http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 6 (4): 359-362, 2003
ISSN 1028-8880

Pesticide-induced Changes in Serum Levels of Acid Phosphatase, Alkaline Phosphates and Glutamate Oxaloacetate Transaminase in Rats

[1]Muhammad Nasim Khan and [2]Tahira Sarwar
[1]Department of Zoology, AJK, Muzaffarabad and [2]Department of Biological Sciences,
Quaid-i-Azam University, Islamabad, Pakistan

Abstract: Three insecticides (Monitor, Talstar and Benzenehexachloride {BHC}), orally administered at the doses of 0.06, 0.5 and 0.2 mg kg^{-1} body weight respectively for 21 days affected the body weight and biochemical environment of blood and liver in the rats. Talstar treatment resulted in an increase in the body weight while Monitor and BHC treatment reduced the body weight. After 21 days of the Monitor treatment, activities of acid phosphatases increased (55%) and alkaline phosphates decreased (2%) in the serum while slight inhibition was observed in the serum glutamate oxaloacetate transaminase activity. Benzenehexachloride treatment resulted in increased serum levels of acid phosphatase, alkaline phosphatase and glutamate oxaloacetate transaminase (42, 2 and 18% respectively). Talstar treatment decreased the activities of acid phosphatase and alkaline phosphatase (76 and 5%, respectively) while glutamate oxaloacetate transaminase activity was increased (25%). These data suggest that chronic exposure to Monitor, Talstar and BHC causes hepatocyte necrosis and increases the liver enzyme synthesis.

Key words: Serum levels, acid phosphatase, alkaline, rats

Introduction

Degradation of insecticides in soil, plants and animals is crucial as large amount of pesticides are either applied directly to the soil or reach it indirectly after application to organisms (Mpofu *et al.*, 1988). A few widely used pesticides are persistent and some relatively non-degradable. Much work has been done on the insecticides belonging to pyrethroid chlorinated and organophosphorus groups.

Monitor is one of the most widely used organophosphorus insecticides for protection against pests of crops and vegetables. The human and animal population is, therefore, directly or indirectly, exposed to the hazardous effects of Monitor (Hazelton and Holland, 1953; Rider *et al.*, 1959).

The action of the organophosphorus insecticides depends upon inhibition of the enzyme acetyl cholinesterase. The neurotransmitter substance acetylcholine functions in various parts of the nervous system in both insects and mammals and inhibition of the enzymes responsible for its removal results in disruption of the nervous control. These insecticides have also been frequently reported to be toxic (Katz *et al.*, 1973). These insecticides are gaining extensive application for agriculture in Pakistan. It is probable that rivers and streams are coming under heavy pollution from these insecticides and they seem to affect the biological fitness of our fresh water fauna.

Gamma BHC an organochlorine insecticide effective against a wide range of soil- dwelling insects is also used in baits for rodent control. These are hazardous to public health, other pests and some animal ectoparasites.

The increasing use of chlorinated insecticide such as Dieldrin has also led to considerable criticism (Watson and Brown, 1977). Such compounds have been declared potentially dangerous because of their persistence in the food crops or because of their penetration into animals (Hill *et al.*, 1994).

Pyrethroid insecticides appear to have superior insecticidal activities. Their breakdown rate is slow as compared to pyriethrin, so are effective in agriculture pest control (Elliott *et al.*, 1972). Despite of claims to the contrary, however, several reports showing their detrimental effects on behavioral, autonomic and neuroendocrine functions of mammals including man have appeared in the past (Beeman, 1982).

Karate pyrethroid insecticide has been shown to increase glutamate oxaloacetate transaminase levels (Shakoori *et al.*, 1992) while Talstar another pyrethroid, was shown to decrease the activities of acid phosphatase and alkaline phosphatase in rabbits (Shakoori *et al.*, 1990).

The assessment of changes in serum enzymes presents an important tool in toxicology of insecticides that was first demonstrated in 1960's (Deichmann *et al.*, 1968).

The objectives of presents study was to assess the changes in the activities of liver enzymes i.e. acid

phosphatase (ACP), alkaline phosphatase (AKP) and glutamate oxaloacetate transaminase (GOT) in the serum of rats after the administration of Monitor, Talstar and BHC for three weeks.

Materials and Methods

Animals and their maintenance: A total of 30 adult male rats weighing 230-320 gm were purchased from the National Institute of Health (NIH), Islamabad. The animals were kept in the animal house of the Department of Biological Sciences, Quaid-I-Azam University, Islamabad, under standard laboratory conditions. Rats were provided with food and drinking water ad libitum. The rats were kept in separate cages with each cage containing five rats.

Insecticides: Benzene hexachloride (BHC, 10% effective concentration [EC] was from Itthad Chemical Industries, Lahore, Pakistan; 0, S-dimethy 1 phosphoramidothion (Monitor, 50% EC) was from Chevron Chemical Company, San Francisco, CA, USA, and Bifenthrin (Talstar, 10% EC) was from ICI Agrochemicals, Survey, U.K. All the above insecticides were obtained from the National Agricultural Research Centre, Islamabad, Pakistan.

Experimental design: Groups of rats (n=5 per group) were randomly assigned to receive BHC (0.66 mg per rat) Talstar (0.5 mg per rat) Monitor (0.2 mg per rat) orally every day for 21 days with the help of a small rubber tube. The control rats were given vehicle only (1 ml of distilled water per rat). The doses of insecticides were estimated from previously available data (Shakoori and Haq, 1986; Shakoori *et al*., 1992).

Blood sampling: At the end of the 21 day treatment period the animals were weighed and killed with an overdose of ether. The trunk blood was collected, allowed to clot overnight (4°C) and serum was separated following centrifugation (1500 g for 30 min). Sera were stored at -20°C until the enzyme analysis.

Analysis of serum enzymes: The changes in AKP, ACP and GOT activities were determined by using the specific enzyme analysis kits (Randox Laboratories Ltd., Crumlin, Co. Antrim, N. Ireland).

Statistical analysis: Changes in the enzyme activity following insecticide administration were compared with pre-administration control values in an individual by using student "t" test. Significant difference was taken at $P < 0.05$ (Steel and Torrie, 1960).

Results

Body growth: The body weight of rats was drastically affected by the Monitor, Talstar and BHC treatment. After Talstar treatment the body weight of rats was increased while after Monitor and BHC treatment the body weight was reduced.

Serum enzyme levels: Monitor administered at a dose of 0.06 mg kg^{-1} body weight per day for 21 days produced significant alterations in the serum enzymatic activity (Table 1).

The serum ACP levels increased significantly after monitor treatment. The activity of AKP decreased in the serum. Slight inhibition was observed in the serum GOT activities, which was not statistically significant.

Talstar administered at a dose of 0.2 mg kg^{-1} body weight per day for 21 days produced significant alterations in serum enzymes. The levels of ACP and AKP decreased while GOT concentrations increased (Table 2).

BHC administered at a dose of 0.5 mg kg^{-1} body weight per day for 21 days also produced significant alterations in serum enzyme levels. ACP, AKP and GOT values in treated rats increased considerably as compared with the control (Table 3).

Discussion

Pesticide use has risen considerably in the recent past. In addition to its primary target, pesticides can also affect human and animal population in the vicinity of insecticide sprayed area. Once the insecticides enter the body, it is transported to different parts of it through the blood (Deichmann *et al*., 1968). The administration of insecticides, therefore affect the biochemical environment of blood and liver.

In line with several previous investigations (Shakoori *et al*., 1990; Shakoori *et al*.,1988; Shakoori and Haq, 1986) results of the presents study demonstrate significant alteration of liver enzyme levels in the blood by orally administration of organochlorine, organophosphorus and pyrethroid insecticides in rats. Treatment with BHC increased the activity of ACP, AKP and GOT in the serum. Synthetic pyrethroids seem to have adverse effects on a number of tissues. Pyrethroids insecticides have been shown to inhibit cholinesterase activity of erythrocytes, liver and brain in rats (Kagan *et al*., 1986). Wang *et al*. (1988) carried out biochemical study about the effects of deltamethrin on animal nerves. Besides having adverse effects on nerve tissue in the body, pyrethroids also had toxic effects in other organs of the body.

Tang *et al*. (1987) studied the effect of Deltamethrin in the cardiovascular system of rabbit. Blood pressure elevation, heart rate decrease and ECG abnormalities were detected in anaesthetized rabbits after intravenous injection of deltamethrin. Blood is the first tissue to be affected by

Table 1: The effect of orally administered Monitor (0.06 mg kg^{-1} body weight) on serum enzyme levels (mean±SEM; n=5) in rats

Enzyme	Control	Monitor
Alkaline phosphatase (IU/1)	12.46±1.96	11.36±0.45
Acid phosphatase (IU/1)	09.80±1.36	18.16±0.63*
Glutamate oxaloacetatetransaminase (IU/1)	52.18±2.68	44.00±11.00

* greater than the control value ($P < 0.05$)

Table 2: The effect of orally administered Talstar (0.02 mg kg^{-1} body weight) on serum enzyme levels (mean±SEM; n = 5) in rats

Enzyme	Control	Talstar
Alkaline phosphatase (IU/1)	33.42±2.55	16.37±4.147*
Acid phosphatase (IU/1)	61.72±5.78	39.88±2.95*
Glutamate oxaloacetatetransaminase (IU/1)	14.28±2.99	29.21±5.02*

• less/greater than the control value ($P < 0.05$)

Table 3: The effect Benzenehexachloride (0.5 mg kg^{-1} body weight) on concentrations (mean±SEM; n= 5) of serum enzymes

Enzyme	Control	BHC
Alkaline phosphatase (IU/1)	58.28±2.36	131.36±24.84*
Acid phosphatase (IU/1)	60.71±5.81	80.37±10.42*
Glutamate oxaloacetatetransaminase (IU/1)	54.17±4.88	92.00±5.08*

* greater than the control value ($P < 0.05$)

insecticides, as a result several deleterious effects on the hematological and biochemical parameters have been reported from different laboratories (Waseermann *et al*., 1973; Lone and Javaid, 1976; Shakoori *et al*., 1988). Liver, being the primary site for biotransformation of foreign compounds, is particularly vulnerable to these chemical assaults. Various enzymes are prone to the actions of insecticides and their metabolites. In most of the cases these enzymes leak out from the necrotic hepatocytes into the blood stream in abnormal amounts. Several of these soluble enzymes have been considered as indicator of liver function and damage (Kulkarni and Hodgson, 1980). Shakoori *et al*. (1990) determined that in rabbits AKP and ACP activities decreased after 15 days if Talstar treatment. This could either be due to excessive excretion of enzymes from the blood of inhibition of enzymes. The GOT activities increased. This increase could be due to leakage of the enzyme from hepatic cells and thus raising levels in blood, increased synthesis and enzyme induction of these enzymes. The increase in the activities of all these enzymes is an ample evidence to indicate the extensive insecticide induced hepatic damage (Shakoori *et al*., 1990).

In the present study AKP and ACP activities decreased in the serum of rats after 21 days of Talstar treatment while GOT activities increased.

Similarly in the present study after 21 days of the Monitor treatment the ACP activities increased while GOT and AKP activities decreased in the serum.

In summary, present data reinforce the toxic effects of organophosphorus, organochlorine and pyrethroid insecticides on hepatic function in rats and demonstrate that these drugs specifically alters liver enzyme systems.

Acknowledgment

The authors gratefully acknowledge the technical assistance of the Pakistan Scientific and Technological information Centre, Islamabad. We thank Dr. M. Shahab, Department of Biological Sciences, Quaid-I-Azam University, Islamabad for stimulating discussions and suggestions during preparation of this manuscript. We are grateful for the help rendered by Nuclear Medicine Oncology and Radiotherapy Institute, Islamabad in carrying out the radioimmunoassays.

References

Beeman, R.W., 1982 Recent advances in mode of action of insecticide. Ann. Rev. Ent., 27: 253-281.

Deichmann, W.B., I. Dressler, Keplingerm and W.E. Macdonald, 1968. Retention of Dieldrin in blood liver and fat of rats fed dieldrin for 6 months. Indian Med. Surg., 37: 837.

Elliott, M., N.F. James, E.C. Kimmel and J.C. Casida, 1972. Metabolic fate of pyrethrin 1, pyrethrin 11 and allerthrin administered orally to rats. J. Agric. Food. Chem., 20: 298-300.

Hazelton, L.W. and E.G. Holland, 1953. Toxicity of malathion, Summary of malathion investigation A.M. A 'Arch. Industr. Hyg., 8: 399.

Hill, D.L., C.I. Hall, J.E. Sander, O.J. Fletcher, R.K. Page and S.W. Davis, 1994. Diazinon toxicity in broilers. Avian Dis., 38:393-6.

Kagan, Y.S., T.B. Pans and L.M. Sasinovich, 1986. Biochemical effects of synthetic pyrethroids. Gig. Sanit, 1: 7-9.

Katz, A.J., W.J. Collins and R.V. Skavaril, 1973. Resistance in the German cockroach (Orthoptera: Blattellidae): the inheritance of diazinon resistance and cross resistance. J. Med. Entomol., 30: 599-604.

Kulkarni, A.P. and E. Hodgson, 1980. Introduction to biochemical toxicology (eds. E. Hodgson and F.E. Guthrie), pp: 341-356. Blackwell, Oxford.

Lone, K.P. and M.Y. Javaid, 1976. Effects of sublethal doses of DDT and Dieldrin on the blood of Channa punctatus Pakistan. J. Zool., 8: 143-149.

Mpofu, S.M., P. Taylor and J. Govere, 1988. An evaluation of the residual lifespan of DDT in malaria control. J. Am. Mosq. Control Assoc., 4: 529-35.

Rider, J.A., H.C. Moeller, T. Swader and R.J. devereaux, 1959. A study of the anticholinesterase properties of EPN and malathion in human volunteers. Clin. Res., 7: 81-82.

Shakoori, A.R., J. Alam, F. Aziz and S.S. Ali, 1990. Biochemical effects of Bifenthrin (Talstar) administered orally for one month on the blood and liver of rabbit. Proc. Pak. Congr. Zool, 10: 61-81.

Shakoori, A.R., S.S. Ali and M.A. Saleem, 1988. Effects of six months feeding of Cypermethrin on the blood and liver of albino rats. J. Biochem. Toxicol., 3: 50-71.

Shakoori, A.R., F. Aslam, M. Sabir and S.S. Ali, 1992. Effect of prolonged administration of insecticide (Cyhalothrin/Karate) on the blood and liver of rabbits. Folio Biological (Karkow), 40: 92-98.

Shakoori, A.R. and R. Haq, 1986. Effect of starvation on the Heptachlor toxicity in rabbits. Folio Biological (Karkow), 35: 33-42.

Steel, R.G.D. and J.H. Torrie, 1960. Principle and procedure statistics. McGraw Hill Book Companies., London.

Tang, T. and Y. Ying, 1987. The effect of Deltamethrin on the cardiovascular system of rabbit. Nanjing Yixueyuan Xuebao, 7: 275-277.

Wang, S.J., Q.L. Zheng, L. Yu, B.H. Xu and Y.R. Li, 1988. Health survey among farmers exposed to deltamethrin in the cotton fields. Ecotoxicol. Environ Saf., 15: 1-6.

Waseermann, M., D. Wassermann, E. Kedar, M. Djavaherian, S. Cocos and S. Ventura, 1973. Effect of organochlorine compounds on serum proteins. Bull environ contam. Toxicol., 10: 42.

Watson, D.L. and A.W.A. Brown, 1977. Pesticide management and insecticide resistance. Academic Press, New York.