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Effect of Fish Oil Substitution with Sunflower Oil in Diet of Juvenile *Catla catla* (Ham) on Growth Performance and Feed Utilization

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Abstract

During the present investigation *Catla catla* fry (0.250 ± 0.008 g) were fed with five iso-nitrogenous (40%) and iso-lipidic (6%) diets in triplicate @ 5% of body weight, for a period of 60 days. Diet A1 (control)was without supplemented oil i.e., whereas diets A2-A5were supplemented with 3% fish oil (FO) and sunflower oil (SFO) at different proportions i.e. diet A2 with(100% FO), diet A3 (70% FO+30% SFO), diet A4 (50% FO+50% SFO) and diet A5 (70% SFO+30% FO). After the end of 60 days of feeding trail a significant difference ($p<0.001$) was observed in weight gain (WG), specific growth rate (SGR), feed conversion ratio (FCR), feed conversion efficiency (FCE) and survival rate in oil supplemented groups as compared to control. The diet A4 shows the best result with 48.84% (WG), 0.193 (SGR) and 5.81 (FCR) 17.31 (FCE) and 96.81% survival rate. However, there was insignificant difference ($p>0.01$) in all the growth performance parameters between oil supplemented diets i.e. A2-A5. However, diet A1 (control) registered poorest performance i.e. 42.54% (WG), 0.271 (SGR), 7.75 (FCR), 12.88 (FCE) and 93.56% survival rate. The present result thus clearly revealed that sunflower oil could be partially replace the fish oil up to 50% in supplemented diet without any adverse effect on the growth performance of *Catla catla* fry, as it is less expensive and easily available.

Keywords: Fish oil; Sunflower oil; Growth rate parameters; Survival rate; *Catla catla*

Introduction

Fish oil derived from wild harvested whole fish currently constitutes the major aquatic protein and lipid source available within the animal feed marketplace. Due to expansion of aquaculture, it is expected that the total use of fish oil by aquaculture sector will decrease in long term. Thus alternatives to use of marine materials in fish feed must be found.

Vegetable oils used as alternative of fish oil consisted lately of an important part of the research on fish nutrition. Nevertheless, lipid digestibility was higher in diets containing vegetable oil than with animal lipid in Atlantic salmon fed diets based on flaxseed oil [1] and in Atlantic halibut fed diets based on vegetable oil [2].

Unlike fish oil, vegetable oils are less expensive and do not accumulate persistent organic pollutants (POPs), thus production costs can be lowered with vegetable oil based diets, as well as contaminant exposure for fish and consumers. Additionally, these feeds will not alter organoleptic properties of the fillets and will be highly digestible for fish.

Dietary lipids play an important role as potential supplier of energy, essential fatty acids and soluble vitamins. They also affect the quality of cultured fish because of their influence on the fatty acid composition of body tissues [3]. The addition of lipids in fish diets contributes to protein sparing by increasing their digestible energy value. Substitution of fish oil (FO) in fish aqua feeds has become inevitable due to the limited global supply of FO [4,5].

Since vegetable oil such as corn, soyabean, peanut, linseed, cotton seed oils contain high levels of n-6 and also significant amounts of n-3 fatty acids, they can be used in *Catla catla* diets. Takeuchi [6] reported that 5% supplement of corn oil or olive oil resulted in better growth and feed utilization than the addition of cod liver oil.

Thus, the current study investigates the effect of replacement of fish oil with sunflower oil on growth performance parameters, survival rate and body lipid composition of *Catla catla* fry (Ham.)

Materials and Methods

Culture conditions

Catla catla fry of initial weight 0.250 ± 0.009 were collected from the Govt. Fish Farm Gou Manhasa Jammu. Fish were acclimatized to the experimental conditions for a period of two weeks. During this period, they were fed with rice bran and mustard oil cake (1:1). To determine the initial body composition 20 selected fish on a random basis were killed for biochemical analysis. At the beginning of the experiment, one hundred and twenty five fry were randomly divided into five different groups, the fry were tried in triplicates manner. Fish were kept in plastic tub containers (50 L). Each plastic tub was put in re-circulating system maintained at (25 ± 2°C). The entire plastic tub was cleaned up every day in the morning by siphoning off the accumulated waste materials. Fish were then fed with 5% of body weight per day. Each diet was fed twice a day at 9:30 am and 4:00 pm for 60 days to triplicate groups. On the other hand, each group of fish was weighed in the beginning and after every 15 days and the amount of diet fed was adjusted accordingly. After 60 days of feeding, fish were taken out from each treatment; the dorsal muscle tissue of each was dissected and used for carcass composition analysis purposes.

Diet preparation

Five diets were formulated to contain approximately equal amount of digestible protein (40%) and digestible energy (14.86 cl/Kg). Main protein sources (fishmeal, soyabean and mustard oil cake) already grounded in mill was passed as particles through no. 40 (425 µm) mesh sieve. Mineral mix and vitamin mix were purchased from market.

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After all, ingredients were thoroughly mixed, and appropriate quality of water provided (30% for 100 g of mixed ingredients). Diets were supplemented with 3% of the mixture of fish oil (FO) and vegetable oil (VO) at varying levels. Diet A1 (without supplemented oil) diet A2 (with 100% FO), diet A3 (with 75% FO+25% VO) diet A4 (with 50% FO+50% VO) and diet A5 (with 25% FO+75% VO) (Table 1). Dough was passed through an extruder to produce spaghetti and dried at 37°C for two days. So, the concerned dried diet was packaged into plastic bag and stored until its usage.

The proximate composition of the experimental diets and samples of the fish muscle were determined by standard methods using hot air oven for moisture, ash, lipid, and protein content respectively (Table 2 and Figure 1).

Sampling and growth measurement

The fishes from each tub were captured once in a fifteen days and were weighed individually and their growth was assessed by calculating following growth parameters.

Percentage weight (%WG): It was calculated by using the formula:

$$\%WG=[(W_f-W_i)/ W_i] \times 100$$

Where W_f is the final weight of the fish W_i is the initial weight of the fish.

Specific growth rate: The formula used for calculating SGR was:

SGR=(In final weight-In initial weight) × 100

No. of days of experiment

Feed conversion ratio (FCR): the FCR was calculated by using the formula:

Treatments					
Ingredients	A1	A2	A3	A4	A5
Fishmeal	39	39	39	39	39
Rice bran	04	04	04	04	04
Wheat bran	04	04	04	04	04
Mustard oil cake	21	21	21	21	21
Soyabean oil	24	24	24	24	24
Vegetable waste	04	04	04	04	04
Fish oil(FO)	-----	03	2.10	1.50	0.90
Vegetable oil (sunflower oil)	------	---	0.90	1.50	2.10
Vitamin+minerals premix*	01	01	01	01	01

Table 1: Composition of experimental diets for *Catla catla*.

*Nutrition super forte (Rejuvenating combination of multivitamin and multi minerals, AROSOL chemicals PVT. Limited)

Vitamin A=700,0001.U; Vitamin D3=140,0001.U; Folic acid=100 mg; Vitamin E=250 mg; Niacin amide=100 mg; Iron=1500 mg; Iodine=325 mg; Cobalt=150 mg; Magnesium=6000 mg; Manganese=1500 mg; Zinc=3000 mg; Selenium=10 mg; Potassium=100 mg; Sulphur=7.2gm; Calcium=270 gm; Phosphorous=130 gm; Copper=1200 mg; Fluorine=300 mg

Treatments					
Composition	A1	A2	A3	A4	A5
Dry matter*	91.62	91.54	91.19	91.25	91.20
Crude protein*	38.10	38.07	38.08	38.09	38.05
Crude lipid*	5.95	8.79	8.80	8.82	8.84
Ash*	17.26	17.89	17.60	17.65	17.69
Energy (cal/Kg)	14.87	14.95	14.89	14.97	14.93

*presented in percentage of dry weight

Table 2: Proximate analysis of experimental diets fed *Catla catla*.

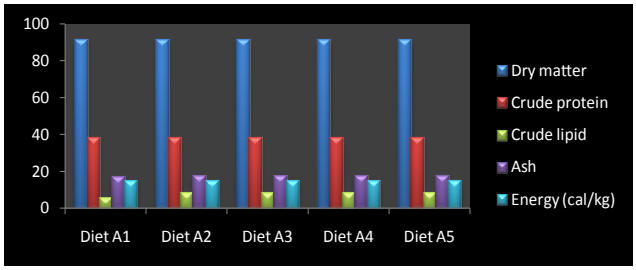

Figure 1: Proximate analysis of experimental diets fed *Catla catla*.

FCR=Feed fed/Gain in weight of fish

Feed conversion ratio FCE (%): It was calculated by using the formula:

FCE (%)=[(Gain in wet weight of fish/Feed Fed)] × 100

Statistical analysis

A one way analysis (ANOVA) was conducted in each and every experiment, using the computer software 'Analyses it'.

Results and Discussion

In the present investigation the results related to growth performance of juvenile *Catla catla* fed on different types of dietary lipids (Table 3). The present results clearly reveal that there was insignificant difference ($p>0.01$) in growth parameters among various oil supplemented diets A2-A5. However, highest growth performance i.e. 48.48 ± 0.208 and specific growth rate (SGR) 0.271 ± 0.005 was observed in the group A4 (50% FO+50% VO sunflower oil) followed by 45.85 ± 1.204 and 0.250 ± 0.001 in diets A2 (100% FO), 42.988 ± 1.777 and 0.215 ± 0.003 in A3 (75% FO+ 25% VO), 43.88 ± 1.777 and 0.204 ± 0.004 in A5 (25% FO+75% VO). Further, there was a significant differences ($p<0.01$) between Diets A2-A5 with 3% additional dietary oil (9% lipid) and Diet A1 i.e. Without oil supplementation (6% lipid), which registered a minimum growth increment i.e. 42.54 ± 0.982% and 0.193 ± 0.002 (SGR).

Similarly, best FCR and FCE were obtained in group fed on Diet A4. (6.73 ± 0.597 and 14.83 ± 1.325) followed by 6.74 ± 0.655 and 14.80 ± 1.33 in A2, 7.23 ± 0.737 and 13.81 ± 1.352 in A3, 7.36 ± 0.292 and 13.54 ± 0.518 in A5 and least in A1 i.e. 7.75 ± 0.70 and 12.88 ± 0.115.

The present findings are in accordance with Rosenlund [7] in Atlantic salmon, Caballero [8] in tilapia, Mourente [9] in *Dicentranchus labrax* and Kamaurudin [10] in *Tor tambroides* , who reported that partial replacement of fish oil up with vegetable oil in fish shows better growth performance without any adverse effect on growth and feed utilization (Table 3). They also attributed this to the sparing effect of dietary protein by increasing dietary lipid levels due to oil supplementation. Bahurmiz and Ng, Gao et al. and Yones et al. [11-13] while working on supplementation of various dietary oils in different fishes reported insignificant differences ($p>0.01$) in FCR, FCE and PER in groups fed on supplemented Fish oil (FO) and a mixed diet containing Fish oil ,soyabean oil and cottonseed oil. However, fishes fed on a mixed diet perform better in terms of feed utilization. They suggested that better growth performance may be due to presence of a balanced proportion of n-3/n-6 fatty acids in the mixed diet which are required for a better growth and feed utilization in fish.

Result of the present study thus suggested that potential exists for

	Treatments				
Parameters	A1	A2	A3	A4	A5
Initial weight g/fish	0.230 ± 0.009	0.261 ± 0.004	0.239 ± 0.003	0.280 ± 0.007	0.233 ± 0.002
Final weight g/fish	0.329 ± 0.005	0.380 ± 0.007	0.341 ± 0.001	0.424 ± 0.003	0.336 ± 0.001
Weight gain g/fish	0.099 ± 0.003	0.119 ± 0.004	0.102 ± 0.003	0.144 ± 0.004	0.103 ± 0.005
SGR	0.193 ± 0.002	0.250 ± 0.001	0.215 ± 0.003	0.271 ± 0.005	0.204 ± 0.004
FCR	7.75 ± 0.070	6.74 ± 0.737	7.23 ± 0.292	5.81 ± 0.591	7.36 ± 0.292
PGR	42.54 ± 1.777	45.85 ± 1.204	43.88 ± 1.777	48.48 ± .0208	42.54 ± 1.777
FCE	12.88 ± 0.115	14.8 ± 1.352	13.81 ± 0.518	17.31 ± 1.325	13.54 ± 0.518
Survival (%)	93.56 ± 1.045	95.76 ± 0.532	95.47 ± 1.50	96.81 ± 0.50	95.26 ± 1.20

Table 3: Initial, final weight, weight gain, SGR, FCR, PGR and survival of *Catla catla*.

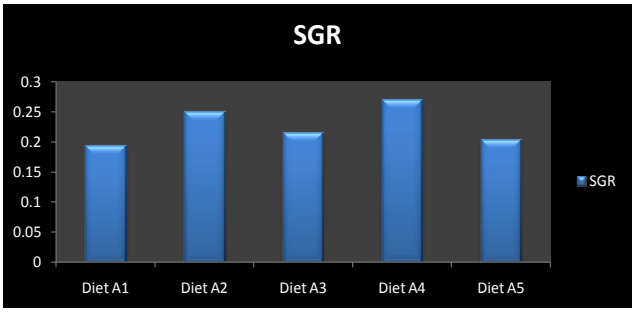

Figure 2: Showing SGR of *Catla catla*.

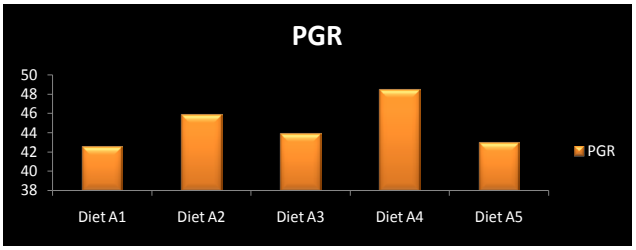

Figure 3: Showing percentage growth rate (PGR).

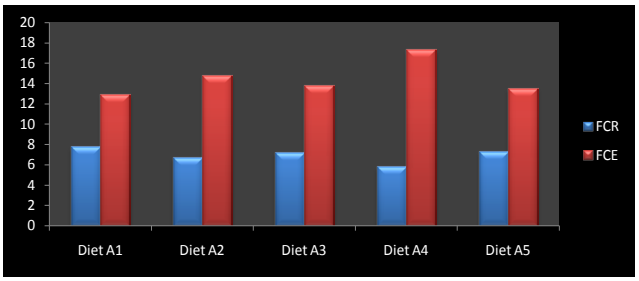

Figure 4: Showing FCR and FCE *Catla catla*.

replacing costly FO with 50% of cheap and easily available sunflower oil in the feed of *Catla catla* juvenile, without compromising the growth performance and feed utilization (Figures 2-4).

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