

LETHAL AND SUBLETHAL EFFECTS OF QUINOLPHOS ON NUCLEIC ACIDS OF FRESHWATER FISH *LABEO ROHITA* (HAMILTON)

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ABSTRACT

The objective of the present study to investigate the toxic effect of quinolphos on DNA and RNA content of Freshwater fish *Labeo rohita*. The fish were exposed to organophosphorus pesticide Quinolphos pesticide 25% EC to 96 h LC₅₀ technical lethal ((2.826 mg/l), Technical sublethal (1/10th of 96 h LC₅₀ value, 0.2826 mg/l), 25% EC Lethal (2.218 mg/l) and 25% EC sublethal (1/10th of 96 h LC₅₀ value, 0.221 mg/l) concentrations for 15 days. The results observed in the present study reveals that quinalphos caused variability in the nucleic acid content in different tissues and the degree of variability by the quinalphos technical was less compared to 25% EC and was found to be dose dependent.

KEYWORDS: Pesticides, Chemicals, Fish, Nucleic Acid, Quinolphos

INTRODUCTION

The aquatic environment is subject to an ever increasing range of man-made pollutants, reflecting the ever more rapid innovations of our technology to manufacture goods to satisfy a perceived increase in consumer demand on which our economy is based. Some of the pollutants that are now present in the tissues of fish, wildlife and humans also reflect past usage of chemicals, such as the organochlorine insecticides and PCBs, which have been banned or restricted in use for several decades. Measurements of tissue concentrations are, however, overwhelmingly limited to a range of pollutants such as pesticides, polyaromatic hydrocarbons (PAHs) and PCBs that are known to be present in the aquatic environment and for which measurement methods do exist. (R. E. Hester, R. M. Harrison and David E. Kime, 1999). The natural physiological functioning of an organism gets disturbed on exposure to toxicant stress. It induces its effect first at cellular or even at molecular level, but ultimately causes physiological, pathological and biochemical alterations. It is, therefore necessary to focus attention on changes in biochemical composition of organisms, which are constantly under pollutant threat. When the pesticides come in contact with internal organs, irreversible changes in metabolic activities take place that eventually cause biochemical changes. Pesticide pollutants act as stress inducing agents, which affect the functional state of tissues of the exposed organisms, all pollutants are not toxic but all pesticides are toxicants. Many pesticides have been reported to produce a number of biochemical changes in fish both at lethal and more often at sublethal levels. Changes in ion concentrations, organic constituents, enzyme activity, endocrinal activity and chemoregulators in fish have been attributed to pesticides. Since aquatic environment is the ultimate sink for all pollutants, aquatic toxicity testing has become an integral part of the process of environmental hazard evaluation of the toxic chemicals. The objective of the present study to investigate the toxicity of quinolphos on DNA and RNA levels of freshwater fish *Labeo rohita*.

MATERIAL AND METHODS

The fish *Labeo rohita* measuring 12 cm in length and 17 g were brought from a local fish farm Nandivelugu, Guntur district of Andhra Pradesh, India. Irrespective of the sex were used in the experiment, fish were washed with 0.1%

KMnO₄ solution to avoid dermal infection. All the precautions laid down by APHA (2005) are followed, for maintaining the fish. The fish were exposed to organophosphorus pesticides Quinalphos pesticide 25% EC to 96 h LC₅₀ technical lethal ((2.826 mg/l),) Technical sublethal (1/10th of 96 h LC₅₀ value ,0.2826 mg/l), 25% EC Lethal (2.218 mg/l) and 25% EC sublethal (1/10th of 96 h LC₅₀ value., 0.221 mg/l) concentrations for 15 days .If mortality occurred during the experimental period, dead fish were removed immediately to avoid depletion of dissolved oxygen (DO) level which adversely affects other fish (Schreck and Brouna, 1975). The vital tissues like muscle, brain, liver, and kidney of the fish were taken for the estimation of Nucleic acids content according to (Schinder WC, 1957 and Burton, K., 1968).

Statistical Analysis

All the obtained results from chemical analysis are presented as means \pm SE. Data obtained were subjected to Student T-test using the Statistical Package for the Minitab 11.5v.

RESULTS AND DISCUSSIONS

The calculated values of nucleic acids along with standard error and the percent change over the control were given in (Table 1 & 2) and are graphically represented in (figures 1-4).The DNA content in control fish *Labeo rohita* in different tissues are in the order of: Kidney > Liver > Brain > Muscle Under exposure to sublethal and lethal concentrations of quinalphos technical grade and 25% EC the DNA content in liver and kidney increased but was found to decrease in brain and muscle. The decreasing order of DNA content in different tissues is in the order of: Technical sublethal: Kidney > Liver > Brain > Muscle, Technical lethal: Kidney > Liver > Brain > Muscle, 25% EC sublethal: Kidney > Liver > Brain > Muscle, 25% EC lethal: Kidney > Liver > Brain > Muscle.

The RNA content in control fish *Labeo rohita* in different tissues are in the order of: Kidney > Liver > Brain > Muscle. Under exposure to sublethal and lethal concentrations of quinalphos technical grade and 25% EC it was found that the liver, kidney and muscle RNA content was decreased but the brain RNA content was found to increase. The decreasing order of RNA content in different tissues is in the order of: Technical sublethal: Kidney > Liver > Brain > Muscle, Technical lethal: Kidney > Liver > Brain > Muscle, 25%EC sublethal: Kidney > Liver > Gill > Brain > Muscle, 25% EC lethal: Kidney > Liver > Brain > Muscle, The results indicate heterogeneous levels of DNA and RNA in the tissues of brain, liver, muscle, and kidney. In the present study, the DNA contents in brain decreased which may be due to reduction or absence of the essential factors controlling DNA synthesis which are the substrates (4-Deoxyribonucleoside triphosphates), enzymes polymerase template activity of deoxyribonucleic-protein and activators like Mg²⁺ and other divalent ions (Altmanal., 1972). Durairaj and Selvarajan (1992) and Tilak *et al.* (2005) which reveal the enlargement of nuclei in the chloride secreting cell in *Channa striatus* exposed to metasytox, *Oreochromis mossambicus* to quinalphos and *Catla catla*, *Labeo rohita* & *Cirrhinus mrigala* to chlorpyrifos. But according to Das and Mukherjee (2000), DNA levels were elevated in the tissues of Indian major carp, *Labeo rohita* when exposed to quinalphos for 15, 30 and 45 days. The alterations in DNA levels could be due to the disturbances in the normal synthesis and turnover rate of DNA besides degenerative changes.

Table 1: Change in the Amount of DNA (mg/gr Body Wet Weight of the Tissue) and % Change over the Control in Different Tissues of Fish *Labeo rohita* Exposed to Sublethal and Lethal Concentrations of Quinalphos Technical Grade and 25%EC

Organs	Technical					25% EC			
	Control	Sublethal	% Change	Lethal	% Change	Sub-Lethal	% Change	Lethal	% Change
Liver	6.74 \pm 1.23	6.81 \pm 1.84	+0.88	6.96 \pm 1.77	+3.11	6.84 \pm 1.42	+1.33	6.95 \pm 0.28	+3.11
Kidney	8.36 \pm 1.74	8.39 \pm 1.32	+0.35	8.47 \pm 1.70	+1.31	8.55 \pm 1.71	+2.39	8.76 \pm 1.33	+4.78
Brain	4.68 \pm 1.90	5.57 \pm 0.26	-1.84*	4.47 \pm 1.31	-3.59*	4.51 \pm 1.88	-3.62	4.46 \pm 1.41	-4.70*
Muscle	0.69 \pm 0.32	0.68 \pm 0.26	-1.44*	0.67 \pm 0.27	-2.21*	0.77 \pm 0.45	-2.43	0.76 \pm 0.59	-3.72*

Values are the mean of five observations, SE is indicated as, (±) and values are significant at $p < 0.05$, * indicates not significant.

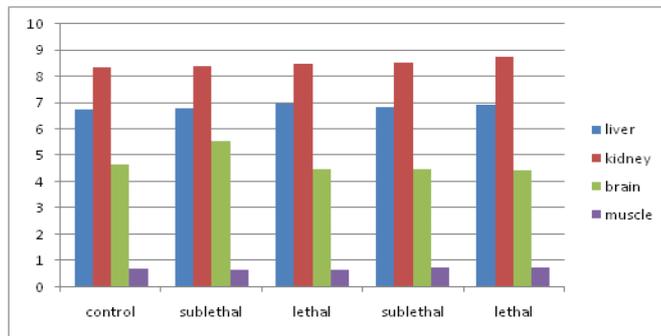


Figure 1: Change in the Amount of DNA (mg/gr Body Wet Weight of the Tissue) and % Change over the Control in Different Tissues of Fish *Labeo rohita* Exposed to Sublethal and Lethal Concentrations of Quinalphos

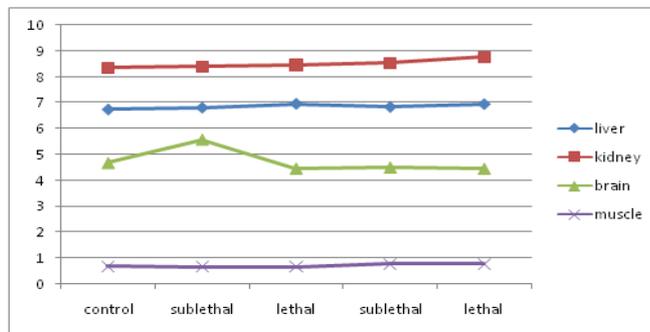


Figure 2: Change in the Amount of DNA (mg/gr Body Wet Weight of the Tissue) and % Change over the Control in Different Tissues of Fish *Labeo rohita* Exposed to Sublethal and Lethal Concentrations of Quinalphos for 15 Days, Mean± S.E,n=5,P < 0.05

Table 2: Change in the Amount of RNA (mg/gr Body Wet Weight of the Tissue) and % Change over the Control in Different Tissues of Fish *Labeo rohita* Exposed to Sublethal and Lethal Concentrations of Quinalphos Technical Grade and 25%EC

Organs	Technical					25% EC			
	Control	Sublethal	% Change	Lethal	% Change	Sub-Lethal	% Change	Lethal	% Change
Liver	2.75±0.16	2.74±0.92	-0.36	2.62±0.28	-4.27	2.69±0.47	-1.8	2.64±0.29	-2.99
Kidney	3.37±0.18	3.29±0.72	-1.93	3.15±0.36	-4.91	3.31±1.58	-1.39	3.27±1.20	-2.27
Brain	4.02±0.18	3.88±1.91	-2.78	3.95±1.79	-1.69	3.87±1.94	-2.99	3.78±0.33	-4.84
Muscle	1.59±0.36	1.61±1.84	+1.56*	1.62±0.35	+1.66	1.6±0.57	+0.89*	1.61±0.39	+1.98*

Values are the mean of five observations, SE is indicated as (±), Values are significant at $p < 0.05$, * indicates not significant.

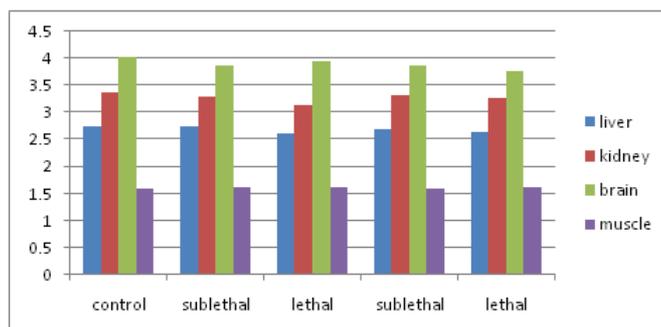


Figure 3: Change in the Amount of RNA (mg/gr Body Wet Weight of the Tissue) and % Change over the Control in Different Tissues of Fish *Labeo rohita* Exposed to Sublethal and Lethal Concentrations of Quinalphos

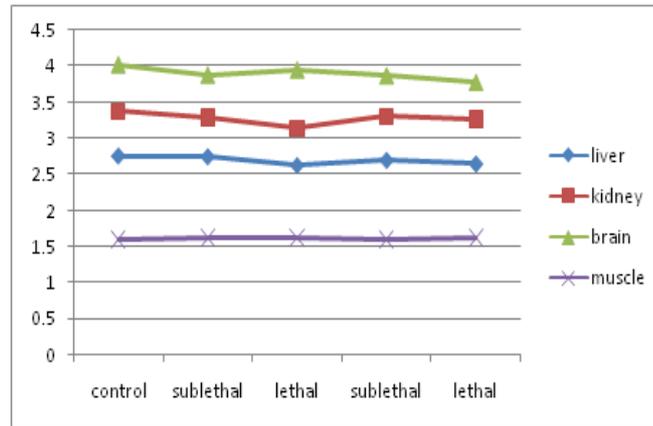


Figure 4: Change in the Amount of RNA (mg/gr Body Wet Weight of the Tissue) and % Change over the Control in Different Tissues of Fish *Labeo rohita* Exposed to Sublethal and Lethal Concentrations of Quinalphos for 15 Days, Mean \pm S.E, n=5, P < 0.05

Nucleic acid content is considered as an index of capacity of an organism for protein synthesis. Various studies on the effects of toxicants on the nucleic acid content in fishes have been reported. Significant decrease in RNA and DNA content in the fish, *Claria batrachus* exposed to endosulfan was recorded by Asfia Parveen and Vasanta (1986). Quinalphos induced significant decreases in RNA content of liver muscle and gill and DNA content of brain of fish *Oreochromis mossambicus* was observed by Durairaj and Selvarajan (1992). In the present study decrease in level of RNA was observed in all the tissues of fish exposed to sublethal and lethal concentrations of both technical grade and 25% EC, whereas RNA increased in brain. Organophosphorus compounds exhibit strong mutagenic and clastogenic potentiality (Patankar Nayana & Vaidya, 1980), which may be responsible for the alteration of DNA level. However the decrease of DNA is not very prominent when compared to RNA. The decrease may be attributed to the increased activity of DNAase as suggested by Tayyaba *et al.*, (1981). Gautam *et al.*, (2002) reported histo-chemical changes in nucleic acids (RNA & DNA) in the stomach and intestine of *Channa punctatus* after the treatment with endosulfan and diazinon pesticides and significant decrease in nucleic acids of gastrointestinal tract was also reported. The depletion of RNA level suggests increased proteolysis and possible utilisation of the products of their degradation for metabolic purposes. The significant decrease in both protein and nucleic acids would suggest that pollutant impair the process of protein synthesis in the tissues of fishes exposed to pesticides. Since RNA is the biochemical mid wife in the formation of proteins, the diminished RNA content also affects the cellular protein content. Dawood (1986) and Benjamin (1990) have suggested that the decrement of RNA may also be due to the non-coding for the process of protein synthesis, thereby decrease in the RNA content, which in turn would have reduced the concentration of RNA. Maruthanayagam and Sharmila (2004) studied the effect of monocrotophos on *Cyprinus carpio* to understand the toxic effects of toxicant on the nucleic acids and concluded that the pesticide lead to several changes in the biochemical markers like DNA and RNA which may be due to the increased activity of the enzyme DNAase and the inhibition of RNA polymerase function. But during recovery period, the DNA and RNA levels increased progressively indicating a probable from the disruption of internal organs. According to Malla Reddy and Bashamohideen (1988) the role of nucleic acids particularly RNA/DNA and protein /DNA ratios, which are used as an index of protein synthesis and cell size, are considered to be important and form an treatment with the pesticides causes variability in the nucleic acid content in different tissues and the degree of variability or extent of alterations caused by the pesticides is found to be dose dependent. The effects of cadmium and lead on DNA and RNA contents have been studied in gill, liver and brain of a common carp, *Cyprinus carpio* exposed to cadmium chloride and lead acetate by Muley *et al.*, (2000) and found that both the heavy metals decreased DNA content in all the tissues along with RNA content in liver and brain, but it was increased in gill due to cadmium and lead toxicity.

CONCLUSIONS

The results observed in the present study reveals that quinalphos caused variability in the nucleic acid content in different tissues and the degree of variability by the quinalphos technical was less compared to 25% EC and was found to be dose dependent.

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