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Malathion alters biochemical parameters of liver in albino rats

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Liver represents a key role in the physiology of animals as most of the metabolic mechanisms occur in it. The pesticides entered into the human body through various routes viz., oral, dermal, inhalation, etc. affect the liver and alter the metabolic rate of the individual. Malathion is an organophosphate pesticide, commonly used in all kinds of crops to protect them from different kinds of pests. Here, we studied the toxicological effects of malathion on the liver of albino rats. Different doses of malathion @ 25, 50, 75 and 100 mg/ kg body wt. were orally administered to the rats for 7 and 15 days. The selected biochemical parameters such as protein, sugar, alkaline phosphatase, acid phosphatase, glutamyl oxalotransaminase (GOT), glutamyl pyruvate transaminase (GPT) and glucose-6-phosphatase dehydrogenase (G_6PD) values were measured. Results indicates that the value of protein, acid phosphatase and GPT significantly increases as 5.54±0.99 to 7.35±0.48 mg/g, 14.5±2.50 to 27.37±6.43 mol/g/h and 28.52±3.62 to 37.87±3.94 IU/dL, respectively after treatment. But the sugar, alkaline phosphatase and G_6PD value significantly decreases after treatment from 126.12±2.64 to 84.5±10.83mg/g, 29.12±2.64 to 15.5±4.24,6.46 ±1.56 mol/g/h to 4.62±1.18 IU/gHb, respectively. Value of GOT increased moderately from 38.5±2.44 to44.87±3.31 IU/dL. The above changes revealed the toxic effects of the pesticide malathion.

Keywords: Cythion, Liver toxicity, Organophosphate pesticides, Pesticide toxicity

Pesticides are used globally in agriculture to increase the yield and profit. They control various pests of different crops. Most of the pests exposed to these pesticide chemicals are killed by absorption through the body surface. All the crops like vegetables, fruits, cereals also absorb these chemicals. Pesticide chemicals enter into the body of human through the air, water and food. The pesticide after reaching into the human body affects many bio-chemical activities. Most of the people involved in the farming practices are affected by different diseases caused by these pesticides. Pesticide alters the metabolic activity of the body and causes the most common deadly diseases in society by creating hormonal mediated disruption like the insecticide parathion, malathion, and estrogen, which are responsible to cause breast cancer in women[1].The pesticidal activity also disrupts the vital organs functioning inside the body. When albino rats are treated with a mixture of insecticides like endosulfan, monocrotophos, and hexa-chlorocyclohexane, it creates toxic symptoms in the liver, kidney, and muscles[2].The biochemical parameters of fish *cyprinus carpio* (L.) also alters when treated with a biopesticide Derisome[3]. Occupational workers and non-practicing persons suffer from diabetes disease and the basic reason of the disease is insecticides. Insecticides too have been reported to contribute to obesity and type 2 diabetes in experimental rats[4]. Awareness on pesticide toxicity still requires attention and necessary action. In the present study, we investigated the effect of the commonly used organophosphate pesticide, malathion on selected biochemical parameters of albino rats, particularly in the liver.

Materials and Methods

Malathion, one of the commonly used pesticides, is sold by its trade name cythion or malathion in agricultural store of the local market. The sexually matured rat (*Rattus norvegicus*) of 100 to 200 gm bodyweight of the controlled breed was procured from Humdard University New Delhi. Before starting the experiment, animals were acclimatized under laboratory conditions at room temperature 25 to 30°c. Properly acclimatized animals were divided into five groups — one without any treatment known as the normal group, and the rest of four called the treated group. Each group had 8 animals. The different doses of malathion as 25, 50, 75 and 100 mg/kg body wt./day were orally administered for 7 and 15 days to the experimental animals after calculating the LD_{50} value. The experiment was conducted by getting clearance from the ethical committee of the Institute and necessary precautions were taken to keep the animals free from disease as directed by the competent authorities from CPCSEA Chennai. All the experimental trials for the study done in

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the Zoology Department of D.N (PG) college, Meerut, Uttar Pradesh, India. After 7 to 15 days of treatment and dissecting the animal and removing the liver quickly and then 1.0 g of a clean piece of liver was cut and placed in to cold of 0.25 m sucrose solution. The piece of tissue was crushed with pastel mortar, transferred into centrifuge tube and centrifuged at 12000×g for 30 min[5]. After that, the supernatant was collected for enzyme assay. The tube of supernatant was stored at 4°C[6].

Parameters involved in the study

Protein estimation was done according to the standard method[7], and sugar by the Orthotoluidine method. Alkaline phosphatase and Acid phosphatase were estimated by the biochemical procedure described earlier[8]. Other biochemical parameters, such as glutamyloxalo transaminase(GOT), glutamine pyruvate transaminase (GPT) and Glucose6-phosphatase-dehydrogenase (G_6PD)were measured using calorimeter with standard chemistry[9].

Statistical analysis of the results obtained was done using the ANOVA test. The SD value was used to determine the variation in the sample.

Results and Discussion

Liver dysfunction is correlated to the fluctuation of biochemical parameters such as protein, sugar, alkaline phosphatase, acid phosphatase, GOT, GPT and G_6PD. Significant changes in selected parameters are caused due to the effect of different doses of malathion on experimental animals. Our results indicate significant increases in the amount of protein in albino rats after administration of different doses of malathion as compared to the control group. As shown in Table 1, it represents the damage in liver. At a low dose of pesticide malathion 25 mg to high dose 100 mg/kg body wt. per day, the level of protein significantly increased from 5.54±0.99 to 7.35 ±0.48 mg/g after 7 days of exposure. Initially, the level of protein increased vigorously but at the high dose, the amount of total protein reduced gradually. It indicates that during 15 days of treatment by high dose of malathion liver recover itself against toxic effects of pesticide. Some changes were found in rats when treated with a mixture of pesticides as monocrotophos, hexachlorocyclohexane and endosulfan[2]. Malathion causes an elevation in ALT and significantly decreases the ALP and serum protein level in experimental albino rats[10]. The mice were treated with lambda cyhalothrin (LCT) and it was noticed that the level of protein decreased insignificantly[11]

Sugar is the main constituent of diet and it is used inside the cells as an important fuel for energy production. During the experiment, a significant change in sugar level was observed. The value of sugar reflected indicates the dysfunction of carbohydrate metabolism in the liver. The sugar was significantly decreased after 25 to 100 mg/kg dose/day of malathion for 7 days. As shown in Table 1. The sugar level of experimental animals reduced as per the dose of pesticides increased from 126.12±2.64 to 79.75±12.03 mg/g at 7 days of treatment. But after 15 days of treatment at a dose of 100 mg/kg body wt./day, the amount of sugar in the liver was reported slightly increased up to 84.5±10.83 mg/g. It represents the hypoglycemic condition after administration of a high dose of pesticides. The result indicates an unusual accumulation of glycogen level after administration of different doses of pesticide malathion. A similar finding was observed as oxidative stress marker and glutathione reductase and catalase enzymes altered by the exposure of 2,4-dichloro-phenoxyacetic acid in rats[12]. Liver sugar level depleted at the dose of 25 mg/kg bodywt. of albino rats after administration of acephate insecticide was observed[13].

The enzymatic activity like alkaline phosphatase significantly decreased after the accession of different doses of malathion at 7 days as compared to the normal

Table 1 — Alterations in liver biochemical parameters of albino rats treated with different doses of malathion

Parameters, Days/Doses	Protein (mg/g)		Sugar (mg/g)		Alkaline Phos. (mol/g/h)		Acid Phos. (mol/g/h)		GOT (IU/dL)		GPT (IU/dL)		G_6PD (IU/gHb)	
	7 days	15 days	7 days	15 days	7 days	15 days	7 days	15 days	7 days	15 days	7 days	15days	7 days	15 days
Control	5.54± 0.99	5.54± 0.99	126.12± 2.64	126.12± 2.64	29.12± 2.64	29.12± 2.64	14.5± 2.50	14.5± 2.50	38.5± 2.44	38.5± 2.44	28.52± 3.62	28.52± 3.62	6.46± 1.56	6.46± 1.56
25 mg	6.29± 0.63	7.47± 0.41***	120.48± 14.45	112.8± 8.51***	20.25± 2.31	22.87± 3.52***	17.32± 4.76***	18.75± 4.77**	39.94± 1.27	40.87± 2.16*	28.62± 4.89	28.75± 4.02	5.8± 0.57*	5.5± 0.46
50 mg	6.66± 0.68**	6.29± 0.63	106.42± 7.45**	118.48± 11.23	24± 3.02***	18.37± 2.32***	20.62± 6.32***	18.75± 7.30***	41.75± 1.75	40.37± 2.77*	27.25± 2.05	30± 3.70	5.31± 0.65	5.12± 0.64*
75 mg	6.97± 0.57***	6.49± 0.85*	90.62± 8.08***	89.5± 8.48***	18.37± 2.19***	16.87± 2.74***	20.87± 7.77***	25.5± 5.63***	40.5± 2.39*	41.37± 4.71*	33.62± 3.02**	29.37± 8.15	4.75± 0.65**	4.75± 0.88**
100 mg	7.35± 0.48***	6.65± 0.78***	79.75± 12.03***	84.5± 10.83***	16.12± 3.90***	15.5± 4.24***	25.87± 6.44***	27.37± 6.43***	41.37± 6.47*	44.87± 3.31*	36.25± 4.55***	37.87± 3.94***	4.75± 1.03**	4.62± 1.18**

[P <0.05, **P <0.01, ***P <0.001]

group as 29.12±2.64 to 16.12 ±3.90 mol/g/h as shown in Table 1. After 15 days of treatment, the value of alkaline phosphatase got highly reduced from the normal value 29.12±2.64 to 15.5±4.24 mol/g/h. This reduction indicates the abnormal behaviour of the liver in the albino rat. The acid phosphatase activity significantly increased during both the 7 and 15 days of treatment. The normal values of the animal for acid phosphatase activity after 7 days of treatment reported 14.5±2.50 mol/g/h. But after treatment by lower to higher doses in 7 days, the value increased up to 25.87±6.44 mol/g/h at 100 mg/kg body wt./day dose. After 15 days of treatment, the value of acid phosphates increased up to 27.37±6.43 mol/g/h. Malathion altered the alkaline and acid phosphatase activity in experimental animals. It indicates that liver cells are not working properly. The observation of such high levels of alkaline phosphatase enzyme with acetylcholinesterase could be due to the physiological resistance of med fly against malathion pesticides in Egypt[14].

The value of glutamine oxalotransaminase (GOT) in normal rats reported 38.5±2.44 IU/dL. However, after 7 days of treatment at different doses of malathion, the GOT value significantly increased up to 41.37±6.47. After 15 days of treatment, the GOT value increased highly significantly at a high dose up to 44.87±3.31 IU/dL. The glutamine pyruvate transaminase (GPT) activity in the control group was reported as 28.52±3.62 IU/dL which after treatment by different doses of malathion after 7 days increased up to 36.25±4.55 IU/dL at 100 mg dose. After 15 days, the value 37.87±3.94 IU/dL was highly significant. In our result, a significant increase in GOT and GPT value in experimental rats as compared to the normal group indicates the enzymatic dysfunctioning of the liver. Similar findings reported as insignificant reduction of serum glucose level in *Channa punctatus* (Bloch) fish after the exposure of commercial malathion[15].

The liver functioning enzymes like AST, ALP, and ALT decreased after treatment of malathion. The malathion disrupts the functioning of the liver of rats. It indicates that hepatic malondialdehyde decreased and the amount of serum ASAT and ALAT activity increases after malathion exposure in rats[16]. The malathion causes oxidative stress at different tissue levels because due to its administration in mice the level of hepatic enzymes ALT, AST and GST induced simultaneously after 30 days of exposure[17]. The amount of serum GOT, GPT increased statistically also and acid phosphatase and alkaline phosphatase increased after ingestion of malathion pesticide in rats. It was also noticed that the amount of protein significantly decreased by the exposure of malathion[18]. The G_6PD activity was reported 6.46±1.56 IU/gHb in normal animals but after 7 days treatment with different doses of malathion, the reduction was reported 4.75±1.03 IU/gHb. But the simultaneous decrease was reported after 15 days treatment with a dose of 100 mg/kg body wt./day. Values decreased were highly significant. Hence, the pesticides cause alteration in the biochemical parameters in rat liver. Glucose-6-phosphatase dehydrogenase was significantly decreased in experimental albino rats during the experiment. These changes indicate the damage of liver tissues.

Malathion causes similar toxic effects in *Colossoma macropomum* also in the form of damage in liver and gill region[19]. Oral administration of mixture of monocrotophos and methyl parathion and dimethoate has been reported to significantly decrease the esterase enzyme level in female albino rats[20]. In the case of neonatal rats, the glutathione S transferase enzyme activity is found increased approximately twice the level and liver protein decreased significantly by malathion.

Conclusion

Experimental observations indicate that the pesticide malathion causes toxicity in the liver of rats and disrupts its metabolic functioning. It causes increased oxidative stress to the liver at the tissue level, and also decreases the protein level significantly. The results highlight the risk of exposure to humans as the malathion is used commonly to control pests in agriculture. The society still needs to be educated on creating awareness on pesticide toxicity.

Conflicts of interest

Authors declare no competing interests.

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