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Efficacy of Quinalphos (25 % EC) on Protein Content in Different Tissues of the Freshwater Fish, Channa gachua (Hamilton, 1822)

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Abstract: Channa gachua freshwater teleost fish exposed to quinalphos at 24 h, 48 h, 72 h and 96 h for 5.35 ppm, 3.55 ppm, 2.70 ppm concentrations. This study was conducted to investigate the toxicity (LC_{50}) of quinalphos and its effects on protein contents of the gill, liver, muscle and kidney tissues. The estimated protein in the gill, liver, kidney and muscle tissues were found to reduce during the all exposure period. Muscle tissue at 96 h for 2.70 ppm (74.96 %) was drastically affected than other tissues, it shows that the increasing protease activity which suggest the damage to protein resulting in monomer release due to oxidative damage by quinalphos intoxication. Protein depletion during the exposure period of quinalphos insecticide, affects the natural value of nutrients of fish.
Keywords: Channa gachua, Gill, Kidney, Liver, Muscle, Quinalphos, Protein.

I. INTRODUCTION

The use of pesticide is a common and integral part of agriculture practices. Among all the pesticides, the organophosphates are widely used to control pests (Mahboob and Siddiqui, 2002). Pesticides have contributed considerably to the human welfare but their residues often reach ecosystems causing undesirable impact (Vani et al., 2012). The organophosphate pesticides represents one of the most widely used classes of pesticide with high potential for human exposure (Ngoula et al., 2007). Organophosphate pesticides became increasingly popular for both agricultural and home use because of their unstable chemical structure leads to rapid hydrolysis and little long-term accumulation in the environment (Kumar et al., 2010). Recent incidents of farmer's death because of organophosphate pesticide toxicity in Maharashtra state show the lack of awareness of farmers towards the pesticide handling or practices, which shows serious threat of organophosphate pesticide to the environment.

Quinalphos 25% emulsified concentration is an organophosphate insecticide which is widely used in agricultural practices. It is extensively used in agriculture for pest eradication (Das and Mukhergee, 2000) and it is hard insecticide having potential and hazardous effect (Muttappa et al., 2014). Organophosphate (OP) compounds are one of the most commonly used insecticides in agriculture and public health, accounting for 50% of the global insecticidal use (Casida and Quistad, 2004). Insecticides are among the most hazardous chemicals to human and all other environment, such pesticides used for crop protection in agriculture and horticulture may enter ditches, ponds, lakes and rivers in numerous ways such as direct overspray, spray drift, leaching to surface and ground water, run off from land and or accidental spills (Capri and Trevisan, 1998). Such insecticide enters into the aquatic ecosystem and adversely affects to the aquatic biota. The pollution of freshwater ecosystem by chemical pesticides has become one of the most critical environmental problems (North off and William, 2004). This causes extensive damage to the activities of the living resources of food-web due to their toxicity, persistency with half-lives of decades and tendency to accumulate in the organisms (Joseph and Raj, 2010; Joseph and Raj, 2011). Contamination of aquatic ecosystem by quinalphos is fairly common and had serious impact on fish (Chebbi and David, 2009).

Fishes are the excellent experimental models for toxicological investigations (Shiekh and Lee, 2008). Au (2004) stated that, fishes are frequently exposed to a wide variety of aquatic pollutants leading to deleterious effects, especially when these contaminants are slightly decomposable and exhibit a high biological effectiveness and possess a high potential for accumulation. Fish constitutes one of the major protein sources for human as well as many predators. Fishes are the most important component of the food chain and any toxicological effects may have adverse influence on the nutritional value of fish and on human being through its consumption (Gupta and Srivastava, 2006). The test fish Channa gachua is a "Dwarf Snake Headed Fish" belongs to the family "Ophiocepalidae", it is commonly found in Aurangabad region and it is commonly consumed as protein source fish. Hence, the present investigation deals with the toxicity test, toxicity test is essential to find out toxicants limit and safe concentration, so that

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there will be minimum harm to aquatic fauna in near future (Nikam and Shejule, 2015) and effect of a quinalphos insecticide on the protein content in freshwater teleost fish Channa gachua exposed to different concentrations.

II. MATERIALS AND METHODS

A. Test Organism and Acclimatization

The freshwater fish Channa gachua (length 18 ± 1.00 cm and weight 40 ± 5.00 gm) was procured from Godavari River, Kaygaon Toka near Aurangabad. These fishes were acclimatized to the laboratory conditions with de chlorinated tap water and fed with dried prawn for 10-15 days at a room temperature 27 ± 2^0C prior to the experimental condition.

1) *Toxicity assay:* To the study of LC_{50} viz. 24, 48, 72 and 96 hrs in an experimental glass aquaria of 40 l capacity. Ten fish equal size were used in 20 l of water. The stock solution of 1% Quinalphos was prepared. From this stock solution, different concentrations were prepared. The range of concentration was selected between 0 to 100% mortality. Fishes not fed during the experiment and water was never aerated. To calculate the LC_{50} values Finney's Probit analysis (1971) was followed.
2) *Protein estimation:* The total protein content of the pesticide exposed tissue samples were estimated by the modified method of Lowry *et al*., (1951). The optical density was measured at 540 µm against blank. The standard graph was plotted with bovine serum albumin (BSA) as standard, supplied by Sigma Chemical Company, U. S. A. The values were expressed as mg/100 mg wet weight of the tissue. The data was subjected to one-way analysis of variance (ANOVA) and the significance difference was set up at $p < 0.05$.

III. RESULTS AND DISCUSSION

During the toxicity test, the mortality of Channa gachua was found to be increased in response to higher concentrations of quinalphos viz. the fish mortality is increased with the increased in quinalphos concentration. The LC_{50} value was calculated at 5.35 ppm, 3.55 ppm 2.70 ppm and 1.47 ppm at 24 h 48 h 72 h and 96 h respectively (table no. 1). The results of the toxicity studies are in agreement with Kumar (2010) for Channa punctatus, observed the LC_{50} values of quinalphos 25 % EC at 24 h, 48 h, 72 h and 96 h are 3.70 mg L^{-1}, 3.60 mg L^{-1}, 3.15 mg L^{-1} and 2.32 mg L^{-1} respectively. The observed results show the sensitivity of test fish C. gachua towards the quinalphos 25 % EC toxicant.

Table No 1. LC_{50} values and Relative toxicity of Quinalphos against the freshwater fish *Channa gachua* for 24 h, 48 h, 72 h and 96 h.

Sr. No.	Exposure Period (h)	Regression equation $y = \bar{y} + b(x-\bar{x})$	LC_{50} Values in ppm	Standard Error S. E.= $\sqrt{v}$	Variance 'v'	Chi-Square Values	Fiducial Limits	
							M_1	M_2
1.	24	y = 18.1556x-8.4431	5.3505	0.0333	1.11×10^{-03}	0.3313	0.1129	0.2434
2.	48	y = 12.0227x-1.6223	3.5546	0.0554	3.07×10^{-03}	0.3993	0.0883	0.3055
3.	72	y = 7.1505x+1.9138	2.7015	0.0822	6.75×10^{-03}	0.2697	0.0610	0.3837
4.	96	y = 4.0173x+4.3235	1.473	0.1446	2.09×10^{-04}	0.0445	-0.0704	0.4964

A. Protein content

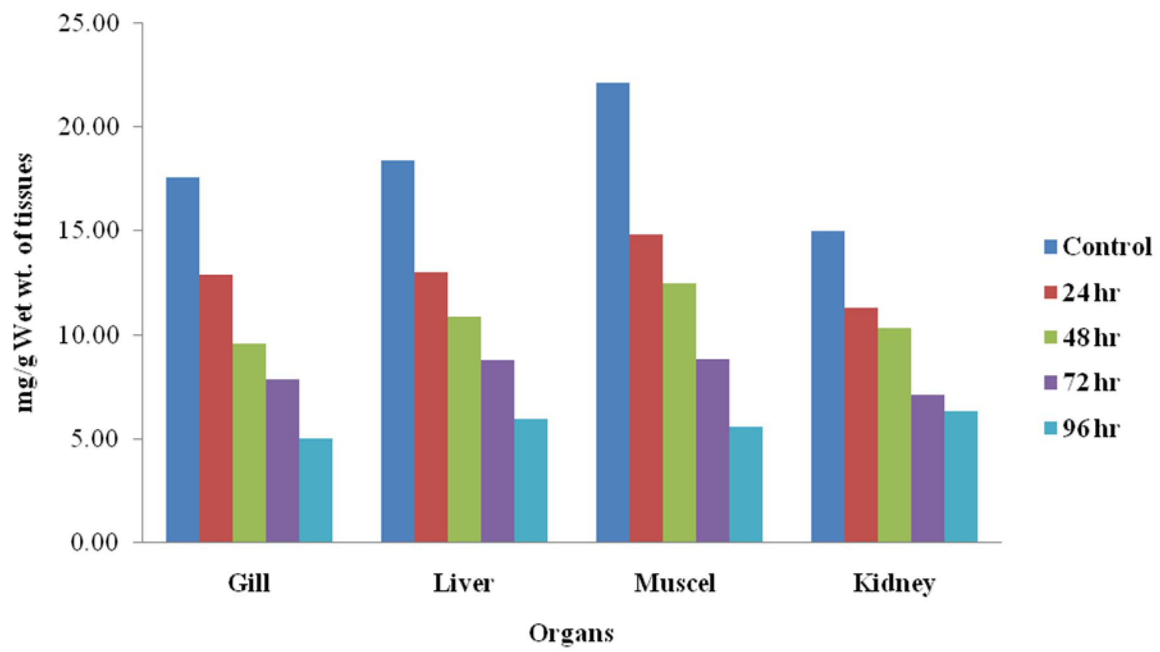
A significant gradual depletion in protein level was found as compared to control, in gill, liver, kidney and muscle tissues of C. gachua when exposed to acute and chronic exposure period of quinalphos 25 % EC insecticide. The dose dependent and time dependent gradual decrease in protein level indicating the breakdown of these protein contents due to quinalphos intoxication. The observed values of protein content tabulated in table no. 2 and presented in graph viz. fig. 1 respectively. The data indicates that, muscle tissue was most affected followed by gills, liver and kidney. The muscle tissue was drastically affected and the protein content reduced gradually at 14.80 mg, 12.45 mg, 8.86 mg and 5.56 mg for 24 h, 48 h, 72 h and 96 h respectively as compared to control viz. 22.11. This reduction was highly significant ($p < 0.05$) of (33.06 %), (43.70 %), (59.93 %) and (74.86 %) at 5.35 ppm, 3.55 ppm, 2.70 ppm and 1.47 ppm respectively. The other tissues viz. gill, liver and kidney was less affected than the muscle tissue. Depletion in muscle protein suggests stress in metabolism and impairment of protein synthesis machinery in fish; the catabolic process was initiated by increased proteolysis that led to rapid decline in protein concentration to meet the energy demand in extremely stressful condition or environment (Baruah et al., 2004). Protein content significantly decreased in muscle tissue of freshwater fish Labeo rohita suggest that muscle was highly affected and gill and kidney are relatively less affected when exposed to indoxacarb (Ram, 2016). Sastry and Siddiqui (1984) reported the depletion in protein content in gill, liver, brain, kidney, intestine and muscle of Channa punctatus when treated with quinalphos.

Table no. 2: The amount of total protein (mg/100mg) in different tissues of *C. gachua* on the exposure to lethal concentration of quinalphos (25 % EC).

Organs	Control	Experimental			
		24 h (5.35 ppm)	48 h (3.55 ppm)	72 h (2.70 ppm)	96 h (1.47 ppm)
Gill	17.58 ± 0.016	12.87 ± 0.016 (26.80)	9.58 ± 0.035 (45.51)	7.86 ± 0.041 (55.30)	5.05 ± 0.045 (71.28)
Liver	18.34 ± 0.042	13.05 ± 0.022 (28.84)	10.89 ± 0.029 (40.62)	8.77 ± 0.029 (52.18)	5.97 ± 0.016 (67.44)
Muscle	22.11 ± 0.029	14.80 ± 0.047 (33.06)	12.45 ± 0.027 (43.70)	8.86 ± 0.029 (59.93)	5.56 ± 0.029 (74.86)
Kidney	14.96 ± 0.029	11.29 ± 0.034 (24.54)	10.30 ± 0.029 (31.15)	7.12 ± 0.019 (52.41)	6.30 ± 0.016 (57.89)

Mg/g wet wt. of tissue.
[Each value indicate the mean (X ± SD) of five estimations] [Values in the parenthesis indicate percent change over control] [Values are highly significant at $p<0.05$]

Fig. I. Protein level changes (mg/100mg) in different tissues of *C. gachua* exposed to lethal concentration of quinalphos (25 % EC).



A significant depletion of protein content in gills, liver, muscle and kidney indicates that the increment in protease activity, which suggest the damage to protein resulting in monomer release due to oxidative damage by quinalphos intoxication, it also may be due to excessive proteolysis to overcome the metabolic stress, as deposited protein in the cytoplasm can easily be used to replace the loss of proteins that occur during physiological stress (Patil, 2011). This depletion may be attributed by increase in the rate of its degradation to amino acids which may be fed to TCA cycle through amino transferases probably to cope up with high energy demands in order to meet the stress condition (Ganeshwade et al., 2012). A reduction in the protein content in gill, liver, kidney, brain and muscle tissues of Channa striatus when exposed to endosulfan, suggests that the tissue protein undergoes proteolysis which results in an increase in the production of free amino acids (Leon, 2014).

Similar depletion in protein content was observed by Suneetha et al., (2010) when Labeo rohita treated with endosulfan and fenvalerate, Magar and Shaikh, (2012) when Channa punctatus treated with malathion, Kawade and Khillare (2012) when Channa gachua treated with coper, Lakshmanan et al., (2013) when Oreochromis mossambicus treated with dichlorvos, Jain, (2014) when Channa gachua treated with methyl parathion. All these reports supports the present results of decrement of protein content in gills, liver, muscle and kidney of test fish Channa gachua treated with quinalphos 25 % EC.

IV. CONCLUSION

The contamination of quinalphos an organophosphate pesticide in environment is a serious threat to the non target organism. The depletion in protein content indicates the fact that protein was excessively utilized for metabolism. The present study reveals that the quinalphos pesticide has a profound effect on non target organism viz. fish, which results in depletion of protein content in test fish *Channa gachua* shows an alteration in natural value of nutrient in fish.

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