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Research Article

Assessment of toxicity of lambda-cyhalothrin for *Heteropneustes fossilis* and *Channa punctatus*

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Abstract: Insecticidal use in agriculture gained momentum around the mid-twentieth century. Fungicides are also used in agriculture for the prevention of fungal infection in seed grain. Later these compounds discharge in nearby water bodies and consumed by fishes and other aquatic life. These fat-soluble contaminants concentrate in the adipose tissue of fishes by bioaccumulation and biomagnification. The present study helps in assessment of toxicity of lambda-cyhalothrin, a pyrethroid to fishes *Heteropneustes fossilis* and *Channa punctatus*.

Keywords: Lambda-Cyhalothrin, *Channa punctatus*, *Heteropneustes fossilis*, LC_{50}.

1. Introduction

The river systems may be excessively contaminated with heavy metals released from domestic, industrial, mining and agricultural effluents. The various types of pollutants from industries and sewage directly reach the river water and produce toxic effects on the aquatic flora and fauna and degrade the quality of water. It, therefore, aims to study the impact of polluted water coming out as an effluent and mingling with the river water of the different aquatic life and plankton. Pesticides are related chemicals; destroy the delicate balance between species that characterizes a functioning ecosystem. Pesticides are economical way of controlling pests. Pesticides are often used to stop the spread of pests in imports and exports, preventing weeds in gardens and protecting house and furniture from destruction. Pesticides include a wide variety of chemicals with great difference in their mode of action, uptake by the body, metabolism and elimination from the body and toxicity to target and non-target organisms. Poisoning risks depend on dose, toxicity, duration of exposure and sensitivity.

The freshwater is polluted due to the entry of excess sewage water, industrial effluents and large number of pesticides in natural and agricultural pest. Lambda-cyhalothrin is an important pyrethroid pesticide indiscriminately used in India. Lambda-cyhalothrin is used in agriculture to control a range of insect pest in horticulture and agriculture crops. Fisheries provide an important source of food, employment, income and recreation for people throughout the world. *Heteropneustes fossilis* and *Channa punctatus* are selected for study purpose because they are hardy and freshwater fishes so it is easily handling, rearing and adapted to the laboratory environment. Fish is an important bioindicator species can play an important role in the aquatic environment. The fishes, best indicator of water body pollution, are the most sensitive of all the aquatic animals towards the pollutant. The accumulation of effluents becomes hazardous to the aquatic organism because they are the most important factors of food chain. Fish and other aquatic species has been victim of pesticide poisoning. Keeping these views in front, this study is designed to assess the extent of toxicity of lambda-cyhalothrin to *Heteropneustes fossilis* and *Channa punctatus* in laboratory conditions.

2. Material and Methods

In order to estimate the LC_{50} value, the fishes of different experimental sets have been treated with different concentrations of test compound as given in Tables. The mortality number of fishes at different time intervals i.e. 24 hrs, 48 hrs, 72 hrs and 96 hrs and percentage mortality for 96 hrs have been calculated which was used as final mortality for calculation as per international standards for fishes. The mortality number showed a corresponding increase with the increasing concentrations of the test compounds.

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LC_{50} values have been calculated by the log dose/probit regression line method (Finney, 1971). The test doses have been converted to their logarithms for ease of calculation. Empirical probit values corresponding to the percentage mortality have been obtained from standard table (Finney, 1971) and tabulated in the appropriate columns of the respective tables. The empirical probit values have thereafter been plotted against log dose on the graph paper and a provisional line filling the points is drawn. From this line, expected probit values 'Y' are noted for the values of log dose 'X'. The working probit 'y' have been calculated using the following formula:

$$y = y_0 + kp$$

Where y_0 and k are noted from the table for the expected probit Y and p is the percentage mortality.

The weighing coefficient 'n' for each point is also noted from the table (Finney 1971). Each weighing coefficient is multiplied by the number of fishes used and the products have been taken as 'w'. After this, for each row, the products of wx, wy, wxy, wx^2, wy^2 have been calculated and summed up as $\sum wx$, $\sum wy$, $\sum wxy$, $\sum wx^2$, $\sum wy^2$ respectively and finally, the mean have been calculated by the following formula:

$$\overline{X} = \Sigma wx / \Sigma w$$
$$\overline{Y} = \Sigma wy / \Sigma w$$

The value of 'b' has been calculated by the following formula:

$$b = (\Sigma wxy - \overline{X}\Sigma wy) / (\Sigma wx^2 - \overline{X}\Sigma wx)$$

Regression equation:

$$Y = \overline{Y} + b\,(x - \overline{X})$$

Values of 'Y' corresponding to the original values of 'X' have been calculated and the regression line is drawn.

The variance has been calculated by the following formula:

$$\text{Variance (V)} = \frac{1}{b^2} + \left(\frac{1}{\Sigma w} \frac{(X - \overline{X})^2}{\Sigma wx^2 - \frac{(\Sigma wx)^2}{\Sigma w}} \right)$$

The fiducial limits with 95% confidence have been obtained by the following formula:

$$m_1 = m + 1.96\ V$$
$$m_2 = m - 1.96\ V$$

3. Results and Discussion

The LC_{50} value for *Heteropneustes fossilis* and *Channa punctatus* were calculated as 8.32 and 6.88µg/l respectively using lambda-cyhalothrin as toxicant (Table 1-6).

Table 1. Mortality rate of *Heteropneustes fossilis* after treatment with lambda-cyhalothrin at different time intervals.

S. No.	Concentration (µg/l)	No. of fishes	Mortality number after exposure time of			
			24 hrs	48 hrs	72 hrs	96 hrs
1	3.0	10	0	0	0	0
2	6.0	10	0	1	2	4
3	9.0	10	1	2	3	6
4	12.0	10	1	2	4	8
5	15.0	10	1	4	8	10

Table 2. Survival number and percentage mortality of *Heteropneustes fossilis* after 96 hours of treatment with lambda-cyhalothrin.

S. No.	Concentration (µg/l)	No. of fishes	Exposure time (hrs)	Mortality number	Percentage mortality	Survival number
1	3.0	10	96	0	0	10
2	6.0	10	96	4	40	6
3	9.0	10	96	6	60	4
4	12.0	10	96	8	80	2
5	15.0	10	96	10	100	0

Table 3. Toxicity evaluation of lambda-cyhalothrin to *Heteropneustes fossilis.*

Experimental animal	Compound	LC_{50} (µg/l)	Variance	Fiducial limits
Heteropneustes fossilis	Lambda-cyhalothrin	8.32	0.003	0.92588(+) 0.91412(-)

Table 4. Mortality rate of *Channa punctatus* after treatment with lambda-cyhalothrin at different time intervals.

S. No.	Concentration (µg/l)	No. of fishes	Mortality number after exposure time of			
			24hrs	48hrs	72hrs	96hrs
1	2.5	10	0	0	0	0
2	5.0	10	0	1	2	4
3	7.5	10	1	2	3	6
4	10.0	10	1	2	4	8
5	12.5	10	1	4	8	10

Table 5. Survival number and percentage mortality of *Channa punctatus* after 96 hours of treatment with lambda-cyhalothrin.

S. No.	Concentration (µg/l)	No. of fishes	Exposure time (hrs)	Mortality number	Percentage mortality	Survival number
1	2.5	10	96	0	0	10
2	5.0	10	96	4	40	6
3	7.5	10	96	6	60	4
4	10.0	10	96	8	80	2
5	12.5	10	96	10	100	0

Table 6. Toxicity evaluation of lambda-cyhalothrin to *Channa punctatus.*

Experimental animal	Compound	LC_{50} (µg/l)	Variance	Fiducial limits
Channa punctatus	Lambda-cyhalothrin	6.88	0.004	0.84534(+) 0.82966(-)

Lethal concentration for 50% mortality is defined as LC_{50} value for a particular species against a particular pesticide. This can be calculated by using different doses against the organism and tested for mortality. Then after a massive statistical calculation, the final LC_{50} value has been estimated which is lethal up to 50% mortality of organism. Then the sublethal concentrations are decided by dividing with 10 to minimize the risk of mortality for further studies if any. LC_{50} value for *Heteropneustes fossilis* and *Channa punctatus* were calculated as 8.32 and 6.88µg/l respectively. This reflects that *Heteropneustes fossilis* are more resistant amongst the two.

The LC_{50} values differ from genus to genus and species to species for the same or different pesticides because of different mode of action and physiology of organism. Environmental factors may also affect the LC_{50} value. Many studies have been done in this regard as Raizada and Rana (1998) reported an LC_{50} value of 0.86mg/L to be highly toxic at 96 hrs exposure of *Clarias batrachus* (Linn.) to malachite green. Subramanian *et al*., (2007) studied the toxic effect of heavy metal; chromium on *Clarias batrachus* (Linn.) and reported an LC_{50} value of 2.3401mg/L at 96 hrs exposure to be highly toxic. Venkatesan and Subramanian (2007) observed an LC_{50} value of 0.253mg/L at 96 hrs exposure of *Oreochromis mossambicus* (Peters) to copper sulphate. The LC_{50} value in the present study is temperature regulated and also depends on water parameters.

Acute toxicity testing is done by earlier workers and summarized by Smith and Stratton (1986) and Bradbury and Coats (1989) give a clear glimpse of the comparative lethal values of these pyrethroids for different fish species. For the 96 h treatment period, LC_{50} values of cypermethrin indifferent fish species have been reported as follows: 2 and 6 lg/L for *Salmo salar* and *S. gairdneri*, respectively (Smith and Stratton 1986); 0.9–1.1, 1.2, 0.5, 0.4 and 2.2 lg/L for *C. carpio*, *Salmo trutta*, *S. gairdneri*, *Scardinius erythrophthalmus*, and *Tilapia nilotica*, respectively (Bradbury and Coats 1989). Very recently for 72 h treatment period, the LC_{50} value of cypermethrin has been reported to be 1.27 lg/L by Saha and Kaviraj (2003).

The LC_{50} values with different formula grades of lambda-cyhalothrin for 96 h treatment period have been reported. Hill (1985) found LC_{50} values of 5% EC lambda-cyhalothrin for *S. gairdneri* to be 0.93 lg/L, respectively. Charles and Hance (1968) reported the 96 h LC_{50} value of lambda-cyhalothrin for brown trout to be 2–2.8 lg/L. The behavioral response to these pyrethroids started appearing only after 3 h of treatment. The alterations in behavior such as hyperactivity, loss of balance, rapid swimming, increased surfacing activity, enhanced rate of opercular activity and convulsions in treated fish were observed with the changing concentrations of these pyrethroids when compared to the control fish. The effects of pesticides were found to be in dose and duration-dependent manner.

References

[1]. American Conference of Governmental Industrial Hygienists (1991). Documentation of the Threshold Limit Values and Biological Exposure Indices: Sixth Edition, Volume I. ACGIH. Cincinnati, OH.

[2]. Bradbury, S.P. and Coats, J.R. (1989). Comparative toxicology of the pyrethroid insecticides. *Rev. Environ. Contam. Toxicol.*, 108:133–177.

[3]. Janice E. Chambers and Patricia E. Levi (1992). Organophosphates Chemistry, Fate and Effects. Academic Press, Inc. New York, NY.

[4]. Charles, R. and Hance, R.J. (1968). A world compendium crop pesticides constituents technical data. *Brit. Crop Prot. Council*, 203–233.

[5]. Finney, D.J. (1971). Probit Analysis. Cambridge University Press, 333 pp.

[6]. Fisher, R.A. and Yates, F. (1950). *Statistical Tables for Biological, Agricultural and Medical Research.* Longman VI edition, X+146 pp.

[7]. Hayes, W.J. Jr., E.R. Laws, Jr., (eds.) (1991). Handbook of Pesticide Toxicology. Volume 1: General principles; Volumes 2 and 3: Classes of pesticides. New York, NY: Academic Press, Inc.

[8]. Hill, R.W. (1985). PP321: Determination of acute toxicity to Rainbow trout (*Salmo gairdneri*) of a 5% EC formulation (Unpublished proprietary report No. BL/B/2783, submitted to WHO by ICI).

[9]. Raizada, S. and Rana, K.S. (1998). Acute toxicity of malachite green to an air breathing teleost, *Clarias batrachus* (Linn.). *J. Environ. Biol*., 19 (3): 237-241.

[10]. Saha, S. and Kaviraj, A. (2003). Acute toxicity of synthetic pyrethroid cypermethrin to freshwater catfish, *Heteropneustes fossilis* (Bloch). *Int. J. Toxicol.*, 22:325–328.

[11]. Smith, T.M. and Stratton, G.M. (1986). Effects of synthetic pyrethroid insecticides on nontarget organisms. *Residue Rev.*, 97:93–120.

[12]. Smith, G.J. (1993). Toxicology and Pesticide Use in Relation to Wildlife: Organophosphorus & Carbamate Compounds. C.K. Smoley. Boca Raton, FL.

[13]. Subramanian, J., Nethaji, V. and Shasikumar, R. (2007). Toxic effects of the heavy metal chromium on the freshwater catfish; *Clarias batrachus* (Linn.). *J. Exp. Zool. India.*, 10(2): 357-362.

[14]. The Agrochemicals Handbook, Third Edition. (1994). Royal Society of Chemistry Information Systems, Unwin Brothers Ltd., Surrey, England.

[15]. U.S. Environmental Protection Agency (1985). Pesticide Fact Sheet No. 72: Monocrotophos, U.S. EPA. Washington, DC.

[16]. Venkatesan, R. and Subramanian, N. (2007). Effect of copper sulphate on histopathological changes in the freshwater fish; *Oreochromis mossambicus* (Peters). *J. Ecotoxicol. Environ. Monit.*, 17(4): 353-361.