Effect of textile effluent on some enzyme activities in different tissues of freshwater crab *Paratelphusa jacquemontii*

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Abstract:
Wastewater from industrial processes is concerned with problem of pollution especially of water. Disposal of effluent into water bodies is associated with damage to aquatic ecosystem. Aquatic biota is getting hampered due to load of pollutants which needs to be studied. Freshwater crabs are one of the ecologically important species which and are exposed to variety of organic and in organic pollutants coming in their contact. Textile wastewater was used in present investigation to assess its impact on enzymological characteristics in fresh water crab *Paratelphusa jacquemontii*. Crabs were exposed to sub lethal concentrations for 15 and 30 days. Enzymes such as Acid Phosphatase (ACP), Alkaline Phosphatase (ALP), Glutamate Oxaloacetate Transaminase (GOT), Glutamate Pyruvate Trans aminase (GPT) and Adenosine Tri-phosphatase (ATPase) showed marked alteration in enzyme composition as compared to control. Significant increase was observed in phosphatases and decrease in ATPase was observed as compared to control. Present study gives details of these enzyme alterations in exposed group of animals.

Key words : Textile effluent, freshwater crab, enzymes, *Paratelphusa jacquemontii.*

Introduction :

Surface water resources are most vulnerable to industrial pollution due to direct discharge of effluent in them. Various point and non point sources of pollution are putting constant pressure on these water sources and on aquatic ecosystem in broader way. Wastewater from domestic as well as municipal services are cause of deteriorated quality of fresh water reservoirs. Undesirable odour, specific color and objectionable taste to water are becoming common in case of aquatic bodies. Rivers and impoundments are getting contaminated with waste water from various processes. No treatment or inadequate treatment on wastewater is cause of water pollution.

Textile industries are oldest industries in India. These industries are classified in three categories viz. cotton, woolen and synthetic. On the basis of waste generation from a textile industry depends on the processing operation employed during the conversion of fiber to fabric. Wastewater from textile industries is serious issue world over as it contains variety of components. It is a mixture of organic and inorganic matters some of them are very hazardous to living organisms especially dies and surfactants. Water generated through textile processing may possess characteristic such as dark colour, fluctuating pH and higher temperature.

The presence of dyes in water course can also cause many waterborne diseases like nausea, hemorrhage, ulceration of skin and mucous membrane, dermatitis, perforation of nasal septum and severe irritation of the respiratory tract. Dark colour dyes block sunlight from entering the water, thus inhibiting photosynthesis and killing aquatic flora and fauna. Also the suitable animal from the water body is to be selected and the bioassays will be carried out to understand toxic effect of the effluent. Textile effluents can seep into the aquifer and pollute the underground water or where it is discharged without proper treatment into water body. The pollutants can not be confined within specific boundaries. They can therefore affect aquatic life in enormous ways. Colour is the first contaminant to be recognized in this wastewater. A very small amount of dye in water (10-50mg/l) is highly visible and reduces light penetration in water system, thus causing a negative effect on the photosynthesis. Enzymes are indicators of stress due to impaired metabolism. As among the vertebrates a large number of enzymes are involved in the regulation of metabolism of invertebrates including crustaceans. Toxicity studies of this waste are gaining importance as it has hazardous effects on aquatic biota. Present study was an attempt to study response of antioxidant enzymes in freshwater crab, *Paratelphusa jacquemontii* as a toxicity marker.

Material and methods :

The fresh water crabs were collected from local fish market and brought to laboratory through plastic containers. Healthy crabs of identical size and weight were selected for acute toxicity assay. Animals were acclimatized

for eight to ten days at laboratory condition. Normal photo period was maintained throughout the experiment period. Textile wastewater was collected in sufficient quantity from textile industry. Range finding test was carried out by exposing animals to different wide range of concentrations. Static bioassay was carried out to determine LC_{50} value for 96 hrs by exposing crabs to different concentrations diluted with tap water. Chronic toxicity bioassay was carried out by exposing crabs to 1/ 10^{th} dosages of LC_{50}. Animals were exposed to this concentration for 30 days. Simultaneously control set of animals was maintained. After completion of exposure period of 15 days animals were sacrificed and various tissues were excised to carry out enzyme studies. Other group of animals was sacrificed on 30^{th} day and similar estimations were carried out using standard methods. ACP and ALP were estimated using method adopted by Butterworth and Probert (1970) while Reitman and Frankel (1957) method was used to check GOT and GPT activities in the tissues. ATPase was analysed by with method given by Du Boise and Potter (1943) method.

Results and discussions :

Textile wastewater of 20% concentration was found to be LC_0 while of 60% as LC_{50} for freshwater crab, *Paratelphusa jacquemontii*. Enzyme constituents viz. ACP, ALP, GOT, GPT and ATPase activities of animals exposed to sub lethal concentration i.e. 2% and 6% textile waste for 15 and 30 days were estimated. In the present investigation a significant fluctuations in the enzyme contents in all the tissues was observed due to exposure to textile wastewater.

Sr. no.	Tissue	Control 15 d	2% for 15 d	6% for 15 d	Control 30 d	2% for 30 d	6% for 30 d
1	Hepatopancreas	6.53 ± 0.51	5.12 ± 0.43	1.92 ± 0.38	5.9 ± 0.40	6.41 ± 0.61	3.12 ± 0.42
2	Ovary	5.72 ± 0.55	1.12 ± 0.41	0.17 ± 0.06	5.3 ± 0.40	1.7 ± 0.57	0.7 ± 0.26
3	Muscles	0.65 ± 0.21	0.71 ± 0.35	2.21 ± 0.41	0.82 ± 0.23	0.78 ± 0.29	1.6 ± 0.32
4	Testis	4.9 ± 0.20	1.3 ± 0.31	0.39 ± 0.40	4.75 ± 0.23	1.42 ± 036	0.50 ± 0.19
5	Gills	3.20 ± 0.04	3.78 ± 0.05	4.12 ± 0.09	3.32 ± 0.41	4.32 ± 0.38	4.51 ± 0.20

Table 1. ACP activity in freshwater crab, *Paratelphusa jacquemontii* exposed to different concentrations for 15 days and 30 days period, Enzyme activity is expressed in mg/gm of the tissue protein

Sr. no.	Tissue	Control 15 d	2% for 15 d	6% for 15d	Control 30 d	2% for 30 d	6% for 30 d
1	Hepatopancreas	0.76 ± 0.39	0.73 ± 0.27	0.89 ± 0.31	0.72 ± 0.34	0.75 ± 0.32	0.90 ± 0.26
2	Ovary	0.63 ± 0.37	0.31 ± 0.20	0.97 ± 0.26	0.62 ± 0.25	0.32 ± 0.30	0.85 ± 0.27
3	Muscles	0.26 ± 0.09	0.35 ± 0.17	0.26 ± 0.20	0.27 ± 0.30	0.35 ± 0.25	0.33 ± 0.27
4	Testis	0.67 ± 0.05	0.37 ± 0.09	0.82 ± 0.14	0.73 ± 0.05	0.47 ± 0.04	0.88 ± 0.36
5	Gills	1.40 ± 0.05	2.98 ± 0.06	4.02 ± 0.07	1.47 ± 0.30	2.89 ± 0.26	4.12 ± 0.18

Table 2. ALP activity in freshwater crab, *Paratelphusa jacquemontii* exposed to different concentrations for 15 days and 30 days period, Enzyme activity is expressed in mg/gm of the tissue protein

Sr. no.	Tissue	Control 15 d	2% for 15 d	6% for 15 d	Control 30 d	2% for 30 d	6% for 30 d
1	Hepatopancreas	0.15 ± 0.0012	0.054 ± 0.0025	0.058 ± 0.0015	0.14 ± 0.002	0.063 ± 0.002	0.068 ± 0.001
2	Ovary	0.12 ± 0.0015	0.11 ± 002	0.10 ± 0.0022	0.13 ± 0.002	0.11 ± 0.003	0.10 ±0.003
3	Muscles	0.123 ± 0.0011	0.132 ± 0,0023	0.131 ± 0.0031	0.13 ± 0.002	0.13 ± 0.002	0.12 ± 0.002
4	Testis	0.13 ± 0.001	0.13 ± 0.002	0.10	0.13 ± 0.001	0.17 ± 0.003	0.18 ± 0.003
5	Gills	0.13 ± 0.001	0.13 ± 0.002	0.135 ± 0.003	0.14 ± 0.003	0.05 ± 0.002	0.07 ± 0.003

Table 3. GOT activity in freshwater crab, *Paratelphusa jacquemontii* exposed to different concentrations for 15 days and 30 days period, Enzyme activity is expressed in mg/gm of the tissue protein

Table 3. GOT activity in freshwater crab, *Paratelphusa jacquemontii* exposed to different concentrations for 15 days and 30 days period, Enzyme activity is expressed in mg/gm of the tissue protein

Sr. no.	Tissue	Control 15 d	2% for 15 d	6% for 15d	Control 30 d	2% for 30 d	6% for 30 d
1	Hepatopancreas	0.074 ± 0.001	0.071 ± 0.001	0.062 ± 0.002	0.073 ± 0.001	0.050 ± 0.001	0.052 ± 0.002
2	Ovary	0.006 ± 0.001	0.09 ± 0.002	0.06 ± 0.002	0.070 ± 0.002	0.06 ± 0.002	0.068 ± 0.001
3	Muscles	0.11 ± 0.001	0.09 ± 0.002	0.084 ± 0.002	0.090 ± 0.001	0.080 ± 0.002	0.069 ± 0.002
4	Testis	0.073 ± 0.002	0.12 ± 0.001	0.075 ± 0.002	0.075 ± 0.002	0.13 ± 0.003	0.065 ± 0.001
5	Gills	0.013 ± 0.002	0.012 ± 0.002	0.014 ± 0.002	0.014 ± 0.002	0.011 ± 0.002	0.012 ± 0.003

Table 4. GPT activity in freshwater crab, *Paratelphusa jacquemontii* exposed to different concentrations for 15 days and 30 days period, Enzyme activity is expressed in mg/gm of the tissue protein

Sr. no.	Tissue	Control 15 d	2% for 15 d	6% for 15d	Control 30 d	2% for 30 d	6% for 30 d
1	Hepatopancreas	1.91 ± 0.09	5.01 ± 0.21	3.49 ± 0.02	2.52 ± 0.08	3.46 ± 0.07	3.12 ± 0.06
2	Ovary	1.49 ± 0.07	5.01 ± 0.15	4.25 ± 0.06	2.10 ± 0.07	4.61 ± 0.07	4.01 ± 0.08
3	Muscles	1.69 ± 0.05	6.70 ± 6.07	4.95 ± 0.08	2.31 ± .080	5.35 ± 0.08	5.76 ± 0.03
4	Testis	1.34 ± 0.05	6.74 ± 0.06	5.12 ± 0.08	2.12 ± 0.01	4.42 ± 0.023	4.12 ± 0.05
5	Gills	1.76 ± 0.05	2.12 ± 0.06	1.76 ± 0.08	2.70 ± 0.08	1.90 ± 0.74	1.08 ± 0.07

Table 5. ATPase activity in freshwater crab, *Paratelphusa jacquemontii* exposed to different concentrations for 15 days and 30 days period, Enzyme activity is expressed in mg/gm of the tissue protein

This increase may be attributed to increased autolysis in tissues due to cytotoxicity. It indicates environmental stress on biological system (Verma *et al*., 1984, Murti and Shukla, 1984). The regulation of metabolic processes in the body of the crab is controlled by the hepatopancreas and thus any changes occurring in the hepatopancreatic tissue is a reflection of cellular damage to the animals.

Phosphatases are linked with growth as related with carbohydrate metabolism in organisms. Acid phosphatase is lysosomal enzyme has important role to play in autolytic degradation of the tissue and dissociation of dead cells. Gupta and Rao, (1974) have reported that Alkaline phosphatase is brush border enzyme and splits various phosphorous esters at alkaline pH mediates membrane transport and is involved in glycogen synthesis.

Pesticide exposure in fresh water fish, Murrel has caused decrease in ALP activity in a study carried out by Saxena and Saxena (1996). Similar increase in ACP and ALP activities are reported by Thaker and Haritos (1989) while studying effect of Cd in freshwater fishes and prawn. These enzymes are important in protein metabolism by affecting Keto glutarate, pyruvate and Oxaloacetate.

GOT and GPT are the key enzymes of nitrogen metabolism and are important in energy mobilization. GOT is very active and widely distributed of the transaminases. GPT is much more abundant in tissue like hepatopancreas than any other tissues and consequently an altered activity of this enzyme points to some disorder in those tissues. The rise observed in the GOT, GPT activities might be attributed to a compensatory mechanism attempting to provide energy to drive an impaired metabolism. Present investigation shows that textile wastewater produces rise in GOT activity in animals exposed to both 15 and 30 days. GOT serves as precursor in synthesis of essential organic constituents and this increase is found to be in agreement with study carried by Venkatramana and Radhakrishnan (1987) to asses metal stress in *Pila globosa*. Adham (2002)

reported increase in this enzyme in fresh water fish from polluted water indicating cellular damage.

GPT is much more abundant in tissue like hepatopancreas than any other tissues and consequently an altered activity of this enzyme points to some disorder in those tissues. GPT and ATPase activities in the crab, *Paratelphusa jacquemontii* exposed to 2 % and 6 % showed an insignificant decrease as compared to control. Adenosine triphosphatases (ATPases) which are involved in osmoregulation and intracellular function e.g. the 'sodium pump' are very sensitive indicators of DDT and trace metal toxicity (Doherty and Matsumura, 1975). Adenosine triphosphatase (ATPase) is a mitochondrial enzyme and it carries out oxidative phosphorylation, i.e. it catalyses the hydrolysis of Adenosine triphosphate (ATP) to Adenosine diphosphate (ADP) and Phosphoric acid. This brings about the release of enormous energy. It is also involved in osmoregulation. The bulk of cellular energy in normal cell is derived from ATP. In the present study slight decrease in ATPase activity was observed in all tissues for both the exposure periods.

Conclusion :

In the present investigation stress exerted by exposure of crabs to textile effluent showed altered activity of enzymes. This indicates that there is significant influence of textile waste on crab as an important species of aquatic ecosystem. The foregoing discussion suggests that the exposure of the crab, two sub lethal concentrations as 2% and 6% lead to altered metabolism clearly shown by enzyme studies. This study gives scope to study histological and biochemical assessment of textile wastewater on organism under study.

Acknowledgement :

Authors are grateful to management committee of textile industry for their co operation during sample collection and also to all those who helped to accomplish this work successfully.

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