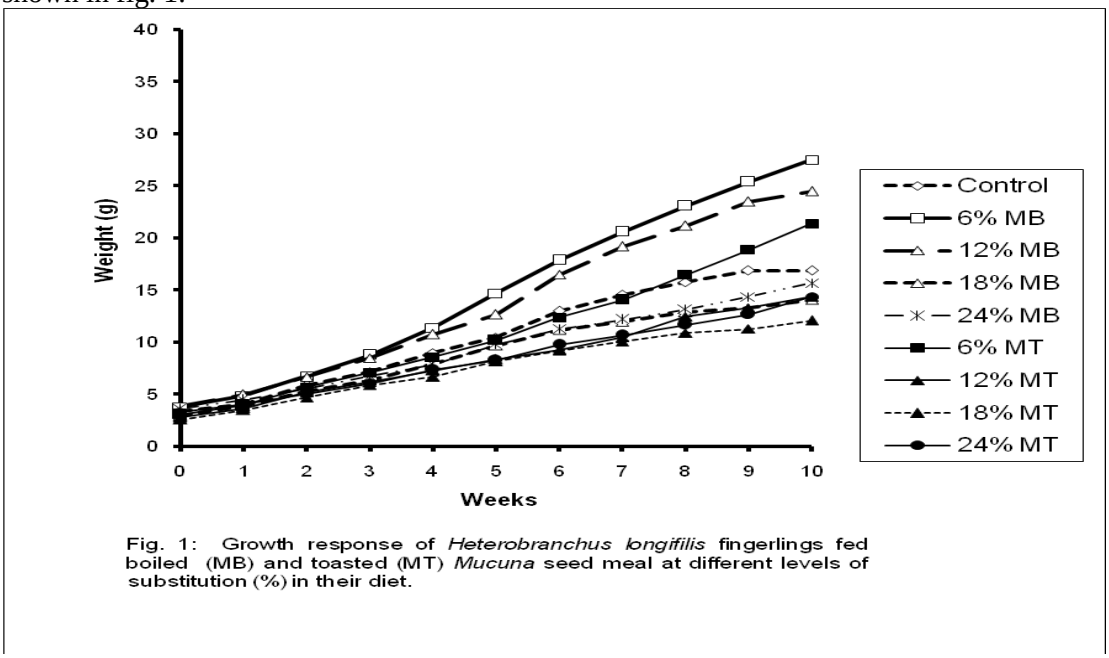

Fig. 1: Growth response of *Heterobranchus longifilis* fingerlings fed boiled (MB) and toasted (MT) *Mucuna* seed meal at different levels of substitution (%) in their diet.

Fingerlings fed with 6% MB diet had the best growth performance and was followed by fish fed 12% MB, 6% MT and control in that order. The response of fish to 18% MT diet was the least in terms of growth. Fish fed 6% BMSM recorded the highest cumulative mean weight increase of 27.5g. This was followed by 12%MB, 6%MT and control diet with 24.5g, 21.4g and 17.5g respectively while the least in growth response was from 18% MT with 12.1g. The result was not significant (P>0.05). The improvement of growth using boiled diets over toasted was 26.23%. There was no significant difference

(P>0.05) on the replacement levels although fish fed 6% had the highest value, while the least was observed in 18% diet.

Table 2 depicts the effects of treatment on MWG/D, FCR, FI, SGR, and mortality on *Heterobranchus longifilis* fingerlings. The results from feed intake (FI) and Specific Growth Rate (SGR) were significant (P<0.05) while those from Feed Conversion ratio (FCR), MEAN Weight Gain/Day (MWG/D) and mortality were not significant (P>0.05). Using Tukey HSD, 6% inclusion level significantly differed from 18% and 24% inclusion levels. However, there was no significant difference in all the parameters between the two processing methods except in the feed intake. The levels of treatments were significant in FCR, MWG, FI and SGR while the processing method x level interaction were not significant (P>0.05)

Table 2: Effects of processing methods and levels of substitution of *Mucuna* seed meal on mean FCR[1], MWG/D[2], FI[3], SGR[4], % Mortality[5] and PER[6] of *Heterobranchus longifilis* fingerlings.

TREATMENTS	FCR[1]	MWG/D[2]	FI[3]	SGR[4]	% Mortality
MB 0%	2.03[a]	0.20[ab]	27.8[a]	2.31[ab]	10.0[a]
MB 6%	1.74[a]	0.34[b]	40.8[a]	2.80[b]	16.7[a]
MB 12%	2.21[a]	0.29[ab]	44.3[a]	2.55[ab]	3.3 [a]
MB 18%	2.16[a]	0.16[a]	23.3[a]	2.20[a]	23.3[a]
MB 24%	2.35[a]	0.17[a]	27.8[a]	2.08[a]	13.3[a]
MT 0%	2.03[a]	0.20[ab]	27.8[a]	2.31[ab]	10.0[a]
MT 6%	1.81[a]	0.26[b]	30.6[a]	2.65[b]	13.3[a]
MT 12%	2.05[a]	0.16[ab]	23.3[a]	2.31[ab]	0.0[a]
MT 18%	2.38[a]	0.13[a]	21.6[a]	2.15[a]	0.0[a]
MT 24%	2.31[a]	0.16[a]	25.0[a]	2.07[a]	23.3[a]

Legend: 1 Feed conversion ratio, 2 Mean weight gain/day, 3 Feed intake, 4 Specific growth rate, MB *Mucuna* boiled, MT *Mucuna* toasted.

Mean with same superscript are not significantly different (P>0.05).

However, the result of the mean weight gain of *Heterobranchus longifilis* fingerlings showed that fish fed boiled diets had 27.3% improvement over toasted diets. Table 3 shows the effect of processing MSM on the proximate composition of *Heterobranchus longifilis* fingerlings. The ash content ranged from 12.11 in 18% TMSM to 9.66 in 12% BMSM while fish fed control diet had 9.99% ash content. However, the result was not significant (P>0.05). The effect of the treatments on the crude fibre content of *Heterobranchus longifilis* fish was significant P<0.05). The crude fibre content of fish fed 12%, 18% and 24% *Mucuna* seed based diets did not differ significantly from each but differed from the control diet effect. The crude protein of the test fish ranged from 62.94% in 6% BMSM to 59.46% in 24% BMSM diet. The result was however not significant.

Table 3: Effects of processing method of *Mucuna* seed meal and substitution levels (%) on ash, crude fibre, crude protein ether extract and Protein efficiency ratio of *Heterobranchus longifilis* fingerlings.

Treatment/Proximate content		Ash	CF[1]	CP[2]	EE[3]	PER[4]
Boiled	0	9.99[a]	1.30[a]	61.89[a]	7.35[a]	1.18[a]
	6	10.14[a]	2.14[ab]	62.94[a]	6.65[a]	1.38[a]
	12	9.62[a]	1.98[b]	62.76[a]	7.49[a]	1.12[a]
	18	11.34[a]	2.00[b]	61.93[a]	7.31[a]	1.12[a]
	24	11.16[a]	2.05[b]	59.46[a]	8.77[a]	1.11[a]
Toasted	0	9.99[a]	1.30[a]	61.89[a]	7.35[a]	1.18[a]
	6	9.61[a]	1.14[ab]	62.44[a]	7.11[a]	1.37[a]
	12	10.25[a]	1.84[b]	61.63[a]	7.50[a]	1.20[a]
	18	12.11[a]	1.77[b]	61.50[a]	8.34[a]	1.07[a]
	24	11.58[a]	2.24[b]	59.53[a]	8.72[a]	1.11[a]

Legend: 1= Crude fibre, 2 = Crude protein, 3=Ether extract, 4= Protein efficiency ratio; MB Mucuna boiled, MT Mucuna toasted; Mean with same superscript are not significantly different (P<0.05).

DISCUSSION

The effect of growth response (Fig.1) showed that weight changes were higher in fish fed diets with lower quantities of the MSM than where there was no soybean meal in the diet. Fish fed on BMSM had better growth performance of fish than those fed TMSM. The poor growth response with increase in TMSM is similar with the findings of Siddhuraju and Becker (2001) who reported that higher inclusion rate of autoclaved MSM significantly reduced growth performance. This is because of the presence of toxicants that cause growth depression and death (Ene-Obong and Carnovale, 1992). They opined that diets containing more than 13% MSM produced significantly poorer growth and nutrient utilization indices when compared with the control diet.

Fish fed 6% MSM diets had similar FCR with those fed other levels of *Mucuna* seed meal diets. The higher FCR values obtained from fish fed 18% and 24% *Mucuna* based diets may be due to the degree of the anti-nutrients which might have resulted in poor feed efficiency and nutrient utilization. Kian *et al*., (2004) observed that growth and FCR were influenced by dietary composition and ration size. Feeding in excess of optimal dietary requirement waste feed, fouls the culture medium, increase the FCR and raises the production cost. Underfeeding reduces growth and increases the FCR. Iyayi *et al* (1998) demonstrated that reduced feed consumption was responsible for the reduced weight obtained. They concluded that reduced feed intake due to cyanide, L-Dopa, tannins and other anti-nutritional factors in the *Mucuna* impacted negatively was not significant. However, fish fed 12% and 18% TMSM diets did not suffer any mortality. The % mortality was higher in fish fed 18% BMSM, 24% TMSM, 6% BMSM and 6%TMSM in decreasing mortality order as 23.3%, 23.3%, 16.7% and 13.3% respectively. Conceicao *et al* (1993) expressed the opinion that the moment absorbed nutrients do not satisfy the energy needs, the fish tissue starts to be catabolized. The findings from this work did not reveal any progressive decrease in the fish weight. Thus the recorded fish death may not be attributed solely to the diets fed to them. There were generally low values of protein efficiency ratio in all the treatments. The reason for the low PER may be attributed to the effect of the anti-nutritional factors.

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