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RESIDUES OF SOME ORGANOCHLORINE PESTICIDES IN HUMAN BLOOD IN THE FADASI AREA, SUDAN

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ABSTRACT

Introduction: For many years, organochlorine pesticides (OCPs) have been of interest, because of their toxicity and high persistence .In developing countries, (OCPs) were used in large quantities to control agricultural pests and vectors of endemic diseases. In Sudan (OCPs) were restricted to public health purposes in 1981.

Objective: This study was conducted to asses the residue levels in the human blood.

Methodology: A randomized population sample from Fadasi Village, which is located in a rural area where pesticides have been used for over 35 years were examined.

Result and Discusion: Analysis of human blood revealed the presence of HCH, aldrin, heptachlor epoxide and DDE in varying concentrations. Statistical correlation was found to exist between the pesticide concentration and age, weight and duration of exposure. DDE was present in high concentrations, ranging between 0.38 6.88 ppm.

Key word: Organochlorine, Pesticides, Fadasi, Sudan.

INTRODUCTION

Pesticide residues became a global problem arising from pesticide heavy usage for agricultural purposes, as well as the vectors of human and animal diseases control. Since these chemicals are toxic by nature, they

are considered as a potential health hazard to human and environment pollutants .The majority of these compounds are toxic at high residue levels, and a few are carcinogenic in small animal tests. They reach man through the food chain [1, 2] and accumulate in various organ but organochlorine (OCPs) mainly in fatty tissues [3, 4].

Pesticides can come in contact with man and domestic animals by accidental encounter [5] or as residues in food [6], water [7] and air [8] .The former route often causes acute poisoning, and has been

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studied by medical and veterinary toxicologists. Occupational exposure e.g. pesticide factory workers [9] and pest control operators [10] usually result in chronic poisoning.

The synthetic halogenated organic compounds include such well known compounds as DDT (1, 1, 1-tricholor 2, 2- bis (p chlorophenyl ethane), dieldrin, aldrin and hexachlorocyclohexane (HCH) .They are known as the organochlorine or chlorinated hydrocarbon insecticides. These compounds are highly persistent, low mammalian toxicity and broad spectrum activity. The OCPs have a strong effect on the central nervous system both in insects and mammals. The analysis of the bodies of animals which died from the poising with some OCPs revealed that the kidneys and liver had been harmfully affected .They cause liver damage at high concentrations.The nature of damage ranges from increasing the liver weight and fat contents to cellular necrosis [11] .The OCPs, in common with many other drugs as alcohol and other foreign substances, are capable of inducing an increase in the liver microsomal enzymes. OCP are shown to affect the biochemistry of mammalian systems in numerous ways .These include the induction of microsomal drug metabolizing enzymes, influencing steroid metabolism, increase cellular growth in vitro and modification of the immunological response to certain toxins [11].

Most contaminants found in human blood are fat-soluble substances, which are detected mainly in the erythrocytes and plasma and not in leukocyte and platelets [9], found that plasma albumin and secondarily smaller globulin are the principal plasma protein constituents associated with blood borne p, p' DDT and p, p DDE.They occur primarily in the triglyceridrish low density and very-low density lipoproteins. Probably, the factors affecting the levels of pesticide in the blood are the increase in serum lipids and decreases in serum albumin, [11]. Stehr, 1988, has stated that the severity of clinical signs of poisoning are directly proportional to the concentration of the unmetabolized compound in the brain [12].

SUBJECT, MATERIALS AND METHODS

Fifty blood samples (5ml) were collected from farmers and laborers at Fadasi Village and placed in 10 ml glass stoppered tubes containing 0.1 ml of 20 percent aqueous potassium oxalate as an anticoagulant .The tube contents were gently mixed by inversion. Donors completed a brief questionnaire regarding their exposure to pesticide, food habits, age and weight .Samples were subjected to silica gel clean up and extracted with hexane according to a previously described procedure [13] .

Extracts of these samples were analyzed by gas-liquid chromatography, using a

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Carlo Erba Factor Vap 2101 equipped with a Ni -63 electron capture detector (ECD). Glass column used was 2M 2mm id packed with 5 % OV- 210 on chromosorb WHP 80 100 mesh.

Temperatures of the injection block, oven and detector were 250, 190,300 C^o respectively, nitrogen carrier gas flow rate 60 ml / minute was used. [(11)].

The result was subjected to quantitative and qualitative analysis in comparison with an authentic sample of f HCH, aldarin, heptachlorepoxide and DDE. Standard authentic substrates of > 99% purity were used, p, pg . [1.1.1- trichloro- 2,

2- di (4-chlorophenyl) ethane] was prepared by recrystallization from technical DDT using 85% ethanol. The purity of the product was checked by melting point

determination [found (108.5^o)] and thin-layer chromatography (TLC), P.Pg DDE (1, 1-dichloro-2, 2-bis (P-chlorophenyl) ethylene] , P,Pg TDE (1,1,1 Trichloro -
2,2-bis (P-chlorophenyl) ethane], O,PDDT [1,1,1-trichloro-2-(O-chloropenyl)-2(P-chlorophenyl], aldrin obtained from G. El-Zorgani, and were originally provided by Shell Chemicals (East Africa) , f HCH from Rhone Poulence , France and heptachlor epoxide from Velsicol Corporation , U.S.A.

RESULTS AND DISCUSSION

The results of random sampling grouped on the basis of age (Table 1), weight (Table 2) and duration of exposure (Table 3), have been computed.

Table 1. Relationship between organochlorine pesticide residues in human blood (ppm) and age.

Pesticide	Age (Years)				
Detected	14-21	22-25	26-33	35-42	45-75
	(Mean – SE)	(Mean– SE)	(Mean – SE)	(Mean – SE)	(Mean – SE)
f HCH	0.15 – 0.02	0.18– 0.04	0.17– 0.09	0.12– 0.02	0.16– 0.03
Aldrin	0.01– 0.004	0.02– 0.005	0.02– 0.008	0.03– 0.03	0.009– 0.003
Heptachlor	1.72– 0.72	1.48– 0.25	1.07– 0.30	1.54– 0.34	1.52– 0.30
Epoxide					
DDE	2.56– 0.32	1.98– 0.45	1.78– 0.65	2.18– 0.56	2.16– 0.40

For age, results presented in (Table 1) indicated that residue levels are quite different among distinct segment of the general population and was not associated with age. f HCH show a fairly constant rate in all men aged groups. The maximal f HCH concentration mean (1.18 – 0.04) was in the blood of 22-25 year-old, while minimal detectable amount (0.12 – 0.02) was in the blood of 35-42 yearold. The other three compounds, aldrin, heptachlor- epoxide and DDE show a reduction in concentration level as the age increases. The mean concentration of aldrin (0.01 – 0.004) was the highest in the blood from men14-21 year-old compared with 0.009 – 0.003 observed in 45 -75 years-old i.e. residues were higher for the first age group, likewise heptachlor epoxide, the highest concentration mean in the blood of men aged 14-21 was 1.72 – 0.70, while the minimum detectable levels (1.07 – 0.30) was in the blood of 26-33 year-old. The same for DDE, the mean concentration (2.56 – 0.32) was highest in blood from men 14-21 year-old compared with (1.78 – 0.65) was in the blood of 26-33 yearold. These findings are in contrast to ([14, 15, 5, 16 and 12]), but in agreement with [17], which indicate that changes in human levels as results of decreased chlorinated pesticide residues are more easily detected by monitoring younger than older subjects, these changes are mainly dependent on the duration of exposure. The influence of age is less well defined, although it is generally acknowledged that residue levels rise with increasing age, in general agreement with data obtained from animals. Stehr (1988) [12], found that the level of DDT/DDE rapidly increased from about 5.5 to 11.5 ppm up to the age group 35-44 year-old and became stabilized at 9.0 ppm in the four subsequent age group (45-85 years-old). It has pointed out that obese persons do seem to accumulate fewer residues than the nonobese, although such observation is largely based on human and animal feeding tests, [18].

For weight, the result presented in (Table 2) showed that the mean concentration of f HCH in farmer weighing 44-50 kg was 0.12 – 0.02 and in farmer, weighing 68-80 was 0.16 – 0.04. For aldrin no weight dependent trends for the accumulation of pesticide were detected.

Table 2.Relationship between organochlorine pesticide residues in human blood (ppm) and body weight (Kg).

Pesticide	Weight (Kg)				
Detected	44-50	51-57	58-60	62-65	68-80
	(Mean – SE)	(Mean– SE)	(Mean – SE)	(Mean – SE)	(Mean – SE)
f HCH	0.12–0.02	0.15–0.04	0.17–0.24	0.19–0.09	0.16–0.04
Aldrin	0.01–0.004	0.04–0.03	0.01–0.003	0.06–0.007	0.01–0.006
Heptachlor	1.46–0.32	1.41–0.28	1.33–0.25	1.13–0.26	1.51–0.40
Epoxide					
DDE	2.85–0.50	1.90–0.37	2.03–0.33	1.96–0.69	1.83–0.51

The mean concentration in farmer weighing 44-50 kg was (0.01 – 0.004), and in farmers weighing 68-80 kg was (0.01 – 0.006). For heptachlor epoxide, the maximal concentration mean (1.51 – 0.51) was in the blood of

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68-80 kg weight, while minimum detectable amount (1.13 – 0.26) was in the blood of 62-65 kg weight. DDE show the opposite, the highest concentration mean (2.85 – 0.50) was in the blood of men weighing 44-50 kg, while minimum concentration (1.83 – 0.51) observed in men weighing 68-80 kg. No direct relationship was found between concentration of organochlorine pesticide residue and the weight gain of the donors. This is in acceptance with those reported by [19, 20 and 3].

For the duration of exposure, results presented in (Table 3), showed that all the samples have the highest concentration mean at period 8-10 years. The maximum f HCH concentration mean (0.20 – 0.01) was at period 8-10 years while the minimum detectable levels (0.17 – 0.03) at period 2-3 years.The mean concentration of aldrin in blood with 2-3 years exposure was (0.02 – 0.004) and those with 8-10 years was 0.04 – 0.01.The mean concentration of heptachlor epoxide and DDE in blood with 2-3 years exposure was (1.71 – 0.26), (2.59 – 0.33), an those with 8-10 years exposure was (2.20 – 0.11) and (2.84 – 0.17) respectively.

Table 3 .Relationship between organochlorine pesticide residues in human blood (ppm) and duration of exposure:

Pesticide	Duration of Exposure				
Detected	2-3	4-7	8-10	12-20	25-50
	(Mean – SE)	(Mean– SE)	(Mean – SE)	(Mean – SE)	(Mean –SE)
f HCH	0.17–0.03	0.18–0.08	0.20–0.01	0.08–0.02	0.17–0.02
Aldrin	0.02–0.004	0.01–0.01	0.04–0.01	0.004–0.001	0.008–0.002
Heptachlor	1.71–0.26	1.26–0.23	2.20–0.11	0.82–0.20	1.49–0.28
Epoxide					
DDE	2.59–0.33	1.95–0.58	2.84–0.17	1.18–0.32	2.25–0.48

Although high levels of residue at period 8-10 year exposure are to be expected in the people occupationally exposed to OCPs. These subjects were exposed in different ways ranging from mixing and spraying to supervision of aerial spraying. Typical chromatograms of human blood extract are presented in Fig.1. Naturally, factors such as food habits, physiological state and life style must play an important role in determining the residue levels in man [11] and suggest that meat eater should accumulate more chlorinated pesticide residues than vegetarian. It has been difficult to regulate pesticide intake in man, because of the minute quantities concerned, that most people in large population have been taking microgram quantities of

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pesticides daily through food commodities, which uniformly contain rather low levels of these substance. It becomes apparent that an average person (70 kg) in United States takes in 35 g of DDT per day and has about 5 ppm of DDT in his fat of which 70-80 % in the form of DDE, [21]. The net daily intake amounts to only 0.5 ppb, assuming that the DDT, distributed itselfuniformly throughout the entire body. Thus, it is reasonable to assume that DDT intake at regular dietary level must also affect DDT storage at an early stage and DDE storage after considerable delay.

Turning now to the question of safety, it appears from a study of available cases of accidental intentional ingestion of the compound, that the single oral dose of DDT that will cause poisoning in man is about 10 mg/kg. The repeated dose of DDT that is harmful to man is unknown but studies in volunteers, and in men with massive occupational exposure show that adults can withstand detectable injury 200 times the averages dietary level of 0.18 mg /man/day that prevailed in 1953, [21] .

It is rather difficult to do an epidemiological evaluation because of the small size of samples and absence of health and history of subject sample.

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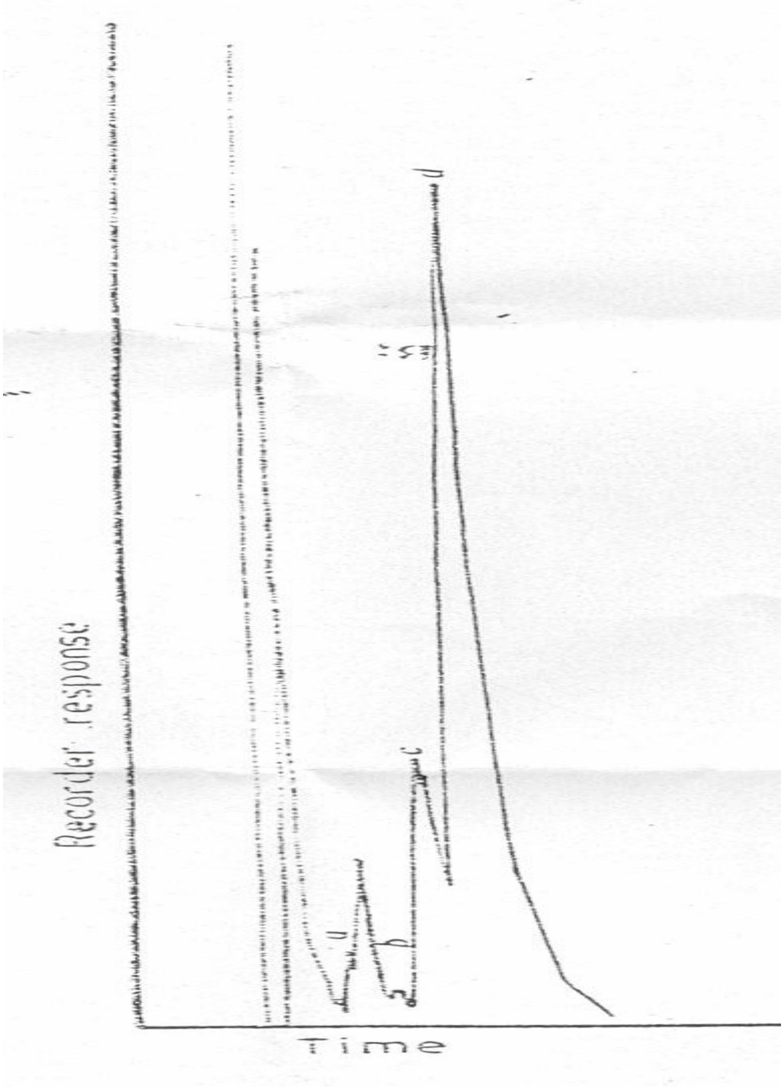

RECOMMENDATION

In order to improve human safety and raise risk awareness during pesticide usage, a number of suggestions are outlined below:

Training on the safe use of pesticides of the target population should be initiated.

Because of the risks to human health inherent by exposure to foreign chemicals, use of pesticide and chemical fertilizers should be integrated with other methods of pest management.

Legislation on transport of toxic substances should be firmly implemented.

Measures should be taken to ensure the safe disposal of obsolete pesticide stocks and pesticide containers.

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Regional seminars on safe use of pesticides should be organized on regular basis for planners, supervisors and other personnel working in this field in collaboration with FAO, WHO and other international organizations.

Toxicological management and application of feasible agro-medical approach to the problem of pesticides usage.

The development of multidisciplinary for more elaborate and wider scale studies in the future.

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