ABSTRACT

A total of 41 healthy male pesticide sprayers exposed to different classes of pesticides for 3-5 years were compared with 21 controls matched for age and economic status with respect to free radical generation, lipid peroxidation, antioxidant status, cholesterol, lipoprotein status and haematological profile. Plasma lipid peroxidation was estimated in the form of thiobarbituric acid reactive substances (TBARS) produced. Significant increase in TBARS was observed in sprayers population when compared with control subjects and the level of TBARS increased with increase in the duration of exposure. The levels of antioxidants such as glutathione (GSH) were significantly depleted, whereas those of superoxide dismutase (SOD) were remarkably increased than control population. Significant reduction in total cholesterol, alteration in lipoprotein fractions and nonsignificant changes in hematological parameters were observed. These results suggested that exposure to pesticidal residual drift augments the free radical generation, and lipid peroxidation. Decline in non-enzymatic antioxidant and elevation of enzymatic antioxidant were observed. Supplementation of α-tocopherol for 45 days resulted in the partial restoration of these biochemical changes produced by pesticides.

KEY WORDS: TBARS, Vitamin E, Pesticide, Cholesterol, Haematology.

INTRODUCTION

Pesticides are continuously dumped in the agricultural field in order to enhance food production by eradicating some unwanted pest or insect vectors. Our present study correlates with three different classes of pesticides namely organophosphates (OP), organochlorine and carbamates. These pesticides differ in chemical nature, physico-chemical properties, mode of entry, uptake by body and metabolism (1).

Several studies have shown an association between health effects and exposure to insecticides which include disorders of cardiovascular system, nervous system, reduced lung function. Disorders like dermatitis, headache and nausea have also been reported. Abnormal electroencephalograms (EEG) were observed in some studies of farm workers exposed to organochlorine, organophosphate and carbamate pesticides. Altered liver enzyme activities have been reported among pesticide workers exposed to organophosphorus pesticides alone or in combination with organochlorine or other pesticides (2).

More recently, various studies from several parts of the world revealed the toxic effects of pesticides on human beings especially by elucidating free radical mechanism, which can be confirmed by the direct measurement of lipid peroxidation byproducts such as malondialdehyde (MDA), lipofucin, diene conjugates and oxido-redox parameters such as superoxide dismutase (SOD), glutathione peroxidase (GPx) and reduced glutathione (GSH) (3).

α-Tocopherol, a proven chain-breaking antioxidant has been used in medicine in the treatment of cataract, atherosclerosis, cancer, tarsive dyskinesia and peripheral neuropathy, but no one carried out
on its effect on sprayers elsewhere. Few reports assessing immunologic and hematologic changes in pesticide sprayers who are occupationally exposed to individual pesticides are available (4) but no detailed report is available on lipid parameters and antioxidant status of farmers occupationally exposed to many different classes of pesticides simultaneously and the role of α-tocopherol supplementation to these sprayers.

MATERIALS AND METHODS

Subjects

Sixty two male subjects were taken up for the present study. Among them, forty one occupational male sprayers with the age group of 22-34 years have been randomly selected based on oral questionnaires from rural area of Chidambaram Taluk, Cuddalore district, Tamil Nadu, who have been in this field for 3 to 5 years with two minimum exposures in a fortnight. The control group consisted of twenty one male healthy volunteers from department of Biochemistry, Annamalai University, Annamalai nagar, who were not performing spraying activity and did not have any kind of pesticide exposure. Consent was obtained from both sprayers and control group persons.

Blood was collected after an overnight fast in heparinised and unheparinised tubes in the sprayfield. Plasma, serum and hemolysate were prepared and stored at - 4°C for further analysis as per the details given below.

Methods

For lipid peroxidation products, thiobarbituric acid was added to plasma sample under acidic condition, and the absorption of colour that developed after heating was estimated spectrophotometrically at 535 nm (5). 1, 1', 3, 3'-tetramethoxy propane was used as an internal standard and the concentration was expressed in nmol of malondialdehyde (MDA) per ml of plasma.

Plasma reduced glutathione was estimated according to the method of Beutler and Kelley (6). This method was based on the development of yellow colour when 5,5'-dithio-bis 2-nitrobenzoic acid (DTNB) was added to compounds containing sulphhydryl groups.

Superoxide dismutase (SOD) activity was assayed according to the method of Kakkar et al (7) using phenazine methosulphate and nitro blue tetrazolium for colour development.

The total serum cholesterol was estimated by the method of Zak (8) and the HDLc was analysed in an Autoanalyser using the reagent kit obtained from Boehrrienger Mannheim, Germany. LDLc was calculated using the formula (9) \[ \text{LDLc} = \text{Total cholesterol} - (\text{HDLc} + \text{TG}/5). \] Serum total lipid content was calculated as recommended by Phillips and colleagues (10). Total serum lipid (mg/dl) = 2.27 x serum cholesterol (mg/dl) + serum triglycerides (mg/dl) + 0.623. Glucose, urea, uric acid and creatinine were assayed in Autoanalyser using the reagent kit (Boehringer Mannheim, Germany).

RESULTS AND DISCUSSION

The present study demonstrated a significant but small increases in Hb (p < 0.05), eosinophil (p <0.01) and decrease in Hct (p < 0.01) in association with increasing pesticide use in a cohort of Chidambaram Taluk farmers. (Tables1 & 2). These findings are in agreement with the investigation of blood chemistry of Nebraska farmers [4] who applied pesticide to their fields. Myeloid: erythroid ratios were markedly increased in bone marrow of beagle dogs exposed daily to the OP insecticide diazinon [11] and erythroid progenitor cells were markedly reduced in the bone marrow of mice, one week after the treatment with OP insecticide, parathione (12). This change was due to a reduction of erythroid element in the bone marrow of pesticide sprayers.

In our present study GSH (P < 0.001) and cholesterol (P < 0.01) (Table 3) were significantly decreased whereas the plasma TBARS and SOD were significantly elevated (P < 0.001) when compared to control subjects. Glutathione is responsible for the protection of cell against oxy-free radicals (13). Decreased level of GSH could be due to the reaction...