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Effect of Chlorpyriphos 20% EC on Respiratory Physiology of Mosquito Fish, Gambusia Affinis

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ABSTRACT

The enormous use of pesticides in the agricultural system, leads to deposition of large amount of toxicant which produces adverse effects on human as well as fresh water organisms. The respiration is an important physiological activity in all living organism These pesticides decreases the level of dissolved oxygen in the water bodies and leads to changes in the respiratory physiology of the aquatic organisms. The pesticides used in the fields get collected in the water bodies enter into the body of aquatic organisms like fish and may cause adverse effects on it. The oxygen consumption tendency is decreased when the time of exposure to toxicant is increased. The reduced O_2 consumption could be due to gill damage. The total O_2 consumption is one of the indicators of the general wellbeing of the fish. The study reveals the effect of pesticide Chlorpyriphos 20 % EC on the respiratory physiology of mosquito fish *Gambusia affinis*. The O_2 consumption level of fish *Gambusia affinis* was observed in the different concentration of (0.02, 0.04, 0.06, 0.08 ppm) at different time of exposure periods (24, 48, 72 & 96 hrs). The oxygen consumption exhibited decreasing trend in treated group up to 96hrs as compared with control group. The present study has clearly showed that commonly used pesticide in agriculture, chlorpyriphos 20% EC affects the oxygen consumption of mosquito fish, *Gambusia affinis* under all exposed concentration. The oxygen consumption level of the exposed fish at different times of exposure (24, 48, 72 and 96 hrs.) was found to be declined gradually till the end of exposure period (96hrs), the gradual decline was attributed to the interference of pesticide with oxidative metabolism. This pesticide caused respiratory distress, decreased level of oxygen consumption in fish *Gambusia affinis*, which suggested that Chlorpyriphos 20% EC is highly toxic to fish. Possibility of water pollution by this pesticide can be monitored through adapting proper assessment mechanism.

Keywords : Pesticides, Respiratory Physiology, Chlorpyriphos, Gambusia Affinis, Oxygen Consumption.

I. INTRODUCTION

Abundant use of fertilizers and pesticide became essential for better agricultural practices in most of the developing countries including India. Environmental pollution caused by pesticides, especially in aquatic ecosystem, has become a serious problem. These pesticides even when applied in restricted areas are washed and carried away by rains and floods to large water bodies like ponds and rivers and there by alter the physiochemical properties of water (Neelam Sharma *et.al.*, 2016), this proved to be highly toxic, not only to fishes but also to aquatic life forms and their environment (Sudha Summarvar et, al, 2016). Aquatic animals have to pass large quantities of water over their respiratory surfaces and are subjected to relatively greater risk of exposure to toxic substances. Oxygen consumption has been reported as a valuable index of the overall physiological activity of animals and is generally used as an indicator under stress conditions either due to pathological state of the animal or adverse ambient

environmental conditions Fish are largely being used for assessment of the quality of aquatic environment and as such can serve as bio indicators of environment pollution. Pesticides became one of the leading polluting agents of aquatic ecosystem. The organic pollutants decrease the level of dissolve oxygen in the water bodies. It leads to many changes in organisms physiology (Rajkumar *et.al.*, 1998). Excessive use of such chemicals resulting in environmental pollution and toxicity risks to non-target organism. Toxicants in the environment mainly enter into fish by means of their respiratory distress (Tovell, 1975). These pesticides have various physiological effects such as enzyme inhibition, inhibitory effects on growth, metabolism and general development of animal (Bare, 2014). Amongst the pollutants found in agriculture waste, insecticides are most hazardous since they have an ability to immobilize or kill the aquatic organisms at extremely low concentration (Cope, 1965 & Eisler, 1969). Insecticides cause serious toxicology problem mainly due to their persistence and high toxicity. Pesticides affects the ecosystem, reproduction and behavior by causing, pathological & physiological changes (Holden, 1973). Pesticides are not highly selective but are generally toxic to many non-target organisms such as fish (Mohammed A. AI Kahtani 2011). The poisoning by pesticides from agricultural fields is a serious water pollution problem and its environmental long term effect may results in the incidence of poisoning of fish and other aquatic life (Jyothi and Narayan, 1996).

Respiration in fish

Respiration is an important physiological activity in all living organism. The oxygen is necessary to provide energy to carry out metabolic activities .Respiratory activity of a fish is often the first physiological response to be affected by the presence of toxic pollutants including pesticide in the aquatic media. Any change in the aquatic medium affects respiratory potential of the fishes. Some pollutants could be depressants and some stimulants. It appears logical that internal poisoning could damage the respiration rate, (Sprague, 1971. A change in respiratory rate is one of the common physiological response to toxicant including pesticide and easily detectable through change in metabolic under environmental deterioration (Magor, Shaikh, 2012). The respiratory rate of an animal are the important physiological parameters to assess the toxicity stress (Prosser, 1977). The metabolic rate in relation to respiration of fish could be increased under chemical stress (Chebbi and David, 2010). Changes in oxygen consumption, is indices of energy expenditure, are a useful tool to assess the physiological stress on aquatic organism (Lee,1969). Total oxygen consumption of fish reflects it's basal metabolic status and is one of the indicators of the general health and wellbeing of the fish. The differential oxygen consumption can be used as bio indicator to evaluate the basic damage caused on the animal which could either increase or decrease the oxygen uptake (Venice, 2014). Variation in respiration rate is an indicator of stress and frequently to evaluate the changes in metabolism (Chebbi and David, 2016). Oxygen consumption is a valuable indication of sub lethal stress. The decrease in oxygen consumption appears to be a protective measure to ensure that there is low intake of the toxic substance. Gills, are the most important organs of the respiration, continuously exposed to water to absorb vital oxygen, they become the first target to come in contact with external toxicant environment. (Pawar. Neelam, et..al 2016). They are the major respiratory organs were subjected to damage due to pesticide toxicity and causing chain of destructive events, which ultimately lead to respiratory distress. (Magar and Patil 2000). Gills perform various functions like respiration, osmoregulation and excretion of nitrogenous waste. So all metabolic pathways depend upon the efficiency of the gills and they reflect the metabolic state of fish through respiratory activities. Hence gills are important

biomarkers of the water pollution and good indicator of the water quality. It has been tried to assess (Chlorpyriphos EC 20%) altered respiratory responses in mosquito fish, *Gambusia affinis* which can be used as a bioindicator for assessing pesticide toxicity to fish. Hence, the present study was undertaken to evaluate the effect of the pesticide, Choropyriphos 20% EC on oxygen consumption of the mosquito fish *Gambusia affinis*.

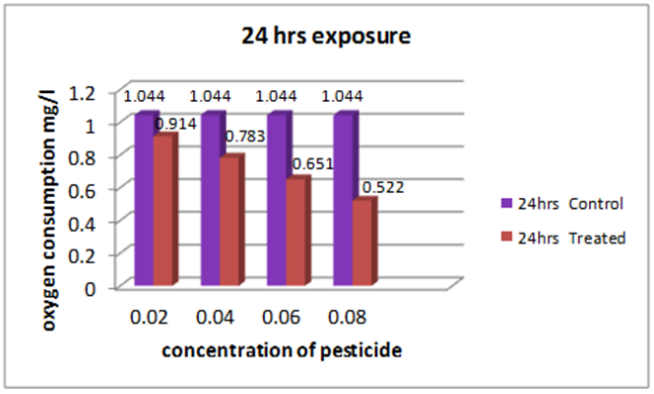
II. METHODS AND MATERIAL

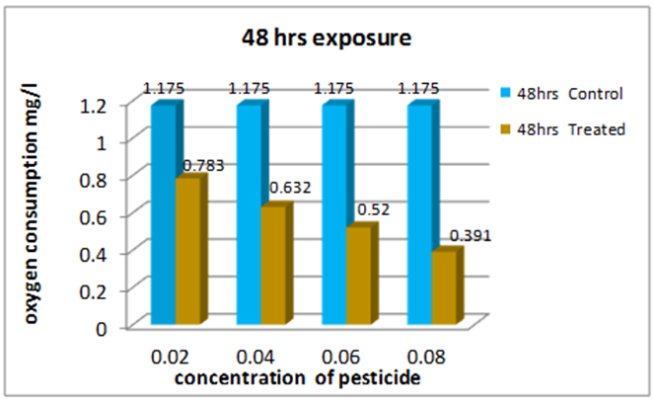
In the present investigation almost equal sized mosquito fish *Gambusia affinis* were collected from the local pond of the Sangamner College, Sangamner. Dist, Ahemadnagar India. The fish were cleaned by using 0.1% $KMNO_4$, to avoid dermal infection. The fish were acclimatized for two weeks in the laboratory condition. During the period of acclimatization the water was changed for every 24hrs. The fishes were fed with pond water containing zooplanktons. The most widely used organic insecticide in and around Sangamner for agriculture Chlorpyriphos 20% EC was selected as the toxicant for the present study. Feeding of the experimental animal was stopped prior to experiment. After acclimatization, fish were kept in up to 3 liters capacity jars. Fish were exposed to sub lethal concentration of this pesticide (Chlorpyriphos) for 24hrs to 96 hrs respectively. The oxygen consumption was carried out in a respiratory chamber (stopper bottle or BOD bottle). Two sets were carried out for control and treated fish. One set kept as control consisting of fishes, which were placed in de chlorinated water without any pesticidal residue. In treated, fishes were exposed to different concentration (0.02, 0.04,0.06,0.08) of chlorpyriphos EC 20%. The consumed oxygen was measured from 24hrs to 96hrs with an interval of 24hrs. 6 fishes were taken for each experiment as well as control. The amount of oxygen consumption in this sample was determined by using Wrinkle's method. The same procedure was repeated for 48, 72, 96hrs and control set also. The difference in the oxygen concentration of the initial and final sample is taken as the amount of oxygen consumed by the fish during the period of experiment. The oxygen consumed by control and exposed fish were determined accordingly, the values for oxygen consumption were expressed as mg/l/24hrs.

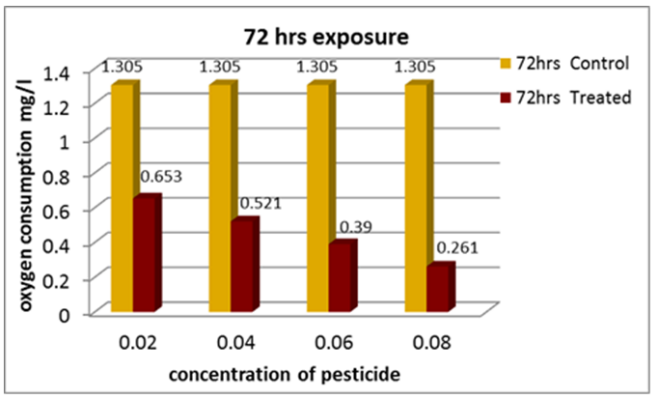
III. RESULTS AND DISCUSSION

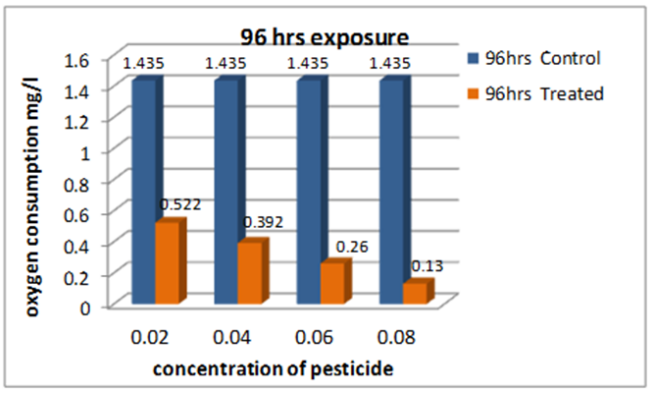
In the present investigation, the oxygen consumption level was observed in the different concentration (0.02, 0.04,0.06,0.08) of chlorpyriphos pesticide at different time of exposure periods (24, 48, 72, and 96 hrs). The oxygen consumption was seen gradually decreasing with increasing exposures periods. Oxygen consumption exhibited decreasing trend in treated group up to 96 hrs as compared with control groups. The result of the experiments and control values are graphically represented in fig -1 by taking different concentration of pesticide (chlorpyriphos) on X-axis and oxygen consumption mg/L on Y-axis.

Fig.1: Oxygen consumption level (mg/L) by *Gambusia affinis* at different concentration of Chlorpyriphos 20%EC, at different time of exposures (hrs)









The rate of oxygen consumption of fish *Gambusia affinis*, exposed to different concentration of pesticide for 24, 48, 72, and 96 hours of exposure are shown in above figure. It was noted that the oxygen consumption of control fish were 1.044, 1.175, 1.305, 1.435 mg/L at 24, 48, 72 and 96 hours respectively. The oxygen consumption of fish exposed to at 24hrs to the Chlorpyriphos 20%EC concentration of 0.02ppm, 0.04ppm, 0.06ppm, 0.08ppm; oxygen consumption were obtained to be 0.914, 0.783, 0.651, 0.522 mg/L respectively. The maximum oxygen consumption was observed at 0.02, whereas the minimum content was recorded at 0.08ppm. The fish exposed at 48hrs of treatment showed the different level of oxygen consumption. The mean of three reading were taken. The mean values were found to be 0.783, 0.632, 0.520, and 0.391mg/L in 20 % concentration of 0.02, 0.04, 0.06 and 0.08 ppm respectively. The maximum consumption was observed at 0.02 whereas minimum was at 0.08 ppm. At 72hrs of exposure, the values showed decline the level of oxygen consumption. The values were found to be 0.653, 0.521, 0.390, and 0.261mg/L in different concentration of 0.02, 0.04, 0.06, and 0.08ppm respectively. The oxygen consumption was higher in 0.02ppm than the remaining concentration. At the 96hrs of exposure, concentration of 0.02, 0.04, 0.06,and 0.08ppm depicted a reduction In oxygen consumption of 0.522, 0.392, 0.260 and. 130 mg/L respectively.

In the present study, the oxygen consumption was gradually decreasing with increasing exposure periods. Manjula Sree Veni S (2014) reported that the oxygen consumption of the exposed fish *Cirrhinus mrigala* exposed to Cypermethrin found to be declined gradually till the end of exposure period (24), due to the interference in oxidative metabolism and also due to the histopathalogical changes that occurred in the gill anatomy. During the study, the rate of oxygen consumption increased in lower concentration and decreased in the higher concentration as reported by several scientists in the toxicant exposed fishes several authors (Rao, 2005, Siva kumar and David, 2004, Veeneth kumar and David 2008) reported that the disturbance in oxidative metabolism leads alteration in whole oxygen consumption in different species of fish exposed to pesticide. It has been well documented that the toxicity of these pesticide to fish may decreased the level of oxygen consumption at different times of exposures under all exposed concentration. Oxygen consumption is decreased when the time of exposure to toxicant is increased. It has been found that, in mosquito fish *Gambusia affinis*, long or short term exposure of pesticide

Chlorpyriphos 20%EC, decrease the amount of oxygen consumption to a significant level as compared to control. The decreased oxygen consumption in Chlorpyriphos 20%EC, exposed fish is likely due to the absorbance of a greater amount of pesticide, which directly effect on the respiratory physiology of fish (O_2 consumption). Thus, it is clear from this study that, the commonly used pesticide chlorpyriphos 20%EC affect the oxygen consumption of mosquito fish, *Gambusia affinis* under all exposed concentration.

IV. CONCLUSION

The present study has clearly showed that commonly used pesticide in agriculture, Chlorpyriphos 20%EC affect the oxygen consumption of mosquito fish, *Gambusia affinis* under all exposed concentration. The oxygen consumption level of the exposed fish at different times of exposure (24, 48, 72 and 96 hrs) was found to be declined gradually till the end of exposure period (96hrs), the gradual decline was attributed to the interference of pesticide with oxidative metabolism. This pesticide caused respiratory distress, decreased level of oxygen consumption in fish *Gambusia affinis*, which suggested that Chlorpyriphos 20% EC is highly toxic to fish. Possibility of water pollution by this pesticide can be monitored through adapting proper assessment mechanism.

V. REFERENCES

[1]. Carpenter, J. H. (1965) : The Chesapeake Bay Institute. Technique for the Winkler oxygen method. Limnol. Oceanography., 10, 141–143.

[2]. Grasshoff, K. Ehrhardt, M, and K. Kremling (1983): Methods of Seawater Analysis. Grasshoff, Ehrhardt and Kremling, eds. Verlag Chemie GmbH. 419 pp.

[3]. I. Ahmad, T. Hamid, M. Fatima, H.S. Chand, S.K. Jain, M. Athar, S. Raisuddin, (2000) : Induction of hepatic antioxidants in freshwater catfish (Channa punctatus) is a biomarker of paper mill eZuent exposure, Biochim Biophys. Acta 1519 37–48.

[4]. J. Venkateswara Rao, Ghousia Begum, R. Pallela, P.K. Usman, R. Nageswara Rao,(2005): Changes in behavior and brain acetylcholine esterase activity in mosquito fish, Gambusia affinis in response to the sub-lethal exposure to Chlorpyrifos, Int. J. Environ. Res. Pub. Health. Vol. 2, 478–483.

[5]. Neelam Sharma, Sudha Summarwar and Jyoutsna Pandey (2016) : Enzymatic Responses to pesticide Chlorpyrifos exposures in kidney of fish Gambusia affinis. Int. Jr. of Pure and Applied Bioscience 4(3) : 136-143.

[6]. Magar R.S. and Afsar Shaikh (2012) : Effect of Malathion on Respiratory Response of freshwater fish Channa Punctatus, International Jr. of Trends in Fisheries Research Vol 1 (3), 1-4.

[7]. Manjula Sree Veni S and Veeraiah K(2014) : Effect of Cypermethrin (10% EC) on Oxygen consumption and Histopathology of freshwater fish Cirrhinus mrigala. IOSR Jr.of Environmental Sciences, Toxicology and Food Technology Vol. 8, Issue 10 Ver. II, 12-20.

[8]. Murray J.N., Riley, J.P. and Wilson, T.R.S. (1968) : The solubility of oxygen in Winkler reagents used for the determination of dissolved oxygen. Deep-Sea Res., 15, 237–238.

[9]. Strickland, J.D.H., and Parsons, T.R. (1968): Determination of dissolved oxygen in A Practical Handbook of Seawater Analysis. Fisheries Research Board of Canada, Bulletin, 167, 71–75.

[10]. Sharan P. Lawler, Deborah A: (2003): Effects of the agricultural insecticide Lamda-cyhalothrin(worrior) on mosquito fish, Gambusia affinis. Journal of the American mosquito control association, 19(4):430-432.

[11]. Shreena, K. M, Logaswarmy, S and P Sunitha (2009): Effect of organophosphorous pesticide (Dimethoate) on oxygen consumption of the fish Tilapia mossambica. Recent Research in science and technology.1(1); 004-007.

[12]. Shivakumar, R. and David, M (2004): Toxicity of endosulfan to fresh water fish, Cyprinus carpio. Indian journal of Ecology,31(1); 27-29.

[13]. Suchismita Das and Abhik Gupta(2012): Effect of endosulfan (EC 35) on oxygen consumption patterns and gill morphology of the Indian flying Barb, Esomus danricus. Ceylon journal of science 41(2):145-150.

[14]. Sumita Roy and Jyotsna kumara (2016): A comparative studies on the effects of agrochemicals on respiratory physiology of Channa punctatus (Bloch). Proc. zool. soc. India. 15(1); 39-41.

[15]. Venkateswara Rao, J., (2004): Effects of monocrotophos and its analogs in acetyl cholinesterase activity's inhition and its pattern of recovery on euryhaline fish, Oreochromis mossambicus. Ecotoxicol. Environ. Saf. 59, 217–222

[16]. Venkateswara Rao, J., Parvati, K., Kavitha, P., Jakka, N.M., Pallela, R., (2005): Effect of chlorpyrifos and monocrotophos on locomotor behaviour and acetylcholinesterase activity of subterranean termites, Odontotermes obesus. Pest.Manage. Sci. 61, 417–421.

[17]. Vineetkumar K Patil and M. David (2008) : Behaviour and Respiratory Dysfunction as an index of Malathion Toxicity in the freshwater fish, Labeo rohita (Hamilton). Turkish Jr. of Fisheries and Aquatic Sciences Vol 8 : 233-237.

[18]. Williams, P.J. LeB., and Jenkinson, N.W. (1982): A transportable microprocessor controlled precise Winkler titration suitable for field station and shipboard use. Limnol. Oceanography, 27 (3), 576–584.

[19]. Winkler, L.W. (1888: Die Bestimmung des in Wasser gelösten Sauerstoffen. Berichte der Deutschen Chemischen Gesellschaft, 21: 2843–2855.

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