Biochemical alterations in intertidal gastropod *Bursa tuberculata* exposed to Cadmium from Uran coast (West coast of India)

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Abstract : Uran and nearby coastal area is surrounded by many industrial plants. Under such circumstances coastal area of Uran is slowly becoming ground of chemical pollution. It is well known that by physiological and biochemical mechanisms of intertidal organisms play an important role to adapt the organism to variable environmental conditions. *Bursa tuberculata* was exposed to sub lethal concentrations of cadmium for 15 and 30 days. Control as well as experimental animal tissues was dissected out for analysis of glycogen, protein, lipid, lactic acid and pyruvic acid. A significant depletion in glycogen content was found in 15 and 30 days. Protein content in tissue of *Bursa tuberculata* was elevated significantly in 15 and 30 days. Lipid content of the tissue found declined after 15 and 30 days of exposure. A significant elevation in lactic acid was noticed in 15 days whereas after 30 days it was found depleted in the tissue. A significant reduction of pyruvic acid was noticed during 15 and 30 days. Sub lethal concentrations of cadmium do not kill the animals instantly but alter their overall metabolism. Among heavy metals cadmium is one of the most toxic pollutant because of its persistence, toxicity and potential for bioaccumulation.

Key word **:** Glycogen, Protein, Lipid, Lactic acid, pyruvic acid.

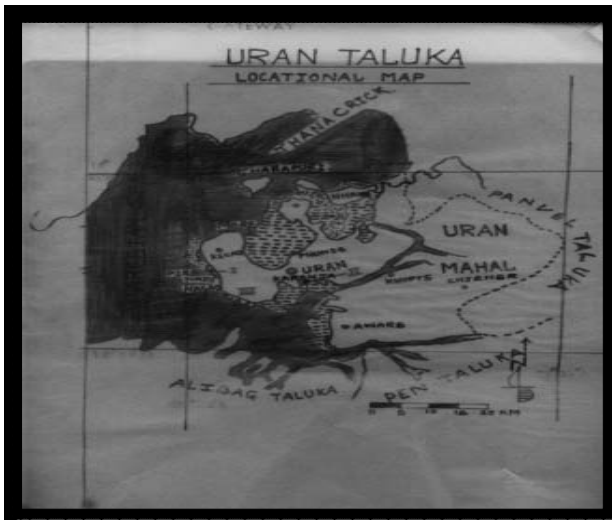
Introduction

Uran and nearby coastal area surrounded by industries of chemical production. Under such circumstances coastal area of Uran is slowly becoming a ground of chemical pollution. At the beginning of the investigation coast of Uran was surveyed for recording intertidal gastropod *Bursa tuberculata*. Animals for pursuing research were collected from rocky shore. Gastropods are among the most promising candidates used in biomonitoring studies focusing on heavy metals. Biochemical alterations occurring in the body give first indication of stress in the organism. Heavy metals are reported to induce many changes in biochemical and physiological dysfunctions of the organisms. Heavy metals like lead, mercury, cadmium and others contaminate water bodies when pass out into effluents **(**Everaarts and Fischer, 1992). This acts as toxicants for animals and cause health hazards knowingly and unknowingly in human beings and enters in food chain (El-Nady, 1996). Therefore, biochemical alterations act as a safety measures to overcome the altered conditions. In toxicological investigation also the change in the tissue metabolites proved to be a sensitive indicator of stress caused by toxicants **(**Gabbot, 1983). Therefore, many investigators have resorted to the assessment of tissue metabolites like glycogen, proteins, fats, lactic acid & pyruvic acid in fishes exposed to various pollutants under field and laboratory investigations (Venkatrama and Radhakrishniah, 1987). The studies have proved the utility of assessment of such metabolites in organisms to know the toxic mode of action of pollutants on fishes. Such methods have also been applied in assessment of the effects of various pollutants on metabolism like crustaceans & mollusks (Reddy et al, 1994; Roy, 1994). In India, considerable importance is given to the studies on ecophysiological aspects of marine bivalves (Deshmukh, 1998). Some of the investigators have also used intertidal bivalves as test organisms in toxicological research (Kulkarni & Kulkarni, 1988; Eapen & Patek, 1989; Kulkarni, 1983; Roy, 1994). However, the literature on biochemical responses with respect to tissue metabolites in intertidal gastropods is very scanty. Therefore the present investigation was conducted to assess Biochemical alterations in intertidal gastropod *Bursa tuberculata* exposed to Cadmium from Uran coast. It is well known that the efficient functioning of metabolis process in organisms is related to structural integrity of their tissues and organs. Sometimes intravenous and extraneous factors damage normal build up of tissue in organism which may go unnoticed before significant damage caused to the organism. Therefore toxicological investigations behavioral studies have gain prime importance. The behavioral modifications include changes in learning ability, chemically mediated behavior like reproductive activates, food findings and locomotion.

Materials and Methods

Study Area

In the beginning of the investigation coast of Uran was surveyed for recording intertidal gastropod. Uran coastline is a combination rocks, sand and mudflats. Gastropods were recorded from rocky part of the shore.



Map of Study Area

Plate No. 1.1

The intertidal gastropod *Bursa tuberculata* were exposed to sublethal concentrations (96 hrs LC50) of cadmium 50 µg/l and 100 µg/l for period of 15 and 30 days. At the end of experimental period of 15 days and 30 days and control, experimental gastropods were removed, tissues were dissected out for the analysis of glycogen, protein, lipid, lactic acid and pyruvic acid. The glycogen content was estimated by Anthrone method (Seifter et. al, 1950). The protein content was estimated by method of Lowry et al, 1951. While lipid contents were estimated by method of Bling and Dyer (1959) using chloroform menthol mixture of extract. A lactic acid level was determined according to the method of (Barker and Symmerson 1941) and pyruvic acid contained was determined by the method of (Friedmaan and Hawgen 1943).

Result and Discussion

The result of present investigation revealed that a significant depletion in glycogen content was noticed in tissues of gastropods, reduction in glycogen content was most significant after 30 days exposure (Table No 1.1). The protein content was found to be elevated after exposure of gastropod to cadmium for 15 and 30 days respectively. The elevation is more prominent after 30 days of exposure (Table No 1.2).The lipid content found to be depleted after 15 and 30 days of exposure .The decline was most significant after 30 days of exposure. (Table No 1.3) Significant elevation in lactic acid content was noticed in the tissue after 15 days, where as after 30 days exposure it was found depleted. (Table No 1.4). A general decreasing trend of pyruvic acid content was observed in gastropod exposed to 15 and 30 days (Table No 1.5).

Depletion in glycogen content in tissues of the marine clams under pollution stress was also reported (Dunning and Major, 1947).The maintenance of high reserve of glycogen is one of the adaptations in intertidal gastropod. Against anoxic conditions carbohydrates are the sole or main source of energy, such a depletion of glycogen reserves have also been observed in marine organisms, crustaceans under pollution stress. (Deshmukh, 1998; Kulkarni, 1983; Reddy et al, 1994). Protein forms one of the major fuels in marine gastropods. The observed increases in protein of the tissues of experimental animal also suggest that mobilization of protein which might have released in to the blood of gastropod during chronic exposure period. The presence of metallothionine and other low molecular weight protein in the clams has been suggest as indication in involvement in uptake ,storage ,transport and elimination of metals. The elevated level of protein in tissues of the cadmium treated gastropod suggests stimulation and synthesis of metallothionine which might be utilized to remove cadmium content via excretion **(**Chandravathy, 1994). An elevated level of protein under copper stress has been reported in the bivalve(Kattikaran et al,1995).The lipid content depleted in the tissues of gastropod *Bursa tuberculata.*It has been shown that lipids are utilized as a metabolic substrate in fishes under the stress of cadmium. (Gill and Pant, 1983).Furthermore lipid in mollusks acts as a external source of energy similar to that of other animals. The depletion in the lipid content in the tissues of gastropod may be due to utilization of stored lipid as metabolic structure under hyper metabolic state arises due to cadmium exposure. Significant elevation in lactic acid content was noticed in the tissue after 15 days cadmium treatment whereas after 30 days exposure it was found depleted. A general decreasing

trend of pyruvic acid content was observed in gastropod exposed to 15 and 30 days.

During environmental anoxia six end products of pyruvate metabolism have been identified in mollusks. Lactate is one of the six end products of anaerobic pyruvate metabolism in marine organisms. Furthermore, during environmental anoxia, marine bivalve accumulate a varieties of organic acids in addition to small amount of Co_2, opines and lactate (Katticaran, 1995; Goddard, 1966). Therefore observed changes in lactic acid and pyruvic acid content in tissues of gastropod suggest disturbed carbohydrate metabolism.

Conclusion

The contamination of heavy metals is serious threats because of their toxicity, long persistence, bioaccumulation and biomagnifications in the food chain. Sub lethal concentration of cadmium does not kill the gastropods instantly but affect their overall metabolism thereby reducing their chances to leave healthy life.

Table No. 1.1: Glycogen (mg/gm wet wt.) in tissues of *Bursa tuberculata* exposed to cadmium

Exposure Period (Days)	Control	Cadmium concentration (µg/l)	
		50	100
15	5.23 ± 1.23	6.33 ± 1.24	6.64 ± 0.53
30	7.10 ± 0.37	5.52 ± 0.34	56.73 ± 10.25

Table No. 1.2: Protein (µg/gm wet wt.) in tissues of *Bursa tuberculata* exposed to cadmium

Exposure Period (Days)	Control	Cadmium concentration (µg/l)	
		50	100
15	12.40 ± 1.43	9.83 ± 1.64	11.07 ± 0.69
30	9.16 ± 1.24	14.34 ± 1.67	13.73 ± 0.92

Table No. 1.3: Lipid (µg/gm wet wt.) in tissues of *Bursa tuberculata* exposed to cadmium

Exposure Period (Days)	Control	Cadmium concentration (µg/l)	
		50	100
15	30.65 ± 2.51	22.32 ± 1.52	22.35 ± 1.53
30	27.23 ± 5.30	21.53 ± 1.35	17.53 ± 4.39

Table No. 1.4: Lactic acid (µg/gm wet wt.) in tissues of *Bursa tuberculata* exposed to cadmium.

Exposure Period (Days)	Control	Cadmium concentration (µg/l)	
		50	100
15	27.75 ± 8.65	29.40 ± 0.01	42.03 ± 6.63
30	29.52 ± 5.31	26.21 ± 0.42	22.70 ± 4.47

Table No. 1.5: Pyruvic acid (µg/gm wet wt.) in tissues of *Bursa tuberculata* exposed to cadmium

Exposure Period (Days)	Control	Cadmium concentration (µg/l)	
		50	100
15	39.20 ± 3.30	29.60 ± 4.29	24.40 ± 6.14
30	37.80 ± 5.34	20.80 ± 2.68	18.40 ± 3.28

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