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Toxicity of Cypermethrin and ß-cyfluthrin on Certain Haematological Parameters of Albino Rat

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Abstract

Acute and sub-acute toxicity of Cypermethrin and ß-cyfluthrin were studied separately on certain blood parameters of albino rat by administering oral dose to albino rat and observing them for one day for acute and 7, 14 and 21 days for sub-acute treatment. Doses were selected on the basis of LD_{50} values (i.e LD_{50} of Cypermethrin and ß -cyfluthrin are 643mg/kg and 726mg/kg of body weight respectively). In the investigation acute dose of Cypermethrin and ß-cyfluthrin were 129 mg/kg of body weight and 242mg/kg of body weight respectively and for sub-acute treatment dose were 6.14 mg/kg and 8.64mg/kg of body weight respectively. Both the pyrethroids (synthetic pyrethroid) showed dose dependent toxicity with slight tremor in whole body and caused significant alterations in blood parameters, i.e TEC (total erythrocyte count), Hb. Conc.(Haemoglobin concentration), TLC (total leukocyte count), PCV (Packed cell volume), ESR (erythrocyte sedimentation rate) of albino rat.

Keeping this in view, toxicity of Cypermethrin and ß-cyfluthrin has been observed. Considering the paucity of information on the effect of pyrethroids on blood, it is necessary that blood pyrethroid interaction be exposed further.

Keywords : *Toxicity, Synthetic Pyrethroid, Cypermethrin, ß-cyfluthrin*

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Introduction

The indiscriminate use of insecticide posed potential health hazard to human beings. Synthetic pyrethroids has become one of the most important insecticide in wide scale use. Synthetic pyrethroids are chemical analogues of natural pyrethrins, which are derived from the flower, *Chrysanthemum cinerarifolium*. The most commonly used synthetic pyrethroids are Cypermethrin, fenvalerate, deltamethrin, allethrin, ë-cyhalothrin, ß-cyfluthrin etc. For the purpose of creating awareness about the potential of poisoning by insecticides, the focus group of chemical in this paper are synthetic pyrethroids which are widely available in our home in the form of mosquito aerosol, mosquito vapour mats and mosquito coils.

Due to extensive use of these synthetic pyrethroid, human population can get the access of these pesticides through various trophic levels of food chains. A long term pesticide exposure may lead to a health hazard for the animal and human population.

In the present investigation, the synthetic pyrethroids Cypermethrin and ß-cyfluthrin have been selected to investigate their haemotoxic potential in albino rats after acute (1 day) and subacute (7, 14 and 21 days) treatment.

Materials And Methods

Experimental Compounds

Cypermethrin [Q-cyno-3-phenoxybenzyl-3-(2, 2, dichlorovinyl) 2, 2 – dimethyl cyclopropane carboxylate] was obtained from Bayer India Ltd., Bombay and ß-cyfluthrin

[SR- Q-cyno-4Fluro-3-phenoxybenzyl-1RS, 3RS, 3SR-3-(2,2, dichlorovinyl) 2,2 – dimethyl cyclopropane carboxylate] from Hindustan Antibiotic Ltd., (Pune). The acute oral LD_{50} of both prethroids were determined separately on albino rats. The prethroids were dissolved in coconut oil of pharmaceutical quality and introduces by gavage tube. The data were analysed by probit analysis (Finney 1971) for LD_{50} determination. (TABLE 1). Rats from the control set were given coconut oil alone.

Experimental Animal

Albino rats, (*Rattus norvegicus*) ranging in weight from 120-130 gm with an average of 125 ± 2.36 gm and body size ranging 15-16 cm with an average of 15.5 ± 0.24 cm from an inbred colony representing both the sexes were selected for experimentation. The rats were kept in polypropylene cages at the 20 ± 5° C temperature, 50 ± 5% relative humidity and 12 hrs/day photoperiod. Rats were fed on rat feed obtained from Hindustan Antibiotic Ltd., (Pune), and water was provided *ad libitum*.

Experimental Design

Sixty four albino rats were divided into two groups of 32 rats each. The first group of 32 albino rats included the treatment groups for acute (1 day) and subacute (7, 14 and 21 days) studies for ß-cyfluthrin and Cypermethrin with 16 rats in each. The second group of 32 rats served as control for ß-cyfluthrin and Cypermethrin with 16 rats in each for various time intervals. The doses were introduced orally through gavage for 1, 7, 14 and 21 days. The doses were selected on the basis of LD_{50} (TABLE 1). The selected sublethal dose of $1/5^{th}$ of LD_{50} for cypermethrin was given to the rats. The acute and subacute doses for Cypermethrin were 129 mg/kg and 6.14 mg/kg of body weight respectively. The selected sublethal dose of $1/3^{rd}$ of LD_{50} for ß-cyfluthrin was given to the rats. The acute and subacute doses for ß-cyfluthrin were 242 mg/kg and 8.64 mg/kg of body weight respectively.

Four rats were taken out after 1, 7, 14 and 21 days from control and treated sets and rats were anaesthesized by chloroform. The blood was collected directly from cardiac puncture by sterilized needles and stored in vials having anticoagulant (EDTA). Hemoglobin concentration (Hb.Conc.) was estimated by Sahli's method and outlined by Wintrobe et al. (1981). Total erythrocyte count (TEC) and total leukocyte count (TLC) were conducted using the Improved Neubaur hemocytometer (Dacie and Lewis, 1975). Packed cell volume (PCV) and erythrocyte sedimentation rate (ESR) determined by Wintrobe's method (Wintrobe and Landsberg, 1985).

Statistical significance between experimental and control values were calculated according to Fisher's student 't' test. (Fisher, 1950).

Results

Cypermethrin and ß-cyfluthrin showed dose-dependent toxicity. Parker *et al.* (1984) and Desi *et al.* (1986) also observed similar dose-dependent mortality in dogs and rabbits after Fenvalerate and cypermethrin intoxication, respectively.

On the basis of LD_{50} values shown in (TABLE 1) cypermethrin has been found to be more toxic than ß-cyfluthrin.

Discussion

The findings in the present investigation gain support by the observations made by Qadir et al. (1987) and Institoris *et al.* (1999b) who estimated LD_{50} of Cybil to be 669 mg/kg of body weight and 554 mg/kg body weight in rats respectively. Present findings are in contradiction with Bhusan *et al.* (2013), they reported LD_{50} of ß-cyfluthrin was 354.8 mg/kg of body weight. The variation in LD_{50} values may be due to the fact that the toxicity of chemical is found to be dependent on number of

factors such as vehicle used, species, sex and age of experimental animal, temperature, humidity and social atmosphere etc.

These differences between the oral LD_{50} of cypermethrin and ß-cyfluthrin are presumably a consequence of structural variation in both prethroids.

TEC decreased significantly after cypermethrin (Table 2) and ß-cyfluthrin (Table 3) administration. The decreae in TEC may be due to the toxic effect of pyrethroids on the blood forming organ, which in turn causes a decrease in the erythopoiesis. Qadir *et al.* (1987) and Shakoori *et al.* (1988) reported similar decreases in the TEC after cypermethrin intoxication in the chicken and albino rat, respectively, with acute anemia noted as the problem reason.

Table 1
Oral Toxicity of cypermethrin and ß-cyfluthrin to albino rats depicting variance and fiducial limit

Experimental Rat	Test Compound	Regression Equation	LD_{50} (mg/kg)	Variance	Fiducial limit
Rattus norvegicus	cypermethrin	y= 0.6741 + 1.543x′	643	0.034	0.742 (+) 0.544 (-)
	ß-cyfluthrin	y= 7.359 + 4.35x′	726	0.007	0.751 (+) 0.751 (-)

y = expected probit
x′= log dose

Hemoglobin concentration (Hb. Conc.) decreased in cypermethrin (Table 2) & ß-cyfluthrin (Table 3) treated rats. This decrease in Hb. Conc. May be due to the decrease in RBC count because Hb is an integral part of the RBC and/or to hypohaemoglobinemia. Decreases in Hb. Conc. has also been observed by Qadir et al. (1987), Khan and Ali (1993) and Saxena and Saxena (1997) after cypermethrin, pesticides, and Cybil administration in chickens, factory workers and albino rats, respectively. Caballo *et al.* (1992) reported that the cell cycle of the Chinese hamster ovary was effected by Fenvalerate administration.

Intoxication of cypermethrin (Table 2) and ß-cyfluthrin (Table 3) separately induced leukocytosis after acute and subacute treatment. Leukocytosis in some cases may be due to a protective reaction in which leukocytes protect the body when xenobiotic substances invade. Increased

leukocyte count may also be found in leukemia in which uncontrolled abnormal proliferation of haemopoietic cells leads to progressive infiltration of the bone marrow in which a large number of immature forms are produced. These immature forms ultimately escape into the peripheral blood leading to very high leukocyte count. Similar increases in total leukocyte count (TLC) were reported by Khan and Ali (1993) in factory workers, Siroki et al. (1994) in mice, respectively. Contrary to these findings, Institoris et al. (1999b) observed reduction in TLC after cypermethrin treatment in rats.

Table 2
Effect of sublethal doses of cypermethrin on haematological parameters of albino rat after acute (1 day) and subacute (7, 14 and 21 days) treatment

		Cypermethrin treated			
PARAMETERS*	CONTROL	ACUTE	SUB ACUTE		
		1 day	7 days	14 days	21 days
TEC (million/mm^3)	6.75 ± 0.04^1	6.40 ± 0.05^a	6.55 ± 0.01^b	6.50 ± 0.05^b	6.45 ± 0.05^b
Hb. Conc. (gm/l)	11.70 ± 0.05^1	10.43 ± 0.05^b	10.87 ± 0.30^b	10.60 ± 0.41^b	10.40 ± 0.03^b
TLC ($X10^3/mm^3$)	7.10 ± 0.05^1	8.29 ± 0.01^c	7.13 ± 0.05	8.90 ± 0.05^c	8.20 ± 0.05^c
PCV (%)	43.00 ± 0.47^1	38.00 ± 0.94^a	34.67 ± 1.44^a	36.33 ± 0.02^b	30.00 ± 0.47^b
ESR (mm/hr)	3.00 ± 0.47^1	4.33 ± 0.27	4.66 ± 0.27^a	4.33 ± 0.98	5.66 ± 0.72

* Abbreviations used. TEC = Total erythrocyte count, Hb. Conc. = Hemoglobin Concentration, TLC =Total Leukocyte count, PCV = Packed Cell Volume, ESR = Erythocyte Sedimentation rate, 1-Mean ±SEM, Student 't' Test $P<0.05^a$ $P<0.01^b$ $P<0.001^c$

The increased erythocyte sedimentation rate (ESR) in both cypermethrin (Table 2) and ß-cyfluthrin (Table 3) treated rats may be due to decreased total erythrocyte count (TEC) because ESR depends on Rouleux formation of erythrocytes. When Rouleux is formed the density of it's mass increases. Thus, with reduced erythrocyte count Rouleux formation decreases which in turn increases ESR. Saxena and Saxena (1997) also reported a significant increase in ESR after Cybil intoxication.

PCV decreased after acute and subacute treatment of cypermethrin administration (Table 2) and in ß-cyfluthrin (Table 3). Continuous decrease after acute and subacute treatment may be due to hypochromic microcytic anemia. Reduction in PCV can also be correlated with reduced RBC count.

Qadri *et al.* (1987) and Institoris et al. (1999a & b) reported reduction in PVC after cypermethrin intoxication in chicken and rats respectively. Sirkori et al. (1994) revealed enhancement in PCV of rats following treatment by super cypermethrin.

Table 3
Effect of sublethal doses of ß-cyfluthrin on haematological parameters of albino rat after acute (1 day) and subacute treatment (7, 14 and 21 days)

		ß-cyfluthrin treated			
PARAMETERS*	CONTROL	ACUTE	SUB ACUTE		
		1 day	7 days	14 days	21 days
TEC (million/mm^3)	6.87 ± 0.04	6.28 ± 0.12[a]	6.36 ± 0.11[a]	6.11 ± 0.05[a]	6.19 ± 0.05[a]
Hb. Conc. (gm/l)	14.40 ± 0.37	10.60 ± 0.29[b]	11.10 ± 0.33[b]	10.70 ± 0.20[b]	11.20 ± 0.46[b]
TLC ($X10^3/mm^3$)	6.93 ± 0.04	8.46 ± 0.29[b]	8.77 ± 0.14[b]	8.76 ± 0.20[b]	9.32 ± 0.19[b]
PCV (%)	44.00 ± 0.61	33.90 ± 0.71[b]	32.70 ± 0.70[b]	32.90 ± 1.02[b]	34.00 ± 0.63[b]
ESR (mm/hr)	3.40 ± 0.24	7.60 ± 0.51[b]	6.80 ± 0.58	6.30 ± 0.54[b]	6.40 ± 0.24[b]

* Abbreviations used. TEC = Total erythrocyte count, Hb. Conc. = Hemoglobin Concentration, TLC = Total Leukocyte count, PCV = Packed Cell Volume, ESR = Erythocyte Sedimentation rate, 1-Mean ±SEM, Student 't' Test $P<0.01^a P<0.001^b$

In the light of the present findings it can be concluded that both the pyrethroids, cypermethrin and ß-cyfluthrin, are capable of inducing changes in blood and blood-forming organs, in a similar way. There is considerable evidence that all pyrethroids do not act the same way in mammals but poisoning induced by the major kinds of pyrethroids are very similar. It was observed that Cypermethrin is more toxic or reactive then ß-cyfluthrin based on LD_{50} values.

References

Bhusan B, Saxena PN, Saxena N 2013 Biochemical and Histological changes in Rat Liver caused by Cypermethrin and Beta-cyfluthrin. **Arch Indust. Hygiene Toxicol. 6(1) : 57-67**

Caballo C, Heromera A, Barrucca C, Santa Maria A, Sanz F, DeLa Pena E 1992 Analysis of cytogenetic damage induced by the pyrethroid insecticide fenvalerate. **Teratogen Carcinogen Mutagen 12(6) : 243-249**

Dacie J.A., Lewis SM 1975 Practical Haematology.J. and A, Churchilli Ltd., London

Desi I, Dobronyi I, Varga L 1986 Immunoneurological and general studies on a synthetic pyrethroid, Cypermethrin. Ecotoxical Environ Safety 12(3) : 220-232

Finney D.J. 1971 Probit Analysis. Cambridge University Press, London. pp 303

Fisher RA (1950) Statistical method for research workers, 11th ed. Oliver and Boyd Ltd., Edinburg, U.K. pp 146

Institoris, L., Siroki, O., Undeger, U., Desi, I., Nagya Majtenyi, L., 1999a Immunotoxicological effects of repeated combined exposure by cypermethrin and

heavy metals lead and cadmium in rats. **Int J Immunopharmacol 21 (II) : 735-743**

Institoris, L., Undeger, U., Siroki, O., Nehez, M., Desi, I. 1999b Comparison of detection sentivity of immune and genotoxicological effect of subacute cypermethrin and permethrin exposure in rats. **Toxicolgy 137 (1) : 47-55**

Khan, S.A., Ali, S.A. 1993 Assessment of certain haematological responses of factory workers exposed to pesticides. **Bull Environ Contam Toxicol 51 : 740-747**

Parker, C.M., Piccirilles, V.J., Kurtz, S.L., Garners, F.M., Gardinger, T.H., Vangeldox, G.A. 1984 Six month feeding study of fenvalerate in dogs. **Fundam Appl. Toxicol. 4 : 577-586.**

Qadri, S.S., Jabean. K., Mahboob, M., Mustafa, M. 1987 Haemotoxicity to chicken Gallus gallus domesticus by technical and formulation grades of some phosphoric and synthetic pyrethroid esters. **J. Appl. Toxicol. 7 (6) : 367-371**

Saxena, P.N., Crowe, A.J. 1988 An investigation of the efficacy of organotion compounds for the control of the cotton stainer Dysdercus cingulatus, the mosquito, Anophlese stephensi and the common house fly, Musca domestica, **Appl. Organ. Chem. 2 : 185-187**

Saxena, P.N., Saxena, P. 1997 Haemogrammic studies in albino rat after Cybil intoxication. **J. Environ. Biol. 18 (4) : 425-428**

Saxena, P.N., Saxena, S., 1989 Insecticidal activity of some penta and hexacoordinated hetrocyclic ß-diketone derivatives of diorganotion (V) against the store product pest rhizopartha (coleoptera : Bostrichidae). **Appl. Organ. Chem. 3 : 279-281**

Saxena, P.N., Sharma, D.C. (2000) Effect of synthetic pyrethroid on behaviour pattern in Rattus norvegicus. **Proc. Nat Acad. Sci. India 70 (B), I : 41-43**

Shakoori, A.R., Ali SS, Saleem, M.A, 1988 Effect of six months feeding of cypermethrin on the blood and liver of albino rat. **J Biochem. Toxicol. 3 : 59-71**

Singh, A.K,, Saxena, P.N., Sharma, H.N., 2009 Stress induced by ß-cyfluthrin, a type-2 pyrethroid on brain chemistry of Albino Rat. **Biology and Medicine 1 (2) : 74-86**

Siroki, O., Institoris, L., Tatar, E., Desi. J. 1994 Immunotoxicological investigation of SCMF, a new pyrethroid pesticide in mice. **Human Exper Toxicol 13 (5) : 337-343**

Wintrobe, M.M., Landsberg, J.W. 1985 A standardized technique for blood sedimentation test. **Amer J. Med. Sci. 189 : 102-105**

Wintrobe, M.M., Richard, G., Lee. Boggs D.R., Bithell ,T.C., Foerster, J., Athens, J.W., Lukons, J.N. 1981 Clinical Haematology, 8th Edn. Lea and Febiger, Philadelphia.