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EFFECT OF MERCURY ON CARBOHYDRATE METABOLISM OF SPHAERODEMA RUSTICUM (HETEROPTERA: BELASTOMATIDAE)

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ABSTRACT

In the present study *Sphaerodema rusticum* were exposed to sublethal concentration of mercury. The key enzymes of the anaerobic glucose metabolism (Succinate dehydrogenase ,and Lactate dehydrogenase) activity were observed in testis and seminal vesicle of *Sphaerodema rusticum* . During the Sublethal concentration of mercury contamination, the Succinate dehydrogenase (SDH) and Lactate dehydrogenase (LDH) were altered. The present study showed that these changes suggest that the activity of enzymes is modified by a change in ambient water. The overall reduction in the glycolytic enzyme activities of mercury -exposed insect seems to reduce energy availability via glucose metabolism, thereby contributing to enhance mercury toxic effects in *Sphaerodema rusticum.*

INTRODUCTION

Heavy metal pollution is a wide spread global problems, which may threaten ecosystem and human health. The persistence of toxic metals in the environment poses great difficulties (Evangelou *et al*, 2007). Heavy metal enters the aquatic environment naturally through weathering of the earth crust. In addition to geological weathering, human activities have also introduced large quantities of metals to localized areas (Forstner and Wittmann, 1983). Heavy metal constitutes a serious types of pollution in fresh water and being stable compounds, they are not readily removed by oxidation and affect the animal. Heavy metals have a unique property of accumulation over a period of time, along a food chain and a very high level can be accumulated in an organism from very low level concentration in water and sediments (Bose *et al*, 1994). The heavy metal contamination of aquatic system has attracted the attention of several investigators both in the developed and developing countries of the world. Many industrial and agricultural processes have contributed to the contamination of fresh water systems thereby causing adverse effects on aquatic life (Dautremepuits *et al*, 2004). The heavy metal cannot be destroyed through biological degradation and have the ability to accumulate in the environment make these toxicants deleterious to the aquatic environment and consequently to humans who depend on aquatic products as source of food. Heavy metal can accumulate in the tissues of aquatic animals and as such as tissue concentration of heavy metal case of public health concern to animals (Kalay *et al*, 1999).The concern on the effect of anthropogenic pollution of fresh water ecosystems is growing. Heavy metals from natural and anthropogenic sources are continuously released into aquatic ecosystems, and they are a serious threat because of their toxicity, long persistence, bio accumulation and bio magnification in the food chain (Eisler, 1988).Mercury is used in measuring devices (barometer, thermometer, hydrometer, and pyrometers), the manufacture of dry cell batteries, fluorescent light bulbs, mercury salts, mirrors, agricultural poisons, antifouling paint, electrical apparatus, mercury vapor and arc lamp, and dental amalgam. It is also used in the electrolytic preparation of chlorine and caustic soda as a catalyst in the oxidation of organic compounds in extracting gold and silver from ores, in pharmaceuticals and in mercury boilers (Clarkson, 2002; NRC, 2000). The use of mercurial fungicides in papermaking and agriculture of Hg^{2+} catalysts in industry and of disinfectants in hospital result in local increase of several thousand fold (D'Itri and D'Itri, 1978). Mercury and its compounds are used widely in industries and their hazards to humans have been well documented (Wood, 1972; Nishioka, 1975; Nriagu, 1979). Mercury is one of the heavy metals known to be toxic for humans and other organisms (WHO, 1991) originating from occupational or environmental sources. It is present in different industrial settings, in the air as well as in drinking water and food resulting in continuous

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exposure of potentially the whole human population. According to the agency for toxic substances and disease Registry (ATSDR) of the US department of Health and Human Services, mercury is most frequently found in the environment (ATSDR, 2001). Insect reproduction is an essential physiological process from the point of view of propagation and it has received relatively little direct attention perhaps due to the fact that its process so intimately associated with other system and are controlled by both intrinsic and extrinsic factors. In male insects, the reproductive organs are seen visibly affected either as a result of direct or by the indirect effect of chemicals. Induced sterility may be due to the complete cessation of spermatogenesis, resulting in the loss of fertility due to the presence of dominant lethal (Balakrishnan, 1990).

MATERIAL AND METHODS

The insects, *Sphaerodema rusticum* (Heteroptera: Belastomatidae) were collected from the local ponds and streams were maintained in the plastic trough at the laboratory temperature of 28±5. The insects were daily fed with mosquito larvae, pieces of earth worm and aquatic plants. The troughs were cleaned properly every alternative day changing the water. The insects were exposed to mercury(9ppm). The testis and seminal vesicle were isolated and isolated tissues were used for the estimation of succinic acid dehydrogenase (Bernath and Singer, 1962))and lactate dehydrogenase activity(King ,1965). The statistical analysis was done by using student't' test.

RESULTS

In the normal testis tissue, the level of succinate dehydrogenase content was 10.57±0.02 µmole formazone formed/mg of protein/hr when the *Sphaerodema rusticum* exposed to mercury, the level of succinate dehydrogenase content was decreased upto 8.23±0.03µmole formazone formed/mg of protein/minutes.

Table 1.Activity of succinate dehydrogenase (SDH) in testis and seminal vesicle of *Sphaerodema rusticum* exposed to mercury (µmole formazone formed/mg of protein/minutes)

Tissue	Control	Mercury Treated	Percent change over control
Testis	10.57±0.02	18.23±0.03	-22.11
Seminal Vesicle	19.27±0.03	16.66±0.02	-13.54

*Significance at 5 % of student 't ' test

Table 2. Activity of lactate dehydrogenase (LDH) in testis and seminal vesicle of *Sphaerodema rusticum* exposed to mercury (µmole formazone formed/mg of protein/minutes)

Tissue	Control	Mercury Treated	Percent change over control
Testis	3.39±0.02	1.89±0.03	-80.27
Seminal Vesicle	2.47±0.03	1.09±0.02	-55.68

*Significance at 5 % of student 't ' test

In the normal testis tissue, the level of lactate dehydrogenase content was 3.39±0.02 µmole formazone formed/mg of protein/minutes when the fish *Sphaerodema rusticum* exposed to mercury, the level of lactate dehydrogenase content was decreased upto 1.89±0.02 µmole formazone formed/mg of protein/minutes. In the normal seminal vesicle tissue, the level of succinate dehydrogenase content was 19.27±0.03 µmole formazone formed/mg of protein/hr when the fish *Sphaerodema rusticum* exposed to mercury, the level of succinate dehydrogenase content was decreased upto 16.66±0.02µmole formazone formed/mg of protein/minutes. In the normal seminal vesicle tissue, the level of lactate dehydrogenase content was 2.47±0.03 µmole formazone formed/mg of protein/minutes when the fish *Sphaerodema rusticum* exposed to mercury, the level of lactate dehydrogenase content was decreased upto 1.09±0.02 µmole formazone formed/mg of protein/minutes.

DISCUSSION

The succinate dehydrogenase (SDH) is an important enzymes of kreb's cycle whose qualitatine changes are significant during certain pathological conditions (Harper *et al*, 1978). Sucinate dehydrogenase (SDH) is the oxidative enzyme which was drastically affected by the action of heavy metals. Succinic acid dehydrogenase (SDH) is chosen as a representative of metabolic enzyme. It is a marker enzyme for detecting the presence of TCA cycle in tissues (Natarajan, 1979).The Lactate dehydrogenase (LDH) is an important role in carbohydrate metabolism and converts the lactate to pyruvate. It is generally associated with cellular metabolic activity and inhibition in enzyme activity may be due to the imbalance or intracellular action of the metal subsequent to initial damage caused to the plasma membrane. Lactate dehydragenase (LDH) is present in most of the animal tissues and is involved in the inter conversion of lactic acid to pyruvic acid and acts as a vital enzyme between glycolytic pathway and tricarboxylic acid cycle. In the present study, the activity of lactatate dehydrogenase and succinate dehydrogenase was decreased in the testis and seminal vesicle of mercury exposed insects, *Sphaerodema rusticum* which may be suggested that the decreased LDH activity is probably for the conversion of lactate to pyruvate. In the present study, the LDH activity was low in seminal vescle. This observation is in conformity with Jayanthi (2001) who have found in testis and seminal vescicle of *Gryllotalpa africana* exposed to endosulfan. It is inferred that the LDH activity in certain reproductive tissues, perhaps due to treatment with mercury, suggested that these changes might be due to the occurrence of more amount of pyruvate and less amount of lactate in their tissues. In the present study, it has been observed that the SDH activity showed inhibition in testis and seminal vesicle during the mercury treatement, suggesting that the decreased amount of glycogen and increased level of glucose signified their utilization for the energy requiremet during the period of stress. Uthaman (1980) has reported a decreased succinate dehydrogenase activity level in the scorpion *Heterometrus falvipus* exposed to cyanide. Sumathi (2002) who has reported that for inhibition of the SDH activity which may be due to the change in mitochondrial membrane function in *Gryllotalpa Africana* treated with endosulfan. From this result it is concluded that the mercury exposure reduces the function of *Sphaerodema rusticum*.

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