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Evaluation of Growth, Body Composition and Fatty Acid Profile of Genetically Male Tilapia (GMT) Fingerlings Fed Various Dietary Oils Supplemented Diets

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ABSTRACT

The present study has been planned to evaluate the growth, body composition and fatty acid profile of genetically male tilapia (GMT) fingerlings fed four dietary oils supplemented diets as following treatments; 2% fish oil (FO, Control, T1), 2% soybean oil (SBO, T2), 2% sunflower oil (SFO, T3) and 2% canola oil (CO, T4) sprayed on commercial fish feed with 20% CP. The feeding trial was conducted in cemented rectangular tanks with the stocking of 100 fingerlings per tank, average weight 20 g and each tank having a biomass of 2 kg for a period of 120 days. The results indicated that maximum final weight was observed in T1 (fish oil) (158 ± 2.0 g), followed by T2 (soybean oil) (142.5 ± 2.5 g), T4 (canola oil) (116 ± 4 g) and minimum final weight in T3 (sunflower oil) (101.5 ± 3.5 g). Overall growth performance was found satisfactory. Muscle and liver fatty acid profiles reflected dietary fatty acid composition. It is suggested that dietary oils (soybean, sunflower and canola) can be used to substitute fish oil in commercial diets.

INTRODUCTION

Fish is a rapidly growing food source of high value protein as well as micronutrients including vitamins, minerals and polyunsaturated omega-3 fatty acids [1]. Besides being an excellent source of polyunsaturated fatty acids (PUFA), proteins, vitamins and minerals that are essential for human diet, it has been reported by various researchers that the risk of cardiovascular diseases and other human health related problems can be reduced by consuming fish as an essential food source [2,3]. PUFA and fats, needed in diets, are of prime importance in producing prostaglandins, in modulating several processes of body i.e., swelling and blood clotting, in maintaining the integrity of cell membranes of all living organisms, in regulating body cholesterol metabolism and in absorbing fat-soluble vitamins A, D, E and K [4,5]. As a consequence, fish and its products must be significantly consumed in order to maintain human health [6,7].

Nutritionally balanced and formulated feeds are being used in the sustainable development of aquaculture since they play a crucial role in finfish and shellfish production. Fish oil and fish meal are considered as the prime protein ingredients in the feed of aquaculture sector [8,9]. It has been thought that fish oil derived by aquaculture is rich in long chain polyunsaturated fatty acids. Ironically, it was estimated that aqua-feed industries were utilizing 60% of the productivity of fish oil worldwide and now this exploitation has reached to about 71% [10]. Many studies have been performed regarding the partial or complete substitution of fish oils with dietary oils of plant sources in the fish feed [11-13]. Dietary oils rich in C18 polyunsaturated fatty acids (PUFA) are potential for fish oil replacement [14-16].

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To increase the propagation and sustenance of aquaculture sector, alternative viable lipid sources must be explored to use them as sustainable substitutes of fish oil such as different dietary (plant) oils, which are now being used in replacement of fish oil.

MATERIAL AND METHODS

Study area

The study was conducted in rectangular tanks of fish hatchery in the Department of Fisheries and Aquaculture, University of Veterinary and Animal Sciences, Ravi Campus, Pattoki.

Experimental setup

The trial was carried out in eight cemented rectangular tanks having dimension (10 Ч 3 Ч 2.5'). Each treatment was replicated twice, and the design of the experiment was completely randomized design (CRD).

Experimental fish and stocking density

Genetically Male Tilapia (GMT) progeny all males (XY) were used as experimental fish species and were stocked in eight rectangular tanks maintaining stocking density at 100 fish/tank with a total biomass of 2 kg with each fish having average weight of 20 gm.

Feed formulation and maintenance condition

Artificial feed with 20% crude protein (CP) level was procured from Oryza Organics Pvt. Limited and 2% of different oils (Fish oil, Soybean oil, Sunflower oil and Canola oil) was sprayed uniformly on feed with the help of a sprayer and fed to the experimental fish for three months at 3% fish wet body weight twice a day for six days of the week. The rectangular tanks were siphoned weekly to remove waste of fish and residual feed waste.

Feeding protocol

The fish was fed at 3% of fish wet body weight two times a day at 8:00-8:30 AM and 4:30-5:00 PM for a period of 120 days and feed ration was readjusted after monthly sampling.

Growth parameters studied

Morphometric measurements and growth parameters (initial weight and length) were recorded prior to stocking and on monthly basis of random sampling. Other growth parameters such as final weight, net weight gain, percentage weight gain, SGR and FCR were calculated.

Proximate analysis of fish feed and fish

Proximate analysis of fish and feed samples in terms of dry matter, ash content, crude lipid and crude protein was determined to evaluate the nutritive value of fish feed and fish according to AOAC (2006). Five fishes of same size were sampled from each experimental tank. The fishes were oven dried and grounded to powdered form which was then analyzed for proximate composition in fish nutrition laboratory, Department of Fisheries and Aquaculture, Ravi Campus, University of Veterinary and Animal Sciences.

Fatty acid profile

Fatty acid profile of feed and fish liver and muscles were analyzed at Faculty of Fisheries, Ataturk University, Erzurum, Turkey. Lipids were extracted from feed and fish samples in accordance with the procedure of Folch et al. [17]. According to the protocols given by Metcalfe and Schmitz [18], fatty acid methyl esters (FAME) were prepared and analyzed as described by Czesny and Dabrowski [19], in gas chromatography. The fatty acid composition of fish feed, fish muscle and liver will be determined by using Agilent 6890 GC apparatus.

Physicochemical parameters of water

Physico-chemical parameters such as dissolved oxygen (DO), temperature, salinity, electrical conductivity (EC), total dissolved solids (TDS), and pH of water were recorded on daily basis by using YSI Model 55 Dissolved Oxygen and Temperature System, Ohio, 4387, USA by setting the probes to their calculation unit.

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Statistical analysis

The data was analyzed by two-way analysis of variance (ANOVA) using the IBM SPSS Statistics v.2.0 Duncan's multiple-range test was used to compare differences among individual means. Treatment effects were considered significant at ($P \leq 0.05$).

RESULTS AND DISCUSSION

The results showed that maximum final weight was observed in T1 (Fish oil) (158 ± 2.0 g), followed by T2 (Soybean oil) (142.5 ± 2.5 g), T4 (Canola oil) (116 ± 4 g) and minimum final weight in T3 (Sunflower oil) (101.5 ± 3.5 g) as indicated by Ali et al. [20], that the type of dietary lipid significantly affected the growth performance of Shiau [21], reported that the growth performance of juvenile hybrid tilapia (O. niloticus Ч O. aureus) was better on diets containing lipids as compared to those fed lipid free diets. The statistical analysis indicated that the initial weight in all the treatments was not significantly different, however, final weight was found to be significantly different ($p<0.05$). The feed intake (g/fish) was comparable among treatments. Feed intake in T1, T2, T3 and T4 was 156.8 ± 13.1, 159.63 ± 13.5, 154.3 ± 13.9 and 151.9 ± 13.2 respectively. There was non-significant difference between treatments ($p>0.05$). Best FCR was shown in T1 which was 1.1 ± 0.0 while T3 showed poor FCR 1.5 ± 0.0 among all the treatments. There was non-significant difference among treatments. Data on the body composition of fish allow assessing the efficiency of transfer of nutrients from feed to fish and also helps in predicting the overall nutritional status. Both the endogenous and exogenous factors operate simultaneously to affect the composition of fish [22-24]. According to Hepher, endogenous and exogenous factors affect the body composition of fish. It should be noted that, the composition of the feed is the only factor, which could have influenced the difference in chemical composition of fish. In the present study the type of supplemented oil significantly affected the body composition of fish. Sagne et al. [25], stated that the type of dietary lipid significantly affected the body composition of fish. Fish fed diet B (75% FO+25% VO) showed higher body crude protein and higher body fat was observed in fish fed on diet E containing only VO (Soybean oil (SO) and Peanut oil (PO)) at 6% level, ratio 1:1) compared to initial fish which is in line with the present result.

CONCLUSION

It is concluded that dietary oils (soybean, sunflower and canola) can be used to replace fish oil in commercial diets without affecting the body composition and fatty acid profile of GMT.

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