IMPROVING THE QUALITY OF FISH FEED THROUGH OMEGA-III-FATTY ACID INCLUSION IN DIET

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Abstract

Seventy-five (75), four week old hatchery bred fingerlings of Heterobranchus bidorsalis were acclimated in fish holding tanks measuring 1 x 1 x 1 m^3 where they were fed with fishmeal. They were then distributed in fives, into triplicates of five different concrete tanks with equal dimensions as the holding tank. The tanks were labelled $A_{n,}$ B_n and C_n where 'n' ranged from 1 – 5, depending on the number of the tank. Fish specimens in the different set of tanks, were each fed one of five iso-nitrogenous diets formulated, with varying amounts of Omega-III-fatty acid for seven weeks. The quantity of Omega-III-fatty acid in each of the diets were 0.0, 2,000, 4,000, 6,000 and 8,000 mg/kg respectively. The initial length and weight of specimens were measured and subsequently measured on weekly basis in the course of the study. Data collected were subjected to analysis of variance (ANOVA) using the General Linear Models (GLM) and means separated using Duncan Multiple Range Test (DMRT). Results show that growth in specimens fed diets containing 6,000 mg/kg and 8,000 mg/kg were not significantly different (P>0.05) from each other. However both were better and significantly differently (P<0.05) from response to the other diets. Inclusion of 6,000 mg/kg of Omega-III-fatty acid in the diet of heterobranchus bidorsalis is therefore recommended, to improve feed quality and growth of fish.

Keywords: Fish samples, Rations, Tanks, Omega-III-fatty acid, Growth responses.

Introduction

Fish like other animals, have requirements for the essential nutrients such as fatty acids, oils, proteins, carbohydrates, vitamins and minerals in their diets, in order to grow properly (Lovell, 1989). In the wild, such essential food nutrients are available as the fish forage. When fish is placed in an artificial environment, enough food containing these essential nutrients, must be supplied for better growth. The food supplied is in the form of artificial diet that furnishes all the nutrients required by the fish. Conversely the food may be given as supplementary feed, where part of the nutritional needs of the fish are supplied by natural foods present in the aquatic environment (Balfour and Yoel, 1981).

Protein is one of the basic component of animal tissues which constitutes 45 – 47 % tissue dry matter (Murai, 1985). Therefore, it is an essential nutrient for body maintenance and growth. Fish use protein efficiently as a source of energy. A high percentage of digestible energy in protein is metabolised in fish than in land animals. The heat increment for protein consumed is lower in fish than in mammals or birds, which gives a higher productive energy value for fish (Lovell, 1989).

Fishmeal is a very important and major source of animal protein in the diets of fish, livestock and poultry. Although it is a major component of fish feed, its high price, is a major constraint in feed formulation. When used in formulation of feed, it leads to an increase in the cost of feed and a corresponding rise in fish production (Ekelemu *et al.*, 2000). Thus to reduce the cost of feed and hence cost of producing fish, maggot-meal has been successfully used to replace fishmeal as a source of animal protein in fish and poultry feed (Akpodiete, 1997).

According to Lovell (1989) and Clucas and Ward (1996), Omega-III-fatty acid can be used as an energy booster in fish feed. Thus, this study seeks to determine the optimal level of Omega-III-fatty acid inclusion in the diet of fish, to improve the quality of feed and hence increase the growth rate of *Heterobranchus bidorsalis.*

Materials and Method

Seventy-five (75) four-week old hatchery bred fingerlings of *Heterobranchus bidorsalis* were collected from DIL Investment Ltd, Asaba and used for the study. The fish samples were identified to species level according to Holden and Reed, (1978) and Idodo-Umeh, (2003). The specimens were acclimated for one week in a concrete fish holding tank measuring 1 x 1 x 1 m^3. While in the tank the fishes were fed *ad-libitum* morning and evening, with fishmeal (CP = 65 %), before the commencement of the experiment.

After acclimation, the fish samples were randomly distributed in triplicates of fives into five concrete tanks with the same dimensions as the acclimation tank. The triplicates were labelled A_n, B_n and C_n, where 'n' ranged between numbers 1-5 for each set of tanks. The standard length and weight of fishes in all the tanks were measured and different iso-nitrogenous diets (CP = 40 %), were formulated to feed the fishes. The formulated diets contained maggot meal, used as replacement for fishmeal at 50 % replacement level. The different diets were labelled 1, 2, 3, 4, 5, depending on the proportion of Omega-III-fatty acid contained. Diet 1, which had no Omega-III-fatty acid inclusion was regarded as the control. Diets 2 – 5 respectively had 2000, 4000, 6000 and 8000 mg/Kg Omega-III-fatty acid inclusion (Table 1).

Table 1: Composition of diets used in feeding *Heterobranchus bidorsalie* fingerlings in the different tanks

	Diets				
Ingredients	**1**	**2**	**3**	**4**	**5**
Fishmeal(g)	186.1	186.1	186.1	186.1	186.1
Maggotmeal(g)	224.1	224.1	224.1	224.1	224.1
GNC(g)	265.9	265.9	265.9	265.9	265.9
PKC(g)	96.7	96.7	96.9	96.7	96.7
Wheat(g)	93.1	93.1	93.1	93.1	93.1
Maize (g)	53.7	53.7	53.7	53.7	53.7
Bonemeal(g)	30.0	30.0	30.0	30.0	30.0
Starch (g)	35.0	35.0	35.0	35.0	35.0
Omega-III-fatty acid (mg)	-	2,000.0	4,000.0	6,000.0	8,000.0
Lysine (g)	5.2	5.2	5.2	5.2	5.2
Methionine (g)	5.2	5.2	5.2	5.2	5.2
Vit. Premix (g)	5.0	5.0	5.0	5.0	5.0

The tanks were fed diets that corresponded to their numbers. The fingerlings were fed twice daily on 10 % body weight of the prepared diets at 08.00 and 18.00 hrs. The quantity of diets fed to the fishes was reduced to 5 % body weight by the second week. By week 3 the quantity was increased to 6 % body weight and progressively increased to 10 % by week 7 as the consumption rate of the fishes increased.

Further to the initial measurement of the standard length and weight of the fishes, these parameters were subsequently measured on a weekly basis and used as growth indices.

Data Analysis

Data collected were analysed, using the analysis of variance (ANOVA) and Duncan Multiple Range Test to separate the means. Results from the analysis were used to determine the growth of the fish in response to Omega-III-fatty acid inclusion in their diets.

Results

In terms of length gain, the result of this study showed that by the end of week 1, increase in fish length, in tanks 4 and 5, in response to diets 4 and 5 with 6,000 and 8000 mg/Kg Omega-III-fatty acid inclusion in the diet respectively, were not significantly different ($P>0.05$). Both were better and significantly different ($P<0.05$) from fishes in tanks 1 to 3, fed diets 1 – 3. Increase in length in response to diets 1 and 2 were not significantly different from each other ($P>0.05$), but were poorer and significantly different from response to diet 3 ($P<0.05$). By the end of week 2, response to diet 4 was significantly different ($P<0.05$) and better than response to the other diets, while response to diets 1 and 2 still remained poor. By the end of week 3, increase in length of fish in response to diets 3 – 5 were not significantly different from each other. However response to diet 4 with 6,000 mg/Kg inclusion of Omega-III-fatty acid was slightly better than those of diets 3 and 5 with 4,000 mg/Kg and 8,000 mg/Kg inclusions of Omega-III-fatty acid respectively. Apparently, increase in length in relation to diet 1, with no Omega-III-fatty acid inclusion was the least compared to other the diets (Table 2).

Table 2: Weekly increment in length of *H. bidorsalis* fingerlings fed various levels of

Omega-III-fatty acid enhanced diets.

	Diets				
	1	2	3	4	5
Week I	$0.1803^{c} \pm 0.2143$	$1733^{c} \pm 0.2836$	$0.5133^{b} \pm 0.1769$	$0.6533^{a} \pm 0.2199$	$0.6933^{a} \pm 0.1989$
Week II	$0.2998^{c} \pm 0.1986$	$3867^{c} \pm 0.3060$	$0.7533^{b} \pm 0.2081$	$0.9933^{a} \pm 0.2183$	$0.7667^{b} \pm 0.1886$
Week III	$0.5832^{b} \pm 0.2673$	$6667^{b} \pm 0.2943$	$0.1000^{a} \pm 0.2086$	$1.1800^{a} \pm 0.2091$	$1.0133^{a} \pm 0.1954$
Week IV	$0.5981^{d} \pm 0.2451$	$8467^{c} \pm 0.2845$	$1.1867^{a} \pm 0.2061$	$1.3800^{a} \pm 0.2125$	$1.1600^{a} \pm 0.2118$
Week V	$0.6677^{b} \pm 0.3000$	$7733^{b} \pm 0.2999$	$1.3200^{a} \pm 0.2121$	$1.5000^{a} \pm 0.2131$	$1.3733^{a} \pm 0.2135$
Week VI	$0.8420^{c} \pm 0.2495$	$1333^{b} \pm 0.2866$	$1.4600^{a} \pm 0.2108$	$1.6533^{a} \pm 0.2097$	$1.4867^{a} \pm 0.2136$
Week VII	$1.1369^{b} \pm 0.2556$	$3067^{b} \pm 0.2876$	$1.6270^{a} \pm 0.2055$	$1.7313^{a} \pm 0.2231$	$1.6467^{a} \pm 0.2164$

Means having superscripts with the same alphabets on the horizontal rows are not significantly different from each other (P>0.05). Those with different alphabets as superscripts are significantly different from each other (P<0.05).

At the end of week 1, weight gained by fishes in tanks 3 to 5 fed diets 3 to 5 with 4,000 mg/Kg, 6,000 mg/Kg and 8,000 mg/Kg Omega-III-fatty acid inclusions respectively were not significantly different from each other (P>0.05) but were significantly different (P<0.05) from weight increases in response to fishes in tanks 1 and 2 fed diets 1 and 2 with zero and 2,000 mg/Kg Omega-III-fatty acid inclusions respectively. By the end of week 2, weight increases of fishes in tanks 4 and 5 fed diets 4 and 5 were not significantly different (P>0.05) from each other, but were significantly different from the responses of fishes in tanks 1, 2 and 3 fed diets 1, 2 and 3. However weight increases of fishes in tank 4, fed diet 4 were slightly higher compared to the weight gain in fishes fed diet 5, in tank 5. Both were better than the response fishes in the other tanks (Table 3).

Table 3: Weekly increment in weight of *H. bidosalis* fingerlings fed various levels of Omega-

III-fatty acid enhanced diets.

	Diets				
	1	**2**	**3**	**4**	**5**
Week I	$0.3637^{b} \pm 0.4113$	$0.2867^{b} \pm 0.3514$	$1.3330^{a} \pm 0.3007$	$1.3267^{a} \pm 0.4432$	$1.2467^{a} \pm 0.2543$
Week II	$0.4321^{b} \pm 0.3486$	$0.7333^{b} \pm 0.3750$	$0.5533^{b} \pm 0.3299$	$1.4867^{a} \pm 0.3657$	$1.0667^{a} \pm 0.3410$
Week III	$0.7635^{b} \pm 0,3642$	$0.9800^{b} \pm 0.3618$	$0.8067^{b} \pm 0.3111$	$1.6667^{a} \pm 0.3608$	$1.4800^{a} \pm 0.2997$
Week IV	$0.9924^{b} \pm 0.4218$	$1.1733^{ab} \pm 0.3570$	$1.1133^{ab} \pm 0.3069$	$1.9267^{a} \pm 0.3690$	$1.7267^{a} \pm 0.2899$
Week V	$1.0146^{b} \pm 0.3324$	$1.3400^{b} \pm 0.3585$	$1.2733^{b} \pm 0.3045$	$2.1267^{a} \pm 0.3647$	$1.8667^{a} \pm 0.3110$
Week VI	$1.1435^{b} \pm 0.3941$	$1.5333^{b} \pm 0.3460$	$1.4867^{b} \pm 0.0969$	$2.3267^{b} \pm 0.3726$	$2.1867^{a} \pm 0.2843$
Week VII	$1.3755^{b} \pm 0.3298$	$1.7467^{b} \pm 0.3638$	$1.7000^{b} \pm 0.2979$	$2.8267^{a} \pm 0.3985$	$2.3933^{a} \pm 0.2754$

Means having superscripts with the same alphabets on the horizontal rows are not significantly different ($P>0.05$). Those with different alphabets as superscripts are significantly different ($P<0.05$).

Discussion

Fish use protein efficiently as a source of energy. However as shown from studies with Channel catfish, increases in dietary protein above 45 % without proportionate increase in non protein energy, suppresses growth rate (Lovell, 1989).

Generally a dietary excess or deficiency of useful nutrients can reduce growth rate, because energy need for maintenance and voluntary activities must first be satisfied before energy is available for growth. Dietary protein will be used for energy when the diet is deficient in energy in relation to protein. On the other hand, a diet containing excess can restrict food consumption and thus prevent the intake of the necessary amounts of protein and other nutrients for maximum growth. Lipids are a varied group of organic compounds that are insoluble in water, but are soluble in organic solvents. They represent concentrated energy sources, vitamins, pigments and essential growth factors for fish. The lipids that are important energy sources are fats or glycerides, which are chemically esters of fatty acids glycerols. These fatty acids, of which Omega-III-fatty acid is one, can be used as an energy booster in fish feed (Clucas and Ward, 1996).

There was an initial poor consumption of the feed fed to the fish samples as evidenced by the large quantity of unconsumed feed in the tanks by the first week. This could be due to the process of the fishes adjusting to the new feed, having been used to feeding on fishmeal. Their consumption rate however increased by the second week, as they got used to the new diet fed to them, hence the rations were increased. The result of this study is supported by Lovell (1989), who had reported that a deficiency or excess of useful energy can reduce the growth rate of fish. In this study, it was observed that growth rate was higher for fish samples in tank 4 which were fed with diet having 6,000 mg/Kg of Omega-

III-fatty acid inclusion. The growth rate in tanks with less than 6,000 mg/Kg of Omega-III-fatty acid, were lower. Furthermore growth of fish samples in tank 5 though not significantly different (P>0.05), from those of tank 4 were slightly poorer in comparison. Growth of fish samples in the control tank with zero inclusion of Omega-III-fatty acid, which is an energy booster at a rate of 6,000 mg/Kg of feed will result in an increased growth in length and weight of *Heterobranchus bidorslis.* The study also revealed that inclusion of lower or higher values of Omega-III-fatty acid would lead to poor growth. Thus the inclusion of 6,000 mg/Kg of Omega-III-fatty acid in the diet of *Heterobranchus bidorsalis* during feed formulation to improve the quality of the feed and hence increase growth and productivity is recommended.

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