IISUniv.J.Sc.Tech. Vol.1(1),26-30 (2012)
RESEARCH ARTICLE

Evaluation of Cyfluthrin (A Synthetic Pyrethroid) Toxicity in Hematological Profile of Male Swiss Albino Mice

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Abstract

Cyfluthrin is a highly toxic Synthetic Pyrethroid pesticide widely used in agriculture all over the world. The present study was carried out to determine the effects of commonly used pesticide SOLFAC® 050 EW (Cyfluthrin 5% EW) on blood indices of male Swiss Albino Mice. Experimental animals were divided into two groups having 20 animals in each. Group I- in which animals were given acute treatment. Each acute dose treated animal was orally administered 0.10ml of 800ppm of Cyfluthrin only once and sacrificed on 3hrs, 24hrs, 7th day and 15th day. Group II- For prolonged toxicity study each animal was sub chronically exposed to 0.10ml of 100ppm of toxicant for 28 days and animals were sacrificed on 15th day, 28th day, 45th day and 60th day. The control animals in both the groups received equivalent amount of distilled water. Results revealed that acute treatment showed a significant decline in RBC value, Neutrophil count and Lymphocyte count and a significant elevation in PCV Value, MHC value, MCV value, Basophil count and Monocyte count. In subchronic toxicity study, significant alterations were seen in hematological parameters during treatment (till 28 day) but all alteration in values showed a recovery towards normal count after 30 days of termination of treatment except Basophil count and Lymphocyte count. Increase in Basophil count and decrease in Lymphocyte count were significant even in recovery period when compared with control values.

Keywords

Cyfluthrin, Hematological profile, Male Swiss albino mice, Synthetic Pyrethroid

Introduction

The Synthetic Pyrethroids comprises a major class of insecticides that entered the marketplace in 1980 and, by 1982, accounted for more than 30 percent of worldwide insecticides usage (Anon, 1977; Van den Bercken and Vizverberg, 1983). These Pyrethroids are synthesized derivatives of naturally occurring pyrethrins which are extracted from flowers of pyrethrum plant *Chrysanthemum cinerariaefolium* (Mueller-Beilschmidt, 1990). Cyfluthrin- cyano (4-flouro-3-phenoxy-phenyl) methyl 3-(2, 2-dichloroethenyl)-2, 2-dimethyl cyclopropane carboxylate) is an active ingredient of commonly used synthetic pyrethroid SOLFAC® 050 EW. Cyfluthrin is a broad spectrum, non systemic, Type- II Synthetic Pyrethroid used to control chewing and sucking insects. Cyfluthrin has been reported as economically successful insecticide because it has a degree of potency not previously demonstrated in any class of insecticide, and are generally recognized as safe to mammalian species (Bradbury and Coats, 1989). However, a closer look at Cyfluthrin reveals a variety of acute and chronic exposure hazards are associated with its use. It is highly toxic to animals when administered acutely. It affects a wide variety of organs such as sub maxillary gland, liver, adrenal, spleen and ovary in rats.

The vital functions that blood cells perform, together with the susceptibility of this highly proliferative tissue to intoxication, makes the hematopoietic system unique as a target organ. Accordingly, it ranks with liver and kidney as one of the most important considerations in the risk assessment of individual patient populations exposed to potential toxicants in the environment and workplace (Bloom and Brandit, 2001). Therefore, an attempt has been made to study toxicological effects caused by Cyfluthrin on the blood of male Swiss Albino mice *Mus musculus*.

Material and Methods

Toxicant - The pesticide used in the present study was SOLFAC® 050 EW (Bayer CropScience Ltd, Gujarat), with Cyfluthrin as the active ingredient in the concentrations of 5%.

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Animals and Experimental Design

Adult male Swiss Albino Mice of 8-10 weeks age weighing 25-30gms were used in the present study. All animals were kept under laboratory conditions (25±2°C and with 12hr light, 12hr darkness). They were fed with pellet feed and supplied with water *ad libitum*. Toxicant was dissolved in distilled water and administered orally in the dose regimes as described below.

1. Acute toxicity Study (Acute dose) - 0.10ml of 800ppm of Cyfluthrin was administered orally once to each animal. Dose was double of the recommended dose (400ppm) for the control of insect pests in the field. Animals were sacrificed on 3hrs, 24hrs, 7th day and 15th day after treatment for evaluation of hematological parameters of mice.
2. Prolonged toxicity study (Subchronic toxicity) - One fourth of the recommended dose i.e. 100ppm of Cyfluthrin in the concentration of 0.10ml was administered orally once in a day till 28 days in each animal. Animals were sacrificed on 14th day, 28th day, 45th day and 60th day. The control animals in both the groups received equivalent amounts of distilled water for the same periods.

Blood was collected into EDTA anti-coagulant containers from the heart of sacrificed mice. The hematological parameters investigated with standard protocols (Schalm, 1975) were Total erythrocyte count (RBC), Total leukocyte count (WBC), Hemoglobin (Hb) content, Hematocrit percent (PCV), Differential Leukocyte Count (DLC), RBC derived indices-Mean Cell Hemoglobin (MCH), Mean Corpuscular Volume (MCV) and Mean Cell Hemoglobin Concentration (MCHC).

Statistical Analysis-All the obtained values were presented as mean ± Standard error (S.E) and statistical significance was analysed using student "t" test. The value of p as 0.05, 0.01, and 0.001 were considered to be significant, highly significant and very highly significant.

Results and Discussion

As the use of pesticides in agriculture continues, knowledge of safeguards is refined. Most deaths or serious acute effects due to pesticides poisoning can be traced to violations of recommended practices. West and Milby, 1965 stated that it seems most useful to think of exposure to anything as either acute or long term and to consider as either immediate or delayed. Although Pyrethroids possess wide mammalian: insect toxicity ratio, these pesticides are capable of exerting many toxicological changes upon acute and chronic exposure (Prakash *et al*, 2009).

In the present study, results showed that mice after 24 hrs of exposure to acute dose of Cyfluthrin exhibited from very highly significant ($p \leq 0.001$) to significant decrease in the value of RBC, Neutrophil and Lymphocyte count, while there was significant increase in Hematocrit percent (PCV) , MHC and MCV values and Monocyte count (Table 1). Non significant ($p \leq 0.05$) changes in all the hematological parameters of mice were observed after 3hrs and 7th day of Cyfluthrin exposure. After 15th day exposure, acute dose (800ppm) of Cyfluthrin was accompanied by a very highly significant ($p \leq 0.001$) decrease in Neutrophil count and Lymphocyte Count, a highly significant ($p \leq 0.01$) decrease in RBC count, a very highly significant ($p \leq 0.001$) increase in Basophil and Monocyte count, and a highly significant ($p \leq 0.01$) increase in MHC and MCV value when compared with control values. However, changes in WBC count, MCHC value, and Eosinophil count were not significant ($p \leq 0.05$). Decrease in RBC count might be due to anaemic condition resulted from inhibition of erythropoiesis and hemosynthesis and also high rate of erythrocyte destruction in hemopoitic organs (Savithri *et al*, 2010). Sharma and Saxena, 1983 reported that reduction in RBC value may be due to consequence of severe hemorrhage which results in the dilution of blood caused by the influx of cells and fluids from body store. According to Khogali *et al*, 2005 hematological changes in Hematocrit seem to be due to malabsorption of nutrients or hyperactivity of animals. Decrease in RBC count was reported in the mice treated with Chloropyrifos (Savithri *et al*, 2010), Dimethoate (Khogali *et al*, 2005), Deltamethrin and Fenvalerate (Tos-Luty *et al*, 2001; Haratym-Maj, 2002), Aspirin (Merchant and Modi, 2003), and Dimethoate and Diazinon (Salih, 2010).

A significant increase in MHC and MCV value and a non significant decrease in Mean Cell Hemoglobin concentration in our result are in agreement with work of Merchant and Modi, 2003 with Aspirin, Achukwu *et al*, 2009 with Potassium Bromate, and Khogali *et al*, 2005 with Dimethoate. In our result, reduction in Neutrophil count and Lymphocyte count on exposure to acute dose of Cyfluthrin can be due to aplasia of bone marrow and depression of bone marrow due to exposure to chemical poison (Cyfluthrin). Similar results were also observed by Savithri *et al*, 2010 when mice were treated with Chloropyrifos.

Delayed toxicities in some of the hematological parameters of mice even after 15 days of acute exposure to Cyfluthrin can be due to the process known as "bioactivation". Levi, 1987 stated that during the process between uptake from environment and excretion from the body, many exogenous compounds (Cyfluthrin) has

undergone metabolism to highly reactive, electrophilic intermediates. These products may interact with the cellular constituents in numerous ways and induce several kinds of chemical induced toxicities.

Table 1. Effect on Hematological parameters of mice treated with acute dose (800ppm) of Cyfluthrin

Parameters	Control group	Experimental group			
		3 hrs	24 hrs	7th day	15th day
(RBC/mm^3) ×10^6	04.50±0.17	04.35±00.81	02.28±00.12***	04.89±00.63	02.22±0.27**
(WBC/mm^3)×10^3	06.39±0.78	08.06±00.95	06.00±01.61	07.41±00.64	05.62±0.46
Hb (gm/dl)	28.50±1.70	29.05±00.20	30.50±03.52	32.31±00.29	22.35±2.81
PCV (%)	41.90±1.95	42.06±02.62	56.00±09.80***	36.00±04.11	32.94±4.91
MHC (pg/cell)	56.25±3.30	71.80±13.11	150.00±15.15**	67.00±07.65	99.25±5.57**
MCV (μ^3/cell)	82.75±4.71	102.0±15.27	280.0±50.50*	77.66±08.11	142.5±11.0**
MCHC (% / cell)	74.36±8.84	69.53±03.97	100.0±14.69	89.90±08.57	69.75±7.58
Neutrophils (%)	66.00±1.29	67.00±02.06	54.00±04.04*	52.00±01.48	12.00±0.40***
Basophils(%)	01.30±0.37	01.00±00.13	00.50±00.00	06.00±00.58**	37.00±1.25***
Eosinophils(%)	02.30±0.55	02.60±00.80	03.00±00.50	05.00±01.22	2.25±00.48
Monocytes(%)	04.33±2.51	01.00±00.13	28.50±01.51**	09.00±02.44	40.0±00.70***
Lymphocytes(%)	28.00±0.70	25.66±02.35	14.00±02.01*	35.00±02.95	09.00±0.81***

*= p=0.05 (Significant), **=p=0.01 (Highly Significant), ***=p=0.001 (Very Highly Significant) Each value represents Mean ± Standard error of 4-6 animals

Table 2. Effect on Hematological parameters of mice after sub chronic exposure of Cyfluthrin at the dose level of 100ppm per day for 28 days

Parameters	Control group	Experimental group			
		15th day	28th day	45th day	60th day
(RBC/mm^3) ×10^6	04.54±0.14	04.77±1.32	04.29±00.34	03.51±00.57	05.22±0.67
(WBC/mm^3)×10^3	06.04±0.69	07.21±01.83	04.63±00.40	06.76±00.75	05.46±1.16
Hb(gm/dl)	28.80±1.38	20.98±00.93***	28.81±00.63	21.83±02.12**	27.00±1.50
PCV(%)	41.35±1.64	38.73±01.51	41.00±01.61	50.00±02.69**	39.66±1.92
MHC (pg/cell)	57.71±2.99	49.16±09.64	68.15±07.21	65.29±10.81	48.00±2.77
MCV (μ^3/cell)	82.51±3.72	90.73±19.05	96.25±05.81	148.6±21.41***	73.00±09.79
MCHC (% / cell)	74.83±6.97	54.35±03.26**	70.50±03.34	44.22±06.34**	74.26±12.34
Neutrophils(%)	60.00±6.00	28.00±07.71**	20.00±08.52**	16.00±01.17**	58.00±2.22
Basophils(%)	02.70±1.37	35.00±03.33***	36.00±05.22**	39.33±03.34***	07.00±0.58**
Eosinophils(%)	04.70±2.40	12.33±01.48**	07.33±01.48	10.66±01.88	03.0±00.58
Monocytes(%)	04.80±2.34	24.33±02.64**	26.00±07.91*	23.66±01.79**	09.00±00.58
Lymphocytes(%)	27.60±0.69	07.00±01.55***	09.00±02.69***	10.33±01.22***	03.51±2.06***

*= p=0.05 (Significant), **=p=0.01 (Highly Significant), ***=p=0.001 (Very Highly Significant) Each value represents Mean ±Standard error of 4-6 animals

The daily oral administration of Cyfluthrin for 15 days resulted in a very highly significant ($p \leq 0.001$) reduction in Hemoglobin content and Lymphocyte count, a highly significant decrease ($p \leq 0.01$) in MCHC value and Neutrophil count, a very highly significant ($p \leq 0.001$) elevation in Basophil count, and a highly significant ($p \leq 0.01$) increase in Eosinophil count and Monocyte counts when compared with control values (Table 2). These hematological changes were observed only during the period of dose exposure and initial recovery period but all values attained their normalcy during recovery period i.e. on 60th day except Basophil Count and Lymphocyte Count. A highly significant ($p \leq 0.01$) elevation in Basophil value and very highly significant ($p \leq 0.001$) decrease in Lymphocyte count were observed even at 30 days of recovery period (i.e. after 60 days of commencement of experiment). Other alterations observed in blood indices- RBC value and WBC value were not significant ($p \leq 0.05$).

Causes of increase in the Basophil count in treated animals may be due to viral infection, allergic diseases and chronic myeloid leukemia. Increase in Monocyte count and Basophil count were also reported by Bhatia and Kaur, 2009 in mice on sub chronic exposure of an organophosphorus pesticide; Dimethoate. Morawati, 1998 reported significant reduction in Monocyte count in mice treated with subchronic dose of Thimet. Hematological alterations observed by him were back to normal level after recovery period (after 6th week of exposure) which is in accordance with our results. Goel *et al*, 2006 reported that Chloropyrifos treated rats showed a significant lymphopenia (decrease in lymphocytes) ($P \leq 0.05$) after 4 weeks, which deteriorated further at 8 weeks ($P \leq 0.001$) which is also observed in our study. Banaee *et al*, 2008 reported that after 20 days of sub-lethal exposure to an organophosphorus pesticide; Diazinon, Cyprinus carpio had significantly lower ($p \leq 0.05$) hemoglobin content and leukocyte count. They also stated that lower than normal levels of lymphocytes (lymphopenia) can be an indicator of immune system deficiency. Poisonous substances treatment (Cyfluthrin) can also deplete the body's supply of lymphocytes.

The hematological parameters in the present study showed a significant alteration under different doses of Cyfluthrin exposure. Therefore, it can be concluded that Cyfluthrin demonstrated remarkable hematological toxicity in male Swiss Albino mice.

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