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COMPARISON OF EXTRUDED AND NON-EXTRUDED SOYBEAN MEALS IN THE DIET OF GENETICALL Y IMPROVED MUDFISH *HETEROBRANCHUS LONGIFILIS* JUVENILES.

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ABSTRACT

Raw soybeans were subjected to three different processing methods viz Parboiling. Toasting and Extrusion with an Intra Pro Extruder. The processed soybean meals were thereafter incorporated at equal levels into the diets of genetically improved mudfish *Heterobranchus longifilis* juveniles. The fish were fed the experimental diets in triplicates at 5% of their body weight for eight weeks. The growth performance and food utilization indices namely mean weight gain (MWG), Food Conversion Ratio (FCR), Specific Growth Rate (SGR%) and Protein Efficiency Ratio (PER) were monitored bi-weekly. The result shows that fish fed the control fishmeal diets were highest in growth performance, which was significantly different (P:::0.05) from others. Among the fish fed the test diets, those fed toasted soybean had higher MWG, SGR, FCR and PER than juveniles fed the parboiled soybean diet. The juveniles fed the extruded soybean diet recorded the least growth performance. The implication of these results in diet formulation is discussed.

INTRODUCTION

Feed cost account for about 60 percent of the total cost in fish farming (Olomola 1990). The effect of lack of good quality feed for economic production of fish in Nigeria are slow growth, low survival, diseases and poor harvest (Eyo, 2001). Falaye (1992) has agitated for the replacement of the highly expensive fishmeal with very rich protein sources of plant origins to replace higher proportion of fish diets for fish, which will invariably reduce the cost of feed production.

Soybeans *(Glycine max)* is popularly grown everywhere in the tropics and contain high nutritional values among other plant proteins. The crude protein range between 47-50 percent, NFE 40 percent and lipids 15-20 percent (Dabrowska and Wojno, 1977). It is equally high in essential amino acids, essential fatty acids, vitamins and minerals.

Raw soybean, contain antinutritional substances, mainly trypsin inhibitors (Robinson, 1984, Lovell, 1990, Olli and Krogdahl, 1994). The effects of the inhibitors include impairing the activities of growth hormonal factors and the enlargement of the pancreases (Rachis, 1974) Viola *et at.*, (1983), Wee and Shu, (1989), Eyo, (1999), have reported that ~xposition of raw soybean to heat inactivate the actions of the trypsin inhibitors and that excessive heat would have detrimental effects on the nutritive values of soybeans, especially reduction in the quality and quantity of the heat labile essential amino acids (EAA).

Through genetic manipulation in our laboratory potentially fast growing strains are being introduced into fish culture. The production of these genetically improved species must be matched with good quality feeds to enable them exhibit their maximum potentials (Eyo *et.al*, 1998, Eyo and Falayi, 1999).

The objective of this study therefore is to compare the growth performance of genetically improved *Heterobranchus longifilis* juveniles fed diets prepared with extruded and non-extruded soybean meals as the main protein sources inorder to determine the effect of extrusion on the quality of soybean meal. This will be facilitated by determining the growth and nutrient utilization of improved *Heterobranchus longifilis* juveniles treated to diets containing equal levels of the processed beans.

MATERIALS AND METHODS.

All ingredients used in diet preparation except the premix were acquired from New Bussa, Niger State, Nigeria. The vitamins and minerals premix was obtained from Bio-organic Lagos. Two kilogramme weight (2kg) raw soybean each were heat treated using three different methods as follows:- Extrusion using Insta Pro 600 extruder (Fig. 1); operated at temperature of 130-140°C and 30-40 bar pressure without water Toasted was carried out in electric oven at 100°C for 30 minutes (Eyo 1999); parboiling was done in pressure cooker at 100°C for 45 minutes and later sundried (Balogun and Ologhobo, 1988). The processed soybean and other ingredients involved in the ration preparation were milled with hammer milling machine and sieved to obtain fine particles which were used in the feed formulation. All ingredients were singularly weighed with top loading Acculab Electronic Digital scale model 333 in the proportion on the formulation (Table 1), the control diet had fish meal while the others had soybean meal treated at various temperatures. Each treatment ingredients were mixed in a plastic bowl by hand. They were first mixed dry and later with water at 60°C and were kneaded until homogenous viscos paste (dough) were obtained which were placed in a hand pelletizer and rolled through 2 mm die holes in pellets. The pellet was dried in electric oven at 105°C for 2 hours and about 100g pellet from each diet was sent for proximate analysis through sealed bottles while the remaining pellets were kept in sealed container for the feed trial experiment. The milled parboiled soybean, toasted bean and extruded soybean samples were also sent separately in empty sealed sampling bottles for proximate analysis.Twelve concrete tanks each measuring 2 x 2 x 1m^3 located outdoor of the NIFFR Hatchery Complex was filled $^3/_4$ with water prepared by fertilization with chicken manure one week before the experiment commenced. 55 homogenous juveniles of improved *Heterobranchus longifilis* obtained from the genetic laboratory were acclimatized for two days during which they were starved to eliminate the stomach contents. The fish were stocked at 5 juveniles with mean weight ranging from 44.34-51.9g per tank in triplicate units each. The fish were fed with the experimental diets twice daily (morning and evening) at ,5% body weight for 56 days. Sampling was carried out early morning bi-weekly and the growth parameters were recorded and subsequent adjustment in feed intake was made from the biweekly new weight. The growth parameters observed include: Feed intake, weight gain, survival, feed conversion ratio (FCR), protein efficiency ratio (PER) and specific growth rate (SGR). These parameters were determined by the methods of Olvera Novoa *et al.*, (1990). The proximate composition analysis of the diets and the soybeans treated at various methods were determined by the methods of AOAC (1990) and the water quality parameters i.e. pH, Dissolved Oxygen and temperature of the experimental tank water were carried out by the methods of A.P.H.A. (1990). Data obtained from the biological and chemical analyses were subjected to the statistical analysis of Variance (ANOV A) and the differences in means were further subjected to Duncan's multiple range Test at 95 percent confidence (Duncan, 1955).

RESULTS AND DISCUSSION

Table 2 shows the growth performance of genetically improved *Heterobranchus longifilis* juveniles fed the experimental diets for eight weeks. The initial mean weight was not significantly different (P>0.05) whereas the final mean weight was significantly different (P<0.05) in some of the treatments. The fishmeal control diet (DT4) gave the highest mean weight gain of 228.31g. Among the experimental diets DT2 that was formulated with diets containing soybean meal toasted at 100°C for 30 minutes had the highest mean weight gain of 130.79g. This was followed by DT3, which contained the Parboiled soybean meal with a mean weight of 117.91 g. The least mean weight gain of 85.48g was obtained in DT1 containing extruded soybean meal. The Food Conversion ration (FCR) was highest in diet 1 (2.71) followed by DT3 (2.31). However DT4 (control) recorded the best FCR (1.59) followed by DT2 (1.86). The Protein Efficiency Ratio (PER) was highest in the control diet DT4 (1.63) followed by DT2, the PER of diets 1 and D3 were significantly lower (P~0.05). The specific growth rate (SGR) also followed similar trend with Diet 4 (control) having higher significant (P~0.05) value above the others.

The result of the growth response and food utilization curve of genetically improved juvenile *Heterobranchus longifilis* fed experimental and control diets are represented in Figure 2.

Raw soybean contains antinutritional factors, which are inactivated by heat treatment (Robinson, 1984, Olli and Krogdahi, 1994). Trypsin inhibitors are predominant (Lovell, 1990). The inhibitors have been implicated in causing pancreatic hypertrophy with excessive endogenous protein losses (Rachis, 1974). Soybean toasted at 100°C for 30 minutes produced the highest crude protein, while the parboiled beans gave lower percent C.P. The soybeans extruded at 135°C -140°C and 30-40 bar pressure produced the least crude proteins. The high temperature of extrusion must have denatured the proteins and caused losses of some heat labile amino acids present in the beans as reported by Robinson (1994) and *Eyo* (1999).

The fishmeal control diet gave the best growth performance. The improved growth and nutrient utilization factors in the juveniles fed fish meal diets have been reported by other authors (Pike *et at.* 1990, *Eyo* 1999) and the reason have been expressed as caused by high digestibility of fish meal and the presence of abundant essential amino acids *(BAA)* in fish meal (Dabrowski and Kozak, 1979, Lovell, 1988). In a similar study *Eyo,* (1999) recorded the highest crude protein and *EAA* for diets produced with soybean toasted under the same moderate temperature (100°C for 30 minutes). Viola *et at.* (1983) also reported that high lysine value was improved when soybean was not over heated.

The poor growth rate of the fish fed with the extruded beans could be as a result of the over exposition of the beans to very high temperature (Wee and Shu, 1989, Lovell, 1990) which must have denatured the proteins and reduce the heat labile essential amino acids thereby lowering the nutritive values of the diet.

CONCLUSION

Extrusion method has been identified as one of the best options in soybean processing in commercial feed production in that it denatures emzymes urease, lipase, amylase and reduce the trypsin inhibitors activities. It improves starch digestion as measure by rate and efficiency of gains (Mitchel, 1979). Further studies are therefore recommended at reducing the temperature of dry extrusion,so as to reach a balance between destruction of trypsin inhibitors and reduction of losses to heat labile essential amino acids such as lysine due to over heating.

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Table 1: Formulation and a proximate composition of the control and experimental diets g/100g.

Ingredient	Diet 1 Extruded soybean diet (g)	Diet 2 Toasted soybean diet (g)	Diet 3 Parboiled soybean diet (g)	Diet 4 Fishmeal control diet (g)
Fish meal	-	-		-23.16
Soybeans	35.80	35.80	35.80	-
Groundnut cake	30.63	30.63	30.63	30.63
Blood meal	8.14	8.14	8.14	8.14
Maize	21.43	21.43	21.43	21.43
Vit/Min. Premix*	1	1	1	1
Cod Liver Oil**	2	2	2	2
Bone meal	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Proximate composition (%)				
Crude protein	35.79	35.91	35.72	36.03
Ether extract	17.15	19.15	14.10	16.20
Crude fiber	4.70	5.00	5.60	4.00
Ash	7.55	7.15	7.37	6.25
Moisture	10.20	10.60	12.70	9.00
NFE	26.61	22.20	24.51	28.52

* Vitamins and minerals supplied as follows (mg/kg of Premix) Riboflavin 6,000.
Pyridoxine 24,000. Folic acid 12,000 Manganese 60,000, Iron 40,000. Copper 5,000. Choline 30,000, Selenium 100, iodine 1,100. Ascorbic acid 25,000, antioxidant 125,000, Vitamins A.D. and E were added at 350,000, 130,000 and 7,500 I.U./Kg respectively.

** Cod live oil supplied per 10ml. Vitamin A 7,000 I.U. Vitamin D 800 I.U. Vitamin E. 1 I.U.

Table 2: Summary of Feed Utilization Parameters of Genetically Improved *Heterobranchus longifilis* Fed Experimental Diet.

Treatment	Initial mean weight (g)	Final mean weight (g)	Mean weight gain (g) (MWG)	Daily weight gain (g)	Specific growth rate (SGR%)	Food Conversion Ratio (FCR)	Protein Efficiency ratio (PER)
DT1	51.17[a]	136.65[a]	85.488[a]	1.52[a]	1.75[a]	2.71[a]	1.16[a]
DT2	50.01[a]	180.80[b]	130.79[b]	2.34[c]	2.29[b]	1.86[b]	1.44[b]
DT3	49.75[a]	167.66[c]	117.91[c]	2.10[b]	2.17[c]	2.31[c]	1.24[c]
DT4	46.54[a]	274.85[d]	228.31[d]	4.08[d]	3.17[d]	1.59[b]	1.63[d]

Figures followed by the same superscripts in the same column are not significantly different (P>O.O5).

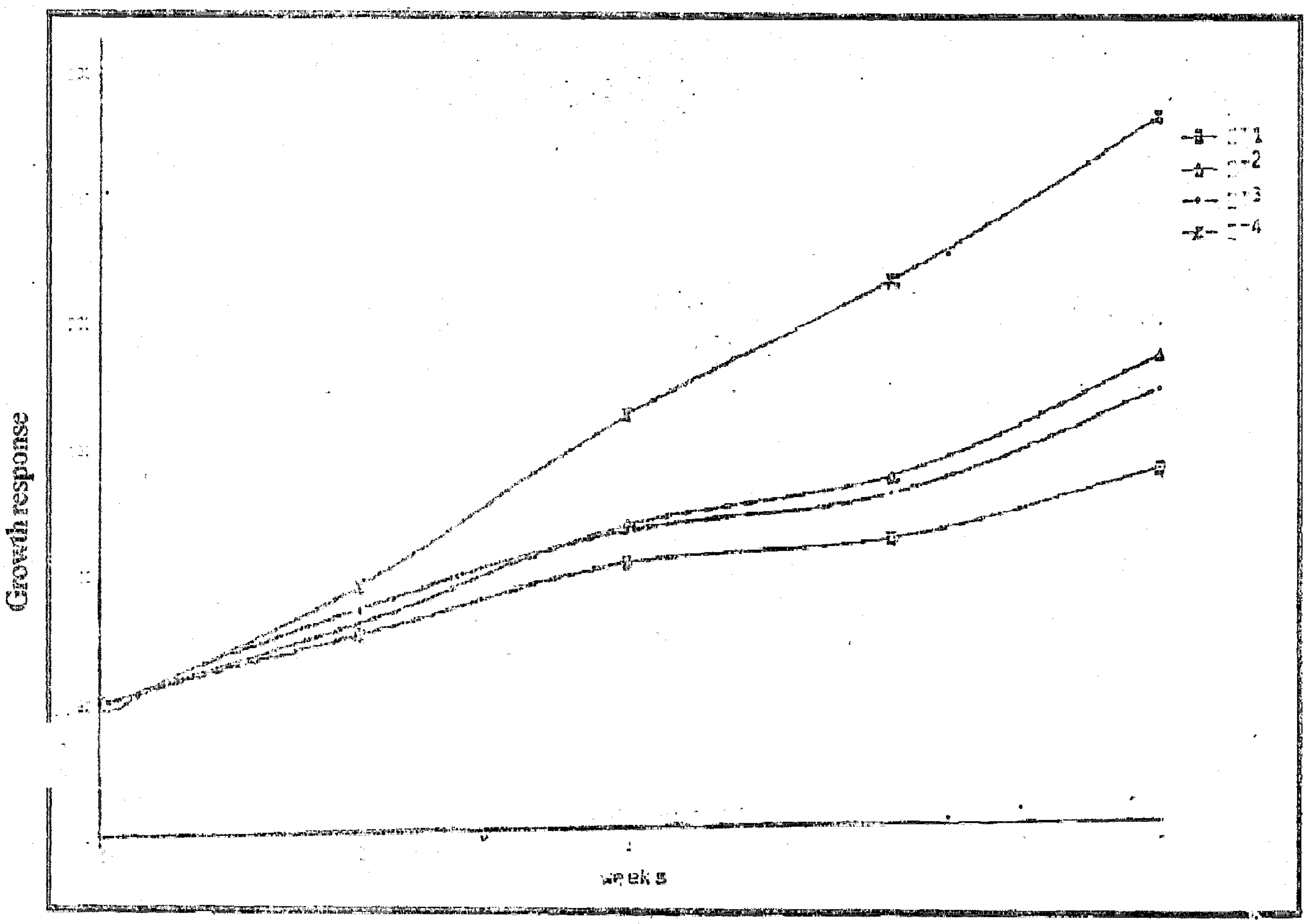

Fig. 2: Means: Bi-weekly growth responses of Genetically Improved Heterobranchus longifilis to the experimental diets.

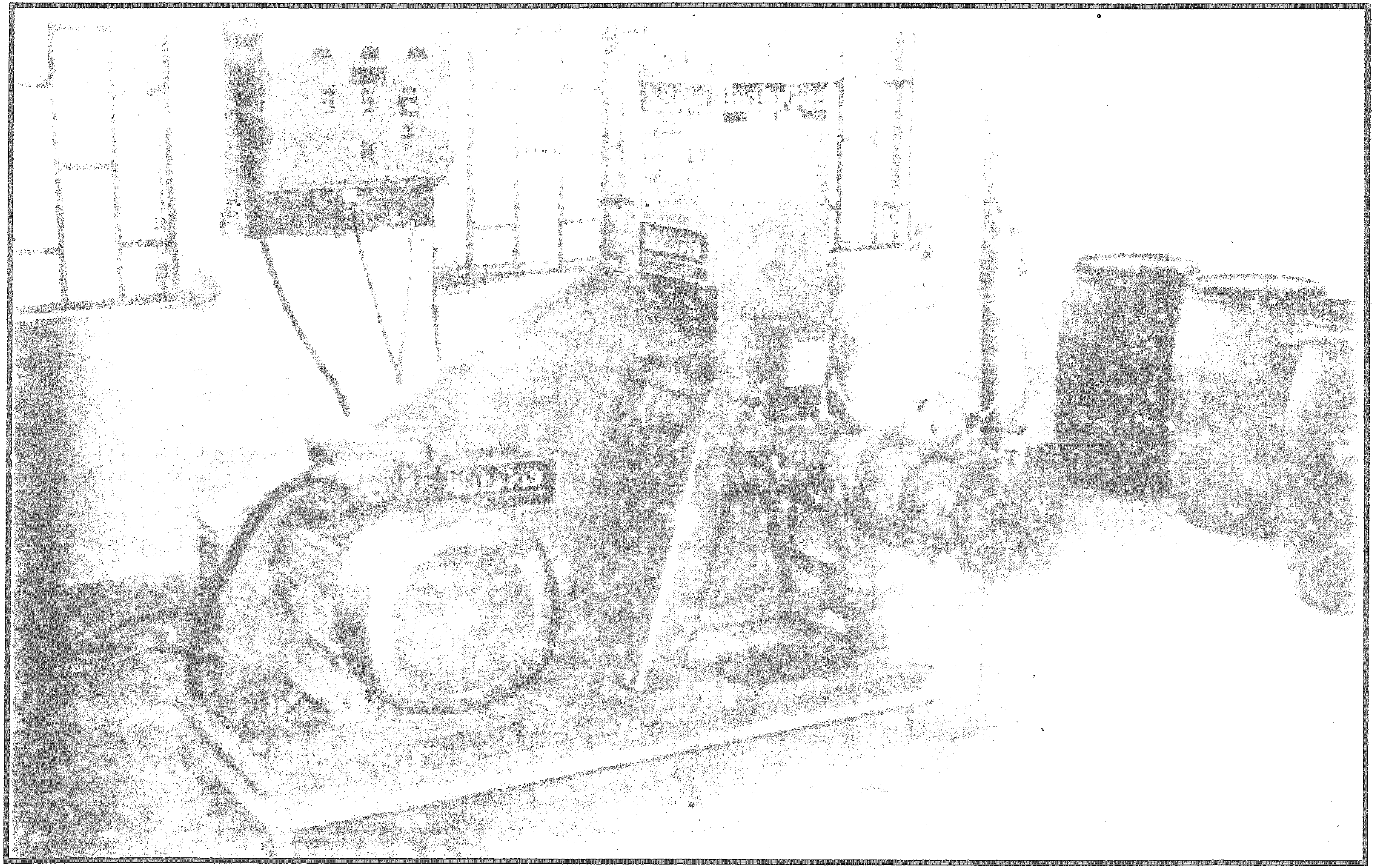

FIGURE 1: INSTRA PRO 600 EXTRUDER