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# STUDIES ON THE IMPACT OF THE PESTICIDES MALATHION AND DELTAMETHRIN ON THE FRESH WATER FISH *GAMBUSSIA AFFINIS*

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## ABSTRACT

The present study investigated the effect imposed by malathion and deltamethrin on the fresh water fish, *Gambussia affinis.* Fishes were exposed to the pesticides for an experimental period of 24 hrs. Subsequently, various tissues such as brain and liver were dissected for AChE (acetyl cholinesterase), SDH (succinate dehydrogenase), LDH (Lactate dehydrogenase), ACP (acid phosphatase) and ALP (Alkaline phosphatase) activities. AChE activity decreased in both the pesticide treated groups however, maximum decrease was observed in deltamethrin (0.84± 0.05) compared to control (1.92± 0.05). Relatively lactate dehydrogenase and acid phosphatase activity decreased in both the treated groups and a maximum decrease was observed in deltamethrin treated groups. In contrast, succinate dehydrogenase showed increased activity in deltamethrin and alkaline phosphatase in malathion treated groups.

**KEYWORDS:** *Gambussia Affinis*, Malathion, Deltamethrin, Pesticides, Enzymes.

## INTRODUCTION

Pesticides are the agri-friendly components, it increases the yield of the crop by protecting it from the harmful pest by different inhibiting properties and it can be handled easily. Due to these properties pesticides are used widely all over the world. In spite, of these qualities the undeniable fact is that they are the harmful toxicants which is capable of causing genetic level damages in the non- target organism, particularly fish. Fish is considered as most accessible and important animal protein in the diet of majority of the *population* (Hossain et al., 2000). Fish behavior under stress conditions provides vital information on, water pollution and toxic material in water (Kristiansen et al., 2004 and Kane et al., 2004). *Gambussia affinis* are widespread freshwater fish in the world and are present and wide spread on all continents except Antarctica (Krumbolz, 1948). Because of the widespread distribution, high levels of abundance ease of captive maintenance and divergent attitudes, a very large and disuse literature has developed with regard to *Gambussia affinis*. A majority amount of the pesticides used in agricultural field not only reaches the targeted site and but also enter the aquatic environment cause acute and chronic poisoning of fish and damages the vital organs (Joshi *et al*., 2007). Deltamethrin, pyrethroid group and malathion, organophosphate group are found to be neurotoxic. It affects the AChE activity and leads to accumulation of acetylcholine at central cholinergic synapses and neuromuscular junctions and inhibits the locomotion and equilibrium of exposed organisms (Sancho et al., 1997; Varó et al., 2003; Bretaud et al., 2000). Succinic dehydrogenase (SDH) is one of the active regulatory enzymes of the TCA cycle (Shailendra Kumar Singh et al., 2010). Elevated LDH indicates the cell lysis and ACP indicates proliferation of lysosome. ALP increase indicates increased osteoblastic activity and extra and intra hepatic obstuctions of biliary passage (Nafisa shoiab and pirzada jamal ahmed Siddique, 2016). The present experiment was aimed to examine the impact of the pesticides malathion and deltamethrin on the mosquito fish *Gambussia affinis* on enzymatic activity.

## MATERIALS AND METHODS

Healthy and active fish Gambussia affinis were collected from Hydrobiological Research Station, Tamil Nadu, Fishery Department, Chetpet and transported to laboratory for experimental purposes. Fishes were transferred to the 50l tank and acclimatized for a week and fed with commercial feed. Subsequently fishes were transferred to two different tanks containing deltamethrin (pyrethroid) and malathion (organophosphorus). Experiment was continued for 24 hours to study the impact of the pesticide on the enzyme activity of fishes. After the experiment period, brain and muscle tissues were dissected for various analyses.

### Enzyme Analysis

Estimation of Acetylcholinesterase (Acetylcholine hydrolase, EC: 3.1.1.7) activity AChE activity in the organs of the fish was estimated by the method of Ellman et al and the enzyme activity was expressed as μ moles of Ach hydrolyzed /mg protein/hr. Succinate dehydrogenase was done by Nachalas et al., 1960 method, Lactate dehydrogenase by King, 1965 and acid and alkaline phosphates by Tenniswood et al., 1976.

## RESULTS

### Behavioral studies

Fishes in treated groups showed excess mucus secretion, darting movement with imbalance swimming activities and equilibrium loss. Subsequently fishes showed avoidance behavior towards the toxic medium by jumping out of the aquarium in both pesticide treated groups.

**Brain:** Acetyl cholinesterase activity was examined in brain of *gambussia affinis* which showed variation in both treated groups compared to control (Fig.1). AChE activity decreased in both malathion and deltamethrin treated groups compared to control (1.92± 0.05). However maximum decrease of 0.84± 0.05 was observed in deltamethrin treated group compared to control.

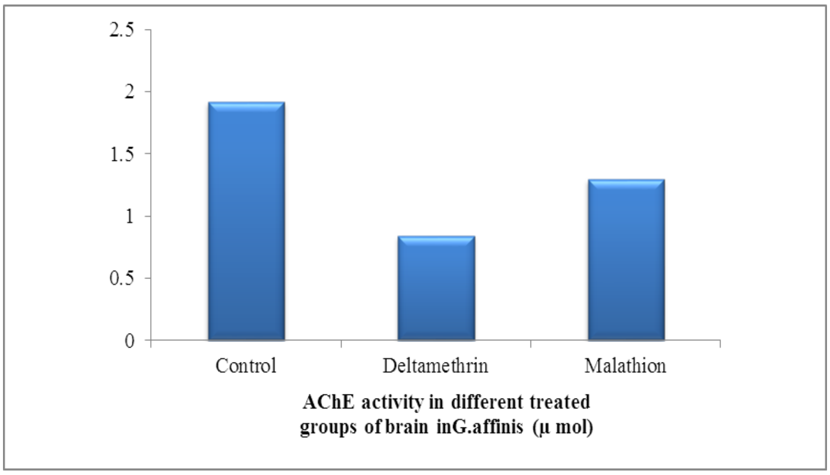


**Fig. 1. Effect of pesticides on the AChE activity in the brain tissue of *gambussia affinis.***

**Liver:** LDH, SDH, ALP and ACP activities was examined in the liver of *gambussia affinis*. Variations were observed in treated groups compared to control (Fig.2). Lactate dehydrogenase activity decreased in both malathion (3.54± 0.03) and deltamethrin (3.25± 0.04) treated groups. However a maximum decrease was observed in deltamethrin treated groups.

Similar to Lactate dehydrogenase, SDH activity decreased in malathion (4.17± 0.05) treated groups compared to control. However *gambussia affinis* treated with deltamethrin (6.15±0.03) showed increased succinate dehydrogenase activity.

Alkaline phosphatase activity varied in treated groups compared to control. Fishes treated with malathion showed increased (5.71±0.06) ALP activity. However deltamethrin showed decreased (3.91± 0.04) ALP activity compared to control.

Acid phosphatase activity was found to decrease in both malathion and deltamethrin treated groups compared to control. However, a maximum decrease 4.66± 0.03 of was observed in deltamethrin treated groups.

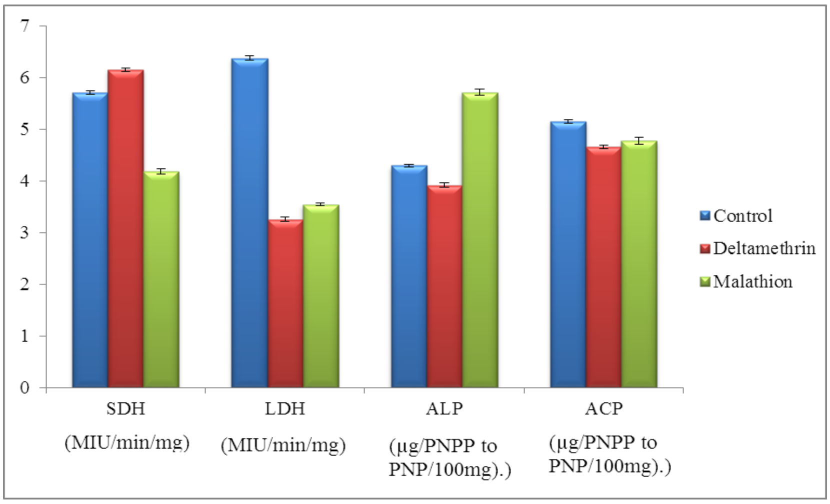


**Fig. 2. Effect of pesticides on SDH, LDH, ALP and ACP activity in the liver tissue of *G.affinis.***

**DISCUSSION**

The present study evaluates the impact of the two pesticides deltamethrin and malathion on the fish *Gambussia affinis*. This pesticide inhibits the action of the AChE in species. These inhibition may cause deleterious effects on the activity of the heart (Nafisa and pirzada famal ahmed Siddique, 2016). They may cause altered feeding, reduced swimming, stamina, fecundity, reduced growth, disturbances in social interaction and great impact on the biodiversity of the fishes (Van dolah et al., 1997). Basanta kumar das and Subhas Chandra Mukherjee (2003) observed at the various concentration of the cypermethrin decreased AChE in the fingerlings of *Labeo rohita* at the 45 days of the post exposure highest reduction is found in the fingerlings. AChE is good stress indicator of all the xenobiotic in the aquatic ecosystem (Das, 1998). Bizenzinski and Ledwicki (1973) proposed that the inhibition of AChE is accompanied by an increase in acetylcholine level. Jaqueline iren gilombieski et al., (2008) found depletion in both brain and muscle of the carps at every different concentration when exposed to diafuron. Maximum depletion in the brain is found in common and grass carps. Depletion in muscle is found in big head carp. AChE plays major role in the physiological functions such as prey location, predatory evasion and orientation towards food (Miron et al., 2005). When it decreases, ACh is not broken and accumulates within synopsis which therefore cannot function in normal way (Dutta and Arends, 2003). Its inhibition in brain cause the adverse effects in movement because it is responsible for neural and neuromuscular transmission (Fernandez-vega et al., 1999, 2002). 96hrs of cypermethrin exposure at four different concentration exposure *Colisa fasciatus* showed the significance decrease in the AChE activities in nervous tissues (shailendra kumar et al., 2010). ACh is the most important neurotransmitter in most animals. Once ACh is seccreated in synapse its binds to the receptor sites on the next nerve cell, causing the latter to the receptor to the nerve impulse. Before transmission of second impulse through the synopse, ACh secreated after first impulse must be hydrolised by the AChE in the function (Shailendra kumar et al., 2010). inhibition of this enzyme paralyse the musle and cause death (Koelle, 1975).

The pesticide used in the present study altered the enzyme activities of the fishes. SDH increased in the deltamethrin group whereas, declined in the malathion treated groups when compared to the control the present study. Succinate dehydrogenase activities were depleted in brain, kidney and liver whereas, acid phosphatase was unchanged while alkaline phosphatase was depleted and Lactate dehydrogenase activity in brain and liver was increased but inhibited in kidney in the study of Basanta Kumar Das and Subhas Chandra Mukherjee(2002) when *Labeo rohita* fingerlings exposed to cypermethrin. The alteration of SDH and LDH level indicated anaerobic metabolism of pesticide treated fish and thus the oxidation through the Krebs cycle was adversely affected (Koundinya and Ramamurthi, 1979). In the present study, LDH activities in both pesticides declined when compared to control but maximum in deltamethrin. LDH activity compared with the control group indicates a decrease in the glycolytic process due to the lower metabolic rate as a result of the effect of cypermethrin in *Clarias griepinus*(Gabriel et al.,2012). Similar report was observed in *Cyprinus carpio* by Asztalos *et al.* (1990) when he observed decreased activity of LDH in time periods of 48 and 96hrs. ALP activities decreased in the deltamethrin treated group. It increased in the malathion treated group than the control. In the study of Gabriel et al.,2012 cypermethrin induced fish *Clarias gariepinus* at different concentration ALP showed highest enzyme activity in kidney and lowest in the gill and concluded that it is the result of interference of the pesticide in transaminations and metabolic process of the enzyme. Potassium permanganate when introduced to *Clarias gariepinus,* plasma alkaline phosphatase levels decrease due to the damage and dysfunction of the liver.( Kori- Siakpere et al.,2010). Decrease in ALP activity leads to the hepatic parenchymal damage and hepatocytic necrosis and reflects alteration in protein synthesis and uncoupling of oxidative phosphorylation (Onikienko F. A., 1963; Verma et al.,1984). The enzyme acid phosphatase is a lysosomal enzyme that hydrolyzes the phospho-esters in acidic medium (Agrahari and Gopal, 2009) and possesses different properties in distinct biological materials (Sarsiek et al., 2005). Similarly, it catalyzes dephosphorylation of many molecules at alkaline pH. ACP activities in both the pesticides declined compared to the control. ALP activities were significantly increased and ACP activity decreased in the liver and kidney in the *Labeo rohita* when exposed to deltamethrin (Lenin suvetha et al., 2015). This resulted the increase of glycogenolysis or damage in the kidney and liver (Saha and Kaviraj, 2009; Adeyemi et al., 2010). Decreased activity of different enzymes may be attributed to a repressor effect in their synthesis or to the direct action of pesticides on the enzymes (Shophiya and Kalaiarasi,2017). Thus the present study provides a baseline data on the effect of malathion and deltamethrin in the fresh water fish *Gambussia affinis.*

## REFERENCES

1. Hossain Z, Haldar GC, Mollah MFA. Acute toxicity of chlorpyrifos, cadusafos and diazinon to three Indian major carps (Catla catla, Labeo rohita and Cirrhinus mrigala) fingerlings. Bangladesh].h. Fish, 2000; 4(2): 191-198.
2. Kane AS, Salierno JD, Gipson GT, Molteno TCA, Hunter CA.. Video based movement analysis system to quantify behavioural stress response of fish. Water Res., 2004; 38(18): 3993-4001.
3. Kristiansen TS, Ferno A., Holm J.C, Privitera L, Bakke S, Fosseidengen J.E. Swimming behavior as an indicator of low growth rate and impaired welfare in Atlantic halibut (Hippoglossus hippoglossus L.) reared at three stocking densities. Aquaculture, 2004; 230(1-4): 137-151.
4. Joshi N, Dharmlata Sahu AP. Histopathological changes in the liver of Heteropneustes fossilis exposed to Cypermethrin. J. Environ. Biol, 2007; 28: 221-228.
5. Graham R. Scott, Katherine A. Sloman. The effects of environmental pollutants on complex fish behaviour: integrating behavioural and physiological indicators of toxicity. Aquatic Toxicology, 2004; 68: 369–392.

6. Sancho E, Ferrando MD, Andreu E. Response and recovery of brain Acetylcholinesterase in the European eel, Anguilla anguilla, exposed to feniltrothion. Ecotoxicology and Environmental Safety, 1997; 38: 205-209.
7. Varó I, Navarro JC, Amat F, Guilhermino L. Effect of dicholorvos on cholinesterase activity of the European sea bass (Dicentrarchus labrax). Pesticide Biochemistry and Physiology, 2003; 75: 61-72.
8. Bretaud S, Toutant JP, Saglio P. Effects of carbofuran,diuron, and nicosulfuron on acetylcholinesterase activity in goldfish (Carassius auratus). Ecotoxicology and Environmental Safety, 2000; 47: 117-124.
9. Shailendra Kumar Singh, Sunil Kumar Singh, Ram P. Yadav. Toxicological and Biochemical Alterations of Cypermethrin (Synthetic Pyrethroids) Against Freshwater Teleost Fish Colisa fasciatus at Different Season. World Journal of Zoology, 2010; 5(1): 25-32.
10. Nafisa shoiab, Pirzada jamal ahmed Siddiqui. Impact of organophosphate pesticide, methyl parathion and chlorpyrifos on some tissue enzymse in fish (Aphanius dispar). Indian Journal of Geo-Marine Sciences, 2016; 45(2016): 869-874.
11. Nachlas MM, Margulius SI, Selligman AM. A colorimeteric method for the estimation of SDH. J. Biol, Chem. 1960; 235: 499-503.
12. King, J.1965. In:Practical Clinical Enzymology. D.Van Norstrand Co., London.
13. Tenniswood M, Bind C.E, Clark AF 1976. Acid phoshpatases androgen dependent markers of rat prostate. Can. J. Biochem, 1976; 54(4): 350-357.
14. Ellman GL, Courtney KD, Andres V, Jr RM Featherstone. A new and rapid Colorimetric determination of acetylcholinesterase activity. Biol. Pharmacol, 1961; 7: 88.
15. Koelle GB. Anticholinesterase agents. In “The Pharamacological basis of therapeutics” (Ed. L.S. Goodman and A. Gillman), Macmillan Publishing Co., New York, 1975; 404-466.
16. Elif Özcan Oruç. Oxidative stress, steroid hormone concentrations and acetylcholinesterase activity in Oreochromis niloticus exposed to chlorpyrifos. Pesticide Biochemistry and Physiology, 2010; 96: 160–166.
17. Ferandez-Vega C, Sancho E, Ferrando MD, Andreu M. Thiobencarb-induced changes in acetylcholinesterase activity of the fish Anguilla anguilla. Pesti Biochem Physiol, 2002; 72: 55–63.

18. Basanta Kumar Dasa, Subhas Chandra Mukherjee. Toxicity of cypermethrin in Labeo rohita fingerlings: biochemical, enzymatic and haematological consequences. Comparative Biochemistry and Physiology Part C, 2003; 134: 109–121.
19. Brzezinski J, Ludwicki K, 1973. The interrelationship of the changes of acetyl cholinesterase and catecholamines, blood and urine levels in rats poisoned with disyton. Pol. Pharmacol. Pharm, 1973; 25: 313.
20. Dutta HM, Areids, DA. Effects of endosulfan on brain acetyl cholinestarate activity in juvenile blue gill sunfish. Environmental Research, 2003; 91: 157-162.
21. Lenin Suvetha, Manoharan Saravanan, Jang-Hyun Hur, Mathan Ramesh, Kalliappan Krishnapriya. Acute and sublethal intoxication of deltamethrin in an Indian major carp, Labeo rohita: Hormonal and enzymological responses. The Journal of Basic & Applied Zoology, 2015; 72: 58–65.
22. Jaqueline Ineu Golombieski, Enio Marchesan, Edinalvo Rabaioli Camargo, Joseânia Salbego, Joele Schmitt Baumart, Vania Lucia Loro, Sérgio Luiz de Oliveira Machado, Renato Zanella, Bernardo Baldisserotto. Acetylcholinesterase enzyme activity in carp brain and muscle after acute exposure to diafuran. Sci. Agric. (Piracicaba, Braz.), 2008; 65(4): 340-345.
23. Miron DS, Crestani M, Shettinger MR, Morsch VM, Baldisserotto B, Tierno MA, Moraes G, Vieira VLP. Effects of the herbicides clomazone, quinclorac and metsulfuron methyl on acetylcholinesterase activity in the silver catfish (Rhamdia quelen) (Heptapteridae). Ecotoxicology and Environmental Safety, 2005; 61: 98-403.
24. Gabriel UU, Akinrotimi OA, Ariweriokuma VS. Changes in Metabolic Enzymes Activities in Selected Organs and Tissue of Clarias Gariepinus Exposed to Cypermethrin. Journal of environmental engineering and technology, 2012; 1(2).
25. Kori-Siakpere O, Ikomi R B, Ogbe MG. Variations in Acid Phosphatase and Alkaline Phosphatase Activities in the Plasma of the African Catfish: Clarias Gariepinus Exposed To Sublethal Concentrations of Potassium Permanganate. Asian j. exp. biol. Sci., 2010; 1(1): 170-174.
26. Asztalos B, Memcsok J, Brenedeczky I, Gabriel R, Szabo A, Refale OJ. The effects of Pesticide on some biochemical parameters of carp. (Cyprinus carpio). Arch. Environ. Contam. Toxicol, 1990; 19: 275-282.
27. Onikienko F A. Enzymatic changes from early stages of intoxication with small doses of chloroorganic insecticides. Giginea. I. Fiziol. Ruda. Pro. Toksilol. Klinika (Kietcv: Gos IZ. Med. Lit. UKHS), 1963; 77.

28. Verma S, Saxena M, Tonk I. The influence of Ider 20 on the biochemical and enzymes in the liver of Clarias batrachus. Environ. Pollu, 1984; 33: 245-255.
29. Adeyemi OO, Akindele AJ, Nwumeh KI. Acute and subchronic toxicological assessment of Byrsocarpus coccineus Schum. and Thonn. (Connaraceae) aqueous leaf extract. Int. J. A. Res. Nat. Pro., 2010; 3(2): 1–11.
30. Agrahari S, Gopal K. Fluctuations of certain biochemical constituents and markers enzymes as a consequence of monocrotophos toxicity in the edible freshwater fish, Channa punctatus. Pestic. Biochem. Physiol, 2009; 94: 5–9.
31. Saha S, Kaviraj A. Effects of cypermethrin on some biochemical parameters and its amelioration through dietary supplementation of ascorbic acid in freshwater catfish Heteropneustes fossilis. Chemosphere, 2009; 74(9): 1254-1259.
32. Sarsiek BWysocka J, Wysocki P, Glogowski J.Characteristics of acid phosphatase from rainbow trout (Oncorhynchus mykiss) spermatozoa. Arch. Poli. Fish., 2005; 13: 131–146.
33. Koundinya PR, Ramamurthi R. Effect of organophosphate pesticide sumithion (Fenitrothion) on some aspects of carbohydrate metabolism in freshwater fish, Sarotherodon mossamblcus (Peters). Experientia, 1979; 35: 1632.
34. Nancy Shophiya j, Kalaiarasi JMV. Chronic toxic effects of ekalux on some biochemical parameters in Cyprinus carpio (Lin.) International Journal of Fisheries and Aquatic Studies, 2017; 5(2): 274-277.
35. Das BK. Studies on the effect of some pesticides and commonly used chemicals on Indian major carps and their ecosystem. Phd. Thesis. Bhubaneshwar Orrisa University of Agriculture And Technology, 1998; 1-216.
36. Van Dolah RF, Maier PP, Fulton MH, Scott GI.Comparison of Azinphosmethyl toxicity to juvenile red drum (Sciaenops ocellatus) and the mummichog(Fundulus heteroclitus). Environ. Toxicol. Chem., 1997; 16: 1488-1493.