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# LINDANE INDUCED RESPIRATORY CHANGES IN JUVENILES OF AN ESTUARINE FISH *THERAPON JARBUA*

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ABSTRACT

The Incipient LC50 of lindane for juveniles of *Therapon jarbua* was 0.057 ppm. The effects of a lethal concentration (Incipient LC50 = 1 toxic unit, TU) and two sublethal concentrations Viz. 0.1 TU (0.0057 ppm) and 0.25 TU (0.0143 ppm) of lindane were studied using flow through experiments. Lethal concentration induced hyperactivity and significant increase in oxygen uptake by the juveniles. Sublethal concentrations induced significant fall in rates of oxygen consumption; an indication of conservative approach by the juveniles for energy resources. Increase and decrease in oxygen uptake induced by lethal and sublethal concentrations respectively, were related to ATPase activity. During the tests starvation was found to be additive to sublethal stress of lindane and antagonistic to lethal stress.

**Key words:** Respiration, Lindane, lethal concentration, *Therapon jarbua*

Growth and reproduction of an organism depends upon its metabolic activity. The latter is proportional to the rate of oxygen consumption. Any deviation from normal rate of growth and reproduction due to toxic stress would be reflected in alterations in the rate of oxygen consumption. The latter is often taken as a measure of metabolic expenditure of an animal (Farmer and Beamish, 1969). Therefore studies on the effects of pesticides on respiratory activity acquire much importance (Mount, 1962; Waiwood and Johansen, 1974; Lingaraja, Selvakumar and Venugopalan, 1980 and Sasi Bhushana Rao and Venugopalan, 1984).

Juveniles of *Therapon jarbua*, of the same size group (1.4 to 1.8 cm long, 76.7 mg average weight) were collected from Vellar estuary (long 72° 49′ E; Lat 11° 29′ N) using a scoop net and acclimatised to laboratory conditions for four days, when they were fed with the juveniles of *Ambassis commersoni*. No reduction in growth and activity of fish was noticed. Mean salinity, temperature and pH of the ambient medium were 27.18‰, 26.4 °C and 7.25 respectively.

The flow through respiratory apparatus described earlier by Lingaraja, Selvakumar and Venugopalan, (1980) and Sasi Bhushana Rao and Venugopalan, (1984) was used in this study. Oxygen concentration in the water was estimated by Winkler's method.

Acetone was used to prepare stock solutions of lindane (Technical 99.5% supplied by M|s Pesticide India Ltd. Udaipur). Low concentrations of

acetone did not affect the test animals (Sasi Bhushana Rao, 1980). Half of the controls were studied to know the effect of acetone if any. The incipient lethal concentration (Incipient LC50), 0.057, of lindane for the juveniles of *T. jarbua* was considered as 1 toxic unit (TU). The effects of one lethal con centration (1 TU = 0.057 ppm), and two sublethal concentrations (0.1TU = 0.0057 and 0.25 TU = 0.0143 ppm) were studied. Oxygen consumption of the juveniles on immediate exposure and also after an exposure of 24h and 96h to the pesticide (for 3 periods) was measured.

To prevent from total starvation during the test period (4 days), the juveniles were fed rationally. Feeding was stopped 24h prior to the respiration measurements. Thus juveniles suffered from starvation for a period of 24h in tests of immediately after exposure, 48h of starvation in tests of 24h after exposure and only 24h in tests of 96 after exposure to lindane. In tht latter case feeding was possible between 24h and 72h.

After 3h of acclimatisation in the respiratory chamber, hourly measurements (four) were taken to determine the amount of oxygen consumed by the test organisms and the mean uptake was calculated. Four tests for each (controls and treatments) concentration were conducted. Test of analysis of variance was conducted on the data (Snedecor and Cochran, 1967).

During the 96h test period the incipient lethal concentration of 0.057 ppm, induced hyperactivity, which was not uncommon due to acute pesticide toxicity (Grant and Mehrle, 1970 and Venugopalan and Sasi Bhushana Rao,

**Table I.** Oxygen consumption by *Therapon jarbua* exposed to lindane (Results are mean ± S.E of four tests each in ml $O_2$ / g wet tissue/ h). Percentage increase (+) and decrease (—) are given in parantheses.

| Conc. in ppm | Immediately after Exposure (24h starvation) | 24h after Exposure (48h starvation) | 96h after Exposure (24h starvation) |
|---|---|---|---|
| 0 (Control) | 2.208 ± 0.0189 | 1.585 ± 0.0132 | 1.995 ± 0.015 |
| 0.1 TU (0.0057) | 2.015 ± 0.0226 ( 8.7) − | 1.313 ± 0.0125 (17.2) − | 1.978 ± 0.0118 (0.02) − |
| 0.25 TU (0.0143) | 1.79 ± 0.0129 (18.9) − | 1.275 ± 0.0096 (19.6) − | 1.79 ± 0.0141 (12.8) − |
| 1 TU (0.0570) | 3.758 ± 0.0469 (70.2) + | 2.063 ± 0.0165 (30.2) + | 3.213 ± 0.0179 (61.0) + |

1979). Table I indicates that 1 TU also induced a very high rate of oxygen uptake ($P < 0.01$) at all periods of observation. The percentage increase varied from 30 to 70.2. Such increase in oxygen uptake was also observed earlier by Mount, (1962); Waiwood and Johansen, (1974) Pandey, Chanchal, Singh, Prasad and Singh (1979) and Sasi Bhushana Rao and Venugopalan (1984). To cope up with the hyperactivity, the juveniles had to spend more energy (ATP) and hence consumed more oxygen. O'Brein (1967) suggested a possible increase in oxidative phosphorylative reactions and production of more ATP. Desaiah, Cutkomp, Koch and Jarvinen (1975) also observed activation of Oligomycin insensitive $Mg^{++}$ and $Na^{+}-K^{+}$ ATPase induced

by lethal concentrations of DDT. So the increase in Oxygen uptake observed in the present study could be due to stimulated ATPase activity to produce and utilise more energy to cope up with the increased demand which was again due to hyperactivity induced by lindane (Sasi Bhushana Rao and Venugopalan,. (1985).

Sublethal concentrations (0.1 TU = 0.0057 and 0.25 TU = 0.0143 ppm) depressed ($P < 0.01$) the rate of oxygen uptake. The percentage decrease ranged from 0.02 to 19.6. The decrease could be related to the inhibition of

**Table II.** Percentage decrease in rate of Oxygen consumption 24h after exposure (48h starvation) in *Therapon jarbua*.

| Conc. in ppm (lindane) | $O_2$ ml/g wet tissue/h Immediately after Exposure | 24h after Exposure | Percentage decrease |
|---|---|---|---|
| 0 (Control) | 2.208 | 1.585 | 28.22 |
| 0.1 TU (0.0057) | 2.015 | 1.313 | 34.84 |
| 0.25 TU (0.0143) | 1.79 | 1.275 | 28.77 |
| 1.0 TU (0.057) | 3.758 | 2.063 | 45.1 |

ATPase activity by sublethal toxicity of organochlorines (Desaiah, Cutkomp, Koch and Jarvinen, 1975 and Desaiah and Koch, 1975). It must be due to the reduction in metabolic activity, a conservative approach of the juveniles to resist sublethal toxicity.

After 24h of exposure (48h of starvation) to lindane, oxygen consumption in control as well as in treatments, decreased (Tables I & II), compared to the same in those of immediately after exposure (24h starvation). The percentage reduction in oxygen consumption was significant ($P < 0.05$) between observations made immediately and 24h after exposure. Such a fall in oxygen uptake (metabolic activity) might be due to 48h of starvation (24h more than the other sets of experiments). Inhibition of oxygen uptake due to starvation was also reported earlier (Beamish, 1964). Number in parantheses of Table I would suggest that starvation would become an additive factor to sublethal toxicity but antagonistic to lethal toxicity. Similar observations were made earlier by Sasi Bhushana Rao and Venugopalan, (1984) in juveniles of *Mugil cephalus*.

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