Evaluation of Toxic Impact of Beta - Cyfluthrin by Estimating LD_{50} in Albino Rats

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Abstract

The LD_{50} of commonly used synthetic Pyrethroid i. e. - Beta – Cyfluthrin was estimated by Probit analysis (Finney, 1971) [1] in albino rats. Rats were selected randomly from the inbred colony. LD_{50} has been defined as "a statistically derived expression of a single dose of a material capable of killing 50% of the animal. LD_{50} value is a useful means of classifying pesticides (chemical) as extremely, highly, moderately and slightly hazardous or unlikely to present acute hazards. The result of this study suggests that oral LD_{50} of Beta – Cyfluthrin in coconut oil was found to be 726 mg/kg of body weight in albino rats.

Keywords

Synthetic Pyrethroids, $LD_{50,}$ Acute toxicity.

Introduction

Synthetic pyrethroids are widely used insecticides. Since they are more effective against a wider range of insects and used in crop care, they are considered highly economical as well as beneficial by most farmers. The purpose of this paper is to evaluate the toxicity potential of these insecticides to humans and other life forms. Pyrethrum are pesticides found naturally in some Chrysanthemum flowers [2]. Pyrethrins are separated from the flowers and used to produce more effective pesticides, Synthetic pyrethroids. Various toxicological studies revealed the neurotoxin effects of these pesticides. [3-5]

Pesticides have contaminated almost every part of our ecosystem. Pesticides contamination pose a potential risk to the environment and also non-target organisms ranging from beneficial soil microorganism to insects plants, fish, birds and human.

Materials and Methods

Experiment Animal and Compound

Experiment was conducted on albino rats *(Rattus norvegicus*) ranging in weight from 120 – 130gm from inbred colony representing both the sexes. The rats were kept at 20±5°c temperature, 50±5°c relative humidity and 12hrs/day photoperiod. Rats were fed on rat feed obtained from Hindustan Antibiotics Ltd. (Pune) and water was provided ad. libitum.

Experiment compound Beta-Cyfluthrin[SR-Q-Cyno-4Fluro-3-phenoxybenzyl-1RS, 3RS, 3SR-3-(2, 2, dichloro vinyl) 2,2-dimethyl cyclopropane Carboxylate] was obtained from Hindustan Antibiotics Ltd. (Pune).

Design of Experiment - LD_{50} Determination

The twenty animals (albino rats) were divided into five groups with four animals in each group. Each group was treated with five different doses of Beta-Cyfluthrin. The dose solution was prepared by dissolving 50ml of compound in 50ml of coconut oil. The respective five doses i.e. 0.25, 0.50, 0.75, 1.0 & 1.25ml were administrated orally by gavage, within this range, mortality and survival numbers for each dose were recorded after 96 hrs. Control set with 10 animals run simultaneously. The rats of control sets were given coconut oil only.

Observation and Result

The acute LD_{50} of Beta-Cyfluthrin was determined by log–dose probit mortality method [Finney][1] on albino rats [Table - II]. Each experiment group showed a corresponding decrease in survival percentage with an increased dose of Beta-Cyfluthrin [Table – I], while control was given the same quantity of diluent alone showed no mortality.

Table - I
Acute Oral Toxicity of Beta–Cyfluthrin to Albino Rats

S. No.	Dose mg/kg body weight	Number of Individual Treated	Exposure	Survival Number	Survival Percentage
1.	250	4	96	4	100%
2.	500	4	96	3	75%
3.	750	4	96	2	50%
4.	1000	4	96	1	25%
5.	1250	4	96	0	0%

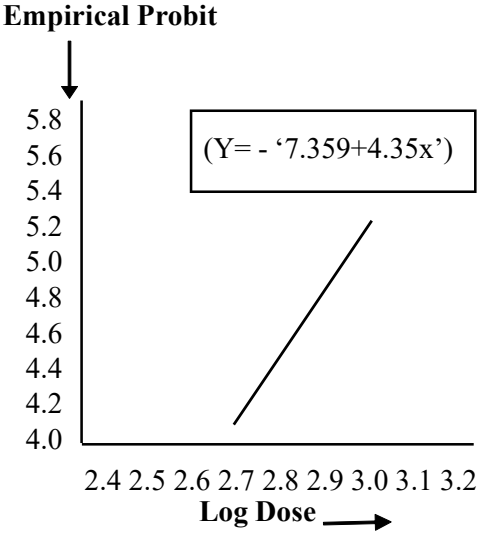
The empirical probit values corresponding to the percentage mortality have been obtained from the table (Finney, 1971). The empirical probit values have been thereafter plotted against log–dose value on ordinary graph paper and provisional line closely fitted to the points drown **(Fig.1).** From the provisional line, the expected probit values (Y) were read for the value of the log – dose (X) and then the working probit values have been calculated by using the following formula:

$$Y = Yo + Kp$$

Where 'Yo' and 'Kp' were used from the table (Finney 1971) for the expected probit (Y) and 'p' is the percentage mortality.

Fig-1

The graph between probit mortality and log – dose shows regression line for the calculation of LD_{50} of Beta-Cyfluthrin



The weighting coefficient for each point was obtained from the table (Finney 1971). The weight (w) has been calculated by multiplying each coefficient by the number of rats used [Table - II]. The values of 'b' for the regression equation has been obtained by the following formula:

$$b = \frac{\Sigma Wxy - \bar{X}\Sigma Wy}{\Sigma Wx^2 - \bar{X}\Sigma Wx}$$

Table-II

S. No.	The concentration of Beta-Cyfluthrin	No. of Rats	Mortality (%)	Log Dose (X)	Empirical Probit	Expected Probit (Y)	Working Probit	Weighing Coefficient	Weight (W=Nxn)	WX	WY	WXY	WX^2	WY^2
1	250	4	0	2.398	0	-	-	-	-	-	-	-	-	
2	500	4	25	2.699	4.33	4.33	4.326	0.532	2.128	5.743	9.206	24.846	15.501	39.824
3	750	4	50	2.875	5.00	5.10	5.000	0.634	2.536	7.291	12.680	36.455	20.961	63.400
4	1000	4	75	3.000	5.67	5.67	5.673	0.558	2.232	6.696	12.662	37.986	20.086	71.832
5	1250	4	100	3.097	0	-	-	-	-	-	-	-	-	-
									W=6.896	WX=19.73	WY=34.548	WXY 99.287	WX2 56.55	WY2 175.056

DETERMINATION OF LD_{50} AFTER GIVEN DOSES OF DIFFERENT CONCENTRATION OF BETA–CYFLUTHRIN ORALLY IN ALBINO RAT BY LOG-DOSE/PROBIT REGRESSION ANALYSIS

The values of 'Y' corresponding to the original values of X have been obtained from the regression equation.

$$Y = y+b\ (X'-\bar{X})$$

The variance of estimated LD_{50} values has been calculated by the following formula.

$$V = \frac{1}{b^2}\left[\frac{1}{\Sigma W} + \frac{1(X'-\bar{X})^2}{\Sigma WX^2-(\frac{\Sigma WX)^2}{\Sigma W}}\right]$$

There after the fiducial limits m_1, m_2 with 95% confidence have been calculated from variance (V) by the following formula (Table III)

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

Table – III
Acute Oral Toxicity of Synthetic Pyrethriod (Beta–Cyfluthrin) to Albino Rats

Experimental Animal	Test Compound	Regression Equation	LD_{50} (ml/kg b. wt.	Variance	Fidvcial Limit
Rattus norvegicus	β-Cyfluthrin	Y=7.359+4.35x'	0.726	0.007	0.751(+) 0.751(-)

Result: After all the calculations the LD_{50} of Beta–Cyfluthrin in this study = 726 mg/kg of body weight.

Discussion

While thinking of the present, the future should not be forgotten. In this pesticide era, it is necessary to evaluate the toxic potential of these pesticides. Risks associated with pesticides can be greatly reduced, or even eliminated by selecting the least toxic product to control a pest and by minimizing your exposure. In the present study LD_{50} of Beta – Cyfluthrin come out to be 726 mg/kg body weight. Beta – Cyfluthrin has produced noticeable signs of poisoning such as Tremors throughout the whole body, excessive salivation after acute doses and showed dose depended on toxicity. Soderlund et.al. reported acute oral LD_{50} of pyrethroids ranging from 22 to 5000 mg/kg in rats. Rajawat et.al. reported LD_{50} of Beta-Cyfluthrin 260 and 407 mg/kg b.wt. in male and female Swiss albino mice respectively [7]. Bhusan and Saxena reported LD_{50} of Beta'-Cyfluthrin in male rats after 96-hour treatment to be 354. 8mg/kg b.wt. and also found neurotoxic effects [8]

Based on the LD_{50} value in the present study, Beta – Cyfluthrin falls under moderately hazardous class of pesticide according to WHO recommendation [9]. The difference in LD_{50} values might be due to the use of vehicles, sex, experimental condition, etc. It can be concluded that, the toxic potential of these chemical should be exposed further for a better tomorrow.

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