Asian J. Exp. Sci., Vol. 23, No. 1, 2009; 165-168

Yaltox Induced Biochemical Alterations in Blood of *Columba livia* Gmelin

B.K. Gupta, L.L. Sharma and Surendra Pal Singh
Department of Zoology,
M.S.J.Govt. P.G. College,
Bharatpur-321001 (Raj); India

Abstract : Yaltox, a widely used, carbamate pesticide, and producing reversible anticholinesterase activity, was intramuscularly administered into blue rock pigeons at 4.17 mg./kg body wt. for acute (one day) and at 1.04 mg/kg. body wt. for sub-chronic (four weeks) treatment to study its impact on blood glucose, serum phospholipids, alkaline and acid phosphatase. Yaltox caused a significant increase in blood glucose level, serum phospholipids, alkaline and acid phosphatase, after acute treatment, however their increase was nonsignificant after sub-chronic exposure. The observed changes may be due to metabolic stress (convulsion and labored breathing) and anticholinesterase activity of yaltox.

Key words : Blood glucose, Serum phospholipids, Serum alkaline and Acid phosphatase.

Introduction

Yaltox, popularly called as carbofuran, a broad spectrum systemic carbamate, produces toxicity by virtue of reversible inhibition of acetylcholinesterase leading to accumulation of acetylcholine at the synapse (O' Brien, 1967). Recently, it has been reported that carbofuran also produces several other biochemical changes, such as alterations in the spectrum of lipid constituents (Gupta *et al. 1986*) and leakage of mitochondrial and cytoplasmic enzymes (Gupta *et al.1991*).

Although it is well recognized that the brain, muscles and heart are the major target organs of anticholinesterase toxicity (Gupta e*t al*., 1991) it seems that carbofuran produces biochemical changes of a greater magnitude in blood biochemistry. Blood plays an important role in coordinating the activities of various tissues through distribution of nutrients, metabolites and other substances to maintain homeostasis. Blood glucose, serum phospholipids, alkaline and acid phosphatase reflect tissue metabolism and the state of health of an animal.

It therefore becomes necessary to investigate alterations in blood biochemistry for the evaluation of normal and abnormal physiological state of the blue rock pigeon after acute and sub-chronic yaltox intoxication.

Matrials and Methods

Experimental animal: Blue rock pigeons, *Columba livia* Gmelin purchased from local animal catcher were acclimated to laboratory conditions for 10 days before experimentation. They were fed on pearl millet (Bajra) and provided water *ad libitum*.

Chemicals: Yaltox (2,3 dihydro 2, 2-dimethyl – 7 benzofuranyl methyl carbamate) obtained from M/s Bayer (India) Limited, Mumbai was dissolved in distilled water. All the other chemicals were obtained from Sigma Chemical Company, New Delhi.

Dose determination: Doses were selected after the determinations of LD_{50} by

* **Corresponding author :** B.K. Gupta, Department of Zoology, M.S.J.Govt. P.G. College, Bharatpur-321001 (Raj); India.

the log probit analysis method (Finney, 1971). The sub lethal doses were selected for experimentation.

Experimental protocol: Forty healthy pigeons irrespective of sex were selected for experimentation. The pigeons were weighed and divided randomly into four sets- one acute of 4 pigeons, one sub-chronic of 16 pigeons, and two control of 4 and 16 pigeons for acute and sub-chronic treatments respectively. The experimental groups were given intramuscular injection of yaltox suspension in doses of 4.17 mg/kg body weight and 1.04 mg/kg body wt. for acute and sub-chronic treatments respectively, Sixteen pigeons of sub-chronic group were given four fractionated sub-lethal doses on 1^{st}, 7^{th}, 14^{th} and 21^{st} day. The controls were given vehicle treatment only using a similar amount of diluent through intramuscular injection.

Blood samples: The pigeons were euthanized and the blood was drawn by ex–sanguivation from heart into the oxalate-fluoride bulb for glucose estimation and test tubes without anticoagulant for serum separation. Serum was separated by centrifugation at 300-400 rpm for 20 minutes.

Biochemical estimation: Level of blood glucose, serum phospholipids, alkaline and acids phosphatase were estimated by the method given by Somogyi (1952), Kind and King (1954), King and Jagatheesan (1959) respectively.

Analysis of data: Data were subjected to statistical evaluation using standard statistical procedures students t-test.

Results and Discussion

The following clinical symptoms and blood biochemical changes in acutely and sub-chronically yaltox treated pigeons were recorded as compared to controls.

Clinical symptoms: On introduction of an acute dose of yaltox pigeons exhibited hypersalivation and tremors within 5-7 minutes. The convulsions, diahrroea labored breathing and leg weaknesses with high severity were evident within 15-30 minutes and lasted about three hours. However in sub-chronically treated pigeons the toxicity manifestations were of mild severity and lasted about one hour as has also been reported by Sarin and Gill (2002).

Blood biochemical changes: The blood biochemical changes are depicted in Table- 1. Blood glucose level rises significantly after acute and sub-chronic (7 days) exposure followed by non-significant increase in subsequent sub-chronic treatments.

An increase in blood glucose level might be due to interference in the cellular blood supply and enhanced fuel and energy requirement of the tissue as a result of convulsion and pulmonary stress caused by yaltox. The intense muscle activity and pulmonary stress so induced may stimulate the conversion of hepatic glycogen (Guyton and Hall, 2001) into blood glucose to compensate the high energy consumption due to the stimulatory effect of yaltox, as has also been reported by Gupta and Saxena (1996), Gupta (1997) and Saxena *et al* (1998).

The normal value of blood glucose after sub-chronic (day 21 to 28) treatment may be accounted on the basis of a clearance of glucose from the blood and transformation of this precursor into glycogen in liver which may be due to either lower toxicity stress or the very less residual effect of pesticide in question, the findings are in agreement to Gupta (1997) and Sarin and Gill (1999).

A significant elevation in the level of serum phospholipids after one-day acute treatment and a non-significant increase after all the sub-chronic intoxication of yaltox in pigeons has been observed. In the present study the increase in serum phospholipids along with the increasing blood glucose level and acid and

Table 1 : Blood Biochemical changes after yaltox intoxication in Columba livia Gmelin

Treatment and Dose	Days	Blood glucose (mg/100 ml) Mean±S.E		Serum phospholipids Mean±S.E		Serum alkaline phosphatase Mean±S.E		Serum acid phosphates Mean±S.E	
		C	**T**	**C**	**T**	**C**	**T**	**C**	**T**
Acute (4.17 mg/kg.)	1	125.34 ± 3.95	148.04 ± 4.16 A	2.45 ± 0.167	3.189 ± 0.147 A	12.497 ± 1.582	20.681 ± 1.263	1.666 ± 3.77	2.039 ± 0.343 N.S
Sub-chronic 1.04 mg/kg	7	142.78 ± 3.14	158.06 ± 3.006 **C**	2.417 ± 0.121	2.407 ± 0.110 N.S	10.452 ± 0.689	16.050 ± 0.593 A	2.878 ± 0.072	3.446 ± 0.225 N.S
	14	145.79 ± 3.389	162.09 ± 6.114 N.S	2.592 ± 0.80	2.680 ± 0.071 N.S	9.807 ± 0.569	17.082 ± 1.296 A	2.812 ± 0.418	1.978 ± 0.234 N.S
	21	147.52 ± 2.455	149.45 ± 3.592 N.S	2.857 ± 0.026	2.807 ± 0.020 N.S	11.762 ± 0.637	15.277 ± 1.116 N.S	2.083 ± 0.447	2.499 ± 0.2 N.S
	28	156.63 +6.317	157.74+5.065 N.S	2.815 +0.057	2.827 +0.049 N.S	20.765 +0.637	23.550 +0.853 B	6.562 +0.474	7.125 ± 0.37 N.S

C= Control, T= Treated, N.S. = Non significant, A= P< .01, B= P<.05

alkaline phosphatase is evident. These findings are in accordance to Fayez and Kilgore (1992), Gupta (1997) and Ender (2006).

Activity of serum alkaline phosphatase increases significantly after acute and sub-chronic (up to 14 days) treatments with a non-significant elevation in the successive sub-chronic exposures.

The increase in the level of serum alkaline phosphatase may be attributed to the pulmonary stress and sustained muscle fasciculations that may lead to oxygen insufficiency causing impairment in the cell membrane permeability of hepatocyte (Gupta *et al.* 1991). Since alkaline phosphatase is a membrane bound enzyme, any change in membrane permeability results in leakage of enzyme into the blood causing an increase in its level.The finding gain support by Ceron *et al.* (1995), Saxena and Gupta (1997) and Gupta (1997), who also recorded increased level of serum alkaline phosphatase in birds. In sub-chronic treatment however the non significant increase in the activity of serum alkaline phosphatase might be due to lower or very less residual effect of yaltox.

A non-significant increase in the activity of serum acid phosphatase has been noted after both the treatments. The non-significant elevation in the level of serum acid phosphatase may be due to thromboembolic condition and the high level of serum alkaline phosphatase (Guyton and Hall, 2001). The findings are in agreement to Tomar *et al.* (1995) and Gupta, (1997).

It is quite probable that to the acute and sub-chronic yaltox intoxication does not affect survivability of pigeons but induces hyperglycemia, increased level of serum phospholipids and alkaline and acid phosphatases after acute treatments.

References

Ceron J., Panizo C.O. and Montes A. (1995): Toxicological effects. In rabbit induced by endosulfan, lindane and Methyparathion representing agricultural by products contamination. *Bull. Environ, Contam, Toxicol.* **54**, 258-265.

EnderY.C. (2006) : Effects of dichlorvos on lipid peroxidation in mice on subacute and subchronic period. *Pesticide Biochem. and Physiology*. **86 (2)**, 106 – 109.

Fayez V. and Kilgore W.W. (1992): Acute Toxic effect of **oxamyl** in the rat. Fundam, Appl. *Toxiciol*, **18**, 155-159.

Finney W.J. (1971): Probit analysis, Cambridge University Press, pp.41-303.

Gupta B.K. and Saxena P.N. (1996): Effect of yaltox on blood and liver carbohydrats in *Columba livia* Gmelin, proceding. 66th Anu. Session National Acad. Scaindia

Gupta B.K. (1997): Toxicological evaluation of yaltox in blue rock pigeon, *Columba livia* Gmelin, an assessment based on behavioral changes, blood and liver biochemistry, Ph.D.thesis. Dr. B.R. Ambedkar University Agra (U.P.)

Gupta M., Mukherjee S., Gupta S.D., Dolui A.K., Dey S.N. and Roy D.K. (1986): Changes of lipid spectrum in different tissues of furadan teated mice. *Toxicology*, **38**, 69-70

Gupta R.C., Goad J.Y. and Kadal W.L. (1991): Carbofuram- induced alteration (in vivo) in high-energy phosphates, creatine kinase (CK) and CK isoenzymes, *Arch. Toxicol*., **65**, 304-310.

Guyton A.C. and Hall J.E. (2001): Cardiac Arrythimias and their Electrocardia graphic interprelation in: T.B. of Medical Physiology, First Indian edition, Harcourt Asia PTE Ltd.pp. 149-158.

Kind D.R.N. and King E.J. (1954): Estimation of plasma phosphatase by determinaion of hydrolyzed phenol with aminoantipyrine. *J. Clin. Path.*, **7**, 322-326.

King E.J. and Jagatheesan K.A. (1959).Estimation of plasma acid phosphatase. *J.Clin.Path.*, **12**, 85-89.

O' Brien R.D. (1967) Insecticides: action and metabolism, Acade New York. pp. 83-107.

Sarin S. and Gill K.D. (2002): Biochemical and Behavioral deficits in adult rat following chronic dichlorvos exposure. *Archiv. of Toxicology*, **19**, 222 –225.

Sarin S and Gill K.D.(1999) : Dichlorvos induced alteration in glucose homoeostasis : Possible implication on the state of neuronal function in rat. *Molecular and Cellular Biochemistry.* **199**, 87-92.

Saxena P.N., Gupta B.K. and Sharma L.L. (1998): Impact of phenyl substituted N-Methyl carbamate on liver biochemistry of *Columba livia* Gmelin. *Proc. Acad. Environ. Biol.*, **7**(1), 51-56.

Saxena P.N. and Gupta Y.K. (1997): Effect of mexacarbate on certain liver biochemical parameters of *Passer domesticus* (Linn). *J.Environ. Biol*., **18 (3)**, 266-268.

Somogyi M. (1952): Nelson – Somogyi method of estimation of blood glucose. *J. Biol.Chem.*, **195**, 19.

Tomar M.S., Dhanotiya R.S., Shilaskar D.V. and Dixit N.K. (1995): Effect of malathion on enzyme of goat liver and serum. *J. Environ. Biol.*, **16(2)**, 151-155.