PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
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Pakistan Journal of Nutrition 6 (3): 267-270, 2007
ISSN 1680-5194

Wing Reproductive Termite (*Macrotremes nigeriensis*) – Soybean (*Glyxine max*) Meals Blend as Dietary Protein Source in the Practical Diets of *Heterobranchus bidorsalis* Fingerlings

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Abstract: This study was designed to investigate the utilization of wing reproductive termite (*Macrotremes nigeriensis*) - Soybean meals blend as dietary protein source in the diets of *Heterobranchus bidorsalis* fingerlings (M ± SE = 12.02 ± 0.03). The fingerlings were fed five Isonitrogenous and Isocaloric diets containing blends of wing reproductive termite (WRT) and soybean meal (SBM) in ratios of 75:25; 50:50; 25:75; and reference diets with ratio 0:100 and 100:0 of WRT and SBM respectively for 56 days at 5% body weight. A trend of difference in nutrient utilization was observed as Diet 1 (75WRT:25SBM) recorded mean weight gain (MWG) of 28.48g and better specific growth rate (SGR), food conversion ratio FCR) and protein efficiency ratio (PER) than any other diet. This was followed by Diet 4 (100WRT:0SBM) which gave MWG value of 25.15g and second best SGR, FCR and PER values. There was observed significant difference ($P<0.05$) in the MWG values among fishes fed the five diets. Also, there was marked significant difference ($P<0.05$) in the ash, lipid and crude protein of carcass of fishes fed the five experimental diets.

Key words: Termite, soybean, dietary protein, fingerlings

Introduction

Major constraints to the development and expansion of the aquaculture industry in developing countries are the reduced supply, high demand and prohibitive cost of feeds and feedstuffs particularly fish meal (ADCP, 1983). Fishmeal used in aquaculture industry in Nigeria are mostly imported as they are not readily available locally. This situation has compelled researchers in area of fish nutrition or animal nutrition in general to begin the search for alternative to use of fishmeal in nutrition of pond fishes. There are many unconventional feedstuffs both of animal and plant origin that are not yet researched or where researched, information on their utilization in fish diets is limited. Wing reproductive termite is an insect that is widely found in Nigeria especially during the rainy season and it is the reproductive stage of termite (*Macrotremes nigeriensis*). It can be collected during the rainy season at little or no cost which makes it researchable. The most widely used plant protein in fish diets has been soybean meal because of its high nutritional value, availability and favourable price (Shiau *et al*., 1987). Soybean protein must however be heat treated to destroy the trypsin inhibitor prior to use in animal feeds (Balogun and Ologhobo, 1989; Tiamiyu 2001). The low level of lysine and sulphur containing amino acids like methionine and cysteine are a limitation to the use of soybean. It is therefore thought that a blend of wing reproductive termite with soybean meal will make an excellent diet for *Heterobranchus bidorsalis* fingerlings.

Materials and Methods

Five Isonitrogenous and Isocaloric diets 40% crude protein and 5.6 $Kcalg^{-1}$ respectively were formulated using the best performance of the thermally processed wing reproductive termite which was at 120°C for 12 hours. The blend ratio between wing reproductive termite (WRT) and soybean meal (SBM) used were: Diet 1 (75WRT : 25SBM); Diet 2 (50WRT : 50SBM); Diet 3 (25WRT : 75SBM); Diet 4 (100WRT: 0SBM) and Diet 5 (0WRT : 100SBM). The diets were pelleted using a modified Bohr, mill with a pelleting head mounted with dice dimension of 3mm. The pellets were collected and sundried; packaged and stored for use.

Two hundred fingerlings of *Heterobranchus bidorsalis* average weight (12g±0.02) obtained from a homogenous source through induced breeding using Motilium-M and suprefact as hormones. The fingerlings were pooled in a tank and left to acclimatize for 24 hours after which they were sorted and graded and randomly distributed 15 fish per tank (3 x 1 x 1 m^3). The fish were fed 5% of body weight for 56 days. The fish were weighed weekly and feeding rates adjusted accordingly. At the end of the experiment two fish per treatment was randomly selected for nutrient body composition analysis according to AOAC (1990). The experimental design used was complete randomized design with

Table 1: Inclusion Levels of Ingredients and Proximate Composition of Wing Reproductive Termite – Soybean Blend (WRTSBM) Diet fed to *Heterobranchus bidorsalis* For 56 days. Figures in Parentheses are the Blending Ratios of Wing Reproductive Termite and Soybean meal

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
	(25 : 75)	(50 : 50)	(75 : 25)	(100 : 00)	(0 : 100)
Wing reproductive termite meal	5.77	4.58	8.49	6.63	-
Soybean meal	1.93	4.58	2.83	-	14.80
Fish meal	61.96	60.86	59.23	62.77	56.60
Corn meal	25.34	24.98	24.46	25.60	23.61
Mineral	2.5	2.5	2.2	2.5	2.5
Vitamin	2.5	2.5	2.5	2.5	2.5
Proximate Analysis as analyzed (%)					
Moisture	6.89	7.12	7.71	8.12	7.77
Ash	10.01	10.11	10.51	11.01	11.44
Crude protein	41.12	41.31	39.20	39.11	38.66
Ether extract	22.88	23.01	20.13	21.00	19.18
Crude fibre	8.32	3.98	4.11	4.52	3.88
*Gross Energy ($Kcalg^{-1}$)	6.68	6.25	5.82	7.11	5.39

*Calculated by using the following multiplier factors: Carbohydrate; 4.1 Kcal g^{-1}; Protein 5.4 Kcal g^{-1} and Lipid 9.5 Kcal g^{-1} after Jobling 1983. Vit. A, 15,000,000 I.U; Vit. D_3, 3,000,000 I.U; Vit. E, 30,000 I.U; Vit. K, 2,500 Mgr; Thiamine, B_1, 2,000 Mgr; Riboflavin, B_2, 6000 Mgr; Pyridoxine, B_6, 4000 Mg; Niacin, 40,000 Mgr; Vit. B_{12}, 20 Mg; Pantothenic acid, 10,000 Mgr; Folic acid, 1000 Mgr; Biotin, 80 Mgr; Choline chloride, 500 gr; antioxidant, R_5 gr; Manganese, 96 gr; Zinc, 60g; Iron, 24 gr; Copper, 6 gr; Iodine, 1.4 gr; Selenium, 240 Mgr and Cobalt 240 Mgr.

Table 2: Proximate Composition of *Heterobranchus bidorsalis* Fingerlings fed Wing reproductive termite – Soybean Blend Based Diets for 56 days.

	Control	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Moisture	77.06 ± 1.11^a	76.62 ± 1.31^a	76.28 ± 0.58^a	76.47 ± 0.98^a	74.51 ± 1.15^a	77.31 ± 1.00^a
Ash	8.40 ± 0.77^a	6.34 ± 0.87^c	2.54 ± 0.91^c	4.56 ± 0.77^d	3.77 ± 0.82^e	3.01 ± 0.68^e
Lipid	12.85 ± 1.85^a	18.84 ± 1.15^b	18.11 ± 0.99^b	17.95 ± 1.91^b	21.22 ± 1.00^c	17.70 ± 1.00^b
Crude protein	9.42 ± 0.62^a	12.21 ± 0.65^a	14.68 ± 0.50^c	15.92 ± 0.47^c	16.46 ± 0.66^c	10.50 ± 0.21^a
Crude fibre	2.81 ± 0.00^a	1.81 ± 0.00^b	0.69 ± 0.01^c	2.00 ± 0.01^a	2.70 ± 0.01^a	1.29 ± 0.00^c

Figures on the same row carrying the same superscripts are not statistically significant (P<0.05).

each treatment triplicated. Water quality parameters measured were Temperature, Dissolved oxygen, pH, ammonia nitrogen (NH_3-N), nitrate nitrogen (NO_3-N) and nitrite nitrogen ($N0_2$-N).

Results

Table 1 show the inclusion levels of ingredients and proximate composition of the experimental diets. Table 2 depicts the carcass composition of fish fed the five experimental diets. There was no observed significant difference (P>0.05) in moisture content of the fish fed the five diets. The lipid content of the fish fed the diets differed significantly (P<0.05). The lipid level decrease as the percentage inclusion of WRT decreases. Diet 4 (100WRT:0SBM) gave the highest lipid level of 21.22% while the lowest lipid value of 12.85 was recorded for the control. The carcass crude protein values varied significantly among the five diets (P<0.05).

Table 3 shows the weekly mean weight gain (MWG) of *Heterobranchus bidorsalis* fed WRT – SBM blend diet. Diet 1 gave the highest cumulative mean weight gain (CMWG) of 28.48±3.85 while Diet 3 gave the poorest CMWG of 15.60±6.24.

Table 4 shows the nutrient utilization of experimental diets by *Heterobranchus bidorsalis* fingerlings. The result showed that there was no significant difference (P>0.05) in the mean initial weight (MIW) of the fish fed the experimental diets. However, the mean final weight (MFW) and mean weight gain (MWG) differed significantly (P<0.05). Diet 1 (75WRT:25SBM) gave the highest MWG of 28.48g while Diet 5 (OWRT:100SBM) gave the poorest MWG of 15.56 while Diet 4 (100WRT:0SBM) gave MWG value of 25.15g. The difference in the MWG among the five diets was significant (P<0.05). Diet 1 which gave the highest MWG also was better utilized by the fish as it gave the following biological parameter: SGR, 2.13% day^{-1}; FCR, 2.58; PER, 0.69. Table 5 shows some amino acid profile of WRT compared with that of fishmeal, meat meal and soybean. The table showed that WRT has a higher values of lysine, methionine Histidine etc than FM, MM and SBM.

Figure 1 shows the weekly weight record of *Heterobranchus bidorsalis* fed wing reproductive termite – soybean blend for 56 days. Diet 1 gave a better weekly growth response followed by Diet 4.

Discussion

The mean weight gain (MWG) of *Heterobranchus bidorsalis* increased in response to higher inclusion level of wing reproductive termite (WRT) in the blend with soybean. The fact that Diet 1 (75WRT:25SBM) with the

Table 4: Mean Weight Gain (MWG) of *Heterobranchus bidorsalis* Fed Wing Reproductive Termite – Soybean Meal (WRTSBM) Blend for 56 days

Weeks	Diets				
	Diet I	Diet II	Diet III	Diet IV	Diet V
WK 1	2.44±0.04	2.73±0.28	1.62±0.52	2.63±0.85	1.23±0.21
WK 2	2.74±0.02	3.25±0.31	1.18±0.21	2.66±1.15	1.54±0.19
WK 3	4.18±0.91	4.90±0.53	2.47±0.62	3.32±0.75	2.07±0.52
WK 4	5.24±0.58	4.40±0.07	2.65±0.92	3.52±0.79	3.30±0.80
WK 5	5.58±1.67	4.32±1.40	3.67±1.40	4.24±0.07	2.62±0.17
WK 6	4.21±0.91	0.59±0.02	2.96±0.70	5.02±0.58	2.42±0.55
WK 7	2.28±1.63	1.26±0.03	0.69±0.10	3.47±0.13	1.57±0.31
WK 8	1.78±0.05	-0.76±0.49	0.71±0.01	0.26±0.04	0.87±0.08
Cumulative weight gain (± S.D)	28.48±3.85	20.71±0.72	15.60±6.24	25.15±5.63	15.63±0.62

Table 5: Some Amino Acid Profile of Wing Reproductive Termite (*Macrotremes nigeriensis*) Compared with that of Fishmeal, Meat Meal and Soybean Meal (mg/g)

Amino acid	**WRT	*FM	*MM	*SBM
Lysine	6.15	4.96	3.45	2.67
Methionine	2.24	1.84	0.75	0.66
Tryptophan	-	0.73	0.37	0.58
Threonine	3.53	2.82	1.75	1.88
Leucine	5.95	4.78	3.40	-
Isoleucine	3.13	2.98	1.86	2.42
Valine	3.62	3.31	2.68	2.42
Histidine	1.50	1.47	1.02	1.12
Arginine	4.32	4.41	3.84	3.11
Glycine	4.40	4.84	6.71	-
Cystine	0.83	0.84	0.70	-

**Values obtained from Experimental analysis. *Values obtained from Lovell, 1989. WRT = Wing reproductive termite.
mm = Meat meal. FM = Fishmeal. SBM = Soybean meal.

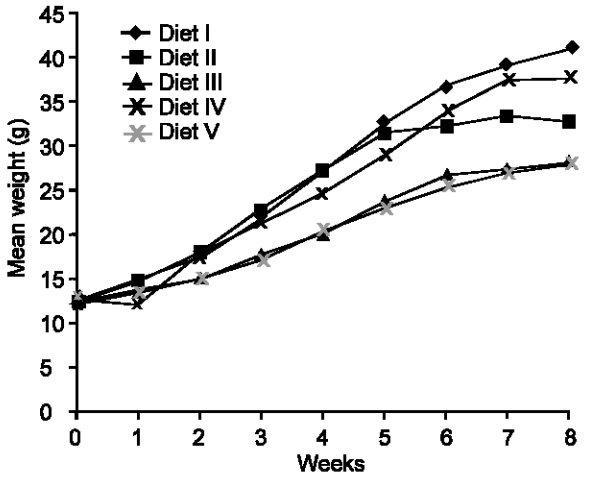

Fig. 1: Mean weekly weight record for *Heterobranchus bidorsalis* fed wing reproductive termite-soyabean meal blend (WRTMSBM) for 56 days.

highest MWG value of 28.48g followed by Diet 4 (100WRT:0SBM) is indicative to the fact that WRT is an excellent protein as its inclusion at higher level gave a corresponding increase in MWG values. Fishes fed Diet 1 are also most utilized from the values of SGR, FCR and PER. The trend of variation in growth performance as in Fig. 1 could be due to imbalance in the essential amino acid EAA of soybean meal as reported by Lovell, 1988; Sadiku and Jauncey (1995). Higher inclusion of soybean in the blend for this study depresses growth and lower utilization of the diet leading to poorer values of SGR, PER and ANPU. Viola *et al.* (1983) reported that soybean meal can be used to replace up to half of fishmeal in tilapia diet having 25% crude protein without requiring any supplementation.

In this present study, Diet 1 (75WRT:25SBM) that gave the best performance in MWG, SGR, FCR and PER values can be attributed to improved essential amino acid (EAA) balance as WRT is richer in sulphur containing amino acids of which soybean is deficient. This is also suggestive of the superiority of 75:25 WRT-SBM blend over the other blends for the culture of *Heterobranchus bidorsalis* fingerlings. Sadiku and Jauncey (1995) showed that poultry meat meal is higher than soybean in methionine + cystine and lysine. The higher value of methionine, lysine and cystine in WRT is responsible for the improved growth performance in Diet 1, Diet 4 and lowest growth performance recorded in Diet 5 that is 100SBM:0WRT. Incorporation of WRT in a blend with SBM improved essential amino acid balance of the blend.

Toasting of soybean to eliminate trypsin inhibitors has been shown to lead to problems of lysine unavailability and sulphur containing amino acids destruction (Gohl, 1981; Synder and Kwon, 1987) but this problem can be ameliorated by the incorporation of wing reproductive termite. A blend of WRT and SBM as in Diet 1, (75:25), Diet 4 (100:0) especially at a higher level of inclusion of WRT gave an improved amino acid balance as WRT is high in limiting amino acid in soybean.

The increased carcass lipid in fish fed the experimental diets compared to the control is consistent with the level of inclusion of WRT in the blend. There was marked increase in carcass lipid as inclusion level of WRT increased, because the insect is very oily in nature. However the increased carcass lipid observed in this study is not worrisome as catfishes could tolerate higher inclusion levels of lipids in their diet than tilapia (Sadiku

and Jauncey, 1995).

In conclusion, there was increased growth performance expressed in MWG, and better utilization of nutrient as expressed in higher SGR, FCR, PER and ANPU values when inclusion levels of WRT increased in the blend. The poorest growth performance in diet 5 with 100% SBM in the blend confirms the fact that the limiting amino acid in SBM manifested in poorer growth response when SBM is fed alone. For better growth expression of *Heterobranchus bidorsalis* the 75WRT:25SBM blend is the best and is therefore recommended.

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