Research article

Journal of Atoms and Molecules
An International Online Journal
ISSN – 2277 – 1247

BIOCHEMICAL CHANGES INDUCED BY CYPERMETHRIN (10% EC), A PYRETHROID COMPOUND IN SUB-LETHAL AND LETHAL CONCENTRATIONS TO THE FRESH WATER FISH *CIRRHINUS MRIGALA* (HAMILTON)

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Received on: 20-12-2013 Revised on: 26-12-2013 Accepted on: 30–12–2013

ABSTRACT:

Freshwater fish Cirrhinus mrigala was exposed to Cypermethrin (10% E.C) a synthetic pyrethroid insecticide, for 24, 48, 72, and 96 h and the static LC_{50} values were determined as 2.69, 2.61, 2.41 and 2.28 ppm respectively. The fish were exposed to lethal and sub-lethal concentration (96 h LC50 and 1/10th of 96 h LC_{50} value) of the pesticide for 96 h and the biochemical changes of total glycogen, total proteins and nucleic acids, were estimated in the tissues of fish exposed to the toxicant Cypermethrin (10% E.C). A decrease in total glycogen, proteins and nucleic acids over control were observed with the increase in the period of exposure in the test fish exposed to the toxicant.

KEY WORDS: Cypermethrin, *Cirrhinus mrigala* (Hamilton), Static $LC_{50,}$ Biochemical Changes.

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INTRODUCTION:

Pesticide usage while desirable for the pest control has resulted in unprecedented chemical pollution (Matsumura, 1975). The pesticides are transported to the aquatic bodies through surface runoff into the aquatic ecosystem, which enter the organisms through food webs and also through contact (Edwards, 1973; Brown, 1978; Murty, 1986).

Cypermethrin (10% E.C) is a synthetic pyrethroid insecticide used to control many pests, such as moth pests attacking cotton, fruit and vegetable crops, including structural pest control, or landscape maintenance. The physiological and biochemical alterations observed in an animal under any physiological stress can be correlated with the structural and functional changes of cellular

proteins. Notable alteration that is declined trend in liver and intestine glycogen of *Ophiocephalus punctatus* exposed to sub-lethal concentration of cypermethrin, these declined values of glycogen showed disturb carbohydrate metabolism due to toxic stress (Gijare *et al*. 2011). In the present study an attempt has been made to study the impact of cypermethrin (10% E.C), on a freshwater Indian major carp *Cirrhinus mrigala* (Hamilton) in sub-lethal and lethal concentrations at 24, 48 and 96 h of exposure periods.

MATERIALS AND METHODS:

The test fish *Cirrhinus mrigala* of size 5-6 $\pm$ ½ cm and weight 3-4 $\pm$ ½ gm were collected from local fish hatcheries of Nandivelugu, Tenali mandal, Guntur district, Andhra Pradesh, and acclimated at 28 $\pm$ 2^{o}C for 10 days. During the acclimation period the fish were fed with rice bran and groundnut cake. Acclimated fishes were exposed to static lethal and sub-lethal concentrations (1/10 of Lc_{50} value for 96 h) of Cypermethrin (10% EC) for 24, 48, and 96 h. The LC_{50} values were calculated by using Finneys probit analysis and the 96 h LC_{50} 2.28 mg/l to the *Cirrhinus mrigala.* The vital tissues of the fish viz., muscle, brain, liver, gill and kidney were taken for the estimation of glycogen, total protein and nucleic acids of both deoxyribose and ribose.

The total glycogen was estimated by the method of kemp *et al.*, (1954). Total protein by Lowry *et al*., (1951), DNA and RNA by the methods of Searchy and Maclinnis (1970 a & b).

RESULTS AND DISCUSSION:

Glycogen:

The glycogen depletion was observed which was graphically represented (Fig.1) for Cypermethrin (10% E.C). Maximum decrease was observed at 24 h exposure to the toxicant. The results indicate that the liver, a vital organ of carbohydrate metabolism was drastically affected by Cypermethrin (10% E.C). In almost all the tissues of the organs i.e. Kidney, Liver, Brain, Muscle and Gill tested at sub-lethal concentrations of Cypermethrin (10% E.C), a decrease in glycogen value was noticed during the exposure periods.

The earlier observations on the effect of pesticides on carbohydrate metabolism in various species indicate an attenuation of the energy reserve under pesticide stress (Radhaiah, 1988; Rama Murthy, 1988). The decreased glycogen level is also attributed to the conversion of carbohydrates into amino acids (Gaiton *et al.*, 1965). Koundinya (1979) reported that stepped up glycogenolysis leads to a decrease in glycogen content. Similar changes were observed in *Heteroneustis fossilils* exposed to malathion (kabeer *et al.*, 1983), sumithion (Koundinya and Rama Murthy, 1978), endosulfan (Vasanti and Ramaswamy, 1987) and in *channa striatus* to metasystox exposure (Natarajan, 1981). Methyl parathion sub-lethal exposure on fresh water mussel *lamellidens marginalis* decreased the glycogen content (Moorthy *et al.*, 1985). Monochrotophos exposure to *channa punctatus* reduced the glycogen levels (Miny Samuel and Sastry, 1989).

Proteins:

The changes in total proteins under exposure to lethal and sub lethal concentrations of cypermethrin (10% E.C) are graphically represented in Fig.2. to pesticide for the fish *Cirrhinus mrigala.* Under sub-lethal concentrations of Cypermethrin, the total protein was found to degcrease in most of the tissue.

Maximum decrease was noticed at 96 h exposure in brain and muscle at 24 hrs

exposure. Same trend was noticed in the same tissue even at 96 hrs exposure. At 48 hrs exposure, maximum decrease was observed in brain and muscle. Schmidt and nielson (1975) stated that the decreased tendency of total protein may also be due to the metabolic utilization of the Keto acids to gluconeogenesis of proteins from the synthesis of glucose or may be due to directing the synthesis of proteins from free amino acids. The decrease protein content was more due to break down rather than retarded synthesis which is supported by the findings of Radhaiah (1988). The investigations of koundinya (1979) revealed a decrease in protein content in *Tilapia mossambica* exposed to different pesticides. Sastry and Siddiqui (1984) reported that the protein content was decreased in liver, musclem, kidney, intestine, brain and gill, when *Channa puctatus* was treated with quinalphos. The decrease in total protein content observed in *Hepedacephalychthys themalis* by jebakumar *et al.,* (1992) and *Cyprinus carpio* by Ravisankar *et al.,* (1992) due to Cypermethrin intoxication is very similar and supportive to the present study. Anita susan *et al.,* (1999) reported the decreased levels of total protein content in *Catla catla* exposed to fenvalerate. The report of decreased protein levels in *Channa punctatus* exposed to cypermthrin by Luther Das *et al.,* (1999) support gives to the present study. Several other investigations revealed a decrease in protein with pyrethroid compounds.

Nucleic acids:

The results are graphically represented for the exposed fish in DNA and RNA as Fig. 3 & 4 respectively for the fish *Cirrhinus mrigala* (Hamilton). DNA- RNA rations of fish tissues are reported to be quite sensitive to changes in feeding levels and growth rates (Bulow 1970,1971; Haines 1973; Buckley 1979b) and are also useful for diagnosis of nutritional status and starving condition (Buckley 1979a, 1980; Bulow *et al.,* 1981). The maximum level of DNA was found in liver and minimum in gill. Increase level of DNA in liver supports the earlier findings of holbrooks (1980). According to Holbrook (1980), thymidine incorporation into hepatic DNA is markedly increased after 1-3 days of administration of various toxicants. The increase of DNA in gill region may be due to hypertrophic nature of chloride cells. These results are in agreement with the works of Natarajan (1981), Durai Raj, and Selvarajan (1992) which reveal the enlargement of nuclei in the chloride secreting cells in *Channa striatus* exposed to metasystox and *Oreochromis mossambicus* to quinalphos respectively. In other tissues, no significant change was observed in DNA levels.

The RNA content further decreased progressively with increase in the period of exposure the decrease of RNA content at 48 hrs. and 96 hrs. of exposure. The RNA content in all the tissues of C*irrhinus mrigala* showed a very significant decrease over the control. The decreasing trend was more in sub-lethal concentration than in lethal concentration.

In the present work, decreased levels of nucleic acid values were obtained in all the tissues exposed to toxicant. The results obtained were in agrement with the earlier reports of Holbrock, (1980). Durai Raj and selvarajan, (1992). Sing *et al.,* (2000) reported a significant reduction in the RNA and protein due to dimithiolate stress Durai Raj and Selvarajan (1988) reported a significant reduction in the DNA and RNA due to phosphamidon stress.

ACKNOWLEDGEMENTS:

The authors thank the Head of the Department of Zoology, Acharya Nagarjuna University

for providing necessary facilities, and also thank UGC for providing equipment to carry out this work under Special Assistance Program.

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Figures:

Fig.1. Changes in the gylcogen content (mg/gr wet weight of the tissue) in different tissues *Cirrhinus mrigala* (Hamilton) on exposure to sub-lethal and lethal concentrations of Cypermethrin (10% E.C) for 24 h.

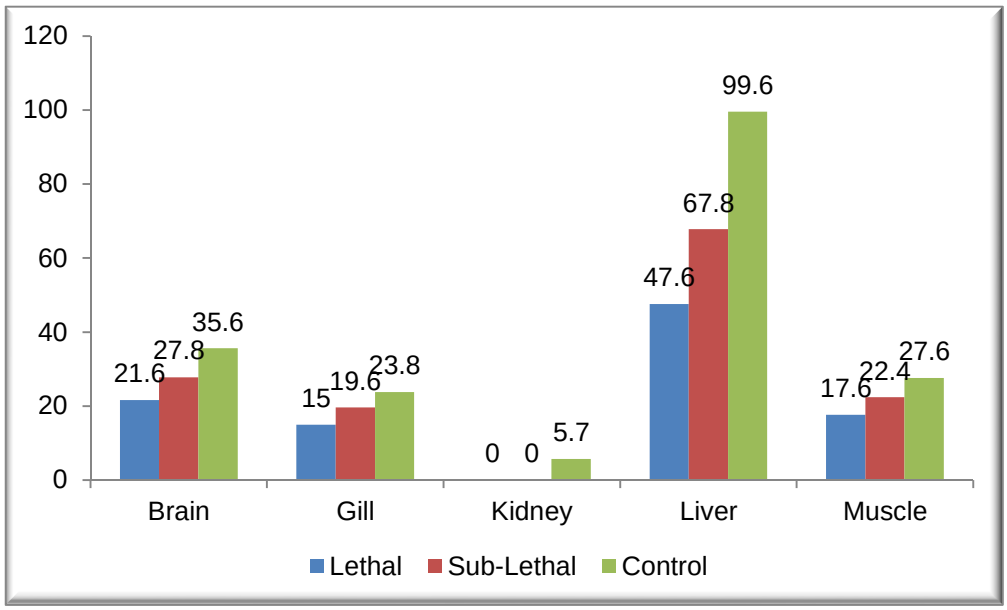


Fig.1.a. Changes in the gylcogen content (mg/gr wet weight of the tissue) in different tissues *Cirrhinus mrigala* (Hamilton) on exposure to sub-lethal and lethal concentrations of Cypermethrin (10% E.C) for 48 h.

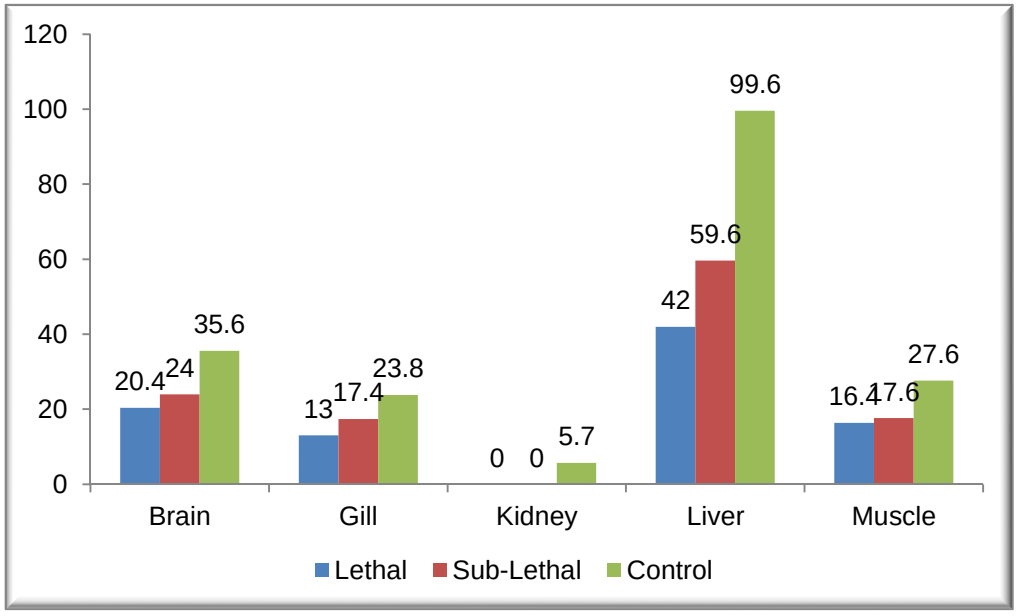


Fig.1.b. Changes in the gylcogen content (mg/gr wet weight of the tissue) in different tissues *Cirrhinus mrigala* (Hamilton) on exposure to sub-lethal and lethal concentrations of Cypermethrin (10% E.C) for 96 h.

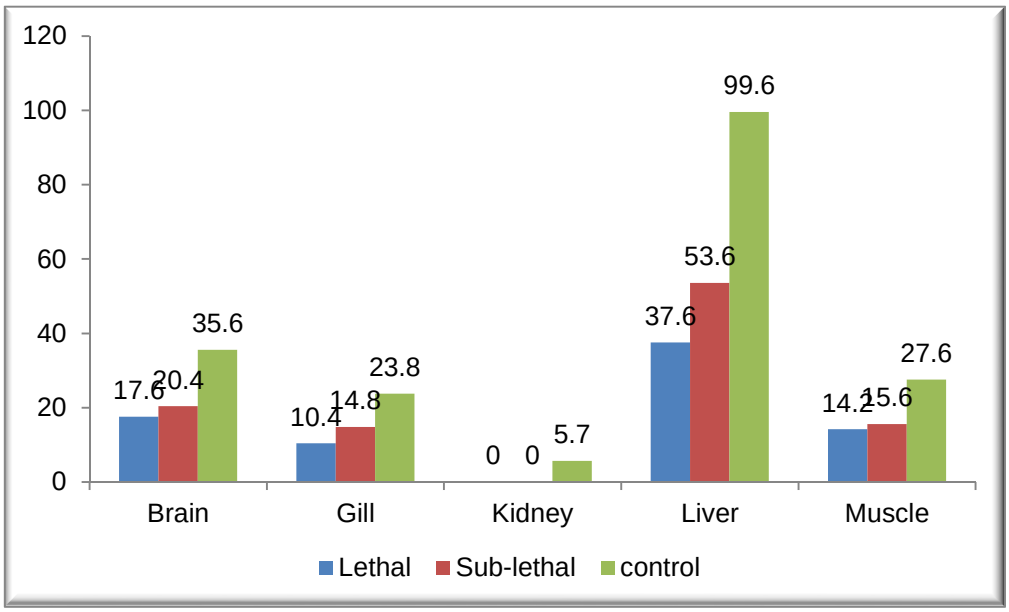
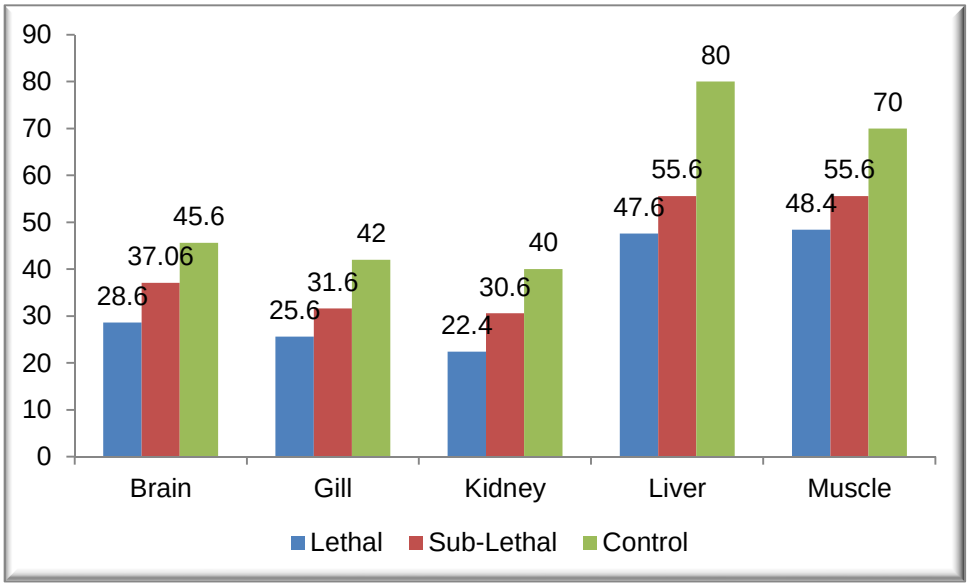


Fig.2. Changes in the protein content (mg/gr wet weight of the tissue) in different tissues *Cirrhinus mrigala* (Hamilton) on exposure to sub-lethal and lethal concentrations of Cypermethrin (10% E.C) for 24 h.



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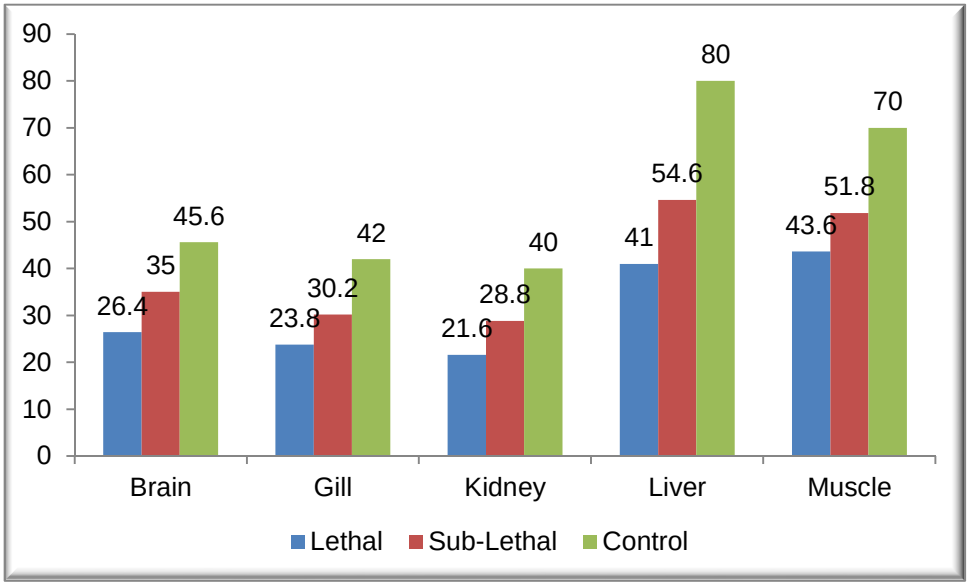

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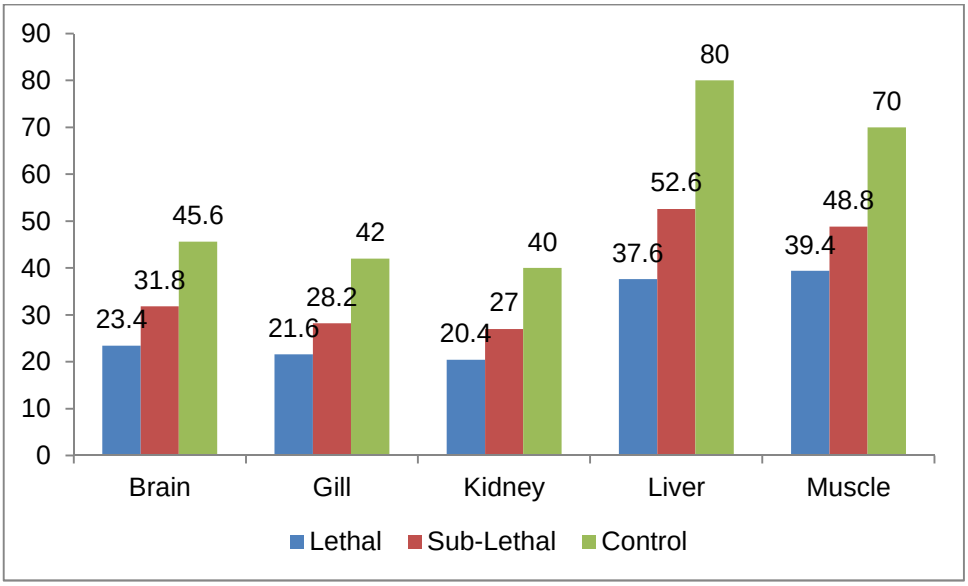
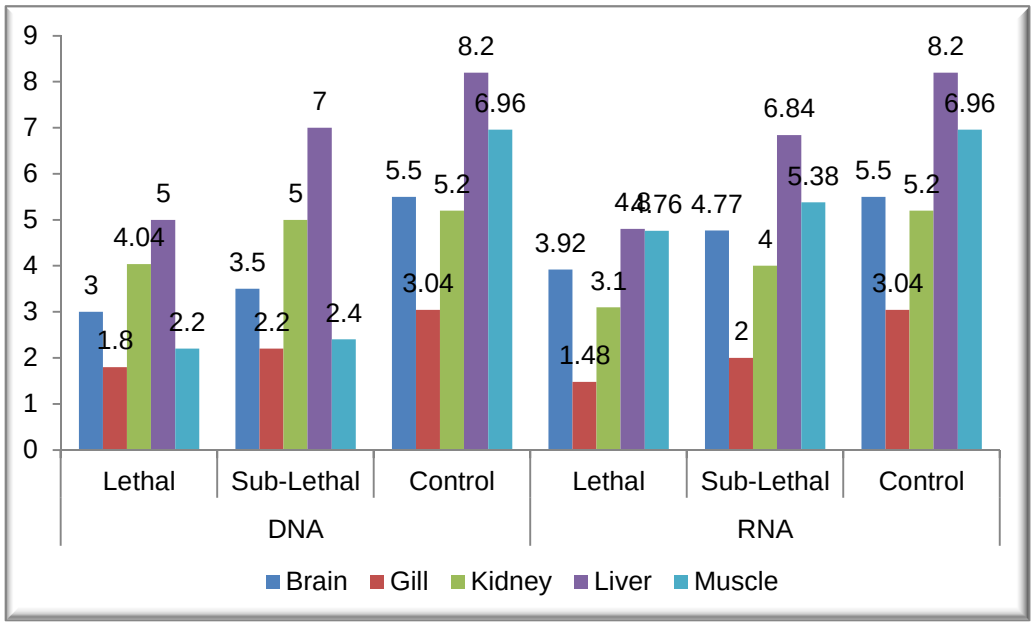


Fig.3. Changes in the amount of DNA and RNA (mg/gr body wet weigh of the tissue) in different tissues *Cirrhinus mrigala* (Hamilton) on exposure to sub-lethal and lethal concentrations of Cypermethrin (10% E.C) for 24 h.



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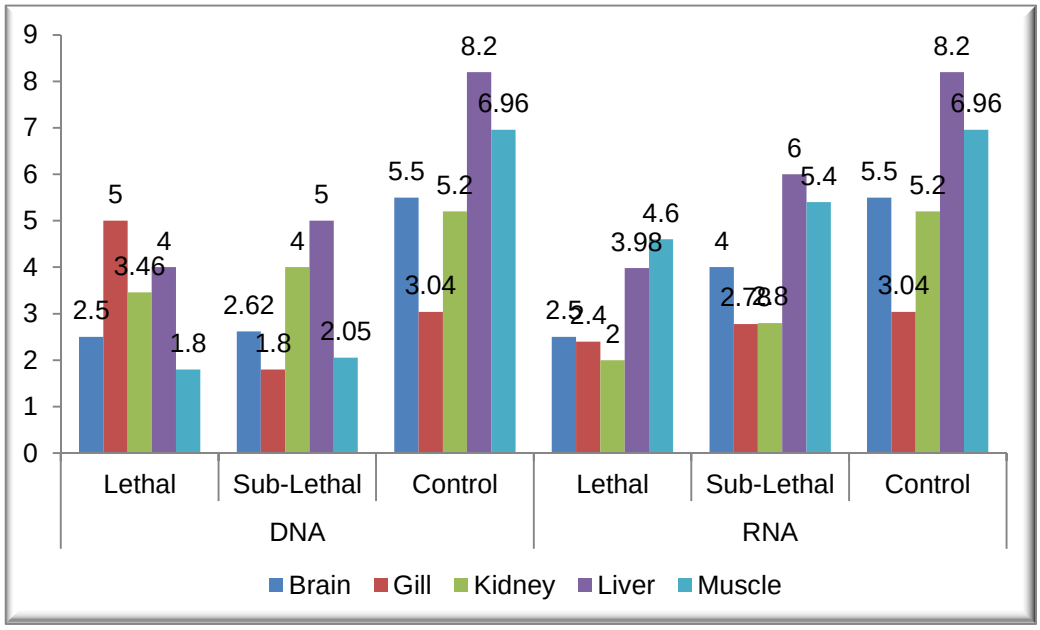

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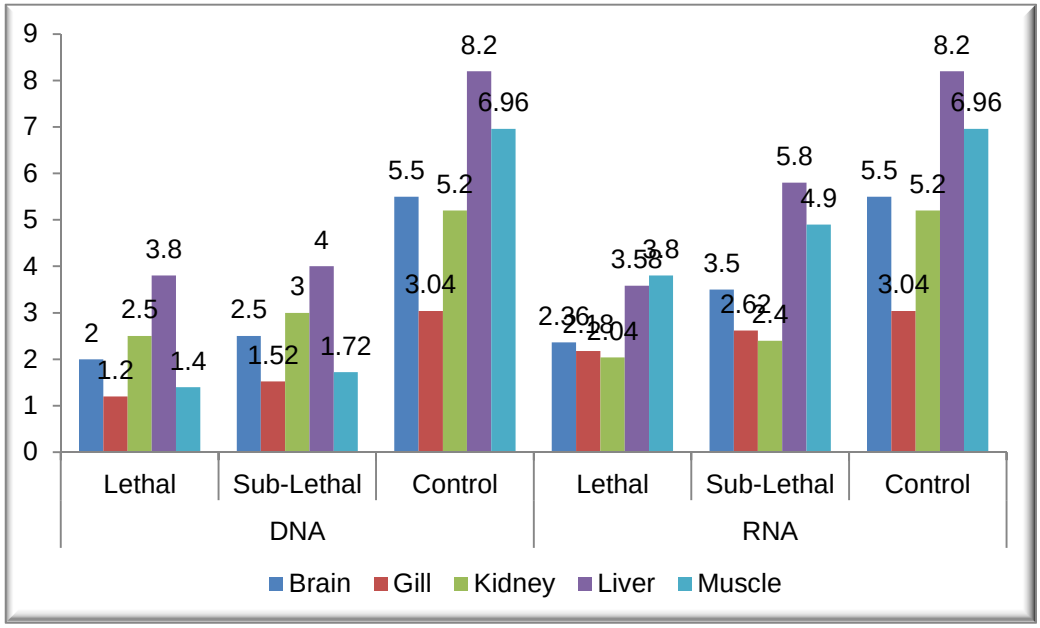

How to cite this article:

Veeraiah K, Vivek Ch, Srinivas Rao P, G Venkatrao "Biochemical changes induced by Cypermethrin (10% EC), a Pyrethroid compound in sub-lethal and lethal concentrations to the freshwater fish *Cirrhinus mrigala* (Hamilton)" *J. Atoms and Molecules*, 3(6), 2013: 625 – 634.

