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# ACUTE CYPHENOTHRIN INDUCED TOXICITY ON RESPIRATION AND BEHAVIOURAL RESPONSES OF FRESHWATER EDIBLE FISH CIRRIHINUS MRIGALA.

**Toxicology**

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## ABSTRACT

Pyrethroids are the third most applied group of insecticides worldwide and are considerably used in agrarian and non-agricultural uses. Pyrethroids parade low toxin to mammals, but have extremely high toxin to fish and non-target species. Their high hydrophobicity, on with pseudo-persistence due to nonstop input, indicates that pyrethroids will accumulate in deposition, pose long- term exposure enterprises to aquatic species and eventually beget significant threat to benthic communities and aquatic environments. The present investigation was undertaken to study the acute toxicity of the insecticide Cyphenothrin and the resulting behavioral alterations in the Indian major carp, freshwater fish Cirrhinus mrigala. The experimental fish were divided into groups of 10 (n=10) and exposed to different concentrations of the test pesticide for 24, 48, 72, and 96 hours. The 96- hour LC50 was found to be 30µg/l. Sub-lethal concentration was fixed based on LC50 value is 6µg/l (1/5th of LC50) of the insecticide Cyphenothrin for a period of 10, 20, 30 and 40 days. Behavioral patterns and oxygen consumption were studied in sub lethal concentrations. Regular observation was made throughout the exposure period to determine the long-term behavioral changes in the test fish. The fish displayed erratic swimming behavior that increased over the days of exposure. Behavioral anomalies such as whirling cork movement, altered opercular movement, altered fin movement and physiological changes such as dyspigmentation and altered mucus secretion were observed. Dissolved oxygen content was measured at 24, 48, 72 and 96 h to assess the impact of toxicant exposure on oxygen consumption. Oxygen consumption of exposed fishes showed significant decrease at sub lethal concentrations. It is concluded that cyphenothrin is highly toxic to fingerlings of Cirrhinus mrigala and severely affects their physiology and behaviour.

## KEYWORDS

cyphenothrin toxicity, oxygen consumption, behaviour, Cirrihinus mrigala

## INTRODUCTION

The current time of the revolution, seeing a fast increase in human population across the world, portrays the reliance of individuals on accessible traditional assets. The present state of affairs has prompted endeavors for innovative progressions to adapt to the necessity of social orders. This, thusly, is bonded by developing forever increasing disintegration of varied combined artificial substances within the setting, that initiate contamination, expressly in aquatic bodies used as unloading destinations in several areas of the earth Jabeen F. *et al*., 2015. Contamination is that the basic widespread objectionable issue, that is deteriorated by the overhasty development of human peoples and quick industrial enterprise Stehle S. *et al.,* 2015. The impure aquatic setting may be a dangerous overall issue, and therefore the ooze of rural, modern, and artificial compounds into the aquatic water bodies has initiated some harmful impacts on aquatic species and living organisms. Also, these toxins might foursquare roll up fish tissue and defile the natural organic phenomenon, which can therefore influence human consumption Naiel *et al.,* 2020.

A pesticide to a rat, nematode, weed, parasite, or another sort of terrestrial or amphibian, plant or species infection, microscopic organisms, or completely different microorganisms that destroys the crops, garden plants or trees, as a vector of sicknesses. For ranchers, pests incorporate insects that kill crop and aquatic plants, and cause animal and plant infections, like growths, infections, microscopic organisms, snails, nematodes, and rodents Liu W. X *et al.,* 2016. Then again, pesticides square measure alluded to as various substances intensifies that have completely different organic activities and artificial qualities, that square measure clustered along to make their ability to destroy Marigoudar S. R *et al.,* 2013. On these lines, as a good definition, pesticides square measure on the entire those substances or their combination utilized for neutralization, annihilation, repulsing, stopping, opposing, or dominant insects Dawood M.A.O *et al.,* 2020.

Water contamination with pesticides could be direct utilization of those artificial compounds for controlling aquatic foliage likewise as outflow from rural grounds through farming overflows Ozkara *et al.,* 2016. These are generally distributed in each metropolitan and farming Fetoui, H. *et al.,* 2010; this is the main impacts of pesticides as important supporters of water contamination Hau J. *et al.,* 2014, Molina-Ruiz *et al.,* 2015. Across the world, variety forms of pesticides measure being utilized in numerous proportions, like bug sprays, that form up roughly eightieth of all pesticides, herbicides (15%), and fungicides (1.46%). Chemical applications are often supported for important stretches within the fields once application to their weakened biodegradation properties Biswas S. *et al.,* 2019, that may be consumed by aquatic species, like fish, prompting negative impacts on their health and meat quality, which is able to contrarily influence human health. Besides, they need a quick biodegradation rate within the aquatic environment wherever inexperienced growth and macrophytes exist Balint T. *et al.,* 1997. These pesticides over one hundred times a lot of toxicants for fish to the multiplied affectability of fish to harmful toxins to their immediate impact to water through gills and the deficient hydrolytic catalysts for pyrethroids Aydin R. *et al.,* 2005. These chemical compounds are modified within the hepatocytes, bile, and platelets to sulfates and glucuronides, inflicting unfortunate impacts on meat quality and also the endurance pace of fish Gautam P. *et al.,* 2008.

Pyrethroids are inferiors of normal Pyrethrins derived from the flowers of pyrethrum plant (Chrysan- themum cinerariaefolium and C. coccineum) P.K. Gupta 2018. They include esters of chrysanthemum acid (ethyl,2- dimethyl- 3-( 1- isobutenyl) cyclopropane-1-carboxylate) and halogenated inferiors of their acids and alcohols L.G. Costa 2015. Despite the fact that Pyrethroids and Pyrethrins are synthetically and toxicologically similar, deterioration when exposed to heat, light, and moistness R.E. Gosselin 1984. Pyrethrins with inferiors (Pyrethroids), originally allowed for people J. Skolarczyk *et al.,* 2017. These pesticides were acquainted due with their lower position of determination when varied with organo chlorine, organophosphate and carbamate fungicides which are related with long haul natural pitfalls. Pyrethroids as a rule break down within the sight of daylight and terrain in a couple of days S.M. Bradberry *et al.,* 2005. Also, they do not basically impact ground- water quality making them favored backups to conventional further persisting pesticides.

Pyrethroids' depend on sodium channels and the investiture of delayed depolarization in neurons in the sensory system K.S. Silver *et al.,* 2014. WHO believed that pyrethroids are neuro- damages following up on the axons in the supplemental and central nervous system sodium diverts in warm blooded species for by S.M. Bradberry *et al.,* 2005 to be multiple times more dangerous to insects than to advanced species. This is because of bugs having further sodium channels, a more modest construction, and lower internal heat position just as lower skin retention and further effective hepatic digestion in warm thoroughbred species. In any case, they've been reckoned for to be dangerous to submarine species e.g., shellfish J. Lidova *et al*., 2016, and fin fishes J.G. Carcamo *et al.,* 2017, impacting flyspeck directs in both neuronal and mitochondrial layers. They've likewise been shown for to be toxic to advanced invertebrates R. Ding *et al.,* 2017.

Another manufactured pyrethroid, typically known as Cyphenothrin (5% EC), assessed as a space splash/ mist for its viability against three vector mosquitoes. Cyphenothrin has been reported dangerous by International Program on Chemical Safety (IPCS). Overtures did nearly differently showed issues against mosquito (*Culex pipiens*), housefly (*Musca domestica*), and German cockroach (*Blatella germanica*). Field concentrates in Malaysia with Gokilaht- S 5% EC against *Aedes aegypti*, *Ae. albopictus* and *Cx. quinquefasciatus* displayed empowering results.

Fishes are bioindicator species that affect significantly in checking water impurity since they reply with extraordinary affectability to changes in the aquatic environment M. David and H. Umme 2016. Exposures of fishes to toxicants makes stress which is a condition of restored homeostasis, an intricate set- up of maladaptive responses with the possibility to beget disturbances and mortality. The freshwater ecosystem is a significant part in the development of multitudinous aquatic organic entities and is known to be an extreme drop for the maturity of the toxicants. Aquatic organisms can go about as organic labels to survey the good status of the aquatic environment. Among freshwater aquatic species, fish are used in toxicological review since they're profoundly delicate to slight natural variations. Toxicity of waterborne replicas could be estimated by fish bioassay. The impacts of waterborne replicas on fish models could help in setting up standard measures for toxicity and good for aquatic environment Zhong Z. *et al.,* 2018. Evaluation of variations on morphological and physiological biomarkers of fish which impacts of ecological impurities on aquatic species.

In the Present investigations, toxicity tests for 24, 48, 72 and 96 h to the fish, *Cirrhinus mrigala* were done with a Cyphenothrin (5% EC). The static one fifth of 96 h $LC_{50}$ was taken as sublethal exposure to concentrate on the behavior modifications and physiological studies. The toxicity test indicates a wide range of test that are directed to quantify some unfavorable impact brought by pesticides. Fishes are the aquatic life forms since they are the most obvious as prevalent and are freshwater fish, *Cirrhinus mrigala*. The current studies were intended to examine the toxicity and behavior studies due to Pyrethroid Cyphenothrin on freshwater fish, *Cirrhinus mrigala.*

The behavioral study assessed by Cyphenothrin is critical to show the impact of the fish with the concentrations of toxic media and the transformation. Along these, behavior toxicology is valuable biomarker of sub lethal evaluation and the endpoints as often as possible happened under the lethal concentrations. Plus, the progressions of the behavior can be pointer for sores in organs like gills. In reality, the intense toxic upsides of a few pesticides for various fish species have been shown for by numerous researchers. Consequently, this study was directed to decide the behavior changes of Cyphenothrin exposed to *Cirrhinus mrigala.*

Oxygen($O_2$) is basic for some metabolic cycles that are pivotal to vigorous life. Like every single vigorous living being, fish are vulnerable with the impacts of responsive oxygen and have innate and important of biotic and abiotic factors on cell system in fish Martinez-Alvarez *et al.,* 2005. Whole animal oxygen consumption by the fish is helpful for evaluation of lethal impacts and is one of the significant factors which reflect physiological condition. In aquatic environment toxins present over the typical position i.e., at lethal concentrations shows mortality of fish and likewise increase the pace of oxygen consumed in live fish Tilak *et al.,* 2007.

A variation in oxygen consumption is a biomarker of stress and is much of the time used to assess the effect in oxygen consumed Chebbi and David, 2010. Pesticides are shown to cause respiratory stress or even by influencing on the brain or the tissue associated. Various studies, for example, *Cirrhinus mrigala* Mushigeri and David, 2003, *Labeo rohita* Patil and David, 2008, *Oreochromis mossambicus* Logaswamy and Remia, 2009, *Ctenopharyngodon idella* Tilak and Swarna Kumari, 2009 have shown either increase or decrease their oxygen consumption because of variety of pesticides.

In fishes, especially carps are oxygen controllers, implying that they keep up with their oxygen utilization at a consistent level along a slope of natural oxygen exposures, until a basic oxygen concentration is present, under which oxygen consumption starts to fall. Under states of stress, this basic oxygen is probably going to increase and decrease, limit of the fish to adapt to ecological conditions. Investigation of oxygen consumption can be shown as a bio detector system to assess the primary toxic caused for the fish which could either increase or decrease the oxygen take-up. Thus, the current study was attempted to assess the toxicity of sublethal concentrations of Cyphenothrin 5% EC on oxygen consumption of the freshwater teleost fish *Cirrihinus mrigala.* There is restricted information accessible looking at toxicity of a few pesticides on this significant species. Hence, the current investigation is done to know the toxicity and behavior of generally used Pyrethroids on their use, in this manner securing important non-target freshwater fishes.

## MATERIALS AND METHOD

### Experimental Animal

Healthy and active fingerlings of *Cirrihinus mrigala* were procured from the State Fisheries Department, Hospet, Karnataka, India and transported immediately to the Department of Zoology, Karnatak University, Dharwad. All the procedures and experiments were performed in the Department of Zoology, Karnatak University, Dharwad. Fish were maintained in large cement tanks (6×3 feet) which were duly aerated. Water in the tanks was treated with 1% KCl solution prior to the introduction of the animals into the tank. Fish were fed with balanced nutritious food pellets (Nova, Aquatic P. Feed) and allowed to acclimatize for a period of 14 days at 24 ºC temperature and 12-14 hours of photoperiod. Water in the tanks was renewed daily and the Physico-chemical parameters of water were examined according to the guidelines of **APHA.**

### Experimental Pesticide:

Cyphenothrin (Type II pyrethroid) supplied by SUMITOMO CHEMICAL INDIA PVT.LTD, GUJARAT, India, was procured from the local agricultural market of Dharwad, Karnataka, India. The expiry date of the test substance was confirmed prior to the initiation of the exposure. Stock solution was prepared by mixing the calculated volume of the commercial solution with distilled water. Test concentrations for acute toxicity test (i.e., 30 µg/l) and sub-lethal behavioral toxicity test (6µg/l) were prepared by serial dilution of the stock solution using variable micropipette.

### Acute Toxicity Test:

Acute toxicity testing was carried out using semi-static renewal assay which involves daily renewal of water and test solution (OECD 2019). Range finding test was conducted to estimate the upper and lower concentrations of the test compound for the selected fish. This step was employed to minimize the unnecessary killing of the animals. Fingerlings weighing 4-6 gm and 7±0.5 cm in length were selected for the study. The fish were divided into 28 groups of 10 each and transferred to clean, pathogen-free glass aquaria. Feeding was withdrawn 24 hours prior to the exposure. All the test concentrations of Cyphenothrin were maintained in triplicates. One group served as control. All the exposed fish were continuously monitored and mortalities were recorded over gradual intervals of time i.e., 24, 48, 72, and 96 hours. Dead fish were removed from the experimental media. Mean was calculated for the number of mortalities in each concentration group over each exposure duration and this value was used to calculate the $LC_{50}$ of Cyphenothrin by performing probit analysis (Finney D. J., 1971).

### Behavioral Studies

Healthy *Cirrihinus mrigala* (n=10) were introduced into a glass aquarium and were exposed to the sublethal concentration of Cyphenothrin. One fifth of $LC_{50}$ was selected and exposed for 10, 20, 30 and 40 days. The fishes were frequently observed for the behavioral changes during each experimental period. Behavioral changes were recorded for further interpretation of the effect of toxicant on *Cirrihinus mrigala*.

### Oxygen Consumption

Fishes predominantly rely on dissolved oxygen in the living environment. Any disruption or variation of oxygen content in the water could cause hypoxia or anoxia in the fishes. Oxygen consumption is one of the parameters to study the stress level of the fish. In present study the oxygen consumption rate of *Cirrihinus* *mrigala* was measured in lethal (24, 48, 72 and 96 hrs) and sublethal (10, 20, 30 and 40 days) concentrations of Cyphenothrin. The experimental set up was made in such a way that there should be minimum 75% oxygen at the end of experiment in order to minimize the effect of low oxygen level and metabolite accumulation. The whole experimental arrangement was made by following the method of Welsh and Smith (1953**)** as described by Saroja (1959)**.** No mortality was observed during oxygen consumption tests and the measured oxygen was expressed in mg/L/g/h. The temperature and pH of the test water were 24±2ºC and 7.1±0.2 respectively.

**Ethical Statement**

All the experiments performed in the present study abide by the guidelines of the Institutional Animal Ethics Committee (IAEC). The experimental animals used in the study were handled with care according to the guidelines provided by the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), New Delhi, India.

## RESULT

### Acute Toxicity

Experimental fishes exposed to various concentrations of commercial grade Cyphenothrin (6% EC). The water was examined for the Physico-chemical parameters to know about exploratory conditions (Table 1). Cyphenothrin toxicity to *Cirrihinus mrigala* exposed for 96 h showed 100% mortalities at 500 mg/L, no mortalities were seen at 100 mg/L and half mortalities were seen at 30 mg/L (Table 2). Mortality was progressively increased from 200 mg/L to 500 mg/L concentration of Cyphenothrin. The LC50 values were determined by probit examination technique (Finney D J., 1971). Table 3 shows 95% certainty limits computations for the acquired fixations. Figure 1 and 2 shows the diagram plotted percent mortality against concentration and percent mortality changed over to probit against log focus individually. A straight line was acquired in Figure 1 and 2 showing the $LC_{50}$ value of 30 mg/L convergence of the test toxin Cyphenothrin. Sigmoid curve was acquired in the diagram plotted percent mortality against log focus (Figure 3). The value from the analysis was showed the $LC_{50}$ of 30 µg/L and the upper and lower bound was displayed in table 3.

**Table No. 1 Physico-chemical Parameters Of Water**

| Sl.No | Parameters | Obtained Values |
|---|---|---|
| 1 | Salinity | 0. 191 gms/1 |
| 2 | pH | 7. 4 to 7. 6 |
| 3 | Dissolved Oxygen | 6 to 7 m1/1 |
| 4 | Chlorinity | 0. 111 gm/1 |
| 5 | Sodium | 1. 22 m moles/1 |
| 6 | Potassium | 30. 5 m moles/1 |
| 7 | Calcium | 4. 31 m moles/1 |
| 8 | Carbon di oxide | 2. 09 mg/1 |
| 9 | Oxygen percent saturation | 8 |
| 10 | Alkalinity | 87ppm (as Caco3 ) |
| 11 | Specific gravity | 210 m moles/cm |
| 12 | Hardness of water | 160 ppM (as Caco3) |

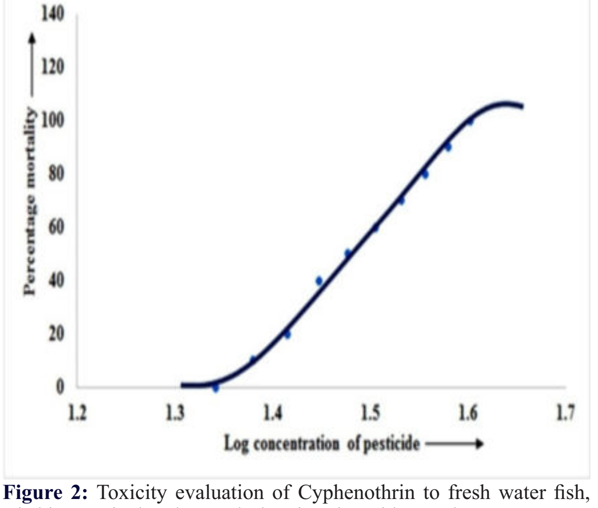


**Figure 2:** Toxicity evaluation of Cyphenothrin to fresh water fish, Cirrhinus mrigala. The graph showing sigmoid curve between percent mortality of the fish against log concentration of Cyphenothrin

**Table No. 2 Mortality Of Cirrhinus Mrigala In Different Concentrations Of Cyphenothrin At 96 hrs Of Exposure Period.**

| Sl. No | Concentration of pesticide µg/L | Log concentration of pesticide. | No.of fish exposed | No.of fish alive | No.of fish Dead | Percent kill (%) | Probit kill |
|---|---|---|---|---|---|---|---|
| 1 | 22 | 1.342 | 10 | 10 | 0 | Nil | 0 |
| 2 | 24 | 1.3802 | 10 | 9 | 1 | 10 | 3.72 |
| 3 | 26 | 1.4149 | 10 | 8 | 2 | 20 | 4.16 |
| 4 | 28 | 1.4471 | 10 | 6 | 4 | 40 | 4.75 |
| 5 | 30 | 1.4471 | 10 | 5 | 5 | 50 | 5.00 |
| 6 | 32 | 1.5051 | 10 | 4 | 6 | 60 | 5.25 |
| 7 | 34 | 1.5314 | 10 | 3 | 7 | 70 | 5.25 |
| 8 | 36 | 1.5563 | 10 | 2 | 8 | 80 | 5.84 |
| 9 | 38 | 1.5797 | 10 | 1 | 9 | 90 | 6.28 |
| 10 | 40 | 1.6020 | 10 | 0 | 10 | 100 | 0 |

**Table 3: Acute toxicity (96 h LC50) and 95% confidence limits of Cyphenothrin to Cirrhinus mrigala**

| Toxicant | 96 h $LC_{50}$ (µg/L) | 95% confidence limits | |
|---|---|---|---|
| | | Upper limit | Lower limit |
| Cyphenothrin | 30 | 22 | 40 |

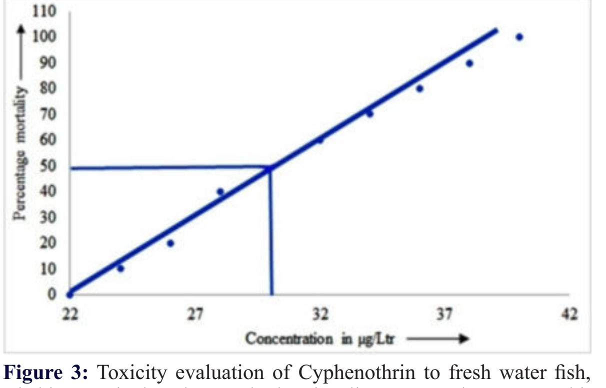


**Figure 3:** Toxicity evaluation of Cyphenothrin to fresh water fish, Cirrhinus mrigala. The graph showing linear curve between probit mortality of the fish against log concentration of Cyphenothrin

**Table 4: Behavioral Changes In Cirrhinus Mrigala Exposed To Different Concentrations Of Cyphenothrin**

| Sl. No. | Observed behavior | Control | Exposure days | | | |
|---|---|---|---|---|---|---|
| | | | 10 Days | 20 Days | 30 Days | 40 Days |
| 1. | Lateral swimming | - | + | + + | + | +++ |
| 2. | Sinking phenomenon | - | + | - | + | ++ |
| 3. | Schooling behavior | +++ | + + | + | - | + |
| 4. | Fright response | +++ | + + | + | - | + |
| 5. | Backward swim | - | + | + | + | ++ |
| 6. | Dashing movement | - | + | + + | + | + |
| 7. | Upward swim | - | + + | + | - | ++ |
| 8. | Whirling cork movement | - | + | + + + | ++ | + |
| 9. | Buccal movement | + | + + + | + + | + + | +++ |
| 10. | Burst swimming | - | + + | + + | + | ++ |
| 11. | Opercular beat | + | + + | + + | + + + | ++ |
| 12. | Fin beat | + | + + | + + + | + + + | + |
| 13. | Mucus secretion | - | + | + + | + + + | +++ |
| 14. | Dyspigmentation | - | + | + + | + + + | ++ |

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Fish exhibiting various behaviors :(+) indicates low, (++) medium, and (+++) high intensity of behavior upon exposure to Cyphenothrin

**Table No. 5 Whole Animal Oxygen Consumption (ml/gram/wet wt/h) Of The Fish Cirrhinus Mrigala On Exposure To The Sublethal Concentration Of Cyphenothrin**

| **Exposure Periods In Days** | | | | | | |
|---|---|---|---|---|---|---|
| Estimation | Control | Sub-Lethal | | | | |
| | | 1 Day | 10 Days | 20 Days | 30 Days | 40 Days |
| MEAN | $0.6465^{F}$ | $0.5258^{A}$ | $0.5477^{B}$ | $0.5843^{C}$ | $0.6142^{D}$ | $0.6336^{E}$ |
| ± SD | 0.0023 | 0.0021 | 0.0013 | 0.0020 | 0.0015 | 0.0035 |
| % Change | ------- | 18.6697 | 15.2822 | 9.6210 | 4.9961 | 1.9953 |

Values are mean ± SD (n=6) for oxygen consumption in a column followed by the same letter are not significantly different ($P \leq 0.05$) from each other according to Duncan's Multiple Range (DMR) test

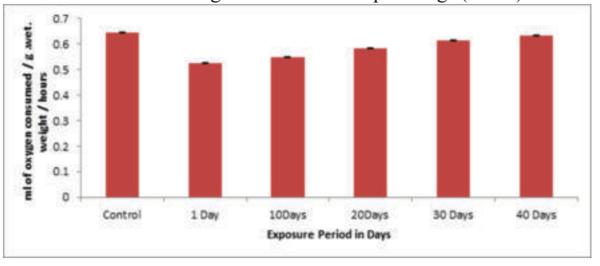


**Figure 4;** Whole Animal Oxygen Consumption (ml of oxygen consumed / g. wet. weight / hours) the fish Cirrhinus mrigala on exposure to the Sublethal concentration of Cyphenothrin.

**Behavioral Studies**

Behavior studies are one of the perceptions which help to view the general reaction of the species towards its surrounding environment. Every one of the behavior perceptions made in the investigation is adhered to OECD rule 203 principles. In the current investigation the control fishes showed delicate fast reactions to the aggravations in the environment. The test fishes exposed to sub-lethal concentration of Cyphenothrin showed different behavior changes. The behavior changes like schooling, fright response, opercular beat, balance beat and buccal development are ordinary in control fishes.10days exposed fishes were seen with medium schooling behavior, fright response, up development, burst swimming, opercular beat, fin beat and high intensity of buccal developments. 20days, 30days and 40days exposed fishes showed continuous increase of opercular beat, fin beat, bodily fluid discharge and dyspigmentation of the body (Table 4). The fishes in 30th day of exposure more articulated with bodily fluid discharge on the body.

**Oxygen Consumption**

Respiratory stress is one of the early indications of pesticide harming. As per the changes in the physico-chemical qualities of the aquatic waters, the air breathing fishes are furnished with double mode gas exchange, utilizing exceptionally vascularized air breathing organs and brachial integument exchange of gases with water. Nowadays' pesticides are used unpredictably, which influence aquatic environment including fishes. One of the early side effects of intense pesticide effect is the toxicity of respiration Karuppiah D. 1996, Oxygen consumption and its estimations give an entire species stress and water quality.

In the current investigation, under sublethal concentrations of Cyphenothrin fish *Cirrhinus mrigala* shows an increased expansion in oxygen consumption during the time of exposure one day i.e., 20ml oxygen devoured/g. wet. weight/hours). Exposure set up is 10, 20, 30, 40 days with 6µg/L which shows continuous reduction in oxygen utilization from 20ml 0xygen/g. wet. weight/hours to 5ml oxygen/g. wet. weight/hours in 40 days.

The mean values of measured oxygen consumption in the fish *Cirrhinus mrigala* exposed at sublethal concentrations of Cyphenothrin were tabulated in Table 5. At sublethal concentration the fishes exhibited increase in oxygen consumption right from day 1,10, 20, 30 to day 40 with 0.7015, 0.7345, 0.7665, 0.8075 mg/L/g/h respectively. The percentage change in oxygen consumption in *Cirrhinus mrigala* is given in Figure 4. The results are significantly different from the control which exhibited oxygen consumption of 0.8983 mg/L/g/h. In lethal concentration the oxygen consumption drastically decreased and in sublethal concentration gradually increased.

The mean values of estimated oxygen utilization in the fish *Cirrhinus mrigala* exposed to lethal and sub lethal concentrations of Cyphenothrin were classified in Table 5. At sublethal concentrations the fishes displayed increased in oxygen utilization directly from day 10, 20, 30 to day 40 with 0.5258,0.5477,0.5843,0.6142,0.6336 mg/L/g/h individually. The rate change in oxygen utilization in *Cirrhinus mrigala* is given in Figure 4. The outcomes are essentially not the same as the control which displayed oxygen utilization of 0.6465 mg/L/g/h. In sub lethal concentrations steadily increased.

**DISCUSSION**

Assessment of toxicological effects on aquatic life is one of the essential and significant to show a toxic pesticide. Fishes being the last chain of taking care of cycle in aquatic ecology exceptionally impacts on the fitness of other aquatic life forms through natural way of life Mehmet Yilmaz *et al.,* 2003.

Toxicity of cyphenothrin for the freshwater fish, *C. mrigala* was observed to be 30 µg/L. The upper and lower 95% certainty limits were observed to be 4.231 µg/L and 3.668 µg/L, individually. It is apparent from the outcomes that cyphenothrin can be evaluated as profoundly toxic to fish.

In the current investigations the control fish acted in a characteristic way i.e., they were active. They were aware of the smallest unsettling influence, however in the toxic environment the fish showed sporadic, flighty and shooting swimming behaviors and loss of balance because of effect of AchE movement, prompting collection of acetylcholine in the cholinergic neurotransmitters, prompting hyperstimulation Mushigeri and David, 2005. They gradually became dormant, hyper invigorated, fretful and discharged abundance bodily fluid all around their bodies. Bodily fluid discharge in fish shapes an obstruction between the body and toxic media consequently presumably decreases contact with the toxin to limit its impact, or to kill it through epidermal bodily fluid. Comparable perceptions were made by PARMA DE CROUX *et al.* 2002 in *Prochilodus lineatus* under monocrotophos stress. Opercular developments increased at first in all exposure periods yet decreased later, consistently in lethal exposure with sub lethal exposure periods. The increased opercular gill developments noticed at first may perhaps make up for increased physiological movement under distressing conditions Shivakumar and David, 2004.

Swallowing air at the surface, swimming on the water surface, upset shoaling conduct and simple predation was seen on the main day itself in lethal and sub lethal exposure periods and proceeded with the equivalent all the more seriously, which is as per the perceptions made by Ural and Simsek 2006. Swallowing of air might assist with staying away from contact with the toxic medium. Surfacing i.e., huge increase of upper layers in the exposed concentrations may be the after effect of the requirement for higher oxygen levels during the exposure time Katja *et al*., 2005. At last fish sank to the base with the least opercular movements and kicked the wall of the test chamber with their mouths open.

In sub lethal exposure, the fish's bodies were lean towards the abdomen position compared to the control fish and they were found to be under stress, but this was not fatal. Leanness in fish indicates a reduced amount of dietary protein consumed by the fish under pesticide stress which is immediately utilized and not stored as body mass Kalavathy *et al.,* 2001.

Species and its behavior are a necrotrophically controlled by synapses. Loss of balance follows changeable and dashing swimming, with solid imbalanced body action, which may be because of the restraint of cerebrum cytochrome c oxidase movement, causing cytotoxic hypoxia, which is a introductory point for anoxia followed by changes in electrical action of brain hence making toxic to the brain related with the support of balance. The behavior of the fish to the lower part of the test chamber on increase of cyphenothrin exposed, the aversion behavior of fish. Sarkar and Konar 1993, also noticed aversion behavior in *Oreochromis mossambicus* on exposure to toxic media. Changes in the breathing rate and surfacing frequentness are seen in the fish after exposure to sodium cyanide. similar changes are most likely because of cyanide- initiated tissue anoxia through the inactivation of cytochrome c oxidase, causing cytotoxic hypoxia within the sight of typical hemoglobin oxygenation, accordingly eliciting fish to pull out further oxygen by means of surfacing to ease respiratory pressure. These conditioning help the fish to stay down from contact with toxic substance and fight against stress.

The fish mortality could be because of the quick restraint of cytochrome c oxidase, the terminal oxidase of the mitochondrial respiratory chain, hence impeding the electron transport chain of indispensable organs because of section of free cyphenothrin through analytical place. The basic impacts for cyphenothrin toxicity in freshwater species incorporate the gills, and different places where osmoregulatory processes is seen. These semipermeable layers, the hydrocyanic acidic particles are generally dispersed through circulatory system to different receptor sites, where harmful activity or detoxification is seen in the fishes. Once brought into the overall flow, cyphenothrin structures a steady cytochrome oxidase complex in the mitochondria, subsequently bringing about a stalemate of electron move from cytochrome c oxidase to oxygen molecules and the discontinuance of cell respiration, causing cytotoxic hypoxia within the sight of ordinary hemoglobin oxygenation. Tissue anoxia instigated by the inactivation of cytochrome c oxidase causes a shift from high-impact to anaerobic respiration, bringing about the exhaustion of energy-rich mixtures and the aggregation of lactate, with decrease blood pH. The mixing up of cytotoxic hypoxia with lactate acidosis pushes down the sensory system and myocardium, which is the most critical site of anoxia, bringing about respiratory stress and death.

During sublethal exposure, the schooling behavior of the fish was gradually disturbed during the first day. On exposure to the sublethal concentrations of cyphenothrin on 10 and 20 days, the fish were ready at the smallest aggravation. The body increased toward the mid-region position compared to control fish, which showed decreased measure of dietary protein devoured by the fish at cyphenothrin stress, which was promptly used and was not put away in the body.

A large portion of the ingested sublethal exposure, concentrations of cyphenothrin responds with within the sight of non-toxins, the vast majority of which is discharged in the urine. Comparable to the controlled fish, the fast detoxification empowers species to ingest high sublethal concentration of cyphenothrin over broadened periods without any damage. Thus, the fish appear to have adjusted to sublethal exposures of cyphenothrin. Acclimatization by fish to low sublethal levels of cyphenothrin through nonstop exposures may upgrade their protection from possibly toxic concentrations, as per current investigation.

The difference in oxygen utilization is a biomarker of stress, which is much of the time used to assess the process in digestion under natural weakening. It is obviously from the investigations that the cyphenothrin influenced oxygen utilization of *C. mrigala* under sublethal concentrations. Fish exposed to lethal concentration portrayed increased oxygen utilization on day 1 to day 2 and decreased on day 4. In sublethal exposure oxygen utilization increased on days 10, 20, 30 and 40 when compared with the control.

Since most fish take in the water in which they live, changes in the compound properties in it could be reflected in the species breathing action, especially if the climate factors influence respiratory gas interchange Mushigri, 2003. The varied reaction in breathing might be due to respiratory stress as a result of the disability of respiration process has been shown cypermethrin toxicity in *Tilapia mossambica* David *et al.*,2002.

Gills are the major respiratory organs and all metabolic pathways rely on the proficiency of the gills for their energy supply and toxic to these important organs which causes a chain of destruction, which eventually lead to respiratory disorder Magare and patil, 2000. Articulated emission of a bodily fluid layer over the gill lamellae has been seen during cyphenothrin stress. Discharge of bodily fluid over the gill shortens the dispersion of oxygen David *et al.,* 2002, which may eventually decrease the oxygen take-up by the species.

If the gills are destroyed due to xenobiotic chemicals or the membrane functions are disturbed by changed permeability, oxygen uptake rate would rapidly decrease Grinwis *et al.,* 1998. On the other hand, the metabolic rate (in relation to respiration) of fish could be increased under chemical stress. Kalavathy *et al.* 2001 reported that the dimethoate is efficiently absorbed across the gill and diffuses into the blood stream resulting in toxicity to the fish.

Gills annihilated due to xenobiotic synthetics Grinwis *et al.,* 1998 or the layer capacities are destroyed by changed penetrability Hartl *et al*., 2001, oxygen take-up rate would quickly decrease. Then again, the metabolic rate (comparable to breath) of fish could be increased under compound stress. Kalavathy *et al.* 2001 showed that the dimethoate is productively retained across the gill and diffuses into the circulatory system bringing about toxic to the fish.

## CONCLUSION
The analysis of data from the present investigation demonstrated that cyphenothrin is highly toxic and had a profound impact on behavior and respiration in *C. mrigala* in both lethal and sub lethal concentrations. Thus, it led to altered fish physiology. Variation in the oxygen consumption in cyphenothrin exposed fish was probably due to impaired oxidative metabolism and pesticide induced stress.

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## Conflicts Of Interest
Authors claim no conflict of interest.

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