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Toxicological Study on Freshwater Fish Saccobranchus Fossilis Exposed to Pesticides - Naled and Isolane

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ABSTRACT

To determine the specific toxic effect, the work has been conducted to calculate the toxic effect of two pesticides i.e. Naled and Isolane, as to work out the LC_{50} and to measure the toxicity for 24, 48, 72 and 96 hr. using the Fish Saccobranchus Fossilis. The safe concentrations, Heterogeneity factors, Fiducial limits (95%), Regression equations and slope functions, were also worked out for each time interval.

Keywords-- Naled, Isolane, Saccobranchus Fossilis

I. INTRODUCTION

Sustainable use of pesticides in farming has hazardous repercussions on land as well as the aquatic environment. Agricultural run-off near water bodies is the major cause of deposition of pesticides in aquatic ecosystem. These toxicants find their way into water bodies like the lakes, rivers and oceans (Adelman *et al*, 1976). However, the data regarding the effect of these pesticides, chemicals are scanty (Goodnight, 1942; Jones, 1951; Trama, 1953; Van Dijk *et al*, 1977; Dalela *et al*, 1979a). These investigations are undertaken to measure the effect of pesticides (Naled and Isolane) for a test fish Saccobranchus Fossilis.

II. MATERIALS & METHODS

Fresh water resources like lakes and rivers were reached out to collect the fish Saccobranchus Fossilis, which was healthy and fit for the experiment. It is seen that this particular fish has long survival capacity under laboratory conditions and hence this fish was chosen for the expeiment. Saccobranchus Fossilis of size range 9 to 11 cm. in length and 47 to 57 gms in weight. Before using them in bioassay, they were washed with 0.0mg/ $1KMnO_4$ solution (a disinfectant) for about 20 minutes to avoid any possibility of external infection. They were then acclimated to laboratory conditions for a period of 5 days in 100 lit. capacity glass aquaria. As per recommendations of Florin and Muller (1970) for the maintenance of bioassay fish, every effort was made to provide the suitable conditions for the fish. During acclamation, the fish were provided with 'fish food' as to avoid any malnutritional effect.

The water used as diluent was tap water supplied by the overhead tank and was analyzed for different physico-chemical characteristics as per standard methods APHA *et al*, (1980). The water indicated the following physico-chemical characteristics: Dissolved oxygen between 7.2 and 7.4 mg/l; pH7.4, total solids between 12.6 and 22.8 mg/l, hardness between 38 and 48 mg/l, biochemical oxygen demand 2.4 mg/l and sulphate 7.4 mg/l. The pesticide selected for the evaluation of the toxicity are:

(1) Naled or Dibrom (organophosphate)

($C_2H_7Br_2Cl_2P$) is 1, 2-dibromo-2, 2, dichloro ethyl di-methyl phosphate (organophosphate).

(2) Isolane (carbamate)

1-isopropyl-3-methyl-5-pyrazolyl dimethylean bamate or 1-isopropyl-3 methylpyrozolyl- (5) N, N-dimethyl carbamate.

95% alcohol and acetone that have little effect on lab results were used as the solvents. The same amount of solvent was also used in control experiment. Different experimental concentrations were prepared by using the dilution techniques as indicated in standard Methods (APHA *et al*, 1980).

Groups of 10 fishes were made. Small hand net was used for taking the Fish, from the acclimation tank into the test containers, which were of the capacity of 10

litres, containing different concentrations of pesticide. This was done to ensure that no mechanical injury is done to the test fish. Fish was not feeded during experiment. The reason being that the production of excretory substances might influence the toxicity of test solutions. During the experiment the physical behaviour of the fish was observed and considered dead when they gave no response while probing with glass rod. The dead fish was removed immediately because such mortality in static bioassays may deplete the DO, affecting tolerance limits *(Schreck and Brouda, 1975).*

LC_{50} was obtained by the interpolation of concerntrations on the logarithmic scale and mortality percentage on arithmetic scale of the semi-log paper and reading directly the concentrations where the 50% mortality line crosses the logarithmic axis *(Doudoroff et al., 1951).* The acute toxic ranges were determined on the lines given by the Sprague (1969). The regression equations for mortality number (Y) and concentrations (X) were processed by a standard regression formula (Snedecor, 1961). Fiducial limits (95%) and heterogeneity factor (X^2) were calculated on the lines of Finney (1952), while slope function (S) was calculated as per methods given by *Litchfield and Wilcoxan (1949).* Further, the safe concentrations were computed by using the formula of *Hart et al (1945)* and application factor (0.05) as suggested by *Warner (1967)*

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Table 1: Acute toxicity range LC_{50} and slope function for Naled and Isolane for test fish Saccobranchus Fossilis

CHEMICAL	24hr.		48hr.		72hr.		96hr.	
	LC_{50}	S	LC_{50}	S	LC_{50}	S	LC_{50}	S
NALED	7.44 (7.38 - 7.50)	1.09	7.33 (7.15 - 7.27)	1.09	7.03 (6.95 – 7.09)	1.05	6.83 (6.75 – 6.88)	1.09
ISOLANE	41.85 (40.91-41.95)	1.04	40.75 (40.45-40.84)	1.056	40.20 (40.11-20.24)	1.036	39.25 (39.21-39.56)	

Values given in parenthesis are acute toxic range.

Table 2: Regression equation and heterogeneity factor (H.F.) for Naled and Isolane for Saccobranchus Fossilis

CHEMICAL	24hr.	48hr.	72hr.	96hr.	H.F.	Fiducial limit	Safe Conc.
NALED	Y = 5.56 X-36.74	Y = 5.58 X+35.24	Y =5.58 X-34.24	Y =5.18 X-30.27	0.235	5.72-8.16	0.25
ISOLANE	Y = 1.37 X-51.77	Y = 1.35 X+50.63	Y =1.37 X-50.93	Y =1.26 X-45.73	0.690	19.65-78.80	0.02

III. RESULT AND DISCUSSION

In table 1 and 2, regression equation, heterogenicity factor, fluidical limit, slope function and safe concentrations data regarding toxicity value are shown. The water contains no toxic substance or factors which can harm the fish in acute conditions, is clear from the Physico-chemical characteristics of water. The bioassay studies have shown various changed physical behaviors for example, erratic opercular movement, respiration difficulty, agitation and body convolution. The fish exposed to pesticides show a common feature of in gulping of surface air and avoidance of toxic environment. The minimizing of the irritating effects of toxicant leads to Excessive secretion by the body. Impairment of the sense in experimental fish might be due to toxic effect of individual pesticide. In control jar, no such changed behavior in fish activity was observed.

It is evident from the acute toxicity results (Table1), that the toxicity of the pesticides was a function of dosage, duration and type of active molecule used in formulating the pesticides. If the field data are worked out, the LC_{50} and acute toxic range in the present investigation can vary if field. However, the relationship developed in laboratory bioassay remained the same. From LC_{50} values, higher toxicity of Naled and Isolane might be due to the presence of phosphate and carbonate respectively, as active ingredients. Isolane is less toxic as compared to Naled.

The death of Fishes in experimental jar seems to be due to depletion in the rate of respiration as the proper exchange of oxygen through gills cannot take place due to pesticide. Excessive mucous depositions have been observed at gill outer lining. Tovell et al (1980) also indicated the death of fishes due to the deposition of high mucous contents over the outer mucous layer of the gills in a number of fish. Parker et al, (1951) and Hall et al (1933) pointed out that at lethal concentration, respiration in fishes become irregular & the circulatory mechanism can no longer keep pace with oxygen consumption and the blood become acidic due to lactate accumulation as a result of which muscular rigidity is obtained causing the death of fish. Similar sequential stresses also occurred in Saccobranchus Fossilis along with hypoxic condition causes the death of fishes during bioassay test.

Abel (1975) suggested that denaturation of protein of the gill membranes due to pesticides probably cause the death of the fishes. Protein denaturation in fishes due to pesticide were also observed by Fogg & Lodge (1945). The same might also be true in this case also.

The safe concentration of these two pesticides have also been worked by using the formula of Hart et al, (1945) using the application factor (0.05) given by Warner (1967). These values are very meaningful because they can be utilized for regulating the discharge of such pesticides in various ecosystems. The values of regression equation, heterogeneity factors are useful for correcting the experimental data.

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