Proc. Indian Acad. Sci. (Anim. Sci.), Vol. 91, Number 5, September 1982, pp. 427–431.

The tannery industrial effluent effect on succinate dehydrogenase activity pattern in a freshwater snail, *Pila globosa*

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MS received 19 January 1982 ; revised 24 July 1982

Abstract. A high degree of pollution by tannery effluent contamination has been recorded in an irrigation reservoir in North Arcot district, Tamil Nadu. Seepage of contaminants into drinking water wells has also been observed. The tannery effluent is found to inflict changes in succinate dehydrogenase activity levels in the hepatopancreas of *Pila globosa*, a common inhabitant of the polluted environment.

Keywords. *Pila globosa* ; tannery effluent ; chromium ; tannin ; succinate dehydrogenase.

1. Introduction

A major irrigation reservoir namely Chennasamudram reservoir of Chennasamudram village along with its hamlets and drinking water wells contaminated by tannery effluents were identified in Walajapet taluk, North Arcot District, Tamil Nadu. Physico-chemical analysis was carried out for a calendar year at the above work spot (Guruprasada Rao and Nanda Kumar 1981) which revealed that tannery effluents contain many toxic substances such as chromium compounds, tannins, sodium chloride, calcium chloride and other compounds in considerable quantities which adversely affect the biological systems thereby posing a threat to the ecosystem (Eye and Lawrence 1971). Hence an attempt is made in the present investigation to study the effect of untreated tannery effluent (TE) at different concentrations and also its toxic ingredients like chromium (VI), sodium chloride and other compounds on succinate dehydrogenase (SDH) activity pattern of a freshwater snail, *Pila globosa*, a common inhabitant of the polluted area which shows low resistance to polluted freshwater environment and is also found to be sensitive to chromium (Guruprasada Rao and Nanda Kumar 1982).

2. Materials and methods

Pila globosa were collected from uncontaminated water resources. They were acclimated to the laboratory conditions for eight days and maintained as reported

earlier (Muralimohan and Sasirababu 1976). The animals were exposed to the media reported earlier (Guruprasada Rao and Nanda Kumar 1982). The ratio of one animal in 500 ml of medium was maintained throughout the exposure period in a glass jar. The media employed consisted of different percentages of TE, and also media containing different concentrations of potassium chromate, sodium chloride, calcium chloride, and tannin (Wattle extract spray dried) prepared in freshwater as they form the main ingredients of TE. The animals were exposed to the above media at selected concentrations and for different periods separately as mentioned in table 1. After the exposure period, they were removed and the hepatopancreas were isolated on ice blocks and immediately transferred to the refrigerator maintaining an ambient temperature of 0° C. The tissue was used for assaying SDH activity. The concentration of the media chosen to expose the animals were either found in the effluent or in the reservoir water under natural conditions. These identifying concentrations chosen are indicated in table 1. Higher concentrations were also chosen to magnify the extent of implication on the enzyme chosen.

Hepatopancreas were homogenised in ice cold 0·25 M sucrose solution, centrifuged at 2,500 rpm and the supernatant used as enzyme source. Enzyme assay : SDH was assayed by the method of Nachlas *et al* (1960) while employing INT as electron acceptor and extracting formazan in toluene layers (Nanda Kumar *et al* 1973).

3. Results and discussion

The succinate dehydrogenase activity (SDH) showed an enhancement when the snails were exposed to TE for 3 and 24 hr. Whereas SDH activity showed a significant decrease when exposed for 10 days. Hence alteration in the enzyme activity level in animals exposed for short periods in the effluent contaminated environment cannot be taken as an index. The change in the enzyme activity level is an overall expression of combined action of all ingredients of TE. However a detailed study was done on the effect of various ingredients of tannery effluent separately on the SDH activity in snails. The effect of potassium chromate, tannin, sodium chloride and calcium chloride separately were studied on SDH activity. Potassium chromate at 3 hr enhanced the SDH activity (table 1) at various concentrations (1–100 ppm). The SDH activity level showed no increase at all concentrations chosen (table 1) at 3 hr period and also at 2·5 ppm level after 10 day period. However the decrease at 24 hr was not significant. Stimulation of dehydrogenase systems in rats (Horecker *et al* 1939), oxidation of NADH to generate NAD by potassium chromate (Gruber and Jennette 1978) and enhanced oxygen consumption (Ergeshev 1974 ; Sheer and Armitage 1973) with subsequent oxidation of citric acid metabolites may be cited for the observed increase in SDH activity.

Tannin was also found to enhance SDH activity (at 3 hr) with a subsequent depressing effect (24 hr and 10 days). Earlier reports of Luciani (1973) on SDH inhibition by tannic acid support the present investigation. Corroborative evidences of the inhibitory action of tannic acid on succinate transportation into rat liver mitochondria (Johnson 1972) in isolated erythrocytes (Mitzavilla *et al* 1977) also strengthen this observation.

Table 1. Succinate dehydrogenase activity levels in the hepatopancreas of *Pila globosa* exposed to different media (% change in enzyme activity is calculated from μ moles formazan formed/mg protein/hr).

Medium (1)	Concentration* (2)	Exposure time (3)	Per cent change in SDH activity level (4)
Tannery effluent	10%	3 hr	+ 9·86±3·45 N.S.
do.	10%	24 hr	+17·69±1·52 $P < 0·05$
do	10%	10 days	—16·43±1·72 $P < 0·005$
Potassium chromate	1 ppm	3 hr	+20·71±2·4 $P < 0·05$
do.	10 ppm	3 hr	+25·28±3·1 $P < 0·05$
do.	50 ppm	3 hr	+27·89±2·2 $P < 0·001$
do.	100 ppm	3 hr	+28·67±2·4 $P < 0·05$
do.	25 ppm	24 hr	—15·98±4·3 N.S.
do.	2·5 ppm	10 days	+20·72±1·15 $P < 0·05$
Tannin (Wattle extract spray dried)	100 ppm	3 hr	+30·76±3·0 $P < 0·05$
Tannin	100 ppm	24 hr	— 5·30±0·48 $P < 0·05$
do.	20 ppm	10 days	—19·76±2·34 $P < 0·05$
Sodium chloride	5000 ppm	3 hr	+ 9·42±4·2 N.S.
do.	5000 ppm	24 hr	+ 8·76±1·17 $P < 0·05$
do.	1000 ppm	10 days	—31·16±3·67 $P < 0·05$
Calcium chloride	1000 ppm	3 hr	+ 2·55±1·5 N.S.
do.	1000 ppm	24 hr	+ 1·28±1·1 N.S.
do.	500 ppm	10 days	+13·99±1·61 $P < 0·05$

+ or — indicate % increase or decrease in enzyme activity over control respectively. Control activity is normalised to 100% = 0·0527 ± 0·001 μ moles of Formazan formed/mg protein/hr.

± S.D. from mean of six observations.

N.S. Not significant at the level of 5%.

* Concentrations comparable to effluent/irrigation reservoir water (Guruprasada Rao and Nanda Kumar 1981).

Sodium chloride enhanced the SDH activity at 3 and 24 hr whereas at 10 day the SDH activity showed a decrease. Variations in the salinity of the environmental medium are known to exert considerable influence on the activity behaviour and metabolism of invertebrates (Gilles *et al* 1971; Negus 1968). Sodium chloride was found inhibitory to TCA cycle (Korff *et al* 1954) and to SDH *in vitro* (Gilles *et al* 1971). The decrease in the SDH activity in *Pila globosa* at 10 day exposure observed in the present investigation might be due to the accumulation of chloride ion in the medium. Corroborative evidence comes from the works of Venkata Reddy (1976) who demonstrated a decrease in hepatopancreas SDH activity in crab under sodium chloride stress.

Enhancement in the SDH activity was observed in *Pila globosa* exposed to calcium chloride (table 1). At present experimental evidence is lacking on the calcium chloride stimulation of SDH system. However it is suggested that the triggering of glycolytic pathway, activation of ATP hydrolysis and increase in glucose amounts (Hochachka and Somero 1973 ; Meenakshi 1956) might be responsible for generation of raw material required for oxidative metabolism (Adams and Quastel 1956: Fruton and Simmonds 1965) and the possible increase in SDH system.

Acknowledgements

We thank Prof. R Ramamurthi for providing facilities and CSIR, New Delhi, for financial support to one of the authors (MGPR).

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