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## Effect of dietary *Spirulina* on the breeding behaviour of *Poecilia reticulata*

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### Abstract

In this study the effect of dietary supplementation of *Spirulina* (5%) were observed in comparison to the control groups on breeding performance of the freshwater fish *Poecilia reticulata*. The experiment was carried out in the P.G. laboratory, Department of Aquaculture, College of fisheries, G.B Pant University, for the time period of 45 days. This site is present in Tarai region Distt. Udham Singh Nagar of Uttarakhand State. Fish fed with a 5% *Spirulina* diet performed breeding earlier than the control groups. At the end of the experiment there were no significant changes in terms of the average length. As a result of the study it can be concluded that 5% *Spirulina* diet can induce breeding in the fish.

**Keywords:** *Spirulina*, Breeding, *Poecilia reticulata*, physico-chemical parameters

### 1. Introduction

With the ever-growing demand of *Spirulina* as a potent protein source, to be used directly or indirectly for human consumption, it has gained quality and importance throughout the globe. The potential of *Spirulina* as a rich source of protein was evident as early as 1940, since it was much used as a part of the diet of the village folks in Africa and the United Mexican States [1]. In the recent days, *Spirulina* had found application in numerous fields like agriculture, wastewater treatment [2], aquaculture practices, nutrient exercise and production of valuable chemicals ( $\beta$ -carotene and phycocyanin). *Spirulina* cultivation is widespread for aquaculture application notably for the employment of pigments as feed for tropical fish [3]. *Spirulina* is employed in aquaculture as a feed to young fishes to complement foods of ornamental fish, shellfish and bivalves.

*Spirulina* is one amongst the essential nutrients needed within the diet of the fishes. Once it is given in sufficient quantity along with fat within the diet, it is employed for growth and development. If not, then it could also be used for energy and life support instead of growth. So, proteins not solely give growth, however conjointly energy for the survival of the fishes. Dietary protein is vital for each the corporal growth and replica processes of Poeciliidae for fry production to be optimized and studies have shown that a minimum of 30% protein is important for fish broodstock [4].

Microalgae being used in cultivation for the farming of aquatic animals like invertebrate, shrimp, and fish; are used because of the nutritional supply in cultivation [5]. *Spirulina* is one in all the foremost unremarkably used microalgae in aquatic animal feeds because of its high contents of protein, vitamins, essential amino acids, minerals, essential fatty acids and inhibitor pigments like carotenoids [6]. *Spirulina* is enriched with raw protein and has seven major vitamins – A1, B1, B2, B6, B12, C and E. It has high nutritional importance, and is five times easier to digest than the meat and soy protein typically found in industrial fish foods due to soft cytomembrane made from complicated sugars and protein. *Spirulina* also has good amount of 'Phycocyanin', a supply of biliverdin that is among the foremost potent of all intracellular antioxidants. It helps within the production of red blood cells and white blood cells also bears antiviral and anti-cancer properties due to a special polymerized sugar molecule, known as Calcium-Spirulan, that has Sulphur and metal which are further vital components for fishes in aquarium since they usually lack these nutrients. Calcium-Spirulan prevents viruses from penetrating the cell membranes thus, prevents it from infecting the cells. Several aquatic studies have shown positive results on growth, feed utilization along with stress and illness resistance. *Spirulina* has shown to increase immune responses by promoting vegetative cell and natural killer activities [7]. High protein content proportion of *Spirulina* and its well-balanced amino alkanolic acid profile compared with alternative plant sources makes it

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as potential feed replacer within the aquafeed formulation [8]. *Spirulina* was reported to exchange up to four-hundredth of feed macromolecule in Tilapia (*Oreochromis mossambicus*) diet [9] and even higher replacement of feed was potential in common carp (*Cyprinus carpio*) [10] and Mekong big catfish (*Pangasianodon gigas*) [11].

At present an experiment is being performed aiming at finding property substitutions for the feed. Non-conventional feed like *Spirulina* having a high protein level of sixty-two amino alkanolic acid content severally in dried type and might be used as protein supply in aquarium fish culture that not solely replace feed, however conjointly offer alternative essential nutrients like vitamins still as a full vary of useful minerals. It has urged that the raised use of plant protein in fish diets will scale back the price of feed and feeds [12] because it reduces its high demand.

## 2. Materials and Methods

### 2.1 Geographical site and climatic condition of the experiment area

- The experiment was carried out in the P.G. laboratory, Department of Aquaculture, College of fisheries, G.B Pant University, for the time period of 45 days. This site is present in Tarai region Distt. Udham Singh Nagar of Uttarakhand State. The coordinates of College of Fisheries, Pantnagar are 29°N latitude, 79.30°E longitudes and present in Tarai belt of Himalayan foothills at an altitude of 243.3m above mean sea level (MSL).
- For the experiment, the tanks were filled with tap water and left for 24 hours for the dechlorination.

### 2.2 Supplementary Diet

- Already prepared 5% *Spirulina* feed and control diet was fed to the fishes during the experiment. Feed composition of the fish feed in the present investigation were fish meal, soya bean cake, rice bran, vitamins & minerals premix and dried *Spirulina* powder.
- Proximate and percent composition of ingredients of both the diets were already known.

**Table 1:** Percent composition of 5% *Spirulina* diet

Ingredients	Percentage
Fish meal	31.05
Rice bran	40.65
Soya bean meal	22.30
Premix vitamins + Minerals	1.00
<i>Spirulina</i> powder	5.00

**Table 2:** Percent composition of control diet

Ingredients	Percentage
Fish meal	35.20
Rice bran	41.50
Soya bean meal	22.30
Premix vitamins + Minerals	1.00

**Table 3:** Proximate composition of Control diet

Ingredients	Percentage (%)
Moisture	8.56
Crude protein	39.85
Lipid	10.41
Ash	9.78

**Table 4:** Proximate composition of *Spirulina* diet

Ingredients	Percentage (%)
Moisture	8.56
Crude protein	39.80
Lipid	10.50
Ash	10.07

### 2.3 Procurement of experimental fish and maintenance

48 healthy and active mature brooders of *Poecilia reticulata*, size 1.9-3.6cm and weight 0.5-2.1gm were collected, divided into two groups and offered with different 5% levels of *Spirulina* diet and a control diet (0% *Spirulina*). Each group consisted of 8 individuals, with 3:1 ratio of female:male was reared in tanks of capacity 50 litres. Triplicates were maintained for both *Spirulina* and control diet. Tanks were provided with the continuous aeration and 5-10% water exchange every fortnight depending on the faecal accumulation. To check and maintain the healthy state of the fishes, parameters including pH, temperature, dissolved oxygen and breeding behaviour were observed for the experiment conducted.



**Fig 1:** Brood fish (Female)

### 2.4 Experimental design

Six glass aquariums of capacity 50 litres were used to conduct the experiment. Prior to the commencement of the experiment the glass aquariums were cleaned and disinfected with lime water and  $\text{KMnO}_4$ , they were then filled with tap water and continuous aeration was provided to the water through aerators. Cleaning of the aquarium and removal of leftover feed and excreta were done by siphoning with water exchange of 25% on every alternate day throughout the study period. Fresh tap water was used to refill the aquarium and continuous aeration was provided.

## 3. Results and Discussion

This chapter narrates the results of the studies conducted to assess the effect of *Spirulina* powder on breeding performance of Guppy (*Poecilia reticulata*), as *Spirulina* is a rich source of proteins. The water temperature recorded in the experimental tanks were within the acceptable range of 23-28°C. Optimal temperature for reproduction in all live bearers are reported to be between 22 and 26 °C [13]. Dissolved oxygen (5.8-6.7 mg/l) and pH values (7.4-7.7) were also within the admissible range throughout the experimental period. Since the water quality parameters were maintained throughout the experimental period for the growth and reproduction of guppy, there was no effect of water quality parameters on the same.

**Table 5:** Table showing the range of water quality parameters during the study period

Parameters	Minimum	Maximum
Temperature (°C)	23	28
Dissolved oxygen (mg/l)	5.8	6.7
pH	7.4	7.7

Triplicates of each treatment were made and the results of the experiments were recorded. Since, the dietary protein is crucial for both the somatic growth and reproduction processes of Poeciliidae for fry production to be optimized and studies have shown that a minimum of 30% protein is necessary for fish brood stock (Alexander *et al.*, 2004)<sup>[4]</sup>, in present experiment the brooders fed with 5% *Spirulina* diet started breeding 10-15 days earlier, showing breeding stimulation, as compared to the brooders fed with the control diet. Survival of fish larvae was 80-85%.

### 3.1 Reproductive performance

Protein and lipid levels of broodstock diet have been identified as essential dietary factors determining efficacious reproduction and survival of off-spring<sup>[14, 15, 16]</sup>. The diets with 30 to 40% protein appeared to be the best for gonadal development since those diets resulted in the greatest mean ovary weight and in the largest mean number of yolky oocytes in the ovary of guppy<sup>[17]</sup>. The fish fed with 5% *Spirulina* diet, which contained 39.85% crude protein and 10.41% crude lipid had a significantly higher breeding performance than control groups.

Fertility is the number of young ones produced by an individual, in this experiment which occurred in *Spirulina* fed brooders prior to control diet ones showing stimulation in the fish fertility. In the present study, it was observed that *Spirulina* is a good source of protein for fishes. 5% *Spirulina* can be incorporated in the fish diet to replace fish meal. Improvement in fish performance in terms of breeding behaviour was observed with the incorporation of *Spirulina* concentration in the diet. Hence, it can be concluded from the study that-

- *Spirulina* fed fishes performed breeding 10-15 days earlier as compared to fishes fed with a control diet.
- *Spirulina* can be easily used as a cost-effective protein supplement for enhanced breeding of the fish.

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