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ORIGINAL ARTICLE

BIOCHEMICAL CHANGES INDUCED BY ALGAE SPIRULINA ON FRESH WATER FISH, *CATLA CATLA* (HAMILTON)

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ABSTRACT

Aquaculture is one of the fast growing systems in the world. The future development of aquaculture greatly depends on the development of alternative feed ingredients that can provide higher resistance against pathogens and protein source. Spirulina can be considered as a nutritional supplement that has various health benefits for humans, and a feed supplement for animals like fishes having economic benefits. It can be a suitable food supplement when fed to fishes. It has been found that the alga can be used as an alternative source of protein. Now days, Spirulina can be used to establish immune-potentiating functions in aquatic organisms like fishes. The present study is to assess the protein and lipid content in Gill, liver and kidney of the fresh water fish *Catla catla* exposed to different concentration of spirulina with formulated feed. In the first group T1 (control) 10 fishes were exposed to 15 gram of formulated feed, in the second group T2 (experiment 2) 10 fishes were exposed 7.5 gram of spirulina with 7.5 gram of formulated feed and in the third group T3 (experiment 3) 10 fishes were exposed 10 gram of spirulina with 5 gram of formulated feed for the period of 30 days. In the present investigation, Gill, liver and kidney of protein and lipid levels were increased when *Catla catla* was exposed different concentrations of spirulina with formulated feed. The increase in protein content in the present study indicates that the tissue protein not undergoes proteolysis. Fish fed with diets containing spirulina exhibited higher protein values. The present study indicates high protein content in group-2 (fishes treated with 7.5 gram spirulina with 7.5 gram of formulated feed) and group-3 (fishes treated with 10 gram of spirulina with 5 gram formulated feed) may be due to spirulina improved fish utilization of protein ratio. This present study clearly indicates that there was no toxic effect influenced by spirulina on freshwater fish *Catla catla and* ultimately spirulina increased the level of protein and lipid content.

Keywords: *Catla catla*, Spirulina, Protein,Lipid

1.INTRODUCTION

Fisheries have always played a very significant role in many countries and communities, fish is a vital resource towards poverty reduction and food security for poorer households (FAO, 2010). In aquaculture, different forms of Spirulina were tested in various fishes (Ungsethaphand *et al.,* 2010). It has been found that the alga can be used as an alternative source of protein (Watanuki *et al.,* 2006). Spirulina can be considered as a nutritional supplement for animals having economic benefits. In general, Spirulina produced better in *Catla catla* results in increased growth rate and biochemical performance. Spirulina diets were most effective in stimulating fish growth and is consider as a rich source of protein, vitamins, minerals, essential amino acids, and fatty acids, antioxidant pigments such as carotenoids and vitamin E and trace elements (Belay *et al.*, 1996). When Spirulina alga is used as feed for young prawns and fingerlings, the fish exhibit low death rate and a high growth rate (Sermwattanakul & Bamrungtham, 2000). The effects of this diet on the growth performance, meat quality and immunity stimulating capacity of fish were increased. Spirulina is suitable for animal feeding (Cohen, 1997). *Spirulina* could be an excellent source of useful nutrients (Glombitza and Koh, 1989) as well as a good energy source that can be used as crucial component for animal feeding (Kishimoto *et al.*, 1994)

Fish is an important dietary animal protein source in human nutrition. Production of aquatic species through freshwater fisheries and aquaculture for protein supply is being encouraged throughout the world. According to nutritionists, fish is an excellent substitute of protein for red meat. Fish

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flesh contains proteins and all the essential amino acid and minerals (Sandhu, 2005). Lipid contents of *S. platensis* are only 4–7%, but it has important essential fatty acids for humans: gamma-linolenic acid and linolenic acid. These components are also mediators of immune and cardiovascular system due to their precursor effects of prostaglandins and leukotrienes (Kulshreshtha *et al.,* 2008). *Labeo rohita* improved the food utilization parameters like feed intake, consumption rate, weight gain and growth rate significantly as the percent dose of *Spirulina platensis* was increased in a short period of time(Shelke and Wni, 2015). Spirulina is an edible blue green micro alga has received much attention as a most promising and food source. Several studies have been conducted to investigate the effects of spirulina on growth, nutrient utilization and immune responses of various fish species, including rainbow trout *Oncorhynchus mykiss* (Matty and Smith, 1978), common carp *Cyprinus carpio* (Nandeesha *et al.,* 1998), tilapia *Oreochromis niloticus* (Takeuchi *et al.,* 2002). Spirulina (*Arthrospira platensis*) is a highly nutritious, protein-rich and edible cyanobacterium. Therefore, alternative protein-rich supplements such as Spirulina, are essential to future industry stability and development (Hume *et al.,* 2011). This study is aimed to elucidate the effect of Spirulina on biochemical in a freshwater fish *Catla catla*. The present study is to assess the protein and lipid content in Gill, liver and kidney of the fresh water fish *Catla catla* exposed to different concentration of spirulina combined with formulated feed for the period of 30 days.

2.MATERIALS AND METHODS

The fish *Catla catla* having mean weight of 170-175 gm and length of 23 – 25 cm were collected from KRP Dam located at Krishnagiri, Tamilnadu, India, and acclimatized in to laboratory conditions. They were given the treatment of 0.1% KMNO4 solution and then kept in plastic pools for acclimatization for a period of two weeks. They were fed on rice bran and oil cake daily. Test fishes were critically screened for the signs of disease, stress, physical damage and mortality. The injured, severely diseased, abnormal and dead individuals were removed. Feeding was discontinued two days prior to the commencement of the experiments to reduce the additive effects of animal excreta in the test trough (Arora *et al.,* 1972). In the first group T1 (control) 10 fishes were exposed to 15 gram of formulated feed, in the second group T2 (experiment 2) 10 fishes were exposed 7.5 gram of spirulina with 7.5 gram of formulated feed and in the third group T3 (experiment 3) 10 fishes were exposed 10 gram of spirulina with 5 gram of formulated feed for the period of 30 days. A treated groups were maintained with identical environment. The water was renewed every day for both control and treated. At the end of 30th days of exposure both the control and treated fishes were sacrificed and the required tissues gill, liver and kidney were collected for protein and lipid estimation. Protein contents in the tissues were estimated by the method of Lowry *et al*. (1951). Total lipid content of the tissue were estimated by the method of Folch *et al.*, 1957. The data so obtained were analyzed by applying analysis of variance DMRT one way ANOVA to test the level of significance (Duncan, 1957).

Table–1 Physical properties and Chemical composition of *Spirulina platensis* (g/100 g sample, on dry weight basis)

Component	Values %	Physical properties	Values
Moisture content	5.37 ± 0.24	pH	6.93+0.12
Total solids	94.63	Bulk density	0.84+0.02 kg/lit
Protein content	61.57	Particle size	100% 60 mesh
Lipid	7.19 ± 0.25	Appearance	Fine, uniform powder
Ash content	7.10 ± 0.09	Color	Blue green to green
Crude fibre	7.93 ± 0.38	Odor and taste	Mild like sea weed
Starch	3.47 ± 0.06	Consistency	Powder

The physical properties and Chemical composition of spirulina are obtained by Habib et al., 2008.

3.RESULTS

PROTEIN LEVEL

The present results revealed that spirulina treated groups were not altered protein metabolism. The results showed significant elevation of protein in gill, liver and kidney of *Catla catla* exposed to different concentration of spirulina (T2,T3) with formulated feed while comparing control group(T1) for the period of 30 days. (Table-2).

LIPID LEVEL

The results showed significant elevation of lipid in gill, liver and kidney of *Catla catla* exposed to different concentration of spirulina with formulated feed (T2,T3) while comparing control group (T1) for the period of 30 days.(Table-3).

Table – 2 Protein level changes in various organs of *Catla catla* exposed to different concentration of *S. platensis* for 30 days of exposure

Experimental Group	Gill [mg/g]	Liver [mg/g]	Kidney [mg/g]
Control (T1)	94.43 ± 0.29^{a}	114.72 ± 0.37^{a}	87.73 ± 0.39^{a}
Treatement - 2	207.01 ± 0.38^{b}	116.13± 0.62^{b}	147.19 ± 0.58^{b}
Treatement - 3	301.29 ± 0.57^{c}	124.31 ± 0.63^{c}	165.40 ± 0.39^{c}

Values are mean ± S.D., Sample Size (N) = 6.
Different letter designations denote significant at $p < 0.05$ level between exposure groups.

Table – 3 Lipid level changes in various organs of *Catla catla* exposed to different concentration of *S. platensis* for 30 days of exposure

Experimental Group	Gill [mg/g]	Liver [mg/g]	Kidney [mg/g]
Control (T1)	4.90 ± 0.49^{a}	18.11 ± 0.41^{a}	16.00 ± 0.31^{a}
Treatement – 2	15.46 ± 0.68^{b}	27.81 ± 0.53^{b}	24.62 ± 0.47^{b}
Treatement – 3	26.45 ± 0.72^{c}	36.90 ± 0.62^{c}	32.36 ± 0.52^{c}

Values are mean ± S.D., Sample Size (N) = 6.
Different letter designations denote significant at $p < 0.05$ level between exposure groups.

4.DISCUSSION

PROTEIN LEVEL

Biochemical studies are the best studies to assess the health and functional activity of fish, which helps to analyze the effect of feed like spirulina in vital tissues. Tissues, Gill, liver and kidney showed higher protein content which might be due to greater concentration of enzyme. Liver is the site of metabolism (Harper *et al.,* 1977). The liver plays an important role in the synthesis of proteins. Protein content rich in the liver than other organ for various metabolism in the fish. In the present investigation protein level is increased in gill, liver and kidney of fresh water fish *Catla catla* exposed to different concentrations of spirulina with formulated feed. Bhaskaran (1980) and Manoharan and Subbiah (1982) reported that depletion in protein level was due to diversification of energy to meet the impending energy demand when the animals were under toxic stress. This present study clearly indicates that there was no toxic effect influenced by spirulina on freshwater fish *Catla catla*. Protein provides sufficient nutrient and energy to support the acceptable growth rates and nutrient utilization of *Catla catla*. The increased level of protein content in gill, liver and kidney (T2 and T3) of the present study indicates that the tissue protein not undergoes proteolysis. Fish fed with diets containing spirulina exhibited higher protein values. The present study indicate high protein content in group-2 (fishes treated with 7.5 gram spirulina with 7.5 gram of formulated feed) and group-3 (fishes treated with 10 gram of spirulina with 5 gram formulated feed) may be due to spirulina improved fish utilization of protein ratio. These results agreed with Soivio *et al*. (1989) who concluded that the differences in protein content of fish body composition may be related to changes in their synthesis, deposition and difference in growth rates. For the improvement of the biological value of dietary protein, the supplemented diets spirulina performed more effect (Ringo and Gatesoupe, 1998).

LIPID LEVEL

Lipids are the best energy producers of the body next to carbohydrates. Dietary lipids play important roles as a source of energy and essential fatty acids necessary for fish growth and development. In common the decreased level of tissue lipid content may be due to liver dysfunction or mobilization of glycerol or inhibition of oxidative phosphorylation (Chezhian *et al.,* 2010). Gilbert and Connor (1970) reported that lipids are vital to embryogenesis, providing two third of energy by oxidation. Lipids act as reversed depot of energy from where the energy is supplied as and when required. Recently, nutritional studies evaluating availability of dietary lipid source and substitution of fish meal with soybean meal for growth in this species have been performed (Kim *et al.,* 2009). In the present investigation, there was a increase in the lipid content of gill , liver and kidney of *Catla catla* exposed to different concentrations of spirulina (T2 and T3) observed. This present study clearly indicates that there was no toxic effect influenced by spirulina on freshwater fish *Catla catla*. Spirulina provides sufficient lipid nutrient and energy to support the acceptable growth rates and nutrient utilization with increasing dietary protein levels of *Catla Catla*. In this study, the lipid contents of fish were positively correlated with dietary lipid level. High lipid diets seem to have more beneficial effects for fish performance compared to low lipid diets (Ahmad, 2008).

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