OXYGEN CONSUMPTION IN THE MARINE PORTUNID CRAB, OZIUS RUGULOSUS EXPOSED TO ORGANOPHOSPHATE (NUVAN) AND ORGANOCHLORIDE (DDT) PESTICIDES

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Abstract

Organophosphate (Nuvan) decreased the respiration of the crab, Ozius rugulosus over the controls after exposure to 4.169, 3.388, 1.862 and 1.122 ppm for 24, 48, 72 and 96 hours respectively. However, chronic treatment to 0.338 ppm increased the oxygen consumption up to 21 days and by 30th day it came to normal levels. 0.048 ppm of DDT brought about elevation in the oxygen consumption in 24 hrs. Later exposures to 0.030, 0.015 and 0.007 ppm for 48, 72 and 96 hours decreased the oxygen consumption. Chronic exposure to 0.003 ppm of DDT brought about similar results as that of Nuvan.

Changes in the respiratory activity have been used as the sensitive indicators of stress in animals exposed to pollutants (Anderson, 1971; Sharp et al., 1979). Various investigators used different types of pollutants such as insecticides (Waiwood and Johnsen, 1974), heavy metals (Saraivo, 1973) and hydrocarbons (Percy, 1977) and studied the respiratory rate of several crustaceans. Pawar and Katdare (1984) have reported the oxygen consumption of prawn Macrobrachium kistnensis after exposure to lethal and sublethal concentrations of fenitrothion, BHC and carbofuran. A survey of the literature revealed that no report has been made on the stress of the organophosphate (OP) and organochloride (OC) pesticides on the respiratory rate of marine portunid crabs. Hence in the present probe, Nuvan (OP) and DDT (OC) were used on the portunid crab, Ozius rugulosus and the stress on the rate of oxygen consumption was investigated.

The crabs, O. rugulosus were collected from Karla backwaters (Ratnagiri, west coast of India) and acclimatized to laboratory conditions for one week (temperature: 31 ± 1°C, salinity: 34% ± 1% pH: 6.2 and dissolved oxygen: 3.13 ml/L). Immature male and female O. rugulosus of intermoult stage having a carapace width of 5-5.5 cm were selected for the experiments. The crabs were not fed during the acute exposure period. The test medium was changed every 24 hours to maintain the pesticide concentration constant. However, the loss of concentration of pesticides during 24 hrs due to degradation, if any, was not estimated. The crabs were exposed to 4.169 (24 hrs LC50), 3.388 (48 hrs LC50), 1.862 (72 hrs LC50) and 1.122 ppm (96 hrs LC50) Nuvan (OP) and 0.048 (24 hrs LC50), 0.030 (48 hrs LC50), 0.015 (72 hrs LC50) and 0.007 ppm (96 hr LC50) DDT for 24, 48, 72 and 96 hrs. For chronic studies the concentration used was 1/10 of the LC50 value for 24 hrs. The oxygen consumption was
measured after 24, 48, 72 and 96 hrs for acute toxicity and 7, 15, 21 and 30 days for chronic studies. The oxygen consumption was measured by Winkler’s method as modified and described by Stirickland and Parsons (1968). The rate of respiratory metabolism is expressed in terms of ml/g/hr/litre.

When *O. rugulosus* were exposed to acute concentrations of Nuvan (OP) the oxygen consumption decreased over that of the controls and this trend continued throughout the acute exposure periods i.e. upto 96 hours. However, chronic exposure upto 15 days brought about a different picture. The oxygen consumption increased significantly over that of the controls. By 21st day the respiratory rate was stabilized and by 30th day it came almost to the normal level (Figs. 1 and 2). With the organochloride pesticide DDT, the picture was a little different. At 24 hour exposure, the oxygen consumption raised over that of the controls, which was significant. The 48 and 72 hour exposure, brought about a decline in oxygen consumption rate. On the other hand, chronic exposure to DDT gave similar results to those of Nuvan i.e. increase in the respiratory rate upto 21 days and then reaching almost to the normal respiratory rate by 30th day (Figs. 1 and 2).

In the present study, it was observed that the rate of oxygen consumption of the crab, *O. rugulosus* increased for 24 hrs of organochloride (DDT) exposure. This initial increase in respiratory rate may therefore exhibit a new steady state of metabolism to compensate physiologically with the stress of organochloride pesticides. According to Rice *et al.* (1977) a part of the increased oxygen consumed is required to support the enhanced physiological activities in metabolising and eliminating pollutants by the exposed animals. Such a possibility might exist in *O. rugulosus* also. Some workers have observed that the rate of oxygen consumption of animals is dependent on the concentration of pollutants.

The rate of oxygen consumption of *O. rugulosus* decreased after the initial increase when the exposure period to organochloride increased. This decrease may be because of the failure of crabs to compensate for the new steady state of metabolism due to stress of
organochloride as the exposure periods increased continuously.

It is known that OP and OC pesticides are inhibitors of cholinesterase (Ware, 1975). Thus the OP and OC possibly inhibit certain enzymatic pathways in crab, _O. rugulosus_ which may result in the decrease of the oxygen consumption of the crab. However, this cannot be the sole reason of overall decrease of oxygen consumption of the crab, though such a possibility cannot be entirely ruled out.

The decrease in the oxygen consumption in OP and OC exposed _O. rugulosus_ may be due to the changes in the gill structure. Lloyd, (1960) has suggested that it is the cellular damage of gills that causes the respiratory distress.

The pesticides may impair the blood transport efficiency of animals which could result in the changes in respiration of animals. The pollutants at higher concentrations might interfere with the respiratory process of the organisms by decreasing blood pigment transport efficiency. Koundinya and Ramamurthy (1979) have observed a significant decrease in the haemoglobin content of the fish, _Tilapia mossambica_ when exposed to sumithion pesticides. However, whether similar changes occur in the haematological status of _O. rugulosus_ due to OP and OC exposure is yet to be understood.

**References**
