International Journal of Zoology and Applied Biosciences
Volume 2, Issue 1, pp: 38-42, 2017
https://doi.org/10.5281/zenodo.1311146
Research Article

ISSN: 2455-9571
http://www.ijzab.com

THE IMPACT OF PESTICIDE ON THE BEHAVIOURAL, RESPIRATORY AND BIOCHEMICAL PARAMETERS IN *CATLA CATLA*

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Article History: Received 12th December 2016; Accepted 25th January 2017; Published 29th January 2017

ABSTRACT

India is rich in inland fishery resources, but the indiscriminate use of the pesticides causes serious threat to such resources like water and land. Pesticides are stable compounds and they enter into the aquatic ecosystem through the agricultural runoff. The pesticides, which enter the body tissues of the fish, affect the physiological activities and the nature of biochemical components like protein and glycogen. Based on the various concentrations of the monocrotophos a pesticide employed the amount of protein and glycogen contents in the muscle of the fish decreases slowly sometimes rapidly on prolonged exposure even at the same concentration. A clear and steady increase in the rate of opercular movement and followed by decreased rate of oxygen consumption was observed with increasing concentrations of the pesticide monocrotophos.

Keywords: Pesticide, Monocrotophos, *Catla catla,* Glycogen, Protein, Muscle.

INTRODUCTION

Pesticides are stable compounds. Indiscriminate liberal and injudicious use of pesticides by man to control the crop pests and diseases for higher agricultural productivity has led to a slow but steady deterioration of the aquatic ecosystem, since water is the ultimate sink. These pollutants also destroy the quality of the aquatic media and render it unfit for various aquatic organisms particularly fishes. Pesticides are useful tools in agriculture and forestry, but their contribution to the gradual degradation of the aquatic ecosystem cannot be ignored (Konar, 1975; Basak and Konar, 1976 & 1977). The aquatic ecosystem as a greater part of the natural environment is also faced with the threat of a shrinking genetic base and biodiversity.

A variety of organophosphate, organochlorine and carbamide pesticides are extensively used in agriculture for the control of pests. It can be seen that the toxic action is specific for a particular animal in a particular toxicant. The toxicity levels were influenced by the sex and the nutrient supply (Arunachalam, 1980; Mathivanan, 2004). The effects of several insecticides and pesticides on various physiological responses of fishes were reported by Anderson (1971), Monoharan and Subbiah (1982), Devi Sewtharanyam (2000) and Prashanth *et al.* (2003).

The fish species showed several abnormal behaviors which included restlessness, arena movements, loss of equilibrium, increased opercular activities, strong spasm, paralysis and sudden quick movements during the exposure. *Anabas testudineus, Channa punctatus* and other indigenous small fishes use paddy fields as breeding and nursery grounds (Shaun *et al*., 2007). *Barbodes gonionotus* is an important species for integrated rice-fish farming. Pesticides at high concentrations are known to reduce the survival, growth and reproduction of fish (Mckim *et al*., 1975) and produce many visible effects on fish (Johnson, 1968).

Monocrotophos (dimethyl (E)-1-methyl-2-(methyl carbamoyl) vinyl phosphate) is one of the largest selling agrochemical in India. The trade names for products containing monocrotophos include Azodrin, Bilobran, Crisodrin, Monocil, Monocron, Nuvacron, Pillardrin, Plantdrin, Susvin, Ulvair, Dominator, Macabre, Suncrotophos and Monopaz.

The present investigation has been taken up to elucidate the effect of monocrotophos at sublethal concentration on certain biochemical parameters of the fish muscle and also to examine the sublethal effect on the behaviour and respiratory activity of the fish *Catla catla.*

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Catla catla which are edible, commercially valuable and distributed all over India.

MATERIALS AND METHODS

The fish for the experimental purpose healthy live *Catla catla* weighing 15.52 ± 2.52 g with a mean body length of 9.11 ± 2.02 cm were collected from culture ponds. The experiments were carried out with help of small circular troughs of 25 liters capacity in which an iron wire gauge covered the trough at the surface level of water to avoid aerial respiration. The lethal concentration LC_{50}, and LC_{100} values were calculated and tabulated. Before the actual starting of the experiment, the test fishes were divided into 6 groups of same weight selecting from the stock tank and transferring into the test chamber with test solution of various concentrations of monocrotophos ie. 0.0 ppm, 1.0 ppm, 2.0 ppm, 3.0 ppm, 4.0 ppm and 5.0 ppm. Each group consisted of 10 fishes per trough. These were actually subjected to both short and long term exposure periods, the former lasting for about 24 to 48 h and the latter lasting for 72 to 96 h. Both the long term and the short-term exposures were given to all the five groups involving the different concentrations of monocrotophos. A control (pesticide free water) was also maintained as above.

After the exposure period was over one of the fishes was taken out and scarified for the analysis of selected biochemical parameters viz., protein by Lowry method (Lowry *et al.*, 1951) and glycogen by Anthrone method (Carroll *et al.*, 1956). Behavioural changes were also studied in normal and treated fishes, which were maintained at room temperature.

RESULTS AND DISCUSSION

Pesticides are xenobiotic substances that have been used in India for a longer period for the management of pests in agriculture fields and control of vectors in public health operations. Most of the insecticides are hydrophilic that they can easily be absorbed by soil particles and can migrate to natural water systems such as rivers, lakes and ponds through the run off causing severe aquatic pollutions. The indiscriminate use of the pesticides, however, resulted in the pollution of our eco-system causing hazards to non-target organisms including fishes. The mortality percentage and survival percentage for the fish *Catla catla* treated with 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0 and 10.0 ppm of monocrotophos for a period of 24, 48, 72 and 96 h were presented in the Table 1. Similar finding was reported by Gupta (2002).

Glycogen and proteins are the chief nutrients of animals. They have a variety of functions. The glycogen supplies energy in the form of ATP molecules. Similarly proteins are made up of amino acids which form the building blocks of the body like essential constituents of protoplasm of all the cells. The proteins in different tissues differ in composition and properties.

In the present study the results obtained clearly indicate that there was a decreased amount of protein and glycogen content (Table 2) to resist the effects of pesticides. That is to provide immediate energy to the fighting elements of the body and protect all systems of the body from the harmful effect of the pesticides. As the fish was constantly kept in the medium of different concentration of pesticides the monocrotophos the dissolved in water there was no way for the animal to move away from the toxic medium. The effect of pesticides dominates. The organ system and the glycogen content are slowly depleted due to the utilization of the already stored glucose contents of the body. At particular level poison overtakes the organisms so that the level of the carbohydrates content is very low in the muscles because of the utilization. With regard to the exposure of fishes to different concentrations of Monocrotophos pesticide there was no much change within 24 h of treatment with mild concentrations of 1.0 ppm and 2.0 ppm but the same on prolonged up to 96 h the glycogen content was observed in decreased amount when the concentration was increased to 3.0 ppm, 4.0 ppm and 5.0 ppm. The glycogen content was observed in the decreasing order with increasing concentrations and with more exposure periods the glycogen content was found more and more decreased. Because of the stress the fish makes suitable adjustments for which the stored energy is utilized. This may be the reason for the decreased amount of glycogen content (Anonymous, 2005). Such reduction in stored glycogen content has been reported in *Tilapia mossambica exposed* to methyl parathion (Rao and Rao, 1929) to endosulfan (Vasanthi and Ramasami, 1987) in *Saratherodon mossambicas*, *Catla catla* following malathion intoxication (Shah and Double, 1983) and in *O. mossambicus* to metacid (Baskaran, 1991).

The protein content in the muscle of *Catla catla* is decreased with increasing concentrations of pesticide monocrotophos. Even with the same concentrations longer exposure resulted in decreased amount of protein content (Table 2), which indicates that the tissue protein undergoes proteolysis. This results in the production of free amino acids, which are used in the TCA cycle for energy production under stresses (Kabeer Ahamed, 1979). There are similar reports of the effects of toxicants on total protein in other fishes (Rath and Mishara, 1980; Shah and Double, 1983; Palanichamy *et al.*, 1989).

In the present study, the opercular beats increased with increasing concentrations of pesticides (Table 3). The initial increase in opercular movement in the less concentrated medium as a primary response to sudden stress was reported by Anbu and Ramasamy (1991) as in *Channa striatus* exposed to carbomate pesticide sevien. Baskaran and Palanichamy, (1990) reported that the opercular beats increased with increasing concentrations of fertilizer in *A. scandens*.

Oxygen consumption of pesticide treated fish showed decreased with increasing concentrations (Table 3). The reduced oxygen consumption could be attributed to gill damage or to hypochromic mirocytic anemia as suggested by Baskaran and Palanichamy (1990). Similar decrease in oxygen consumption was observed by Lars Collivin, (1984) in *Perca fluviatilis*. The decrease in oxygen consumption appears to be a protective measure to ensure that there is a low intake of the toxic substance. Reduced oxygen consumption at higher concentrations of pesticides could also arise as a result of respiratory inhibitory factors that come into play as suggested by Rafia Sultana and Uma Devi (1995) in *Catla catla* under heavy metal pollution. The pesticide monocrotophos dissolved in water brings about extensive changes in the physical parameters of water such as salinity, alkalinity and severe depletion in the dissolved oxygen content. So the aquatic systems are drastically altered due to this new stress in the environmental medium that brings out biochemical changes and to cope up with the situations.

Table 1. Effect of different concentration of pesticide monocrotophos on mortality percentage of *Catla catla* at 24, 48, 72 and 96 h exposure.

S. No.	Concentrations (ppm)	% of mortality				Remarks
		24 h	48 h	72 h	96 h	
1	1.0	0	0	0	0	LC 0/96 hr
2	2.0	0	0	0	0	LC 0/96 hr
3	3.0	0	0	0	0	LC 0/96 hr
4	4.0	0	0	0	0	LC 0/96 hr
5	5.0	0	0	0	0	LC 0/96 hr
6	6.0	0	0	0	10	LC 10/96 hr
7	7.0	10	20	40	50	LC 50/96 hr
8	8.0	10	20	40	70	LC 70/96 hr
9	9.0	10	20	50	80	LC 80/96 hr
10	10.0	40	80	90	100	LC 100/96 hr

Table 2. The total protein content and total glycogen content of muscles of *Catla catla* exposed to pesticide monocrotophos.

S. No.	Concentration of monocrotophos (ppm)	Exposure Period (h)	Amount of protein content (mg /g wet tissue)	Amount of glycogen content (mg /g wet tissue)
1	Control 0 ppm	24	23.50±0.43	3.25±0.15
		48	22.10±0.25	3.10±0.17
		72	21.10±0.17	2.90±0.18
		96	20.75±0.22	2.50±0.23
2	Treated 1.0 ppm	24	22.25±0.51	3.10±0.22
		48	21.75±0.62	2.95±0.13
		72	20.25±0.25	2.35±0.18
		96	19.25±0.15	1.90±0.14
3	Treated 2.0 ppm	24	22.00±0.25	2.85±0.11
		48	21.25±0.15	2.50±0.12
		72	18.50±0.16	2.25±0.13
		96	18.25±0.17	1.90±0.14
4	Treated 3.0 ppm	24	21.50±0.13	2.65±0.22
		48	20.40±0.12	2.35±0.55
		72	1810±0.14	1.70±0.51
		96	15.25±0.11	1.50±0.62
5	Treated 4.0 ppm	24	20.20±0.11	2.50±0.55
		48	19.50±0.12	1.95±0.62
		72	16.50±0.11	1.15±0.63
		96	15.25±0.12	0.50±0.25
6	Treated 5.0 ppm	24	19.76±0.10	2.25±0.92
		48	17.50±0.20	1.70±0.72
		72	16.00±0.23	1.10±0.62
		96	15.25±0.22	0.40±0.50

(Each value represents the mean ± SD of five values).

Table 3. Sublethal effects of monocrotophos on oxygen consumption and opercular beats of *Catla catla.*

S. No.	Concentration (ppm)	Opercular beats (No./min)	Oxygen consumption (ml/g/h)
1	0	125.32 ± 3.85	0.98 ± 0.05
2	1.0	130.00 ± 3.25	0.98 ± 0.03
3	2.0	160 .21± 4.65	0.75 ± 0.08
4	3.0	180.34 ± 6.25	0.60 ± 0.18
5	4.0	195.46 ± 3.50	0.40 ± 0.25
6	5.0	225.12 ± 4.50	0.25 ± 0.45

Each value represents the mean ± SD of five values.

REFERENCES

Anbu, R.B. and Ramasamy, M., 1991. Adaptive changes in respiratory movement of an air breathing fish *Channa striatus* (Bleeker) exposed to Carbonate pesticide Seiven. *J. Ecobiol.*, 3(1), 11-16.

Anderson, J.M. 1971. Sublethal effects and changes in ecosystems. assessments of the effect of pollutants on physiology and behaviour. *Proc. R. Soc. London, Biol. Sci.*, 177, 307-320.

Arunachalam, S. 1980. Toxic and sub-lethal effects of carbaryl on a freshwater catfish *Mystus vittatus* (Bloch). *Arch. Environ. Contam. Toxicol.*, 9, 307-316.

Basak, P.K. and Konar, S.K., 1977. Estimation of safe concentration of insecticides, a new method tested on DDT and BHC. *J. Inland Fish. Soc. India,* 9, 19-29.

Basak, P.K. and Konar, S.K., 1976. Pollution of water by pesticides and protection of fishes: parathion. *Proc. Nat. Acad. Sci*., 46, 382-392.

Baskaran, P., 1991. Use of Biochemical parametes in Biomonitoring of pesticide pollution in some freshwater fishes. *J. Ecotoxical. Environ. Monit.*, 2, 103-109.

Baskaran, P. and Palanichamy, S., 1990. Sublethal effects of ammonium chloride on feeding energetics and protein metabolism in the fish *Orechromis mossambicus. J. Ecobiol.,* 2, 97-106.

Carroll, N.V.R., Longley, W. and Rae, J.H., 1956. The determination of glycogen in liver and muscle by use of Anthrone reagent. *J. Biochemis.,* 220, 583-598.

Collivin, L., 1984. The effect of copper on maximum respiration rate and growth rate of perch, *Perca fluviatilis* L. *Water Res.*, 18, 139-144.

Devi Sewtharanyam, 2000. The effects of endosulfan on oxygen consumption of the fish *Oreochromis missambicus. J. Ecotoxicol. Environ, Moint.*, 10(1), 21-24.

Gupta, M.V., 2002. Effect of Diazinon 60 EC on *Anabas testudineus, Channa punctatus* and *Barbodes gonionotus* Naga, *The ICLARM*, 25(2), 41-48.

Johnson, D.W. 1968. Pesticides and Fishes A review of selected literature. *Trans Am. Fish. Soc.*, 97, 338-423.

Kabeer Ahamed, S.I., 1979. Studies on some aspects of protein metabolism and associated enzymes in freshwater teleost, *Sarotherodon mossambicus* subjected to malathion exposure. Ph.D. Thesis, S.V. University, Thirupuathi, India.

Konar, S.K., 1975. Pesticides and aquatic ecosystems**.** *Indian J. Fish.,* 22, 80-85.

Lowry, O.H., Rosebrough, N.J., Farr, A. and Randhall, R.J. 1951. Protein measurement with folin phenol regagent. *J. Biol. Chem.*, 193, 265-275.

Mathivanan, R., 2004. Effects of sublethal concentraion of Quinolphos on selected respiratory and Biochemical parameters in the fresh water fish *Oreochromis mossambicus. J. Ecotoxicol. Environ, Monit.*, 14(1), 57-64.

Mckim, J.M., Benoit, D.A., Biesinger, K.K., Brungs, W.A., and Siefert, R.E., 1975. Effects of pollution on fresh water fish. *Water Pollut. Contr. Fed.*, 47, 1711-1764.

Monoharan, T. and Subbiah, G.W., 1982. Toxic and sublethal effects of endosulfan on *Barabar stigma. Proc. Ind. Acad. Sci*., pp. 523-532.

Palanichamy, S., Arunachalam, S. and Baskaran, P. 1989. Impact of pesticides on protein metabolism in the fresh water catfish *Mystus vittatus. J. Ecobiol.*, 1: 90 – 97.

Prashanth, M.S., David, M. and Riveendra, C.K., 2003. Effects of cypermethrin on toxicity and oxygen consumption in the freshwater fish *Cirrhinus mri*gala. *J. Ecotoxicol. Environ. Monit.*, 13(4), 271-277.

Rafia Sultana and Uma Devi, 1995. Oxygen consumption in a catfish *Mystus gulio* (Ham) exposed to heavy metals. *J. Environ. Biol.*, 16(3), 207-210.

Rao, K.S.P. and Rao, K.V.R. 1929. Effect of sublethal concentration of methyl parathion on selected oxidative enzymes and organic constituents in the tissues of freshwater fish *Tilapia mossambica. Curr. Sci.,* 46.

Rath S and Mishara BN (1980). Changes in nucleic acid and Protein content of *Tilapia mossambica* exposed to Dichlorovas (DDVP). *Indian J Fish,* 27: 76 – 81.

Shah, P.H. and Dubale, M.S., 1983. Biochemical changes induced by malathion in the body organ of *Channa punctatus. J. Ani. Morphol. Physiol.,* 30, 107-118.

Shaun, S. Killen, Isabel Costa, Hoseph A. Brown and Kurt Gamperl, A. 2007. Little left in the tank metabolic scaling in marine teleosts and its implications for aerobic scope. *Proc. Res. Soc. British,* 274, 431-438.

Vasanthi, M. and Ramasami, M., 1987. A shift in metabolic pathway of *Sarotherodon mossmbicus* (Peters) exposed to Thiodon (Endosulfan). *Proc. Indian Acad. Sci.,* 96, 56-60.