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Monocrotophos (An organophosphate) induced changes in Phospholipids in the Liver of female albino rat: Histochemical Studies

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Abstract
Six groups of female albino rats were taken for experimental work. 1/5th of LD^{50} dose (14 mg/kg body weight) of monocrotophos was administered by intragastric intubation to groups TI, TII and R for 15 days, 30 days, and 30 days with recovery of 15 days respectively. Corresponding controls for all the three groups were fed on normal diet. For histochemical studies, liver was collected from various groups at the end of the experiment and the techniques for the fixation of lipids and the preparation of slides were used. In control group rats, the liver tissue revealed blue stained small granules and large phospholipids bodies, whereas decrease in phospholipid granules in TI and TII groups was observed. The group R showed moderate recovery in the level of phospholipid studied histochemically. Thus it appears that this pesticide interferes with phospholipids metabolism through oxidative stress resulting in hepatotoxicity.

Keywords: moncrotophos, organophosphate pesticide, phospholipids, liver

Introduction

Monocrotophos [3 hydroxy-N-methyI-cis-crotonamide dimethylphosphate], an organophosphorous insecticide is widely used as an effective crop protectant. It has both systemic and contact properties and has been used against a wide range of insects including mites, boll worms, sucking insects, leaf eating beetles and other larvae on variety of crops [1]. The toxicity of the insecticidally active organophosphorous compounds to mammals and insects is primarily attributed to their ability to inhibit acetyl cholinesterase (AChE) [2, 3]. According to Casarett and Bruce (1980) [4], the liver has a high capacity to bind chemicals and this organ probably concenterates more toxicants than any other organ. Various processes of metabolism and detoxification are catalyzed by hepatic enzymes [5]. These are located in various membranous compartments of liver cells and integrity of these membranes play a vital role in the metabolism of these insecticides. The toxic effects of organophosphorous insecticides on the neuronal functions and structure have been investigated by many workers [6-8], but a very little attention has been paid on the toxic stress laid on the intactness of these cell structures and cellular organelles after treatment with organophosphates [9-11]. The present investigations were, therefore, made to throw light on the histochemical changes in the phospholipids of the liver of female albino rat after exposure to monocrotophos for various durations.

Material and methods

LD^{50} of Monocrotophos was standardized on the basis of the dose calculated by Janardhan *et al*, [12] and was found to be 14 mg/kg body weight. Adult female albino rats of Wistar strain in proestrous phase of estrus cycle weighing 100-150 gm were obtained and divided into three groups TI, TII and R groups (8 rats in each group). 1/5th of LD50 value of monocrotophos I.e. 2.8 mg/kg body weight was administered for 15 days to TI group and for 30 days to TII group. To the rats of R group, the same dose was given for 30 days and then the rats were kept on normal conditions i.e. without monocrotophos for 15 days. Another three group CI, CII and CIII (8 rats in same phase of estrus cycle in each group) were kept as corresponding controls for all the treatment groups. All the animals were kept on the commercial standard diet and tap water *ad libitum*. The weight of animals were recorded weekly.

At the end of treatment period, the rats were sacrificed by cervical dislocation. The thoracic cavity was cut opened to take out the liver in all the groups. The extraneous material was removed and liver was washed in saline. For histochemical studies, small pieces of liver were fixed in formaldehyde calcium for 24 hrs. and processed for gelatin embedding according to the standard technique [13]. The gelatin sections were cut by cryostat at 10 µ thickness and later on subjected to Acid Haematein (AH) staining technique [14].

Results and Discussion

Three types of lipid bodies had been observed : (a) Small thick granular bodies. (2) Large uniformly stained bodies (Fig. 1) and (3) duplex / crescentic bodies. The small granules and large lipid bodies were stained blue in acid haematin. In TI & TII groups, there was marked depletion in color taken by small granules and larger lipid bodies showing the decrease in phospholipids (Figs. 2&3). This decrease might be due to necrotic changes in the hepatocytes which resulted in decrease in the synthesis of phospholipids as 90% of phospholipids are being synthesized in liver.

Organophosphorous pesticides result in formation of reactive oxygen species which can cause hepatotoxicity [15]. They being lipophilic interact with cells through lipid-rich bio-membranes and damage membranes through lipid peroxidation. The synthesis of free radicals result in oxidative stress leading to disruption of membrane lipids and degradation of membrane phospholipids and hence cellular deterioration. They also impair enzymatic anti-oxidant defences like superoxide dismutatse, catalase etc [16-17].

In R group, phospholipids were moderately stained showing a lot of recovery in hepatocytes. (Fig. 4)The recovery might be due to revival of reduced enzymatic activity responsible for detoxification of toxic agents in the liver of treated rats. Hence the workers who get exposed to organophosphorous sprays are required to take a brief period of rest to cope up with the any kind of abnormality and to minimize the danger of intoxication from organophosphorous pesticides including moncrotophos intoxication.

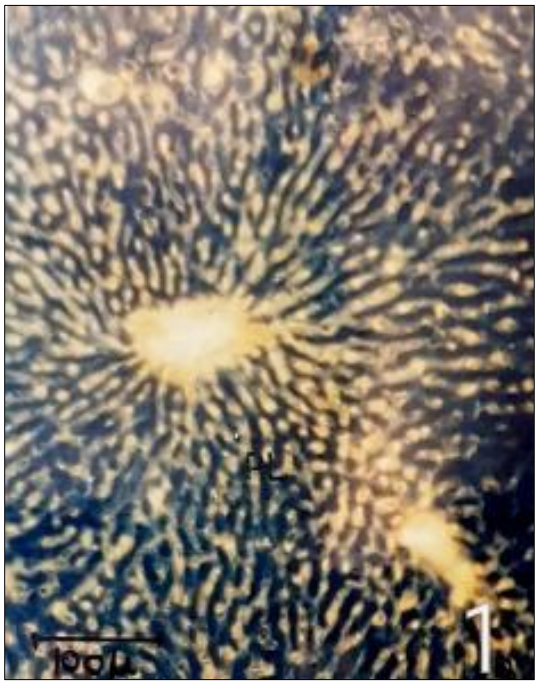

Fig 1: T.S. control liver showing blue stained small granules and large phsopholipids bodies lying towards periphery of hepatic cells and in the sinusoids.FCa-PC/AH.

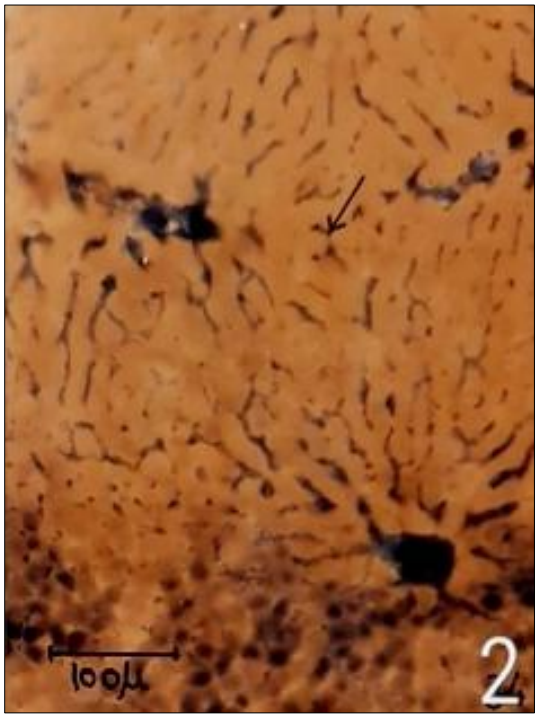

Fig 2: T.S. Liver of TI group showing decrease in phospholipid granules in hepatic cells and sinusoids (arrow). FCa-PC/AH.

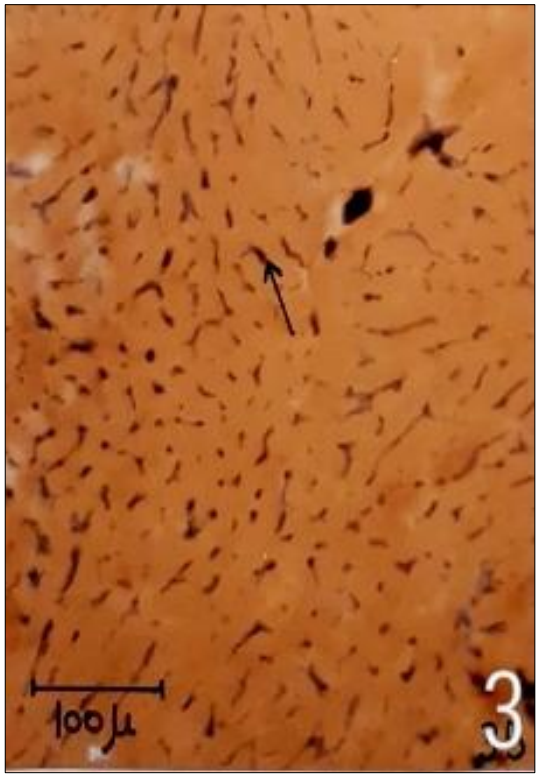

Fig 3: T.S. liver of TII group showing, abundant decrease in phospholipid granules in hepatic cells and sinusoids (arrow). FCa-PC/AH.

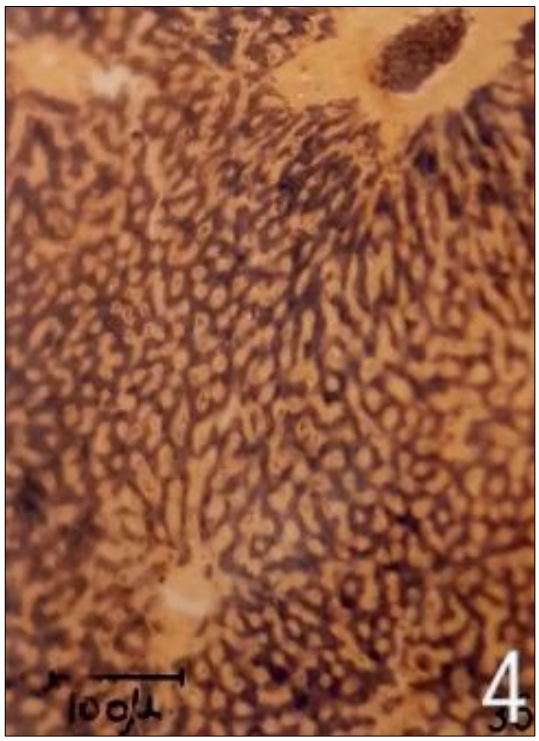

Fig 4: T.S. liver of R group showing increase in phospholipid granules in hepatic cells and sinusoids. FCa-PC/AH.

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