

**SUBLETHAL EFFECTS OF INDUSTRIAL EFFLUENTS ON THE  
BIOCHEMICAL CONSTITUENTS OF THE HAEMOLYMPH IN  
THE LARVA OF *MACROMIA CINGULATA* RAMBUR  
(ANISOPTERA: CORDULIIDAE)**

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The total proteins, free amino acids and free sugars of the haemolymph decreased significantly after exposure to various sublethal concentrations of tannery and paper and pulp mill effluents. The fall in the biochemical constituents of the haemolymph in the experimental animals was dose dependent. The sugars could be used as an instant energy source in the treated larvae while the proteins might be utilized during chronic stress conditions. The paper and pulp mill effluent was found to be more toxic to the larvae than the tannery effluent, as indicated by higher utilization of haemolymph free amino acids in the paper and pulp mill effluent treated individuals.

**INTRODUCTION**

Rapid population growth, increasing living standards and industrialization have resulted in a steady increase of water pollution. The industries discharge large quantities of highly objectionable wastes into water bodies, posing a serious threat to aquatic organisms. There is an increasing body of literature on the effect of different toxicants on the biochemistry of various organisms (e.g. MANSOUR et al., 1980; BANO, 1982; GOEL & SHARMA, 1987). SURRENDER REDDY & PURUSHOTHAM RAO (1982) & CHOCKALINGAM et al. (1988) have made biochemical studies on cockroaches and dragonfly larvae with reference to pesticides and dairy effluent respectively. However, information on the biochemical variations in the haemolymph of larval dragonflies due to industrial effluents is scarce. Therefore the present work was carried out on *Macromia cingulata* to observe changes, if any, in the biochemical constituents of the haemolymph, after exposure to tannery and paper and pulp mill effluents.

## MATERIAL AND METHODS

The dragonfly larvae were collected from a local pond. The tannery effluent from Kattuvaikkal, Erode and the paper and pulp mill effluent from TNPL, Pugalur, Tamilnadu, were used in the present study. Static bioassays were made with the laboratory acclimatised intermoult stage larvae. They were of unknown instar, having a body length of 15 mm and a head width of 4 mm. The LC 50/96 hr value for both the effluents was found to be 50%. A series of sublethal concentrations of the effluents (5, 10, 15, 20 and 25%) in tap water were selected. Five larvae of the same size were introduced into each experimental solution and control water (0%) contained in glass troughs. The insects were separated from each other in the container by compartmental wire mesh to prevent cannibalism. Appropriate test solutions were replaced daily and aerated constantly. The animals were fed with mosquito larvae throughout the experimental period, which lasted for 15 days.

Collection of haemolymph and estimations of total proteins, free amino acids and free sugars of the haemolymph were made according to VARADARAJ (1978). The results were tabulated and analysed statistically.

## RESULTS

The concentrations of total haemolymph proteins, free amino acids and free sugars in the larvae of *M. cingulata* after exposure to sublethal concentrations of tannery and paper and pulp mill effluents are shown in Tables I and II respectively. It is evident that the decrease in the biochemical constituents of the haemolymph increases with increasing concentrations of the effluents (Fig. 1). After exposure to 25% concentrations of tannery effluent for 15 days, proteins, amino acids and sugars all showed a reduction of about 20%; this also applied to proteins and sugars in larvae exposed in the same way to paper and pulp mill effluent. However, in the latter group, the corresponding reduction in amino acids was 60%.

Table I

The concentrations of total haemolymph proteins, free amino acids and free sugars in the larvae of *M. cingulata* exposed to different sublethal concentrations of tannery effluent for 15 days. — [Each value is mean  $\pm$  S.D. of 7 individual observations]

Concentration	Total proteins (mg/100 ml)	Total free amino acids (mg/100 ml)	Total free sugars (mg/100 ml)
0%	127.30 $\pm$ 3.90	381.10 $\pm$ 6.09	420.70 $\pm$ 9.21
5%	126.19 $\pm$ 3.82	379.12 $\pm$ 5.80	408.33 $\pm$ 9.40
10%	120.73 $\pm$ 3.73	347.74 $\pm$ 5.91	395.96 $\pm$ 8.82
15%	114.11 $\pm$ 4.00	340.21 $\pm$ 5.05	371.21 $\pm$ 10.73
20%	107.23 $\pm$ 3.91	297.13 $\pm$ 6.88	360.83 $\pm$ 9.61
25%	100.30 $\pm$ 3.64	288.67 $\pm$ 5.44	346.27 $\pm$ 9.87

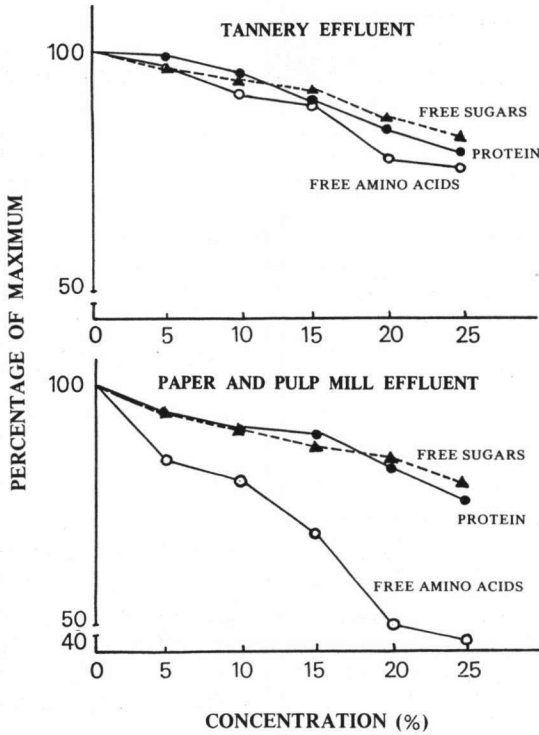


Fig. 1. Percent of maximum of biochemical constituents in the larvae of *Macromia cingulata* exposed to effluents.

## DISCUSSION

These results imply that sugars in the circulation could be used as an instant energy source during stress conditions caused by the effluents, as recorded by KULKARNI & UTKAR (1983) in a freshwater snail. Sugar has also been found to be the principal and immediate energy precursor for fishes exposed to stress conditions. However, GOEL & SHARMA (1987) have observed a significant fall in the total serum proteins in metal-treated fishes, and protein seems to be the energy source during chronic periods of stress (UMMINGER, 1970). NAGABHUSHANAM et al. (1983) have suggested that the

Table II

The concentrations of total haemolymph proteins, free amino acids and free sugars in the larvae of *M. cingulata* exposed to different sublethal concentrations of paper and pulp mill effluent for 15 days — [Each value is mean  $\pm$  SD of 7 individual observations]

Concentration	Total proteins (mg/100 ml)	Total free amino acids (mg/100 ml)	Total free sugars (mg/100 ml)
0%	127.30 $\pm$ 3.90	381.10 $\pm$ 6.09	420.70 $\pm$ 9.21
5%	120.32 $\pm$ 3.64	323.93 $\pm$ 5.80	398.33 $\pm$ 7.60
10%	115.34 $\pm$ 4.00	306.76 $\pm$ 5.13	383.60 $\pm$ 8.14
15%	114.70 $\pm$ 3.82	266.77 $\pm$ 6.43	371.21 $\pm$ 8.05
20%	106.71 $\pm$ 3.19	192.43 $\pm$ 5.92	358.83 $\pm$ 7.08
25%	98.32 $\pm$ 4.02	152.43 $\pm$ 6.88	334.09 $\pm$ 9.85

amino acids are degraded as a supplementary energy source under emergency. The higher utilization of the haemolymph free amino acids of paper and pulp mill effluent treated larvae envisages that this effluent could be more toxic to the present species than is the tannery effluent.

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