SUMMARY

The present work deals with the study of toxic effects of some pesticides (DDT, BHC, Malathion and Carbaryl) on rat, *Rattus rattus* albino. As far as the author is aware of such type of work on the alimentary canal, its associated glands and spleen of *Rattus rattus* albino has not been done. The three group of pesticides (organochlorine, organophosphorus and carbamate) were selected for the present study.

Experiments were conducted on two group of rats. In the first group, lethal dose and LD$_{50}$ values were calculated. In the second group, rats were kept on sublethal dose of pesticides for a period of four, five and six weeks (in case of DDT, BHC and carbaryl) and 10, 20 and 30 days (in case of malathion) and studies were made for histopathological changes and qualitative detection of pesticide residues.

Lethal dose for 96 hrs was 800 mg/kg body weight for DDT, 1000 mg/kg body weight for BHC, 4000 mg/kg body weight for carbaryl and 5 ml/kg body weight for malathion.

LD$_{50}$ values for 96 hrs was 400 mg/kg body weight for DDT, 800 mg/kg body weight for BHC, 3000 mg/kg body weight for carbaryl and 3 ml/kg body weight for malathion.
Sublethal dose for 96 hrs was 200 mg/kg body weight for DDT, 500 mg/kg body weight for BHC, 2000 mg/kg body weight for carbaryl and 2 mL/kg body weight for malathion. The sublethal dose in which rats survived up to six weeks and 30 days (in case of Malathion), used for the present investigation was 50 mg/kg body weight for DDT, 200 mg/kg body weight for BHC, 1 mL/kg body weight for malathion and 1600 mg/kg body weight for carbaryl. Sublethal doses of pesticide was introduced by intramuscular injection in groundnut oil for DDT in olive oil for BHC and in distilled water for carbaryl and malathion.

**HISTOPATHOLOGICAL STUDIES**

After DDT treatment, the histopathological changes on oesophagus were ruptured serosa, space formation and vacuolation in longitudinal muscle and circular muscle layers, and submucosa. Ruptured wall of mucosa showed irregular arrangement and vacuolation.

With BHC treatment, there was fusion in longitudinal and circular muscle layers. Elongated mucosal folds were damaged, submucosa was ruptured and there was space formation in stratified epithelial layer of mucosa and degeneration in columnar epithelial layer.

With malathion and carbaryl treatment, necrosis in longitudinal and circular muscle layers, space formation and
vacuolization in submucosa, ruptured and irregular arrangement of mucosal wall was noticed.

After exposure to DDT, changes observed in stomach were ruptured serosa, fusion in longitudinal and circular muscle layer, space formation in submucosa, space and vacuolization in lamina propria. In ruptured mucosa pycnotic nuclei and vacuolization were seen.

After BHC treatment, serosa was degenerated, there was necrosis in longitudinal and circular muscle layer, splitting in mucosa, ruptured and degenerated cells and space formation in mucosa was seen.

After malathion treatment, ruptured serosa, space formation and vacuolization in submucosa was seen. Dilated and vacuolated blood vessels, ruptured and pycnotic nuclei and vacuolization in mucosa were observed.

After carbaryl treatment, longitudinal and circular muscle layer became compact and fused. Necrosis, degenerated cell and pycnotic nuclei in mucosa was noticed.

After DDT treatment, small intestine showed ruptured and vacuolated villi and submucosa. Damaged intestinal glands, fusion, degeneration and vacuolization in Bruner's glands was
also noticed.

After BHC treatment, flattening of villi, cellular debris, clumping of cells, shrunked Bruner's gland, space formation and vacuolation in lamina propria were observed.

After malathion exposure, necrosis in longitudinal and circular muscle layer, vacuolation in lamina propria, ruptured villi, shrinkage in lamina propria, clumping of cell, and vacuolation in villi were noticed.

After carbaryl treatment, necrosis of villi, space formation and vacuolation was seen in submucosa and Bruner's gland.

After exposure of all the four pesticides, ruptured serosa, necrosis in longitudinal and circular muscle layer, hypertrophied longitudinal and circular muscle layer (in case of carbaryl) space formation and vacuolation in submucosa and lamina propria, necrosis in mucosa and rupture was noticed in rectum.

After DDT treatment, space formation, vacuolization, fusion, hypertrophied pancreatic acini, shrunken blood vescles, and pancreatic ducts, interlobular space, compact islets of Langerhans were seen in pancreas.
After BHC exposure, dilation and space formation were seen in pancreatic ducts. Necrosis, splitting and fusion in pancreatic acini and shrunked blood vessels were also observed.

After malathion and carbaryl treatment, hypertrophy, splitting, fusion, rupture, clumping of acinar cells, ruptured pancreatic duct, shrinkage in blood vessels and dilation and vacuolation in pancreatic duct was noticed.

After exposure to all the four pesticides, ruptured hepatic cells having pycnotic and degenerated nuclei, space formation, vacuolization, hypertrophied intralobular vein (except in BHC) and ruptured interlobular vein were observed.

After DDT treatment, vacuolization, space formation, pycnotic lymphocyte, clumping of lymphocyte in white pulp, ruptured and vacuolated central artery and trabeculae, fusion in red pulp and white pulp, were observed in spleen.

After BHC and carbaryl treatment, splitting in red and white pulp, compact red pulp, elongation in central artery, vacuolation in red pulp and clumping of lymphocyte, swollen trabeculae and dilated central artery, shrinkage in trabeculae (except in BHC) were observed.

After malathion treatment, fusion of red pulp and white pulp, clumping of lymphocytes, space formation in white
pulp, shrinkage and elongation of central artery were noticed.

Histopathological observations reveal that, the entire alimentary canal, its associated glands (pancreas and liver) and spleen gets damaged and loosens the normal architecture indicating toxic and necrotic effects of pesticides, studied in this investigation.

**QUALITATIVE DETECTION OF PESTICIDE RESIDUES**

The accumulation of DDT in the tissues studied was in the following orders -

- liver $>$ stomach $>$ small intestine $>$ oesophagus
- pancreas $>$ spleen $>$ rectum.

After BHC treatment the accumulation was in the following order, liver $>$ stomach $>$ small intestine $>$ oesophagus $>$ pancreas $>$ spleen $>$ rectum.

After malathion treatment the accumulation was in following order, liver $>$ stomach $>$ oesophagus $>$ small intestine $>$ pancreas $>$ spleen $>$ rectum.

After carbaryl treatment the accumulation was in following order, pancreas $>$ liver $>$ spleen $>$ rectum $>$ stomach.
small intestine > rectum.

The qualitative detection study confirms that these pesticides exhibit a wide spread distribution and tendency to stay in all tissues studied as evidenced by their accumulation.

It is concluded that pesticides when enter into the body of mammals induces various harmful effects. Pesticides once observed can remain in the body for some period of time and they may remain as such or in different form after chemical or biochemical modifications. The biotransformations can liberate poisonous moieties from an otherwise innocuous substance. Pesticides thus modified or held as such, may remain at different sites in different concentrations. Constant storage of poisons, viz. in liver may be a source of damage at the site of storage or indirectly in other parts of the body. Action of administered poisons may be either local i.e. localised to the site of application or may occur at sites further away. In later cases, the action may be seen localised to definite tissues.

It is noticed that when pesticides enter into body they are distributed by circulatory system to different organs. Here, with body proteins and fats they produce their metabolites or other complex substances. If the substance is
steadily dosed and is not excreted out, the amount of
substance gradually increases in concerned tissues, raising
its levels of accumulation, causing damage to concerned organs.
Hence, it is necessary to isolate, detect and study the
accumulation of these substances.

ORIGINAL FINDINGS

In the present investigation different part of the
alimentary canal, associated glands and spleen were studied
with reference to four pesticides. The original findings
are:

1. Necrotic and hypertrophic effects on different
   cellular layers of all the parts of alimentary
   canal caused by pesticides studied, as evidenced
   by space formation, vacuolization, rupture, dilation,
   pycnosis and degeneration, shrinkage, etc.

2. Necrotic and hypertrophic effects in the glands
   studied were such as splitting, vacuolation,
   shrinkage, dilation, pycnosis, degeneration in
   different areas and cellular layers.

3. Accumulation of pesticides and their metabolites
   in the tissues studied. This is a novel study and
   have not been done so far.
SCOPE, IMPORTANCE AND RECOMMENDATIONS

The usefulness of the observations reported in the present work provides a concrete evidence of toxic effects of pesticides to rats. It will enable us to understand that how pesticides would behave in the body of humans (if enters into).

The necrotic and toxic effects, causing damage to the alimentary canal and other glands of the experimental animal studied, gave us an information that pesticides if enter into the body of human beings may induce similar type of undesirable changes and thus adversely affect the normal physiology.

The methods used for qualitative detection of accumulation of pesticides in rat tissues could be used as such or suitably modified to detect these pesticides in organs of dead human being as a result of suspected pesticide poisoning and thus may be useful to toxicological and forensic science laboratories.

Area of further researches be devoted to investigate injurious effects of other pesticides and their combinations. By studying this, we can find out that which group of pesticides is more harmful and which group is less? We
can also interpret that in how much concentrations they cause similar effects in other mammals which are of economic importance such as domestic cattles, horse, camel, dog, etc. and then can we identify a particular pesticide simply by studying a specific histopathological changes caused?

It is recommended that extensive work be done taking original cases of chemical poisoning in man and other mammals of economic importance by the forensic scientists, so that an information is gathered, that what actually goes on, in the body when an individual is exposed to such chemicals either by working in the factories or otherwise exposed unknowingly.

It is further recommended that studies on enzymological, biochemical, ultrastructural and quantitative detection of pesticides should be taken up as they will be of much more interest and importance and these studies will tell us that what actually goes on, on enzymological, biochemical and cellular level, if the animals especially mammals are exposed to the pesticides and how much quantity of the same is deposited in their tissues, etc.