TOXICITY OF CARBOFURAN TO A BRACKISH WATER OLI GOCHAETE PONTODRILUS BERMUDENSIS. B EDDARD (1891).


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ABSTRACT
Carbamate (Carbofuran) is found toxic to brackish water Oligochaete Pontodrilus bermudensis at low salinity concentration. The pesticide is highly toxic in low salinity concentration (20% salinity is equal to 6.8‰). Behavioural and symptomatically changes in the worm are more pronounced in Carbofuran exposed worms. The results showed that the toxicity of the pesticide as synergistic at low concentrations of sea water.

KEYWORDS: Toxicity, Carbofuran, Brackish water, Oligochaete (Pontodrilus bermudensis).

INTRODUCTION
Promising urbanization due to the promotion of industrialization on river banks, bays and coasts amounted gifting the marine, estuarine and coastal environments with variety of xenobiotic substances such as hydrocarbons, heavy metals, radioactive compounds, pesticides, detergents and many other chemicals. Many of these substances due to their characteristic persistence accumulate in biological systems subsequently magnify in quantum in food chains.[12] The water in the Visakhapatnam harbour particularly in Southern Lighter Channel (SLC) remain brackish through most part of the year due to continuous influx of sewage containing domestic wastes, detergents, municipal and hospital discharges. In addition, the river Mehadri empties considerable quantum of fresh water containing agrochemicals like fertilizers, pesticides etc. into one of the harbour channels. Thus creating a completely stressful and a non cooperative environment too many of the inhabitants. The experimental organism, Pontodrilus bermudensis is a versatile animal. It has a distribution from subtropical to tropical regions of the world in brackish, estuarine and marine
In the present study, the toxicity of Carbofuran to brackish water oligochaete, *Pontodrilus bermudensis* are reported.

**MATERIALS AND METHODS**

*Pontodrilus bermudensis* occur in good number in the Visakhapatnam Harbour. The worm experiences heavy influx of fresh water during monsoon. The worm often is subjected to changes in salinity concentrations and with different xenobiotic substances. All bioassay experiments were conducted for 24, 48, 72 and 96hrs (short term) and 10days (long term) exposures at low salinity concentration (20% salinity is equal to 6.8‰). The results presented are the averages of a number of replicates (at least ten times). The LC$_{50}$ and sub lethal ($1/5$th of the LC50) concentration values were calculated by using unweighted regression method and the probit analysis. The observed and calculated percentage mortalities recorded at the end of 24, 48, 72, 96hrs and 10days in the low salinity conditions were tested independently for significance applying the chi-square test.

**RESULTS AND DISCUSSION**

The results are presented in Table-1. The difference between observed and calculated values were tested for significance using Chi-square test which showed that the difference was not significant at $P = 0.05$ level at concentrations of 13.54, 12.41, 12.07, 11.41 and 9.22 ppb respectively. Thus the sub lethal concentration was 2.708, 2.482, 2.414, 2.282 and 1.844ppb at 20% seawater media. The results indicate that the worms showed higher mortality rate even at lower concentrations of carbofuran. Higher mortality rate in low sea water media may be due to two reasons. The pesticides in low salinity medium of water diffuse into body easily through the body wall. As there is no food supply, naturally the animals will starve. The results revealed clearly that worms reacted differently to the different concentrations of insecticide (Table-1). Toxicity increased with increasing the concentrations of Carbofuran at different test periods 24, 48, 72 and 96hrs and 10days of exposure in low seawater media. The worms exposed to different concentration of Carbofuran (10 - 18ppb) showed significant behavioural and morphological changes. At higher concentrations swellings and blisters appeared on the body of the worms and worms looked weak. Either recovery of the worm or its death occurred after one or two days. Hyper activity, tremors and convolutions were noticed in Carbofuran exposed worms. During the time course the worms showed characteristic reddening, conspicuous swellings, prominent on clitellar regions and preclitellar regions of the body in Carbofuran exposed worms (Plate- 1).[17] reported that that the
Carbamate insecticides carbaryl and carbofuran are highly toxic to the earthworm *Lumbricus terrestris* producing characteristic sores and tumour like swellings. The test animal being soft skinned, quicker diffusion of the toxicant occurs followed later by neurotoxic effects since the quantity of toxicant in water medium may more readily enter through the body openings resulting reddening and swelling in the anterior segments in the worms within two days (Plate-1). Similar effects were reported in the case of *L. terrestris, Lumbricus rubellus, Eisenia fetida, Allolobophora caliginosa, Allolobophora chlorotica*, when exposed to a variety of organophosphate, organochlorine, and carbamate insecticides.\textsuperscript{1,9,3,17,4,15,2,16} Very few insecticides have been tested with earthworms in the laboratory and majority of the work was done in the field. The LC\textsubscript{50} value (375ppm, 30 days) of the earthworm *Pontoscolex corethrurus* to Sevin under soil exposure was found to be very high.\textsuperscript{[8]} The herbicide atrazine and insecticides carbaryl, aldicrab, carbofuran, few organophosphates\textsuperscript{10,20,17,2,16} affect the earthworm populations either by reducing immobility of worms or causing heavy mortality. The hyper activity of the individuals at lower pesticide contamination and the lethargy developed at higher concentrations in the survivors may great influence on the population’s dynamics of earthworms.\textsuperscript{[8,2]} Based on laboratory studies\textsuperscript{[11]} showed that the earthworms immersed in various concentrations of DDT in water could survive amounts of at least 1: 10,000. In the present study *P. bermudensis* showed that the toxicity increased with increasing the exposure period. This suggested that the toxicity is associated with accumulation of carbofuran in excess amounts that may be metabolised and prove injurious to the earthworms.

**Table 1: Toxicity of Carbofuran to brackish water Oligochaete Pontodrilus bermudensis Beddard at 20% seawater.**

<table>
<thead>
<tr>
<th>Duration of exposure</th>
<th>Temp.</th>
<th>% of mortality</th>
<th>LC\textsubscript{50} value (ppb)</th>
<th>95% Fiducially limits</th>
<th>1/5\textsuperscript{th} of LC\textsubscript{50} values (ppb)</th>
<th>95% Fiducially limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hrs</td>
<td>30±1°C</td>
<td>50</td>
<td>52.65</td>
<td>13.54</td>
<td>13.64 ± 0.033 (13.67 - 13.60)</td>
<td>2.708</td>
</tr>
<tr>
<td>48 hrs</td>
<td>30±1°C</td>
<td>50</td>
<td>54.45</td>
<td>12.41</td>
<td>11.85 ± 0.016 (11.86 - 11.83)</td>
<td>2.482</td>
</tr>
<tr>
<td>72 hrs</td>
<td>30±1°C</td>
<td>50</td>
<td>54.78</td>
<td>12.07</td>
<td>10.77 ± 0.014 (10.78 - 10.75)</td>
<td>2.414</td>
</tr>
<tr>
<td>96 hrs</td>
<td>30±1°C</td>
<td>50</td>
<td>55.85</td>
<td>11.41</td>
<td>9.79 ± 0.019 (9.80 - 9.77)</td>
<td>2.282</td>
</tr>
<tr>
<td>10days</td>
<td>30±1°C</td>
<td>50</td>
<td>57.56</td>
<td>09.22</td>
<td>6.57 ± 0.026 (6.59 - 5.54)</td>
<td>1.844</td>
</tr>
</tbody>
</table>
Fig-1: Relation between LC$_{50}$ & SLC values and period of exposure in *Pontodrilus bermudensis* Beddard (SLC = Sub Lethal Concentration \(1/5^{th}\) LC$_{50}$values).

Plate-1: Carbofuran exposed animals (Large swellings and blisters)

Also$^{[14]}$ found that the salinity dependent naphthalene toxicity increased in low and high salinities to speckled prawn *Metapenaeus monoceros*. Increased toxicity of Monocrotophos with increasing in salinities was reported in *Pontodrilus bermudensis*.$^{[16]}

Nagavalli (1994) found that the different salinities with PCP showed surprisingly a changed toxicity pattern i.e., the toxicity of PCP increased with increasing and decreasing salinities, above and below the optimum seawater media to *Pontodrilus bermudensis*. Endosulfan toxicity to a fouling bivalve, *Mytilopsis salli* also increased in 25 and 75% seawater media.$^{[7]}$

Further, it is also known that the water quality has proved to influence the pesticide toxicity by way of chemical breakdown, precipitation, hydrolysis etc.$^{[18]}$ Furthermore differential rates of uptake in different salinity media reflecting different rates of toxicity is by
degradation of pesticides by alkaline hydrolysis, which generally increase the LC$_{50}$ values of chemical.\textsuperscript{[6]} It may be presumed that an alteration in the physico-chemical properties of the insecticides may influence the apparent LC$_{50}$ values. A comparison of lethality’s obtained by\textsuperscript{[12]} for Dieldrin, Endrin, Chlordane, Endosulfan and DDT in water and sediment to \textit{Nereis virens} and \textit{Crango septemspinosa} indicate that low food chain level species like \textit{Nereis virens} as more tolerant. The experimental species \textit{Pontodrilus bermudensis} in the present study also occupies lower tropic level like \textit{Nereis urens}. The test species \textit{P. bermudensis} also occupies the same tropic level of \textit{N. virens}.

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**REFERENCES**


