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EFFECT OF QUINALPHOS ON BIOCHEMICAL STUDIES IN FRESH WATER FIELD CRAB, *SPIRALOTHELPHUSA HYDRODROMA*

S. Pandiammal*, J. Manju Bashini and P. Senthilkumaar

P.G. and Research Department of Zoology, Sir Theagaraya College, Chennai, India.

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***Corresponding Author**
S. Pandiammal
P.G. and Research Department of Zoology, Sir Theagaraya College, Chennai, India.

ABSTRACT

The effect of quinalphos pesticide on nutritional parameters (protein, carbohydrate and lipid) in the tissues (muscle, gills, hepatopancreas, spermatheca and ovary) of *Spiralothelphusa hydrodroma* was determined in a toxicity test. The LC_{50} values were obtained by probit regression line, taking test concentration and corresponding percent mortalities on log value and probit scales respectively. Sublethal studies are helpful to assess the response of the test organism to stress caused by pesticides. *S. hydrodroma* were exposed to varying sub-lethal concentrations of quinalphos (24h, 48h, 72h and 96h). Chronic time course studies on the effects of pesticide were conducted by exposing to sublethal safe concentrations for 24 hours. At the end of the treatment period the control and treated crabs were dissected and tissues namely, muscle, gills, hepatopancreas, spermatheca and ovary were collected for biochemical studies.

KEYWORDS: *Spiralothelphusa hydrodroma*, tissues, pesticide, nutritional studies.

1. INTRODUCTION

The pollution of rivers and streams with chemical contaminants has become one of the most critical environmental problems of the century. As a result of the pollutants transported from industrial areas into the environment and their chemical persistence, many freshwater ecosystems are faced with high levels of xenobiotic chemicals. Pesticides used in agriculture are among the most hazardous chemical. Such chemicals may reach lakes and rivers through rains and wind, affecting many other organisms away from the primary target. It is estimated that generally only about 0.1% of the pesticide reaches the specific target. The detrimental effect of insecticides on aquatic environments is incontestable. Many such chemicals can induce genetic disorders and physiological alterations, if not death of the exposed organisms.

Because of drift, atmospheric transport, agricultural and residential runoff, individual misuse, and improper disposal, pesticides are also found in aquatic habitats (McConnell *et al*., 1998 and Gilliom and Hamilton, 2006) where it acts as a toxicant for aquatic organisms. These toxicants produce several biochemical and physiological responses. Thus, it is important that toxic effects be determined and interpreted in biochemical terms (Sneha Verma and Anurag Rawat *et al*., 2017).

Freshwater crabs are often exposed to biopesticide in their aquatic habitats through the agricultural runoff; generally most of the pest organisms belong to the lower trophic level of the food chain in an ecosystem. However, no attention has been paid to small invertebrates such as crabs, prawns, gastropods, bivalves, etc, which are also used as food. Hence, further study is warranted to understand the extent of such undesirable effects of the biopesticides on various economically and ecologically important fauna of the aquatic ecosystem (Mintu Deyashi *et al*., 2016). Crustaceans constitute one of the food sources among aquatic organisms. Crabs are consumed by human beings in different forms from time immemorial for their delicacy and as well as for their medicinal benefits.

The fresh water field crab, *Spiralothelphusa hydrodroma* was selected as test animal since the population of these species are on the decreasing side due to their exposures to different routinely used pesticide; quinalphos during agricultural practices. Quinalphos is extensively applied in agriculture for pest eradication in India, it is pertinent to study its hazardous effect on the aquatic and land ecosystem as it is assumed that the residue might affect the crabs. The present study is to extract scientific datas on the quinalphos pesticide impact, nutritional studies were observed in muscle, gills, hepatopancreas, spermatheca and ovary in the fresh water field crab, *S. hydrodroma*.

II. MATERIALS AND METHODS

The freshwater field crab, *Spiralothelphusa hydrodroma* was collected from Neithavoyal village, Thiruvallur District, Tamil Nadu. The freshwater field crab, *Spiralothelphusa hydrodroma* was chosen for the present study because of its presence in the rice fields in the study area. The crabs were collected from the rice fields in early morning hours or late evening hours by hand picking and stored in plastic containers and brought alive to the laboratory. The crabs were immediately transferred into experimental containers. Quinalphos is an organothiophosphate chemical chiefly used as a pesticide. Ranked 'moderately hazardous' in World Health Organization's (WHO) acute hazard ranking, use of

quinalphos is either banned or restricted in most nations. Quinalphos, which is classified as a yellow label (highly toxic) pesticide in India, is widely used in the following crops: wheat, rice, coffee, sugarcane, and cotton.

The acute toxicity tests were conducted in duplicates using 5L experimental containers. The duration of the test was 96h and during the study the experimental crabs were fed. A minimum of 1L water was added for 10 crabs, so that the crabs were half immersed. The experiment was carried out for finding the range of concentrations for confirmatory evaluation. The mortality was recorded for *Spiralothelphusa hydrodroma* at 24, 48 72 and 96h exposure to pesticides were corrected for natural response by Abbott's formula (Abbott, 1925). The LC_{50} values were obtained by probit regression line, taking test concentration and corresponding percent mortalities on log value and probit scales respectively. Straight line (regression line) was drawn between the points which represent the survival percentage verses concentration (APHA, 1989). Sublethal studies are helpful to assess the response of the test organism to stress caused by pesticides. Chronic time course study on the effects of pesticide on *Spiralothelphusa hydrodroma* were conducted by exposing to sublethal safe concentrations for 24 hours. At the end of the treatment period the control and treated crabs were dissected and tissues namely, muscle, gills, hepatopancreas, spermatheca and ovary were collected for biochemical studies. The protein content in the tissue extracts was estimated by Bradford (1976) method using Coomassie Brilliant blue (CCB). The carbohydrate content in the extracts was estimated as per the method of Roe (1955). The lipid content was estimated as per the method of Folch *et al*., (1957).

III. RESULTS

In the present investigation, an attempt was made to identify the staining reactions of the cytoplasmic contents of the neurosecretory cells found in the muscle, gills, hepatopancreas, spermatheca and ovary between the control and the experimental groups.

Median lethal concentration (LC_{50}) of Quinalphos

Median lethal concentration (LC_{50}) of Quinalphos for *S. hydrodroma* was observed for 96 hrs. The logarithm of 50% lethal concentration was obtained by finding the value on the abscissa for straight line which assumes the probit value 5. The concentrations resulting in 50% mortality and slope of the probit line were calculated for specific period of exposure as described by Finney (1971). The percent mortality data were subjected to probit analysis and plotted against log of dose concentrations resulting in a straight line. The values of LC_{50},

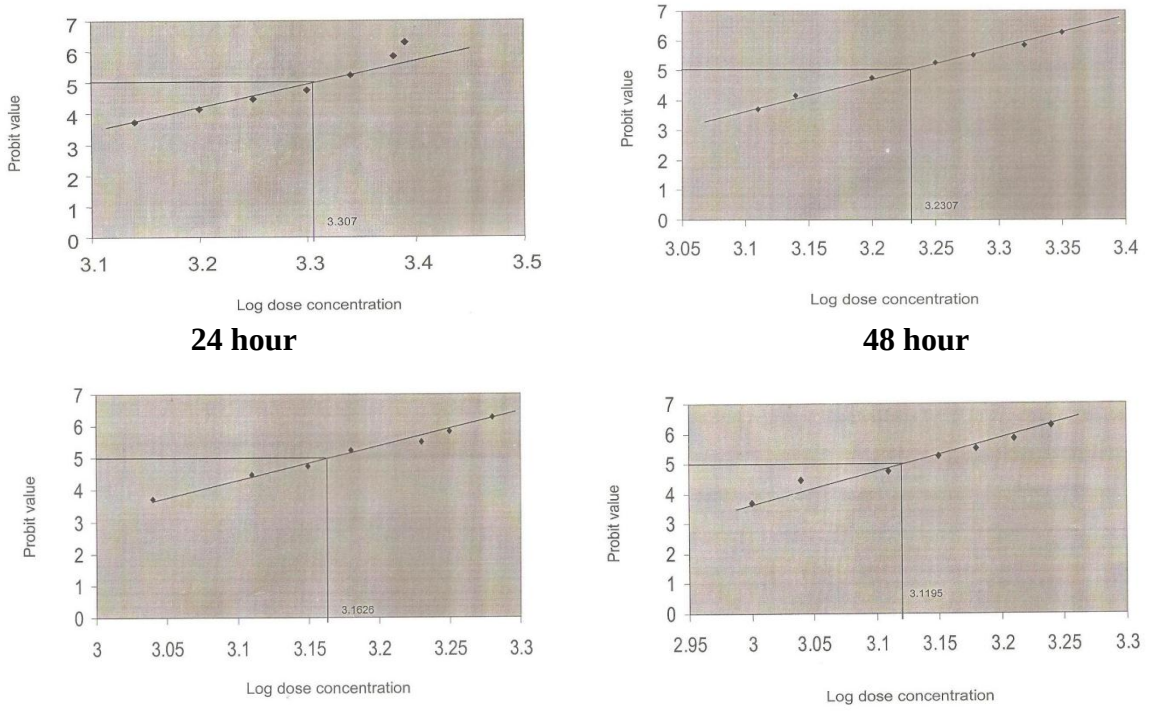
upper and lower confidence limits, slope function, correlations co-efficient square and regression results of Quinalphos on *S. hydrodroma* were given (Table: 1) (Fig. 1). The LC_{50} values for 24, 48, 72 and 96 h of exposure periods were estimated at 2.015, 1.672, 1.372 and 1.305 ppm respectively.

Effect of sublethal concentrations of Quinalphos on *S. hydrodroma*

The experimental crabs of *S. hydrodroma* subjected to Quinalphos to two different durations of 15 days and 30 days exhibited changes in the muscle, gills, hepatopancreas, spermatheca and ovary. The variations between the control and the treated tissues were studied critically and photomicrographed.

Table 1: The LC_{50} values and regression equations for *S. hydrodroma* treated with Quinalphos.

Exposure periods (hours)	LC_{50} (ppm)	Upper confidence limits (UCL) (ppm)	Lower confidence limits (LCL) (ppm)	Regression results	Slope function (SF)	r^2
24	2.015	2.451	1.728	Y=-0.932X + 0.468	2.971	0.99
48	1.672	1.627	1.335	Y=-0.658X + 0.281	3.263	0.98
72	1.372	1.772	1.126	Y=-0.724X + 0.391	4.120	0.99
96	1.305	1.753	1.117	Y=-0.611X + 0.324	4.963	0.99



24 hour **48 hour**

72 hour **96 hour**

Fig 1: LC_{50} values of Quinalphos in *Spiralothelphusa hydrodroma*.

Table 2: Protein content in *Spiralothelphusa hydrodroma* treated with Quinalphos.

Exposure period in days	Tissues	Control	Lower sublethal concentration	Higher sublethal concentration	F-value	P-value
		Mean ± SD	Mean ± SD	Mean ± SD		
15	Ovary	84.19 ± 0.64	70.69 ± 2.05	67.79 ± 1.37	99.86**	<0.01
	Spermatheca	65.59 ± 0.75	63.62 ± 1.33	62.12 ± 1.05	28.10**	<0.05
	Hepatopancreas	70.13 ± 1.02	67.84 ± 1.72	64.28 ± 1.04	22.34*	<0.05
	Muscle	55.65 ± 0.71	52.87 ± 1.30	50.13 ± 1.14	36.25*	<0.05
	Gill	60.17 ± 1.24	56.73 ± 1.12	52.79 ± 1.29	49.76*	<0.05
30	Ovary	84.96 ± 2.56	68.67 ± 1.28	63.19 ± 0.89	43.51*	<0.01
	Spermatheca	66.38 ± 0.49	62.78 ± 0.96	60.32 ± 1.24	54.13*	<0.05
	Hepatopancreas	70.59 ± 0.87	63.49 ± 1.28	61.84 ± 1.18	60.59*	<0.05
	Muscle	55.92 ± 0.53	51.79 ± 1.28	49.59 ± 0.96	71.29*	<0.01
	Gill	60.39 ± 1.17	52.35 ± 1.39	49.09 ± 0.67	96.48*	<0.01

Table 3: Carbohydrate content in *Spiralothelphusa hydrodroma* treated with Quinalphos.

Exposure period in days	Tissues	Control	Lower sublethal concentration	Higher sublethal concentration	F-value	P-value
		Mean ± SD	Mean ± SD	Mean ± SD		
15	Ovary	83.93 ± 1.14	86.79 ± 1.57	77.29 ± 1.57	12.16*	<0.05
	Spermatheca	32.19 ± 0.59	30.38 ± 1.03	24.85 ± 0.94	168.89**	<0.01
	Hepatopancreas	90.83 ± 1.02	85.40 ± 1.48	69.38 ± 0.84	574.71**	<0.01
	Muscle	13.25 ± 1.09	12.49 ± 1.39	8.09 ± 0.97	41.96**	<0.01
	Gill	8.89 ± 1.29	8.29 ± 0.48	6.99 ± 0.49	10.29*	<0.05
30	Ovary	84.39 ± 1.36	78.99 ± 1.79	74.59 ± 2.09	34.43**	<0.01
	Spermatheca	32.58 ± 0.93	29.38 ± 0.66	20.29 ± 1.30	244.83**	<0.01
	Hepatopancreas	91.05 ± 1.07	82.69 ± 1.18	67.49 ± 1.10	512.79**	<0.01
	Muscle	13.72 ± 1.08	11.69 ± 0.92	6.49 ± 1.76	73.69**	<0.01
	Gill	9.29 ± 0.71	7.79 ± 0.53	5.99 ± 0.74	177.58**	<0.01

Table 4: Lipid content in *Spiralothelphusa hydrodroma* treated with Quinalphos.

Exposure period in days	Tissues	Control	Lower sublethal concentration	Higher sublethal concentration	F-value	P-value
		Mean ± SD	Mean ± SD	Mean ± SD		
15	Ovary	17.63 ± 1.14	16.09 ± 0.87	14.59 ± 0.97	9.76*	<0.05
	Spermatheca	10.39 ± 1.15	9.78 ± 1.03	8.52 ± 1.54	3.19*	<0.05
	Hepatopancreas	17.43 ± 1.08	16.74 ± 0.82	15.68 ± 1.44	7.24*	<0.05
	Muscle	11.25 ± 0.81	10.61 ± 1.03	9.29 ± 0.97	5.09*	<0.05
	Gill	9.79 ± 0.54	9.09 ± 0.58	8.29 ± 0.59	6.96*	<0.05
30	Ovary	17.89 ± 0.76	15.29 ± 0.72	13.79 ± 0.89	16.89**	<0.01
	Spermatheca	10.48 ± 0.63	8.68 ± 0.76	7.72 ± 1.30	5.20*	<0.05
	Hepatopancreas	17.75 ± 0.87	15.89 ± 1.48	14.60 ± 0.68	8.49*	<0.05
	Muscle	11.52 ± 1.08	9.49 ± 0.88	8.39 ± 0.46	15.29**	<0.01
	Gill	9.89 ± 0.97	8.39 ± 0.83	7.39 ± 0.69	21.28**	<0.01

Effect of Quinalphos on Biochemical studies

a. Effect of Quinalphos on protein content in muscle, gills, hepatopancreas, spermatheca and ovary of *S. hydrodroma*

1. Muscle

In the muscle of the control crab the protein content was and 55.65 and 55.92 mg/g wet weight of tissue. In the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the protein level was reduced to 52.87 and 51.79 mg/g wet weight of muscle as observed from the Table: 2 whereas it was further decreased in the crabs treated with higher sublethal concentration (0.4383 ppm) which was 50.13 and 49.59 mg/g wet weight of muscle in 15 and 30 d respectively. The decline in protein level was maximum at 30 d for Quinalphos treated crabs and was statistically significant at $p<0.05$ and $p<0.01$ respectively in 15 and 30 d treated crabs in both the concentrations.

2. Gills

In the control crabs the protein content of gill was 60.17 and 60.39 mg/g wet weight of tissue for 15 to 30 d respectively (Table: 2). When treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the protein level was 56.73 and 52.35 mg/g wet weight of gill, whereas in higher sublethal concentration (0.4383 ppm) it was 52.79 and 49.09 mg/g wet weight of tissue respectively for 15 to 30 d of exposure. In 30 d treatment, maximum decrease of protein content was observed in Quinalphos treated crabs, which was statistically significant at $p<0.01$. In 15 d exposure crabs the level of protein content was significantly decreased at $p<0.05$.

3. Hepatopancreas

As observed from the results (Table: 2), the protein content of the hepatopancreas of the control crab was 70.13 and 70.59 mg/g wet weight of tissue for 15 to 30 d respectively. In the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the protein level was 67.84 and 62.49 mg/g wet weight and for higher sublethal concentration (0.4383 ppm) it was 64.28 and 61.84 mg/g wet weight of tissue for 20 and 40 d respectively. The maximum decrease was observed in 30 d of treatment for Quinalphos which was statistically significant at $p<0.05$ in both the sublethal concentrations at both the experimental crabs.

4. Spermatheca

In the spermatheca of the control crab, the protein content was 65.59 and 66.38 mg/g wet weight (Table: 2). In the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the protein level was 63.62 and 62.78 mg/g wet weight of tissue, whereas in

higher sublethal concentration (0.4383 ppm) it was 62.12 and 60.32 mg/g wet weight of spermatheca, respectively for 15 to 30 d of exposure. In 30 d of exposure maximum decrease was observed in Quinalphos which was statistically significant at $p<0.05$ in both the concentrations at both experimental periods.

5. Ovary

In *S. hydrodroma,* the protein content of the crab was 84.19 and 84.96 mg/g wet weight of ovary of 15 to 30 d respectively (Table: 2). In the experimental crabs the protein level was reduced both in the lower (0.1315 ppm) and higher sublethal concentrations (0.4383 ppm) of Quinalphos which was 70.69 and 68.67 mg/g wet weight and 67.79 and 63.19 mg/g wet weight of ovary for 15 d and 30 d respectively. The maximum decrease was observed in 30 d of treatment in Quinalphos treated crabs and at both sublethal concentrations and was statistically significant ($p<0.01$) at both the experimental periods.

b. Effect of Quinalphos on carbohydrate content in muscle, gills, hepatopancreas, spermatheca and ovary of *S. hydrodroma*

1. Muscle

As observed from the results (Table: 3) the carbohydrate content of the muscle of the control crab was 11.25 and 11.52 mg/g wet weight of tissue for 15 and 30 d respectively. In the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the carbohydrate content reduced to 10.61 and 9.09 mg/g wet weight and in higher sublethal concentration (0.4383 ppm) of Quinalphos it further reduced to 9.29 and 8.39 mg/g wet weight of muscle. In 30 d of treatment maximum decrease in the carbohydrate content was observed in Quinalphos treated crabs. It was statistically significant at both 15 d ($p<0.05$) and 30 d ($p<0.01$) of exposure.

2. Gills

In gills of the control crab the carbohydrate content was found to be 9.79 and 9.89 mg/g wet weight of tissue for 15 and 30 d respectively (Table: 3). In the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the carbohydrate content was 9.09 and 8.39 mg/g wet weight and in higher sublethal concentration (0.4383 ppm) of Quinalphos further reduced to 8.29 and 7.39 mg/g wet weight of gills. In Quinalphos treated crabs the maximum decrease was observed in the 30 d exposure and was statistically significant for both 15 d ($p<0.05$) and 30 d ($p<0.01$) in Quinalphos treated crabs.

3. Hepatopancreas

The carbohydrate content of the control crab was 17.43 and 17.75 mg/g wet weight of hepatopancreas for 15 and 39 d respectively (Table: 3). In the crabs treated with lower sublethal concentrations (0.1315 ppm) of Quinalphos the carbohydrate content reduced to 16.74 and 15.89 mg/g wet weight and in higher sublethal concentrations (0.4383 ppm) it further decreased to 15.68 and 14.60 mg/g wet weight of hepatopancreas respectively for 15 d and 30 d. In 30 d of treatment maximum decrease was observed in Quinalphos treated crabs and was statistically significant ($p<0.05$) for both 15 d and 30 d of experimental periods.

4. Spermatheca

In the other crabs the carbohydrate content of spermatheca was 10.39 and 10.48 mg/g wet weight of tissue for 15 d and 30 d respectively (Table: 3). In the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the carbohydrate content was 9.78 and 8.68 mg/g wet weight and in higher sublethal concentration (0.4383 ppm) of Quinalphos it was 8.52 and 7.72 mg/g wet weight of tissues for 15 d and 30 d respectively. The decrease in carbohydrate content was maximum in 30 d of exposure period for Quinalphos. The level of significance was $p<0.05$ for both 15 and 30 d values of experimental crabs.

5. Ovary

In *S. hydrodroma* the carbohydrate content of the control crab was 17.63 and 17.89 mg/g wet weight of ovary for 15 and 30 d respectively (Table: 3). In the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the carbohydrate content reduced to 16.09 and 15.29 mg/g wet weight and in higher sublethal concentration (0.4383 ppm) it decreased to 14.59 and 13.79 mg/g wet weight of ovary for 15 to 30 d respectively. The maximum decrease was observed in 30 d of Quinalphos treated crabs and in both the sublethal concentrations it was statistically significant at 15 d ($p<0.05$) and 30 d ($p<0.01$) of exposure.

c. Effect of Quinalphos on lipid content in muscle, gills, hepatopancreas, spermatheca and ovary of *S. hydrodroma*

1. Muscle

As observed from the results (Table: 4), the lipid content of the muscle of the control crab was found to be 13.25 and 13.72 mg/g wet weight of tissue for 15 d and 30 d respectively. In the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the lipid content was 12.49 and 11.69 mg/g wet weight and in higher sublethal concentration (0.4383

ppm) it was 8.09 and 6.49 mg/g wet weight of muscle. As the concentration of Quinalphos increased the lipid content reduced and the maximum decrease was observed in 30 d exposure and the values were statistically significant ($p<0.01$) in both the experimental crabs.

2. Gills

In the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the lipid content was 8.29 and 7,79 mg/g wet weight of gills (Table: 4). The lipid content of the crabs treated with higher sublethal concentration (0.4383 ppm) of Quinalphos was 6.99 and 5.99 mg/g wet weight of gill, on the other hand, the lipid content of gills of the control crab was 8.89 and 9.29 mg/g wet weight of tissue for 15 to 30 d respectively. The reduction in the lipid content of the Quinalphos treated crab was statistically significant at ($p<0.05$) (15 d) and $p<0.01$ (30 d) in both the concentrations in the experimental crabs.

3. Hepatopancreas

The lipid content of the control crab was 90.83 and 91.05 mg/g wet weight tissue of hepatopancreas for 15 and 30 d respectively (Table: 4). In the crabs treated with lower sublethal concentrations (0.1315 ppm) of Quinalphos the lipid content was 85.40 and 82.69 mg/g wet weight and in higher sublethal concentration (0.4383 ppm) it was 69.38 and 67.49 mg/g wet weight of tissue for 15 d and 30 d respectively. The maximum decrease was observed in 30 d quinalphos treated crabs and was statistically significant ($p<0.01$) at both exposures.

4. Spermatheca

As observed from the results (Table: 4) the lipid content of spermatheca of the control crab was 32.19 and 32.58 mg/g wet weight of tissue. The lipid content reduced in the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos which was 30.38 and 29.38 wet weight and in higher sublethal concentration (0.4383 ppm) it was 24.85 and 20.29 mg/g wet weight of spermatheca. In 30 d of treatment maximum decrease in the lipid content was observed and the values in both concentrations were statistically significant at $p<0.01$.

5. Ovary

In control crab of *S. hydrodroma* the lipid content was 83.93 and 84.49 mg/g wet weight of ovary for 15 and 30 d respectively (Table: 4). In the crabs treated with lower sublethal concentration (0.1315 ppm) of Quinalphos the lipid content reduced 86.79 and 78.99 mg/g wet weight and in higher sublethal concentration (0.4383 ppm) it further reduced to 77.29 and

74.59 mg/g wet weight of ovary for 15 and 30 d respectively. The maximum decrease was observed on the 30 d of exposure in Quinalphos treated crabs and the values were statistically significant in 15 d ($p<005$) and 30 d ($p<0.01$).

IV. DISCUSSION

The results obtained in the present study on the toxicity effect of Quinalphos, an organophosphorus compound on a freshwater field crab, *Spiralothelphusa hydrodroma* at two different sublethal concentrations and two different exposure periods showed interesting results. The results at lower (0.1315 ppm) and higher (0.4383 ppm) sublethal concentrations of quinalphos on the muscle, gills, hepatopancreas, spermatheca and ovary revealed various histopathological changes. Similarly, the biochemical investigations of the protein, carbohydrate and lipid content revealed highly fascinating information. The crabs treated with quinalphos at the acute toxicity level were expressed in terms of LC_{50} value. The acute 96 h LC_{50} value for quinalphos on *S. hydrodroma* was found to be 1.315 ppm concentration.

The decline in tissue protein content in a freshwater teleost *Tilapia mossambica* suggested intensive proteolysis in the tissues which contributes to the amino acids to be fed into TCA cycle (Sahib, 1979). Shah and Dubale (1983) reported reduction in protein level and depletion of RNA suggested that RNAase activity was responsible for the depletion of RNA and protein in *Channa punctatus.* Singh (1985) and Saxena *et al.,* (1989) suggested the decline in protein level was due to decreased availability of energy required for protein synthesis. Decrease in protein level was observed in *Barytelphusa guerini* exposed to zinc sulphate (Sarojini *et al.,* 1990) and chromium (Reddy and Venugopal, 1991) and in *M. lamarrei lamarrei* in response to copper (Krishnamoorthy and Subramanian, 1995). The depletion of tissue protein was due to diversification of energy to meet the impending energy demand under toxic stress and altered enzyme activities (Reddy, 1987 and Vincent *et al.,* 1995). James *et al.,* (1995) studied the effect of copper and mercury on *Rieteropneustes fossilis* and observed that the heavy metals reduced the food uptake and growth. Saravanabhavan and Geraldine (1997) reported decrease in protein level in *M. malcolmsonii* when exposed to endosulfan. Similarly, in the present investigation, the effects of lower (0.1315 ppm) and higher (0.4383 ppm) sublethal concentrations of quinalphos on protein content in different tissues of the treated crabs were analysed. In all the tissues namely muscle, gills, hepatopancreas, spermatheca and ovary the protein content revealed a considerable decrease.

Carbohydrate, an important cellular content and energy rich compound was quantitatively assessed in the present investigation in various tissues namely muscle, gills, hepatopancreas, spermatheca and ovary. Fall in carbohydrate levels after prolonged exposure to heavy metals polluted water was due to the inactivation of the enzyme involved in the carbohydrate metabolism (Nagabhushanam and Kulkarni, 1981). The activity of the enzyme phosphorylase in the hepatopancreas and muscle has been shown to reduce the carbohydrate levels in *O. senex senex* (Ramamurthi and Venkataramanaiah, 1982). Decline in glycogen content was observed in *B. guerini* in response to zinc sulphate (Sarojini *et al.*, 1990). Significant changes were observed in the catabolism of carbohydrate in the tissues of the marine prawn, *Metapenaeus monoceros* following exposure to methyl parathion (Reddy and Rao, 1991). The carbohydrate content was decreased in *Scylla serrata* in response to cadmium toxicity (Reddy and Bhagyalakshmi, 1994) and in *U. annulipes* exposed to cadmium and mercury (Suresh, 2001). The results of the present study showed that the carbohydrate content decreased significantly in both the sublethal concentrations of quinalphos treated crabs. Although decline was observed in both the exposure periods the decrease was maximum in 30 days of treatment in quinalphos.

In the experimental crabs, the lipid content level decreased in all the tissues tested. Nagabhushanam *et al.,* (1972) reported reduction in lipid level in hepatopancreas in *M. kistensis* in response to pesticides. Reduction in lipid content was observed in fish *Sarotherodon mossambicus* when exposed to methyl parathion (Rao and Rao, 1981). Similar results were observed in *M. idaeiu* muscle due to cadmium stress (Villalan *et al.*, 1990); in *B. gueriniin* response to zinc sulphate (Sarojini *et al.*, 1990); in *M. malcomsonii* exposed to endosulfan (Saravanabhavan and Geraldine, 1997); in freshwater snail *Thiara tuberculata* and *Parresia corrugata* exposed to copper sulphate (Lomte and Muley, 1993; Deshmukh and Lomte, 1998) and dichlorovos (Geraldine *et al.*, 1999) and in *U. annulipes exposed* to cadmium and mercury (Suresh 2001). The accelerated hydrolysis of lipid might be to cope up with the increased energy demand occurring due to metal toxicity. Among the biomolecules, carbohydrates, proteins and lipids represent the principal ones to be utilized at times of stress including metal toxicity for the derivation of energy. Their role in activation of energy in tissues has been elucidated in several studies on both vertebrates (Ramalingam, 1990) and invertebrates (Geraldine *et al.*, 1999). Similarly, in the present study, the reduced lipid content in muscle, gills, hepatopancreas, spermatheca and ovary of the treated crabs in

comparison to the control crab, reflects the accelerated hydrolysis of lipid in order to cope with the increased energy demand occurring due to quinalphos toxicity.

V. CONCLUSION

Hence, the present investigation clearly showed that the quinalphos caused damages to the tissues at higher sublethal concentrations. There was a marked decrease in the protein, lipid and carbohydrate levels in response to the quinalphos. High levels of accumulation of quinalphos in the present investigation indicated that the intake was exponential in an environment where the quinalphos routinely used as biocides and fertilizers which is highly toxic was concluded.

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