BIOGLOBIA Vol. 4 (1): 12 – 16, 2017 **ISSN: 2349-5626**

Fish health under Decamethrin stress

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Received: 01.05.2017 **Accepted: 06.05.2017**

ABSTRACT

This study attempts to evaluate the health status of the fresh water fish *Anabas testudineus* (Bloch) on the basis of changes in blood biochemistry under the toxic stress of synthetic pyrethroid. Decamethrin (0.106 ppm) for 30 days significant changes were observed in the blood biochemical properties in the form of hyperglycemia, hypoproteinemia and hypercholesterolemia. The present study concludes that indiscriminate use of Decamethrin even at lower doses, may prove detrimental to fish health.

Keywords: *Blood glucose, Serum protein, Serum cholesterol, Anabas testudineous, Hyperglycemia, Hypoproteinemia, Hypercholesterolemia.*

INTRODUCTION

Pesticides have been extensively used in a variety of agriculture to control the harmful target organisms such as insects, weeds, mollusks, harmful bacteria and viruses. Among the different types of pesticides are pyrethroids; which are considered classes of insecticides widely used in many countries (Sapana *et al*., 2014). Newly synthetic pyrethroid (Decamethrin) having very long mammalian toxicity and high bio-efficacy got its discovery and are being manufactured in recent years with a recommendation to the farmers to use this compound in pest control. In fact that physio-biochemical parameters and histopathological investigation of freshwater fishes in relation to pyrethroid (Decamethrin) toxicity are still very meager led this worker to undertake the present study. The present work is an attempt to reveal the adverse impacts of newly formulated synthetic pyrethroid Decamethrin on various bio-chemical as well as histopathological parameters of fresh water fish *Anabas testudineus* (Bloch). The bio-chemical as well as histopathological alterations, under toxic stress, are manifested much before any histological damage is developed and as such they serve as reliable indicators of pollution and biological deterioration. Delta larvae which were chosen in a study experiment as an example of combination of two pyrethroids (Deltamethrin and Tetramethrin) was extremely toxic to fish (Rehab *et al*., 2016). Pesticides affect the physiology, functions and morphology of various organs of biological organisms (Ali *et al.,* 2014).

Many investigators have been reported the acute and chronic toxicity to such pyrethroid (Prasad *et al.*,1991; Mishra, 1992; Srivastava *et al.,* 1995; Choudhary, 1996; Singh, 2002; Pandey, 2003; Mukhopadhyay *et al.*,2005; Rita and Milton, 2006; Singh *et al.,* 2007; Muthulakshmi *et al.,* 2008; Jha, 2009; Poonam *et al.,* 2010; Yadav and Jha, 2010; Kumar and Jha, 2011; Yadav, 2013 and Patole *et al*., 2016).

MATERIALS AND METHODS

Anabas testudineus procured live from the local fish market were washed with 0.1% $KMnO_4$ solution to remove dermal infection if any. Healthy fishes of average length (9–12cm) and weight (21–25 g) were acclimated for 15 days to laboratory conditions. The fish were fed with chopped goat liver every day adlibitum.

Static acute bioassays were performed to determine LC_{50} values of decamethrin for 24, 48, 72 and 96 hours following the methods of APHA, AWWA & WPCF (1985). The LC_{50} values for these periods were 0.15 ppm, 0.20 ppm, 0.25 ppm and 0.30 ppm respectively. The sublethal concentration was determined following the formula of Hart *et al.* (1945). Fish were exposed to a sublethal concentration (0.106 ppm) of decamethrin for 30 days. Side by side same number of fish as that of experimental one was maintained as the control group. At the end of exposure period the fish were anaesthetized with 1:4000 MS 222 (tricane, methane, sulfonate, sandoz) and were then processed for quantitative estimation of blood glucose (Sinha, 1990), serum protein (Varley, 1980) and serum cholesterol (Kabaras, 1986). Blood samples were collected in heparinized vials with the help of 1 ml disposable syringe equipped with 2-gauge hypodermic needle by puncturing ventral dorta.

RESULTS AND DISCUSSION

The fish of this exposure period reflects hyperglycaemic, hypoproteinemic & hypercholesterolemic response. The blood glucose level elevates to 89.64 ± 2.98 mg/100 ml of blood against the control value of 69.83 ± 2.49 mg/100 ml of blood. The amounts to an increase by 28% and is significant at $P < 0.01$ (Table 1). The protein depletion shows hypoproteinemia which depleted to 3.07±0.77 g/100 ml of blood against the control value of 4.89±0.65 g/100 ml of blood. This amount to decrease by 37% and is significant at $P < 0.001$ (Table 1) .The serum cholesterol elevation shows hypercholesterolemic response which elevates to 171.28±2.53 mg/100 ml of blood against the control value of 144.85±2.38 mg/100 ml of blood. This amount an increase by 18% and is significant at $P < 0.01$.

Table 1

Changes in blood/serum biochemical parameters of *Anabas testudineus* chronically exposed to decamethrin for 30 days. Values are mean ± SE 0f 5 observations.

Parameters	Control	Decamethrin exposed
Blood glucose (mg/100 ml)	69.83±2.49	** 89.64±2.98 (+ 28.36)
Serum protein (g/100 ml)	4.89±0.65	*** 3.07±0.77 (– 37.24)
Serum cholesterol (mg/100 ml)	144.85±2.38	** 171.28±2.53 (+ 18.24)

Decrease (–) over control values significant at
** $p < 0.01$
*** $p < 0.001$

Blood glucose

Various studies have reported similar increase in the level of blood glucose in various fishes subjected to pyrethroidal and other pesticideal exposures. Singh and Srivastava (1982)

observed hyperglycemia in *H. fossilis* treated with 10.4 ppm for aldrin. Similarly, endosulfan induced increase in blood glucose was reported by Kalarani *et al.* (1984). The present study is in conformity with the finding of Ghosh (1990) who recorded significant elevation of blood sugar of *C. Carpio* and *O. mossambicus* exposed to sublethal concentration of fenvalerate. Bhattacharya *et al.* (1987), based on their studies with single and mixture of pollutant exposure to fish, reported that hepatic glycogen is probably the source of hyperglycemia. They found that maximal glycogen depletion corresponded to a dramatic increase in blood glucose levels, suggesting that some of the hepatic glycogen via the intermediate glucose I phosphate was converted to glucose and that this glucose enters the circulation (Hinson *et al*., 1983). Recently Jha (2009), Poonam *et al.* (2010) and Yadav and Jha (2011) has reported similar findings.

In the light of available literature and the present study on blood glucose clearly reveals that there exists a high catabolic potency during pesticide exposure which have serious consequences for the general body metabolism and energetic economy of the fish.

Serum protein

Various studies have reported similar decrease serum protein by Verma *et al.* (1979), Sastry and Siddiqui (1983), Rao *et al.* (1984) and Jha (1992). The present loss in serum protein may also be explained in this light. The liver cells might have reduced or stopped the synthesis of serum protein due to the direct toxic effects of the pesticides and the serum protein would have been utilized under pesticides induced stress leading to their depletion. Recently Jha (2009), Poonam *et al.* (2010), Yadav and Jha (2011) and Kumari and Kumar (2015) has reported similar findings.

Serum cholesterol

Various studies have reported similar increase serum cholesterol by Love (1970), Jha and Jha (1995). The blood cholesterol content is usually high in fishes, often much higher than mammals. It is utilized in the conversion of bile salts and in the synthesis of steroid hormones including androgens. Present findings are conformity with Sastry and Sharma (1980) explained increased cholesterol in *Channa punctatus* exposed to mercuric chloride. Gill *et al.* (1991) have opined enhanced de novo cholesterogenesis in liver to be responsible for rise in blood-cholesterol. Recently Jha (2009), Poonam *et al.* (2010) and Yadav and Jha (2011) was reported similar findings.

REFERENCES

1. Ali, A, Khan, J. A., Khaliq, T., Javed, I., Muhammad, F., Aslam, B. and Khan, M. Z. 2014. Hematobiochemical disruptions by lambda-cyhalothrin in rats. *Pakistan Veterinary Journal* 34: 54–57.
2. APHA 1985. Standard methods for the examination of water and waste water (16th Ed). American Public Health Assoc., Washington D.C.
3. Bhattacharya, S., Ray, A. K., and Bhattacharya, S. 1987. Blood glucose and hepatic glycogen inter relationship in *Channa punctatus* (Bloch). A parameter of non-lethal toxicity bioassay with industrial pollutants. *Ind. J. Exp. Biol*. 25: 539-541.
4. Chatterjee, K. K., Sharma, A. and Talukdar, G. 1986. Cytotoxicity of Pyrethroids. *The nucleus* 29 : 66 – 82.
5. Choudhary, S. 1996. Studies on the adverse impacts of two newly formulated synthetic pyrethroids Fenvalerate and Decamethrin on various bio-chemical parameters of the freshwater fish *Channa punctatus* (Bloch). Ph.D. Thesis, L.N.M.U., Darbhanga.
6. Ghosh, T. K. 1990. Toxicological evaluation of synthetic pyrethroids on the freshwater fishes. In : Environmental pollution and Health Hazards (eds. R. Prakash and S.M. Choubey). Society of Biosciences. Muzaffarpur, India, *p*. 15-25.

7. Gill, T. S., Pande, J. and Tewari, H. 1991. Effects of endosulfan on the blood and organ chemistry of freshwater fish, *Barbus conchonius* (Hamilton). *Ecotoxicol. Environ. Saf.* 21 : 80-91.
8. Hart, W. B., Dondoroff, P. and Greenbank, J. 1945. The evaluation of toxicity of industrial wastes, chemicals and other substances to freshwater fishes. Atlantic Refining Company. Phil. Part (1) : 317-326.
9. Hinson, J. A., Mays, J. B. and Cameron, A. M. 1983. *Biochemical pharmacol*. 32 : 1979.
10. Jha, A. K. 2009. Effect of an organophosphate (Nuvan) on certain haemopoietic tissue and blood parameters of a freshwater air-breathing fish, *H. fossilis* (Bloch). Ph.D. Thesis, L.N.M.U., Darbhanga.
11. Jha, B. S. and Jha, M. M. 1995. Biochemical effects of nickel chloride on the liver and gonads of the freshwater climbing perch, *Anabas testudineus* (Bloch). *Proc. Nat. Acad. Sci.* (India) 65B (1) : 39-46.
12. Jha, M. M. 1992. Studies on the effects of nickel chloride to some organs of the climbing perch, *Anabas testudineous* (Bloch):Ph.D. Thesis, L.N. Mithila University, Darbhanga.
13. Kabara, J. J. 1986. Determination and microscopic localization of cholesterol in method of Bio-chemical analysis (ed. D. Glick) New York. Inter Science Publishers, Inc. *p.* 263-318.
14. Kalarani, V., Reddy, D.C. and Naidu, B.P. 1984. Impact of endosulfan toxicity on certain aspects of carbohydrate metabolism of the freshwater snail, *Pila globosa* (Swainson). *Geobios*. 11 : 197-200.
15. Kumar, A. and Jha, M. M. 2011. Biochemical effects of blood metabolite under fenvalerate & permethrin stress. *J. Environ. Ecoplan.* 18:2-3.
16. Kumari, A and Kumar, R. 2015. Biochemical investigations on the freshwater fish Anabas testudineus exposed to pesticide methyl parathion. *Bioglobia* 2(2): 33-35. *(http://www.bioglobia.in)* SJIF 4.441
17. Love, R. M. 1970. The chemical biology of fishes. Academic Press, New York.
18. Mishra, C. K. 1992. Effects of fertilizers and insecticides on respiration of *Channa punctatus*. Ph.D. Thesis, Magadh University, Bodh Gaya.
19. Mukhopadhyay, K., Bera, R. and Roy, R. 2005. Modern agriculture and environmental pollution, Every Man's Science, Vol. XL No. 3.
20. Muthulakshmi, R., Bendhuga, M D., Revathi, K. and Saravanam, R. 2008. Induced effect of organophosohate pyrethroid combination in fresh water fish Rahu (*Labeo rohita*) *Ind. J. Environ. Ecoplan.* 15 (1-2):199-206.
21. Pandey Ratna 2003. Pesticides and Sterility, Everyman's Science, Vol. XXXVIII, No. 2, *p*. 84 – 86.
22. Patole, S. S., Patil, M.U. and Bhoi, S.S. 2016. Effect of fenvalerate synthetic pyrethroid on a certain haematological parameters of freshwater fish *Channa marulius* (Ham-Bach) *Int. J. Life. Sci. Scienti. Res*.2(3): 269-272.
23. Prasad, T. A. V., Srinivas, T. G. N. and Reddy, D. C. 1991. Effect in vivo of atrazine on haematology and oxygen consumption in fish. *Telapia mossambica*. *Bio-chem. Int*. 23(1), 157-161.
24. Poonam Kumari, Jha, A. K. and Jha, M. M. 2010. Fish health under fenvalerate stress. *Ind. J.Environ. Ecoplan.* 17 : 3-6.
25. Rao, K. J., Baig, M. A. and Ramamurthi, K. 1984. Effect of a systemic pesticide phosphamidon on some aspects of freshwater fish, *Tilapia mossambica*. *Ind. J. Environ. Hlth.* 25(1): 60-64.
26. Rehab, A., Md. Adel F., Tohamy Mahmoud, A., Mahmoud Mohamed A., Elhady and Maher M. Soliman, 2016. Subchronic toxicity of deltamethrin and tetramethrin in nile tilapia fish. DOI: 10.20959/wjpps201610-6738; Volume 5(10):28-52.
27. Richardson, M.L. 1988. Risk assessment of chemicals in the environment. U. K. R. S. C. Publications.
28. Rita J. J. Arockia Milton M.C. and John, P. 2006. Effect of Carbabate pesticide (Methomyl) on the Bio-chemical components of the fish water *Oreochronis Mossambicus* (Petera) *Indian J. Environ. Ecoplex.* 12(1): 1-8.
29. Sapana Devi M. and Gupta A. 2014. Sublethal toxicity of commercial formulations of deltamethrin and permethrin on selected biochemical constituents and enzyme activities in liver and muscle tissues of *Anabas testudineus*. *Pestic Biochem Physiol*. 115: 48–52.

30. Sastry, K. V. and Sharma, K. 1980. Mercuric induced haematological and bio-chemical anomalies is *Channa punctatus* (Bloch). *Toxicol Letters* 5 : 245.

31. Sastry, K. V. and Siddiqui, A. A. 1983. Metabolic changes in the snake-head fish, *Channa punctatus* chronically exposed to endosulfan. *Water, Air and Soil Pollution*. 19 : 133-141.

32. Sinha, S. N. P. 1990. Manual of practical Bio-chemistry scientific book company, Patna.

33. Singh, N. N. and Srivastava, A. K. 1982. Effect of Aldrin on some biochemical parameters of Indian catfish *Heteropneustes fossilis*. *J. Freshwater Biol*. 4: 289-293.

34. Singh, P. R. 2002. Studies on changes in blood of an air-breathing fish exposed to O. C. and O. P., Ph.D. Thesis of L. N. M. U., Darbhanga.

35. Singh, R. N., Pandey, R. K., Singh, S., Singh, N. N. and Das, V. S. 2007. Acute toxicity and behavioural responses of common carp *Cyprinus carpio* (Linn) to an organophosphate (Dimethoate). The National Academy of Sc. India Abstract 77th Annual Symposium CFTRI Mysore Dec. 6-8 *p*. 28.

36. Varley, H. Gowenlock, A. H. and Bell, M. 1980. Practical clinical Bio-chemistry, Vol. I, General topics and commoner tests. William Heinemann Medical Books Ltd., London.

37. Verma, S. R. Bansal, S. K., Gupta, A. K. and Dalela, R. C. 1979. Pesticide induced haematological alterations in a freshwater fish, *Saccobranachus fossilis*. *Bull. Environ.Contam. Toxicol*. 22 : 467–474.

38. Yadav, J. K. and Jha, M.M. 2010. Fish health under permethrin stress. *J. Current Science* 15(2), 425-429.

39. Yadav, J. K. 2013. Effects of permethrin to *Anabas testudineus* (Bloch), Ph.D. Thesis, L.N.M.U., Darbhanga, India.