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Impact of Household Chemicals on the Ornamental Fish *Poecilia sphenops* (Valenciennes)

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ABSTRACT

This study examined the impact of various household chemicals, such as Surf excel, hair dye, popular soap, fabric softener, shampoo, and coconut oil, on the ornamental fish *Poecilia sphenops* (Valenciennes in Cuvier and Valenciennes, 1846). Length-weight relationships, gonadosomatic and hepatosomatic indexes, oxygen consumption, and opercular beat rate were measured to assess the effects of the chemicals (10, 20, and 30 ppm) on the fish. Results showed that at higher concentrations of the chemicals, the fish exhibited increased breathing and signs of distress. The temperature of 28°C was found to be optimum for the growth of *P. sphenops*, while the lowest growth performance was shown at temperature 30°C. Fish ranged from 37 to 67 mm in total length and 1.10 to 3.10 g in body weight. The female to male sex ratio (4.9:1) deviated significantly from the unity (χ^2= 214.2, $p<0.05$). These findings indicate that the presence of such noxious chemicals are deleterious to natural populations of fish, and that the irresponsible discharge of sewage water into water bodies should be avoided.

Keywords: Ornamental Fish, Length-Weight Relationship, Operculum Movement And House Hold Chemicals

I. INTRODUCTION

Members of the Cyprinodontiformes order are widely distributed across tropical and temperate latitudes. Poeciliids, a family within this order, consist of nearly 200 species of small fishes, typically measuring less than 50 mm in length. These species are mainly found in tropical and subtropical regions of the New World [1]. *Poecilia sphenops* is known for its remarkable tolerance, residing in a variety of aquatic environments, from clear to turbid water, and in slow-moving or still water bodies, such as streams, flood ponds, lagoons, reservoirs, and lakes [2]. Length-weight relationships (LWRs) and relative condition factor are essential in fisheries assessment studies as they provide information about the growth of the fish and its general health. Gonadosomatic index (GSI) and Hepatosomatic index (HSI) are two key parameters

used to study the reproductive biology of a species, with GSI in particular indicating the reproductive seasonality. HSI is also a reliable indicator of the effects of organic pollutants.

Water is essential for life on earth, but unfortunately, many of its bodies are becoming murky, smelly and overgrown with algae. A multitude of chemicals, such as pesticides, household chemicals, heavy metals, sewage, hair dye, oils, softeners, herbal syrups, and other industrial waste, have been added to rivers and are having devastating effects on living organisms, including humans [3]. These pollutants are not only highly toxic but are also highly resistant to degradation, making them bio-accumulate in the bodies of animals. Furthermore, the dumping of domestic sewage into fresh water resources has had a serious impact on the aquatic habitat, leading to the decline of numerous fish species. Opercular beat rate is one measure of the response of fish to stress; increased opercular activity leads to increased oxygen consumption [4&,5].

Many chemicals have been known to possess acute toxicities for a wide range of animals, including human beings. Others may not be as toxic, but they are highly resistant to degradation in the environment, and can accumulate within the body of organisms, potentially causing adverse effects. The irresponsible use and dumping of domestic sewage into fresh water resources has been detrimental to the various life forms of aquatic habitats. A number of fish species that were plentiful in years past have been unable to survive the increased concentrations of chemicals found in the water bodies[6]. Operculum beat rate has been used as a measure of stress response in fish. Counting the movement of the operculum is one way to calculate respiration rates. Increased operculum activity leads to increased oxygen consumption [7&8]. In the present investigation, the effects of organic anf synthetic chemicals (xenobiotics) on *P.sphenops* fish were studied at varying water temperatures (30°C and 25°C). Changes in operculum beat and respiratory rate were reported.

II. METHODS AND MATERIAL

2.1.Fish collection and acclimatization:

Freshwater fish *P.sphenops* of was collected from Fish Aquarium (Nazir), Palayamkottai, Tirunelveli district. The fish were brought in plastic buckets without any mechanical injury and kept in aquaria for a week to get acclimated to the laboratory condition. Water in the tanks was changed every day to ensure sufficient oxygen supply to fish and they were fed with formulated feed rice bran and oil cake.

2.2. Length -Weight Relationship (LWR)

The present study different size of fishes were used. The fishes were cleaned and excess water was removed by blotting paper. After cleaning, the fishes were weighed up by a digital balance. The total length was measured from tip of the snout to the end of longer lobe of caudal fin [9].

2.3. Gonado somatic and Hepato somatic indexes

The gonado somatic and hepato somatic indexes (GSI and HSI respectively) were calculated using the following equations:

GSI = [gonad weight / total tissue weight] × 100

HSI = Weight of liver of fish/Body weight of fish x 100
Gastro somatic Index = Weight of gut/weight of body × 100

2.4.Oxygen consumption (DO)

The oxygen consumption was determined using the Winkler's method. The Winkler test was used to determine the level of dissolved oxygen in water sample [10].

2.5. Operculum movements (OP)

The ornamental fish *P.sphenops* which has been selected for study. All fishes used for study were of the size (07-60mm) and weight (0.90-6.0gm). The fishes of

different size were sorted according to their size. Opercular beat rate also has been used to provide a measure of response to stress in fishes. Counting operculum movement is a way to calculate respiration rates. Increased opercular activity can lead to increased oxygen consumption [11].

2.6. Organic and synthetic products

In this experiment the organic and synthetic products of Surf excel, hair dye Black rose, popular soap [Lifebuoy] Fabric softener [Comfort], Shampoo [Dove] and Coconut oil (VVD) were purchased from the local shops at Palayamkottai. The three concentrations 10 ppm, 20 ppm, and 30 ppm were prepared and the *P.sphenops* fish were exposed to this organic and inorganic chemicals. The respiratory response, opercular movements of *P.sphenops* was calculated.

III. RESULTS AND DISCUSSION

The length and weight measurements *P.sphenops* was recorded. A total of 15 fish of 13 fish species were measured and weighed. The total length (cm) of each fish was measured from the tip of the snout (mouth closed) to the extended tip of the caudal fin using a measuring board. Bodyweight was recorded to the nearest gram using a balance. Total body length ranged from 60 to 24mm for females and from 20 to 60 mm for males, with a weight between 1.7 and 3.4 g for males and 1.7 to3.2 g for females. The TL mean for females and males did not differ significantly (*t*-student = - 1.17; p=0.2436). However, the relationship between standard length and total length was statistically significant: SL=-0.229+0.794 TL, (r^2=0.9462, p<0.05).

Sexual dimorphism was evident when examining *P. sphenops* morphological features, the main sexual character being a modification of theanal fin forming a gonopodium in males. Of the 15 specimens dissected 8 females (53.3%), 5 males (33.33%) and 2 individuals with no differentiated sex (13.3%). Fish ranged from 37 to 67 mm intotal length and 1.10 to 3.10 g in body weight (Figure.1). The female to male sex ratio (4.9:1) deviated significantly from the unity (χ^2= 214.2, p<0.05) females were dominated.

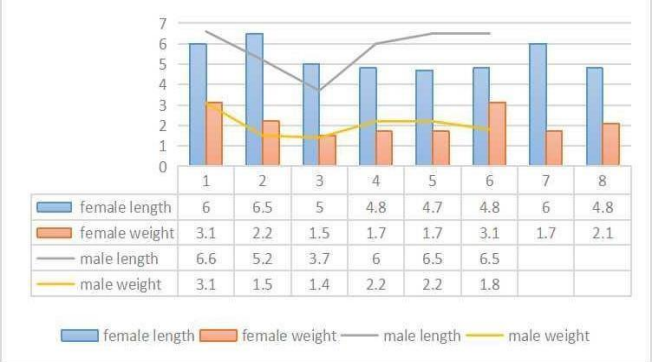

Figure: 1. Length and weight relationship of *P.sphenops*

P.sphenops oxygen consumption has increased with 1/3rd sub lethal concentration of both household chemicals with increase in time. At 2/3rd sub lethal concentration of both household chemicals, significant decrease in oxygen consumption with an increase in time was noticed from 48 hours of exposure (Figure.2 &3).

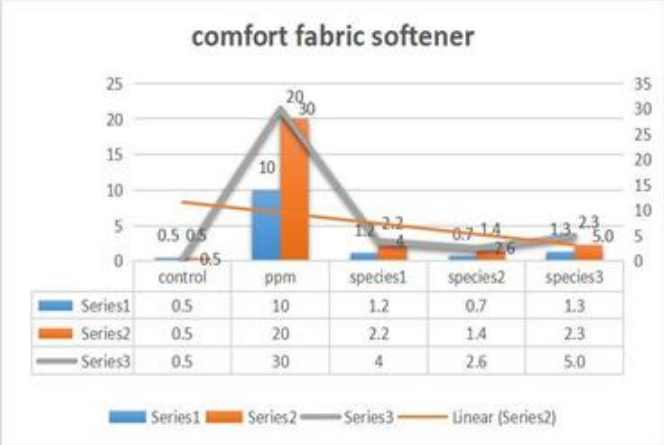

Figure: 2. Effect of fabric softener on *P.sphenops* oxygen consumption rate

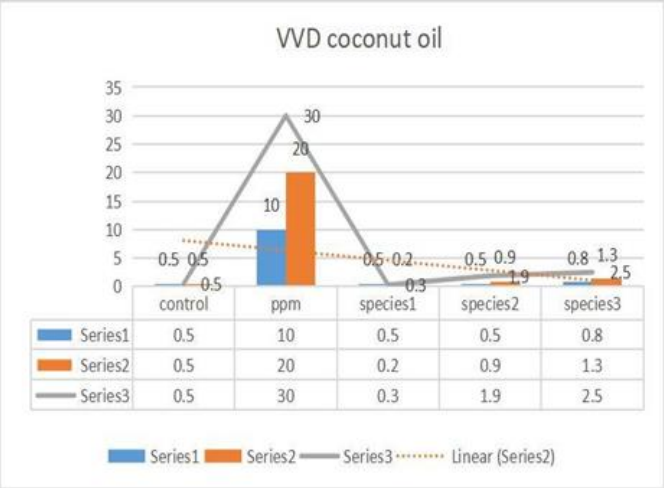

Figure: 3. Effect of coconut oil on *P.sphenops* oxygen consumption rate

Similar results have been noticed by many workers [4,6,7,12,&13] When experimental fishes were introduced into water containing household chemicals, at higher concentrations, they started showing discomfort within few minutes and began to move rapidly. *P.sphenops* exhibited a variety of behavioral responses like opercular movement was 20-25 times more faster than controlled, loss of nervous control, try to jump out of media. Body was slimy due to mucus secretion from epithelium of gills. The fishes were surfacing frequently. Affected fishes were swimming on lateral side of the body; nervous control and equilibrium were lost. During tests, the test fish exhibited several behavioral changes beforedeath such as restlessness, rapid swimming and respiratory distress [6,12,&13]

From the above room temperature effect of 30ºC respiratory rate of *P.sphenops* was seen increased 68.73 as compared to control fish respiratory rate. While in 20ºC treatment respiratory rate of *P.sphenops* fish was found to be decreased 40.35 ascompared to control (50.82). The study indicate that the increases and decreases in temperature of water impacts on the opercular rate of freshwater fish *P.sphenops* which shows the increasing trend in respiratory rate with increase in temperature 30˚C while decreasing trend in respiratory rate with decrease in temperature 20˚C, which affects stress on the metabolic process of freshwater fishes. Thus there is need of maintaining temperature of water and environment temperature forpreservation of local freshwater fish *P.sphenops* for long time.

Opercular ventilation rate as well as visual examination of dead fish indicates lethal effects of the household chemicals on the fish [10,11&13]. The *P.sphenops* dissolved oxygen consumption increased when it was exposed to the water containing household chemicals(Figure.4).With increase in the concentration of the household chemicals, increased breathing and signs of distress were exhibited by the fish. The house hold chemical molecules can penetrate and solubilize the lipid content of cell membrane and may reduce its permeability

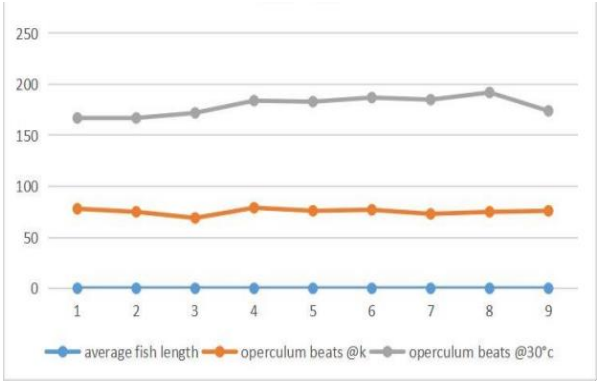

Figure 4. Effect of housel hold chemicals on *P.sphenops* Opercular rate

IV. CONCLUSION

In this study, the respiratory rate of *P.sphenops* was significantly higher at the temperature of 28°C. The temperature of 28 °C, was found to be optimum for the growth of *P.sphenops* while the lowest growth performance was shown at temperature 30°C. The study on effect of different concentrations of chemicals on dissolved oxygen consumption in *P.sphenops* shows that the presence of such noxious chemicals are deleterious to natural population of fish. It was clearly evident from the present study that at higher concentration of these chemicals in water will lead to the decrease in dissolved oxygen. This study

demonstrated the negative impacts of various household chemicals on the ornamental fish *Poecilia sphenops*. Results concluded that at higher concentrations of the chemicals, the fish exhibited increased breathing and signs of distress. These findings indicate that the presence of such noxious chemicals are deleterious to natural populations of fish, and that the irresponsible discharge of sewage water into water bodies should be avoided.

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