Study of mechanism of synthetic pyrethroid type II fenvalerate on biochemical and hematological alterations in poultry

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Abstract: **This study has been undertaken to investigate the effect of synthetic pyrethroid type II fenvalerate on hemato- biochemical alteration in chicks. The oral administration of fenvalerate in chicks was assessed. Birds were divided into five groups with each group containing 40 birds. The birds of group I was given no treatment and served as control. Group II was administered groundnut oil and served as a vehicle. Group III, IV, V were given 3mg/kg, 6mg/kg, 9mg/kg of fenvalerate suspended in groundnut oil for 90 days daily. The blood samples were collected from birds at the end of the experiment randomly and analyzed for hematological and biochemical parameters. The present study showed that hematological parameter Hemoglobin, packed cell volume; total erythrocyte count remained unaffected while the total leukocyte count was decreased significantly. Fenvalerate induced a significant elevation in serum aspartate aminotransferase (AST) and Alanine aminotransferase (ALT) was observed in treatment groups however serum total protein decreased in all treated groups. It is concluded that chronic exposure of low dose of fenvalerate leads to significant biochemical and hematological changes and cause an adverse effect on the metabolism of birds.**

***Key Words*- Synthetic pyrethroid, fenvalerate, chronic effect, toxicity, alterations.**

I. INTRODUCTION:

In the hunger of innovation and industrialization man has contributed contamination to the life and ecology of plants, animals, and microbes. Demand for food and fibers has been Increased lead to the chemically loaded agriculture and now we have reached on such a position that present day agriculture is completely depended on high yielding varieties, which can only be grown under the control of chemicals. The pesticides are the chemicals that are used for public health operation, domestic, agricultural, veterinary purposes etc. are classified in different heads on the basis of their utility viz insecticides, weedicides herbicides fungicides etc. out of which approximate 70% of total pesticides apply in agricultural and veterinary and in domestic purposes. Pyrethroids are very renowned chemicals are extensively used in agriculture, forest, textile industry, and public health programs worldwide [1]. Synthetic pyrethroid another group of insecticides owe their importance to the outstanding rapid knockdown action on flying insects and to a low mammalian toxicity due to their rapid metabolic conversion to non basic produced [2,3]. Synthetic pyrethroids are esters of chrysanthemic acid halo substituted chrysanthemic acid 2-(4-chloophenyl)-3-methyl butyric acid and alcohol (eg. Allethrolene, 3-phenoxy benzyl alcohol) for certain pyrethroid asymmetric centre (s) exist in the acid and / or alcohol moiety and the commercial products sometimes consist of a mixture of both optical (R/S and D/L) & geometric (cis / Trans) isomers. Although most of the compounds having insecticidal properties may reside in only one or two isomers such as of d-phenothrin and deltamethrin, pyrethroid such as allethrin, resmethrin d-phenothrin and teramethrin are used for insects of public health importance and cypemethrin, deltamethrin, fenvalerate and permethrin are largely used for agricultural purposes.

Two distinct of types of synthetic pyrethroid have been identified, as judged by different behavioral neuropathological, chemical and biochemical profiles. Type I also known as class 1 or T for tremor and type II also known as class 2 or cs for choreoathetosis-salivation [4,5]. Fenvalerate is a potent synthetic pyrethroid that has been in use. Since 1976 it is an ester of 2(-4-chlorophenyl)-3-methyl butyric acid and α-cyno -3-phenoxybenzyl alcohol but lacks a cyclopropane ring.

Fenvalerate is a synthetic pyrethroid which has been widely accepted and got profound popularity due to its rapid bio degradability and low mammalian toxicity [3] lead to the emergence of a number of pesticides. However their indiscriminate use very after results in major health problems.

The hazardous effect on the human health is increasing day by day. To combat the problem of insect in food grains and crop initially use of chlorinated hydrocarbons and organophosphate were started due to slow biodegradation of these insecticide, residual may remain on the crop, which if eaten by animals and human beings suffer from many metabolic disorders. In due

course of time most of the insecticides were banned and pyrethroid got place to combat the problem of insect in agriculture but the question of toxicity is still burning problem because ultimately pyrethroid are use to kill insect by attacking on other mechanism of central nervous system and respiratory system or any other else.

On contrary Chicks are prone to insecticide toxicity because poultry houses and birds are dusted with insecticides. Generally the poultry feed is highly exposed to chemicals because the threat of insect during its future storage procedure. Most of time feed which declared unfit for human consumption is used as poultry feed. Introduction of poultry to such chemical toxic substance causes health risk and economic losses, while also poising a potential threat to public health due to the presence of insecticide residues in poultry meat. There are plenty of confirmations to recommend that the use of insecticide in crop, in storehouse, in poultry and animal husbandry leaves behind its residue causing alteration in some of the primary biological processes. There are many fact of insecticide toxicity which are still unexplored and need systematic investigation to protect environmental health in poultry.

II. EXPERIMENTAL DESIGN:

Day old chicks were procured from local hatcheries. The chicks were randomly and equally divided in to five groups of 30 chicks each. All chicks were previously vaccinated against marek's disease prior to delivery. At the start of the first day, chicks were provided electrol in water. That afternoon, chicks received commercial starter feed.

Twenty four hour prior to housing the birds, room was hygiene and fumigated with potassium permanganate and formalin. Birds were housed in a deep litter system and a floor provided with sufficient space to each chick. Each group had a separate marking inside the poultry shed. Methodically dried and disinfected chopped paddy straw was provided as a bedding material for chicks. For estimation of biochemical parameter 6 chicks were selected at random from each group and blood was collected. Fenvalerate 20% EC (sumicidin) was obtained from Rallis India Ltd. Mumbai. Day old chicks were equally divided into five groups each having 40 birds. Group I and II were treated as control and vehicle respectively no treatment of fenvalerate was there they are administrated with simple groundnut oil. Group III, IV and V administrated with 3mg/kg BW, 6mg/kg BW and 9mg/kg BW of fenvalerate for 90 days.

LD50 was tested. The duration and dose exposure was accordingly of sub lethal dose. All the chicks were vaccinated against marek's disease on the first day of hatching they were vaccinated for Ranikhet disease on the sixth day of age. All chicks were given Furasol in water for 5 days in the first week of experiment. Subsequently Bifuran medication of drinking water was used to prevent coccidiosis. On the last day of experimentation, blood was collected from each bird either from wing vein or directly from the heart, centrifuged, and serum sample was subjected to biochemical estimation. Studies on following parameter were carried out. Hemoglobin (Hb) percentage, Packed cell volume (PCV), Total Erythrocyte count (TEC), Total leucocye count (TLC), Aspartat aminotransfease(AST), Alanine aminotransferase(ALT), Total protein (gldl) were estimated following method given by Schalm's veterinary heamatology. Aspartate amino transferase (AST), Alanine aminotransferase (ALT) by adopting the method of [6]. Total proteins are estimated by modified Dumas and Bi- uret method. The data were analyzed using (student t- test) SPSS 24 and (Data expressed Mean±S.D.) statistical significance was ascribed at $P<0.01$ and $P<0.05$

Severity and extent of the clinical signs varied according to dosage administration to the chicks. The clinical symptoms observer after administration of fenvalerate were sudden onset of depression, reduced feed consumption, dullness, ruffled feather, severe limb weakness, some time paralysis, green diarrhea was also observed, while control chicks did not show any visible clinical signs. Nervine symptoms like tremor, head down condition were noticed. Bird showed typical signs of pyrethroid toxicity like low arousal, no approach and touch response, and decreased rearing activity.

III. RESULT AND DISCUSSION:

The present study was carried out to see the effect of synthetic pyrethroid type II fenvalerate hemato-biochemical parameters of chicks despite the healthy appearance of bird. Clinical diagnosis is the basic tool used in human and veterinary medicine to diagnose and predict the diseases and to observe the effect of therapeutic, nutritional, and environmental management [7]. Exposure of fenvalerate did not create any significant change in the level of haemoglobin, Packed cell volume and Total erythrocyte. Although, the Hb level was decreased during the entire period of study but the value was statistically non significant.

This type of decreased in Hb also observed by [8, 9] after administration of different insecticides in chicks. Aminotransferases (AST and ALT) are the first indicator tool in diagnostic enzymology when liver damage has occurred [10], because of their intracellular location in the cytosol, toxicity affecting the liver with subsequent break down in membrane structure of the cells leads to their leakage in to blood and this increase in AST and ALT activity may be due to increased transamination for rapid breakdown of carbohydrates and proteins to compensate the increased energy crisis resulting from fenvalerate intoxication. Increase of blood ALT and AST indicates other hepatic enzyme activities are related to hepatic damage and change in liver metabolism and its functioning [11].Raising level of these enzymes is key indictor to the leakage of these enzymes to the blood stream [12]. The hepatic damage might be attributed to oxidative damage by free radicals [11, 13] statistically significant ($p<0.01$) reduction in total protein was observed during the entire period of experimentation, which agreed with the result of previous research [14, 15, 16]. Total protein reduction may observe due to physiological stress due to exposure of synthetic pyrethroid, and also decreased in non target animal also. Hypoproteinaemia was detect, may poor feed consumption and hepatic toxicity is the main reason for this, because liver is the main site for translation.[14].

Table: 1 Effect of daily oral administration of fenvalerate on hemato-biochemical parameters in chicks (*Gallus domesticus)*

Parameters	Group I	Group II	Group III	Group IV	Group V
Hemoglobin(Hb)%	9.87±0.3	9.85±0.3	9.15±0.3	8.97±0.1	8.78±0.8
Packed cell volume (PCV)	30.06±2.2	30.12±1.3	28.16±0.6	26.32±0.9	26.22±0.2
Total Erythrocyte	2.62±0.9	2.63±0.8	2.40±0.3	2.39±0.9	2.51±0.5
Total leukocyte count	12340.5±333.1	12337.7±184.7	11645.31±132.5^{b}	10267.20±421.9^{b}	10223.87±533.1^{b}
Aspartat aminotransfease(AST)	178.33±1.38	180.3±1.73	213.14±1.24^{a}	241.17±1.45^{a}	243.21±1.23^{a}
Alanine aminotransferase(ALT)(IUl	9.6±0.01	9.7±0.09	12.89±0.01^{b}	13.22±0.29^{a}	13.82±0.32^{a}
Total protein (gldl)	3.88±0.7	3.75±0.3	2.76±0.8^{a}	2.44±0.4^{a}	2.42±0.3^{a}

Mean ± standard error (n = 6)
(a,b)level of significance $P<0.01$,$P<0.05$

IV. CONCLUSION:

This study showed that chronic exposure of minimal dose of fenvalerate cause hepatotoxicity. Chicks are prone to synthetic pyrethroid (SP) toxicity because they are generally dipped into the solution of SP to get rid of ticks and mites. Synthetic pyrethroids are lipophilic in nature and consequently its dermal absorption leads to toxicity, Thus more awareness is needed to bound the use of insecticides, particularly fenvalerate used in the densely populated countries to reduce their way in into the human food cycle by environmental pollution and Application of pyrethroids may, therefore, be carried out on recommended doses, must be exercised to prevent its adverse effect. Overuse of chemical in field may cause bioaccumulation and bio remediation that may affect non target fauna and flora also.

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