SUMMARY

Now a days large number of pesticides are used in different ways for different purposes. Better production of food and agriculture has become more dependent on the pesticides. These pesticides occupy a unique position among the many chemicals that man encounters daily. Pesticides widely used in agriculture and disease prevention have posed potential health hazards not only to live stock and wildlife but also to fishes, birds, and even to human beings. Some of the pesticides are quite persistent and consequently accumulate in the tissues of animals.

The blood is a very important transport system in the vertebrate body. It is such a sensitive tissue which gets affected very soon even with any minor change of abiotic environmental factors. Knowledge of normal and abnormal blood parameters help in understanding the metabolic activities. Hence it was thought to investigate the effects of some pesticides on the haemato-bio chemical parameters in albino rats.

In the present study the investigations have been made in two parts :-
(A) Haematological studies.
(B) Biochemical studies.

Experiments were conducted with all the three pesticides separately to study the acute and chronic toxicity effects of the three pesticides of different nature. Methods suggested by Sood (1989), Simmsons (1980), Dacie and Lewies (1991), Ranadey et.al. 1991 and Mukharjee (1992) have been followed to study the different haematological parameters. Observations of haematological parameters were made in two groups:

a. Erythrocytes and related parameters.
b. Total and differential leucocyte counts.

Experimental animals were examined daily for any abnormal behavior or mortality if any and recorded the same. The hyperirritability was observed after the acute and chronic exposure of Dimecron, Taidrin (Organophosphate) and Propoxur (carbamate) pesticides. Rats receiving repeated sublethal doses showed crowding specially with Propoxur. The experimental animals became little weaker and did stereotype circling movements, (treated with carbamate pesticide) bent their neck and were restless. In some cases there were paralysis like symptoms as well.

The hyperirritability induced vigorous shivering of body indicating that these pesticides not only induced histopathological changes in the lot there but, they were also neurotoxic in action. The animals remained in such condition from 30 minutes to 2 hours. This particular behaviour was observed specially just after the
administration of Propoxur. Thereafter they became dull depressed and partially unconscious. The experimental animals showed significant changes in the food and water intake for another 2 to 3 days.

In the present study normal values of RBC (10^6/mm^3) in male rats 8.32 ± 0.09 and female 7.60 ± 0.14 Hb (g/100 ml) in male rats 14.73 ± 0.17 and female 14.01 ± 0.16, PCV % in male 46.5 ± 0.19 and female 45.87 ± 0.24, ESR in (mm/hr.) in male 1.56 ± 0.08 and female 2.07 ± 0.07, MCV (μm^3) in male 56.42 ± 0.26 and female 62.79 ± 0.46, MCH (Pg) in male 17.99 ± 0.23 and female 19.05 ± 0.24, MCHC (%) in male 31.84 ± 0.28 and female 30.48 ± 0.19, TLC (10^3/mm^3) in male 3.21 ± 0.08 and female 3.4 ± 0.11, lymphocyte % in male 69.5 ± 0.18 and female 65.125 ± 0.25, Monocyte % in male 1.25 ± 0.10 and female Neutrophil % in male 29.125 ± 0.19 and female 33.375 ± 0.21, Basophil are absent in both sexes. Eosinophil in male 0.125 ± 0.07 and female 0.25 ± 0.10.

On exposure to Dimecron for 96 hours the Hb contents significantly increased in all the experimental rats of both sexes, after 72 and 96 hours of pesticide administration. A significant decline was observed in the TEC count in all the experimental rats of both sexes. The PCV % showed a significant decline till 72 hours stage. The PCV % observed significantly increased at the end of the experiment. Significant increase in the values of MCV was recorded in all the experimental rats. The MCH was found significantly higher in all the experimental rats. The MCHC % was also recorded increased in all the experimental male and female rats. Erythrocyte sedimentation rate (ESR)
was recorded increased in all the experimental stages of both sexes of rats. The TLC showed a significant increase in the count. The values recorded higher in females except at the end of the experiment. Lymphocytes recorded a decrease and neutrophils and monocytes recorded an increase in pesticide treated rats. Basophils and Eosinophils were found totally absent in experimental rats. Dimecron caused lymphopenia neutrophilia along with the monocytosis.

On Tafdrin exposure the TEC count and Hb contents and PCV showed a significant decline in experimental rats. Among the absolute values MCV initially showed positive co-relation with Hb contents and recorded a significant increase in both sexes of rats after 48, 72 and 96 hours of pesticide administration. MCH and MCHC recorded increased in Tafdrin administered rats. Macrocytic hyperchromic condition was observed. ESR was also recorded an increase in both sexes of experimental rats. TLC count was recorded higher in Tafdrin treated treated rats of both sexes. The lymphocytes were observed significantly decreased and neutrophils found significantly increased in treated rats.

On Propoxur administration also the values of TEC count and an increase in MCV were observed due to the toxic effects of Propoxur. These are clear indications of anaemic condition. Hb % was increased significantly. Hb contents showed negative relationship with the TEC. The values of PCV recorded higher in 24 hours stage but observed declining afterward and found lowest at the end of the experiment. MCH and MCHC values recorded a significant increase in Propoxur administered rats. These values remained in accordance with the TEC, Hb contents and PCV values. ESR was recorded higher in control and experimental females.
TLC count increased significantly in all the experimental stages of both sexes of rats. Propoxur caused a significant decrease in lymphocyte percent count and increase in neutrophil count. Basophils and Eosinophils were remained totally absent. Monocytosis was recorded in the experimental rats.

On exposure to Dimecron, Tafdrin and Propoxur for 91 days some interesting changes were observed in different clinical haematological parameters in both sexes of rats.

After seven days of pesticide administration the total erythrocyte count (TEC) was recorded a decrease in all the three pesticides administered rats of both sexes. The values of TEC were observed highest in Dimecron and lowest in Propoxur. The TEC count was observed continuously decreased in all the experimental rats of both sexes and each experimental stage upto the end of experiment i.e., 91 days of pesticides administration. In maximum stages of experiments the highest decrease was observed in Propoxur and lowest in Dimecron except at the stage of 70, 84 and 91 days of administration. In 70 days experimental rats the lowest decrease was noted in Propoxur and highest in Tafdrin, in 84 and 91 days experimental rats, respectively highest decrease in count was noted in Dimecron and lowest in Propoxur.

The haemoglobin content were recorded increased in all the three pesticides administered rats of both sexes, during 7 days to 91 days of experiment. It was observed that Propoxur caused maximum increase in Hb in most of the experimental stages and in few stages the maximum increase was caused by Dimecron (7, 14, 49, 56 days). The minimum
increase in maximum experimental stages was observed in Tafdrin but in few stages it was observed in Dimecron (21, 28, 35-F, 77 and 84 males), but at 49 days stage the minimum increase in values was observed in Propoxur.

The packed cell volume (PCV) recorded uneven increase and decrease in all the three pesticides. In Dimecron the PCV percent was recorded decreased from 14 days to 49 days of experiment. From 56 days onwards till the end of the experiment the percent values of $\frac{PCV}{A_{\text{again}}}$ recorded decreased. In Tafdrin and Propoxur the PCV values were observed decreasing in all the experimental stages except 7 & 14 days stage where the values found increased with Propoxur. The highest values were recorded in Dimecron and Propoxur (7, 14, 63, 70 & 91 days), at 77 days females and 84 days stage the highest values were recorded in Tafdrin. Same way lowest values were also recorded in all the three pesticides i.e. Dimecron (7, 70, 77, 84 & 91 days), Tafdrin (14, 56 & 63 days) and Propoxur (21, 28, 35, 42 & 42 & 49 days).

The significantly decreased values of PCV in short and long term administered rats is original finding because the other workers reported increase in PCV values in pesticide treated mammals.

The erythrocyte sedimentation rate (ESR) found increased in all the experimental stages of all the three pesticides, administered for 91 days. The values were observed highest in all the three pesticides at different stages, Tafdrin (14 and 21 days), Propoxur (70, 84 and 91 days) and in Dimecron, in rest of the stages. Same way lowest value were also reported in Dimecron (70, 84, 91 days), in Tafdrin (35, 42, 63 days) and in rest of the stage in Propoxur.
The mean corpuscular volume (MCV) also found increased in all the experimental stages of all the three pesticides. The highest increase was observed in Tafdrin in most of the experimental stages and in Propoxur in few stages (7, 14, 28 days) and lowest increase was observed in maximum experimental stages in Dimecron and few stages in Tafdrin (21 female & 28 days) and Propoxur (35 days female and 42 days stage).

The mean corpuscular haemoglobin values were recorded increased in all the experimental stages of all the three pesticides. The highest increase in MCH values were recorded in Propoxur in most of the experimental stages except 84 and 91 days female (Dimecron) and 77 days males (Tafdrin). The lowest increase in the values of MCH were found in Dimecron except 7, 14 and 84 days stages where it was recorded in Tafdrin.

The mean corpuscular haemoglobin concentration (MCHC) values were also observed increased in all the experimental stages of all the three pesticides. The maximum increase in values was recorded in Propoxur and in few stages in Dimecron, and minimum increase was found in Tafdrin in maximum stages of experiment.

The mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) under the stress of pesticides have studied by only one or two authors like Ragini et al., Jain and Bhargava (author). Thus all these observations are original findings of this study.

The total leucocyte count (TLC) recorded leucocytosis due to an increase in all the experimental stages of all the pesticides studied. The increase in count was observed highest in most of experimental stages in Tafdrin except 28, 35, 77 and 91 days experimental rats (Dimecron) and 63 days stage (Propoxur). However the lowest increase in count was
found in Propoxur in maximum number of experimental stages except females of 77 days stage (Tafdrin) and 7,14 and 63 days experimental rats (Dimecron).

The lymphocyte percent count was observed decreasing in the experimental stage i.e. 7 days to 91 days stage of all the three pesticides. The maximum decrease in stages, i.e. from 7 days to 91 days stage. However the lowest decrease was observed in Dimecron and Tafdrin (21, 35, 70, 77 & 91 days).

The percent count of neutrophils were also observed in all the experimental stages and neutrophilia was reported in all the stages as an increase in values was recorded in all the experimental rats. The highest values were found in Propoxur but lowest values were observed in Dimecron except few experimental stages.

The monocytopenia was observed in few stages and monocytophelia reported in others. In Propoxur in most of the stages the monocytes remained absent. In Dimecron and Tafdrin also they remained absent in 49 days and 63 days and 21, 84 and 91 days stages. In rest of the stages of experiment, the values observed unevenly increased and decreased in different experimental stages and in different pesticides. The highest values were recorded in Dimecron in most of the experimental stages.

On exposure to Dimecron, Tafdrin and Propoxur for 96 hours and 91 days, the histopathology of blood reveals that the erythrocytes showed anisocytosis, anisochromasia, Macrocytosis, Spherocytosis, rouleaux formation and acanthocytosis with crenations in some or the other stages. Some erythrocytes were observed with shrunken state and few
with central unstained areas.

Among leucocytes the effects of pesticides were observed only in neutrophils. The neutrophils were observed with hyper segmented and ring shaped nucleus and left shift in most of the experimental stages. In some stages ruptured neutrophils were also found. Dohle bodies and 8 shaped nucleus were also seen in few of the experimental stages. All these observations are the original findings of this study.

In the present study observations were also made for the quantitative estimations of total serum protein, serum glucose and serum cholesterol in control and experimental rats. Methods used for the estimation of Protein (Biurate method), Glucose (O-toludine method) and cholesterol (Wybenger and Pilleggi method), as described by Raminik Sood (1987).

On exposure to Dimecron, Tafdrin and Propoxur for 96 hours, it was observed that they cause same effect on total serum protein. The values of total serum protein were observed increased in all the experimental stages of the three pesticides. The changes in values were found significant except very few stages. The increase in total serum protein was recorded highest in Propoxur (8.40 ± 0.05 M and 7.73 ± 0.05 F) than in Dimecron (8.27 ± 0.6 M and 7.57 ± 0.03 F) and lowest in Tafdrin (8.03 ± 0.06 M and 7.47 ± 0.05 F) after 96 hours of exposure. Thus as per their toxicity to this particular parameter, they can be kept in a series like Propoxur>Dimecron>Tafdrin.

After long term exposure (91 days) of Dimecron Tafdrin and Propoxur, caused significant increase in total serum protein in all the experimental rats of both sexes. The
minimum and maximum increase in the values of total serum protein were observed respectively in 7 days and 91 days stage. The values were found increasing with increase of pesticide exposure period. The highest total serum protein values after 91 days of exposure were recorded in Dimecron and lowest in Tafdrin. As per toxicity effect on this particular parameter the three pesticides can be put as - Dimecron > Propoxur > Tafdrin significant increase in the values of total serum protein observed here in Dimecron. Tafdrin and Propoxur administered rats is the original finding of this study.

In the present observations after 96 hours of administration of Dimecron, Tafdrin and Propoxur the serum glucose values were recorded a significant decrease in all the experimental rats of both sexes. The difference observed was only in the degree of toxicity. The decrease in values of serum glucose was observed highest in Tafdrin and lowest in Propoxur. As per their toxicity to this particular parameter they can well be kept in a series like - Tafdrin > Dimecron > Propoxur.

On exposure to Dimecron, Tafdrin and Propoxur for 91 days, the values of serum glucose values were observed decreased in all the experimental rats i.e. 7 days to 91 days treated rats. Among these three cases the values were observed lowest in Tafdrin and highest in Propoxur. As per their toxicity to this particular parameter in this particular experiment, they can be kept in a series as Tafdrin > Dimecron > Propoxur.

On exposure to Dimecron, Tafdrin and Propoxur for 96 hours the serum cholesterol values were found initially significantly decreased after 24 hours of exposure. In 48, 72 and 96 hours stage the values of cholesterol found
little increased with the exposure period. The decrease was observed highest Tafdrin and lowest in Propoxur. Hence as per their acute toxicity effect to this particular parameter, they can be placed as Tafdrin > Dimecron > Propoxur.

On exposure to Dimecron, Tafdrin and Propoxur for 91 days also the serum cholesterol values recorded a significant initial decrease after 7 days of exposure. Lateron in rest of the succeeding stages of experiment, with all the three pesticides, the cholesterol values found recording gradually and significantly increasing along with the increase in the exposure period. The values recorded highest at the end of the experiment i.e. 91 days stage. As per their degree of toxicity to this particular Parameter the three pesticides can be placed like - Tafdrin > Propoxur > Dimecron.

These observations recorded for serum cholesterol for short and long term treated rats are original findings are very different from the observations of other workers. The only work available for on pesticidal effect on serum cholesterol is of Soni and Bhatnagar. Who have reported increase in serum cholesterol level in Phosphamidon administered rats.

In present observations the effects of Dimecron, Tafdrin and Propoxur caused same type of effects on different haemato-biochemical parameters. The difference observed was in their degree of toxicity for particular parameter in particular experimental conditions. All the three have been found haematotoxic in nature.
In case of acute toxicity of Dimecron, Tafdrin and Propoxur decreased TEC count caused the toxic aplastic hemolytic anaemia in pesticide administered rats. Increased Hb concentration in experimental rats indicates the hyperchronic condition. Macrocytic and hyperchronic anaemia is stated by the increased values of mean corpuscular volume and mean corpuscular haemoglobin. The anaemia may be due to the defects caused in erythropoiesis due to pesticide administration or due to causative factors. Like - lack of maturation factor i.e. vitamin B\textsubscript{12} and folic acid. These are usually macrocytic and hyperchronic anaemia. The same has been observed in the present studies.

Leucocytosis was observed in all the three pesticides administered rats. Neutrophilia along with monocytosis and lymphopenia were also observed in pesticide treated rats.

To, conclude, the present study reveals some very interesting effects of pesticides on the blood of albino rats. Possibly similar effects can be speculated for human beings also, specially in the high risk groups exposed to such chemicals in agricultural operations like pesticide spraying on crops etc.

Further studies on the effect of other pesticides which are normally used, but not studied so far for haematotoxic potential are recommended. The pesticide normally effect the living beings in nature in combinations. Thus investigations on their haematotoxic potential and their effect on different vertebrates in maximum possible combinations of different pesticides is also recommended.

It is also recommended to investigate the exact reasoning of increase or decrease of protein, glucose and cholesterol in pesticide administered animals.