

TOXICITY OF CYPERMETHRIN INFLUENCED BY P^H AND TEMPERATURE ON THE FRESHWATER FISH *OREOCHROMIS MOSSAMBICUS*

A.PARITHABHANU* and M.DEEPAK**

Associate Professor, P.G And Research Department Of Zoology, Chikkaiah Naicker College, Erode – 638004, Tamil Nadu, India
P.h.D Research Scolar, P.G And Research Department Of Zoology, Chikkaiah Naicker College, Erode – 638004, Tamil Nadu, India
Email ID: farithahameed@gmail.com

Abstract- The influence of P^H and temperature on the toxicity of cypermethrin has been evaluated by using freshwater fishes. Both P^H and temperature were found to affect significantly the toxicity of pesticide by altering the physiological responses of fishes resulting in mortality. The adverse effects of the P^H and temperature were decreased oxygen consumption, acceleration of chemical reaction, impaired respiratory activities, insufficient energy liberation and so on. In general these environmental factors could lead to a higher level of bioaccumulation of the toxic chemicals, thus causing the chemical stress, which affecting the normal functioning of the body.

Index Terms: *Oreochromis mossambicus*, cypermethrin, P^H, temperature and mortality.

I. INTRODUCTION

Cypermethrin is one of the synthetic pyrethroid which are most extensively used for more than two decades as possible alternative to the organophosphate, organochloride and carbamate pesticides. The synthetic Pyrethroids are reported to more toxic than other pesticides and are widely used in crop protection, home pest control, forestry and in public health. But the pyrethroids are shown to produce toxic effects on biochemical, haematology of various aquatic animals [1],[2]. Among them cypermethrin is very toxic to the fish population and aquatic invertebrates [3]. The toxic effect of pyrethroids in mammals, birds, fishes, amphibians and invertebrates have been reviewed by [4].

In aquatic ecosystems P^H and temperature are important environmental variables which adversely affect the fish and fisheries [5], and [6] has recorded that the health of fishes is mostly influenced by the P^H, which would affect the reproduction and growth of fishes. Temperature is one of the most fundamental stressors altering the biological systems. This is because the water quality is greatly affected by temperature, P^H, hardness etc which influence the rate of bioaccumulation of the pollutants Literature are available in plenty with reference to P^H and hardness [7]. But limited reports are available on the toxicity of pollutants in relation to temperature, in aquatic organisms [8],[9]. The interaction of P^H and temperature related to pesticides are seldom let known and the role of these influencing factors on pesticide toxicity is not elaborated. Therefore the present investigation has been made to evaluate the influence of P^H and temperature with reference to cypermethrin toxicity in the freshwater teleost fish *Oreochromis mossambicus*.

II. MATERIALS AND METHODS

The experimental fishes collected from local reservoir were acclimatized to the laboratory conditions for 7 days in chlorinated tapwater contained in glass aquaria. By using 0.5% acetone, the stock solution of 1% cypermethrin was prepared. The stock solution was used to prepare different concentrations like 1%, 2%, 3%, 4% and 5%. In each concentration a group of 10 fishes having the same weight and size were introduced. The mortality of fish was recorded in each concentration of the pesticide at an interval of 24 hours upto 96 hrs (Table-1). From this the LC₅₀ 96 hrs concentration was used to study the effect of P^H and temperature on the toxicity of pesticide.

A healthy fish of known weight and size was exposed to the pesticide contained in a rectangular jar. The time at which the fish died was recorded (survival time) at room temperature. Another test animal of the same size and weight was taken in the pesticide medium contained in a beaker which is kept in a water bath. The temperature of the pollutant medium was increased by 2°C above the room temperature by adding hot water to the waterbath. Now the survival time of the animal was recorded. Another test animal was treated in the pesticide medium in a similar manner and its temperature was decreased by 2°C below the room temperature by adding ice cold water. The survival time of the animal in the reduced temperature also recorded.

In another set of experiments, the test animal was exposed to the pesticide medium to known P^H and the survival time was recorded. Then the P^H of the pesticides was decreased by using P^H tablets and another test animal was introduced into it. Similarly the P^H of the pesticide was increased and the survival time of the test animal in that P^H was noted. The results were tabulated and discussed.

III. RESULTS AND DISCUSSION

Temperature is one of the important factor as it greatly affect the toxicity of xenobiotic chemicals(Table-2). The changing temperature may increase or decrease or cause an effect on the toxicity of the chemicals depending on the species and the chemical nature of the toxicant. The present study the pesticide exerted more toxic effect at high temperature. A high temperature of the pesticide medium could have decreased the oxygen content. So that the fishes died due to decrease in oxygen consumption at high temperatures also noticed by [10],[11] have found that the fishes were more susceptible to the metals at high temperature. [12] have observed that the heat death in animal is due to death of different tissues, sequentially at different temperature.

According to Processor and [13] the chemical reactions are acclerated as the temperature rises whereas the cardia and respiratory activities are slowed down resulting in hypoxia in fishes at lower temperature. In *Oreochromis mossambicus* the lowered temperature of the pesticide medium exhibited mortality because the rate of energy liberation could be insufficient for the maintainance of metabolism when the temperature of the body lowered. In the present study the temperature could affect the nervous system directly altering the input of impulses of fishes through skin thermoreceptors.

The P^H of the medium also highly alters the toxicity of chemicals through the effect on physiological responses of the organisms, as P^H causes a severe chemical stress(Table 3). Packer and [14] have reported that the elevation of P^H will lead the acidosis in fishes which could decrease the oxygen carrying capacity of blood. Drummond [15] have shown that the metal accumulation has been increased at higher P^H of the medium. On the other hand lowering of P^H has also been shown to increase accumulation of metal in fishes [16]. In lower P^H the present experimental fishes might have experienced enhanced bioaccumulation of the toxic substances by the uptake through gills. The same trend has also been noticed [17] in fishes exposed to toxicants. [18],[19] have reviewed the specific effect of P^H on bioaccumulation in fresh water invertebrates under acidic condition more energy is found to be required to maintain normal functioning of animals [20] oxygen uptake is found to be impaired in organisms [21]. Thus from the present investigation it is evident that the pesticide toxicity has been highly influenced by the interaction between the P^H and temperature in fishes under laboratory conditions. This laboratory experiments are highly useful to correlate and explain the dynamics of pollutants in normal environment under the influence of P^H and temperature.

TABLE 1: TOXICITY OF VARIOUS CONCENTRATION PESTICIDE CYPERMETHRIN ON *Oreochromis Mossambicus* DURING VARIOUS EXPOSURE PERIOD

| CONCENTRATION OF THE PESTICIDE | MORTALITY % | | | |
|--------------------------------|-------------------------|---------|---------|---------|
| | EXPOSURE PERIOD (HOURS) | | | |
| | 24 Hrs. | 48 Hrs. | 72 Hrs. | 96 Hrs. |
| Control | 0 | 0 | 0 | 0 |
| 1 | 0 | 10 | 20 | 30 |
| 2 | 0 | 20 | 30 | 40 |
| 3 | 0 | 20 | 40 | 50 |
| 4 | 10 | 40 | 60 | 90 |
| 5 | 10 | 50 | 80 | 100 |

TABLE 2: EFFECT OF TEMPERATURE OF THE TOXICITY OF PESTICIDE

| S.NO. | TEMPERATURE | SUUVIVAL TIME (MINUTES) |
|-------|-------------|----------------------------|
| 1. | 25°C | 95 |
| 2. | 30°C | 55 |
| 3. | 35°C | 25 |

TABLE 3: EFFECT OF P^H ON THE TOXICITY OF PESTICIDE

| S.NO. | P ^H VALUES | SURVIVAL TIME (MINUTES) |
|-------|-----------------------|----------------------------|
| 1. | 6.0 | 70 |
| 2. | 7.0 | 65 |
| 3. | 7.7 | 35 |

REFERENCES

[1]. Saxena, K.K and Seth, N. (2002) Toxic effects of cypermethrin on certain haematological aspects of fresh water fish *Channa punctatus*. Bull. Environ. Contam. Toxicol. 69:364-369

[2]. Saxena, K.K and Gupta, P (2003) Effect of cypermethrin in the activities of acid and alkaline phosphomoneesterases in a fresh water fish Channa Punctatus. Proc. Nat. Symp. Biochem. Sci.Hith. Environ. ASP.477-479.

[3]. Sarkar, B., Chatterjee A., Adhikari S., Ayyappan S. (2005) Carbofuran and Cypermethrin induced histo - pathological alterations in the liver of *Labeo - rohita* (Hamilton) and its recovery. Journal of Applied Ichthyology, 21, 131-135.

[4]. Bradbury, S.P and Coats.J.R (1989) comparative toxicology of Pyrethroid insecticides. Rev., Environ. Contam. Toxicol., 108:133-177

[5]. Brown, D.J.A (1982) The effect of pH and calcium on fish and fisheries water Air soil pollut. 18:343-351.

[6]. Boyd, C.E (1982) Water quality management for pond fish culture, Elsevier Scientific Publishing Company, 318 pp.

[7]. S.Karthikeyan Dr.RM.Palaniappan and Selvi Sabhanayakam (2007) Influence of pH and water hardness upon nicked accumulation in edible fish *Arrhinus mrigala* J. Environ. Biol. 28 (2), 489-492.

[8]. John, P.R., V.Rena and D.J.Mcqueen (1996) Uptake rates of food chain and water born mercury by fish Field measurements. a mechanistic model and an assessment of uncertainties Can.J.Fish. Aquat Sci., 53(2), 395-407.

[9]. P.Kannadi., K.Kannan and S.Raveandran (2008) Effects of temperature on the behavioural and respiratory responses of cat fish *Mystus gulio* (Hamilton) Indian J. Environ and Ecoplan. 14(3)750-754.

[10]. Rafia Sultana and Uma Devi, (1995). Oxygen consumption in a cat fish *Hystus gulio* (Ham) exposed to heavy metals. J. environ. Biol., 16:207-210.

[11]. Gupta, A.K. and V.K.Rajbanshi (1991) Toxicity of copper and cadmium to *Heteropneustes fossilis* (Bloch). Acta Hydrochim. Et. Hydrobiol., 19(3), 331-340.

- [12]. Orr, T.R (1955) Heat death of whole animals and Tissues, Various animals *Physiol. Zool.*28:290-302.
- [13]. C.Ladd Prosser and Frank A. Brown.JR (1965) *Comparitive Animal Physiology* Secondedition.
- [14]. Packer, R.K and Dinson. W.A. (1972) Anoxia and Sodium loss associated with the depth of brook trout low pH *Comparitive Biochem physiol.* 41(A) 17-26.
- [15]. Drummond, R.A. Olson, G.F and Batterman, A.R. (1974) Cough response and uptake of mercury by brook trout *Salvelinus fontinalis*, exposed to mercuric compounds at different hydrogen ion concentrations. *Trans. Amer fish Soc.* 2:244-249.
- [16]. Paulose.P.V (2004) Effect of water pH on toxicity and accumulation of inorganic and Methyl Mercury in a fish *Gambusia affinis* Indian *J.Environ 4 Ecoplan.* 8(1): 249-252.
- [17]. Paulose. P.V 1989 Histological changes in relation to accumulation and elimination of inorganic and organic mercury in gills of *Labeo rohita* Hamilton Ind.*J.Expl.Biol.* 27: 146-150
- [18]. Robert.L. Graney, D.Cherry and J.Cairns (1984) The influence of substrate pH diet and temperature upon cadmium accumulation in the Asiatic clam (*Corbicule fluminea*) in laboratory artificial streams. *Water Res.*, 18, 833-842.
- [19]. Stephenson, M. and G.C.Mackie (1988) Multivariate analysis of correlation between environmental parameters and cadmium concentrations in *Hyalella azteca* (crustacea, amphipoda) from central ontario lakes. *can.J.Fish Aquat.Sci.*, 45, 1705-1710.
- [20]. Rosseland, B.O. and M.Stournes (1994) Physiological mechanisms for toxic effects and resistance to acidic waters: An ecophysiological and eco toxicological approach. In: *Acidification of fresh water ecosystem. Implication for the future* (Eds:C.E.Steinberg and R.W.Ward wright) wiley, Newyork. P.P.227-246.
- [21]. Spry,D.J Wood, C.M. and Hodson, P.V (1981) The effects of environmental acid on fresh water fish with particular reference to the soft water lakes in ontaria and the modifying effects of heavy metals. A literature review. Canadian Technology Report of Fisheries and Aquatic Science No.999: 144p.