Chapter 5

SUMMARY AND CONCLUSION
5.0 SUMMARY AND CONCLUSIONS

The present study was designed to ascertain the toxic effects of oral administration of ethion, an organophosphorus insecticide, on erythrocytes and liver of rats and to see if the supplementation of vitamin E along with ethion could modulate these toxic effects. To carry out the present investigation, adult male albino rats (wistar strain) were orally administered ethion and vitamin E daily for 28 days. The animals were divided into four groups: control; ethion treated (2.7mg/kg bw/day); vitamin E treated (50 mg/kg bw/day) and ethion + vitamin E treated. The animals were sacrificed after 7, 14, 21 and 28 days of respective treatments. Blood and liver tissues were used for various studies. The important findings of the present study are given below:

1. There was a gradual and significant decrease in body weight of ethion intoxicated rats at all the durations of treatment, compared to control and vitamin E treated rats. This decrease in the body weight of ethion-treated rats was more pronounced with the increase in the duration of ethion treatment. However, co-administration of vitamin E along with ethion resulted in increase in body weight.

2. Treatment of animals with ethion resulted in significant increase in erythrocyte and hepatic MDA levels compared to control animals at all interval of treatment. Lipid peroxidation was increased significantly with the duration of ethion exposure. A significant decrease in the LPO in liver as well as erythrocytes was observed when animals were treated with vitamin E along with ethion.

3. A significant decrease in total lipids, cholesterol and protein content of erythrocyte membrane was observed after ethion administration as compared to controls. The decrease was more pronounced with increasing duration of treatment. Supplementation of vitamin E along with ethion had a protective effect against ethion induced alterations in lipid composition.

4. A significant decrease in AChE activity was observed at different time intervals as compared to control animals. Co-administration of vitamin E along with ethion resulted in a significant increase in the AChE activity as compared to the animals treated with ethion alone.
5. *In vivo* administration of ethion resulted in a significant decrease in the activities of membrane bound enzymes (Na\(^+/\)K\(^+-\)ATPase and Mg\(^{2+}\)-ATPase) in erythrocytes. Vitamin E treated rats had significant beneficial effect on Na\(^+/\)K\(^+-\)ATPase and Mg\(^{2+}\)-ATPase activities as compared to their corresponding controls. However, co-administration of vitamin E along with ethion showed mild recovery in erythrocyte Na\(^+/\)K\(^+-\)ATPase and Mg\(^{2+}\)-ATPase activities.

6. A significant decrease in the activity of Ca\(^{2+}\)-ATPase was observed after ethion administration as compared with control rats. The effect was more pronounced with the duration of treatment. However, co-administration of vitamin E along with ethion resulted in significant increase in the activity of Ca\(^{2+}\)-ATPase as compared to the ethion-treated rats. No significant change in Ca\(^{2+}\)-ATPase was observed in control and vitamin E treated rats till 21st days but vitamin E treatment showed its significant beneficial effect after 28 day of treatment.

7. Calcium uptake studies as a function of time and concentration showed that there was an increase in \(^{45}\text{Ca}^{2+}\) uptake in erythrocytes at almost all intervals of time (15 min, 30 min and 60 min) and at various concentrations of radiolabelled calcium (0.5 mM, 1.0 mM, 1.5 mM and 2.0 mM) in all the experimental groups. However, \(^{45}\text{Ca}^{2+}\) uptake was much higher in case of erythrocytes of ethion treated animals at all time intervals and concentrations when compared to erythrocytes of their corresponding control groups. Administration of vitamin E along with ethion resulted in normalization of \(^{45}\text{Ca}^{2+}\) uptake. The change was statistically significant when compared with erythrocytes of ethion treated rats. Similar trends were observed after 14, 21 and 28 days of treatments.

8. Scanning electron microscopy of erythrocytes revealed that administration of ethion resulted in prominent morphological changes (irregular margins, central and peripheral protuberances) in rat erythrocytes. It is evident from the electron micrographs that the erythrocytes of the control group were perfect discocytes (D), that is, typical biconcave disks. The erythrocytes of ethion and
vitamin E treated group showed improved erythrocyte topography as compared with ethion treated group.

9. GSH content in erythrocytes and liver of vitamin E treated group was higher than the control group. Ethion administration led to decrease in GSH content in liver as well as in erythrocytes. It was observed that there was a significant increase in GSH levels in ethion+vitamin E administered groups when compared the ethion treated rats.

10. The activities of superoxide dismutase, catalase, glutathione peroxidase and glutathione-S-tranferase were found to be increased significantly in liver as well as in erythrocytes of ethion treated groups. The increase in the activities of these enzymes following ethion exposure may be an adaptive response to increased production of reactive oxygen species. A significant improvement in activities of antioxidant enzymes in liver and erythrocytes was observed in the ethion and vitamin E treated rats as compared to ethion treated rats. The decrease in antioxidant enzyme activities by vitamin E shows that ethion induced oxidative stress was ameliorated by vitamin E.

11. Ethion treatment resulted in a significant decrease in the activities of glucose-6-phosphate dehydrogenase and glutathione reductase in liver as well as erythrocytes. Vitamin E showed its antioxidant effect by improving the activities of enzymes both in liver and erythrocytes nearly to those in controls.

12. Ethion treatment was found to induce histopathological changes in the liver. There was severe mononuclear infiltration in all portal areas and severe hydropic degeneration. Focal lobular hepatitis was observed and collapse of liver cell cord. Livers of control and vitamin E showed normal morphology. In ethion+vitamin E treated group, hydropic degeneration was also observed as in the ethion treated group, but there was mild vacuolation of hepatocytes. Mononuclear infiltration was less in comparison to the ethion treated group.

13. Genotoxic studies revealed that administration of ethion induced DNA damage in terms of increased micronuclei frequency. A significant protective effect of vitamin E on ethion induced genotoxicity was observed.
It can be concluded from the present study that ethion-induced toxic effects on liver and erythrocytes in terms of biochemical, morphological and genotoxic alterations. The mechanism involved appears to be mediated through increased oxidative stress and compromised antioxidant ability of the cell, which led to alterations in membrane composition and function, ultimately resulting in altered morphology. In addition, alterations in calcium homeostasis and genotoxicity contributed to damage observed following ethion exposure. Vitamin E treatment ameliorated ethion-induced biochemical, morphological and genotoxic changes suggesting that vitamin E supplementation to individuals exposed to ethion as well as other OP pesticides would be beneficial.