

## ORGANOCHLORINE PESTICIDES BHC AND DDE IN HUMAN BLOOD IN AND AROUND MADURAI, INDIA

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### ABSTRACT

*In this study blood samples are taken from two groups of people, one that has direct exposure to pesticides (agriculturists & public health workers) the second group, which has indirect exposure to pesticides through food chain. The objective of our investigation is to analyze the blood of the patients with minimum health complaints and skin diseases for the residue of the banned organochlorine pesticides DDE and BHC using Gas Chromatography. High concentrations of both BHC & DDE were observed in the serum samples of the people who had direct exposure to the pesticides, namely agriculturalists and public health workers with few exceptions. The pesticide residue concentration in serum ranges from 0.006 to 0.130 ppm for BHC and 0.002 to 0.033 ppm for DDE. Significance of this study reveals that the presence of these banned pesticides in human serum.*

### KEY WORDS

*BHC, DDE, Gas chromatography, Human serum, Organochlorine pesticide, Pesticide residues.*

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### INTRODUCTION

Different groups of population are exposed to pesticides in several ways and in varying degrees such as occupational and non-occupational exposure. The occupational exposure could be during manufacture and formulation of pesticides in industrial settings and their distribution in field condition during application of pesticides. The non-occupational exposure (or) indirect toxic effects may be due to pollution of the ecosystem or habitat as a whole such as from water, air and food. Organochlorine insecticides are potentially toxic, highly persistent and resistant to biodegradation and it readily accumulates in human body tissues, causing a variety of health hazards (1). Even after the replacement of organochlorine insecticides by organophosphorous insecticides, consumer products like edible crops, fruits, milk and soil show substantial levels of organochlorine pesticide residues. Organochlorine insecticide residues, especially DDT and HCH have been detected in man and his environment (2-11). High levels of

DDT and HCH have been reported in human blood, fat and milk samples in India (12). Analysis of human exposure to selected organochlorine compounds shows, that the residue levels of P, P'-DDE {1,1-Dichloro-2,2-bis (P-Chlorophenyl) ethylene} and BHC (benzene hexachloride) were found to be persistent and higher in the human milk samples (13), Until the ban imposed on their use in 1960s (14). Organochlorine insecticides like DDT and BHC (HCH) were extensively used in Indian agriculture and public health enterprises in controlling a number of diseases, such as malaria and typhus. In a multi-centric study to assess the pesticide residues in selected food commodities collected from different states of our country, DDT residues Dichlorodiphenyl dichloroethylene (p,p-DDE) was found in 82% of the study samples of bovine milk collected from 12 states (15). This may be due to unauthorized use of organochlorine compounds and direct exposure to organochlorine insecticide or from edible crops and milk with organochlorine residues that are passed to human beings through food chain.

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The presence of organochlorine and organophosphorous pesticides in general and BHC & DDT in particular has been detected in edible crops, fruits, soil, milk and other consumer products (16). A similar situation has been reported in USA, Western Europe and Israel where workers directly or indirectly exposed to the pesticides had residues in their blood plasma.

This leads to a multitude of health problems like hypertension, elevated serum cholesterol, abnormal EEG or impairment of neuromuscular function, stimulation of drug and steroid metabolism, (17). Blood samples with DDT level exceeding the tolerance limit showed abnormal nerve conductions in some patients involved in pesticide spraying. In this study, samples were taken from two groups. Group one - pesticide occupationlists, like agriculturalists and public health workers who have direct exposure to pesticides. The second group includes non-agriculturalists who have indirect exposure to these pesticides through food chain. We have chosen 22 patients of various occupations with minimum health complaints and skin diseases from Aandipatti area of Madurai, South India for our study. Blood samples are collected from these people and the serum is analyzed for the above said pesticides using gas chromatography.

## MATERIALS AND METHODS

100% pure Pesticide standards DDE and BHC were supplied by Hindustan Ciba-Geigy Ltd, Mumbai. Other chemicals and solvents of analytical grade were purchased from Qualigens Fine Chemicals. 22 people of various occupations with minimum health complaints and skin diseases were selected from Aandipatti area of Madurai, South India for our study. 5 ml of blood was collected from them in blood tubes and was frozen immediately. As soon as the samples were brought to the laboratory, they were centrifuged at 3000 rpm for 15 minutes to separate the serum. 1 ml of serum (three different aliquots were taken from the single sample for extraction) was vigorously shaken with 5 ml of hexane in a cyclomixer. The hexane layer was concentrated to 200 ml under vacuum and injected into GC for analyzing BHC isomers and DDE compounds. Pesticide standards are spiked similarly, 90% recovery was obtained by this method.

### GC Conditions

GC: Hewlett - Packard 5830 A, Column: 2 m x 0.2 cm ID, glass column packed with OV210 on Gas Chrome Q, Column temperature: 200 °C, Injector temperature: 215 °C, Ni<sup>63</sup> ECD Detector temperature: 240 °C, Carrier gas flow rate: N<sub>2</sub>, 30 ml/min.

## RESULTS AND DISCUSSION

The BHC and DDE residual levels in the serum of the blood samples of agriculturalist and non-agriculturalist were quantified. The lowest values of BHC and DDE were observed in the blood of a hill worker who is a farmer since 4 years with

direct exposure to pesticides (Table No: 1 Agriculturalists - Sample No.9). This sample was treated as control or point of reference or referred to as 'standard'. The pesticide concentration in serum samples of the people of other areas in and around Madurai were compared with the standard value (or) point of reference is presented in table1. The values expressed in table are mean values of triplicate readings of three aliquots of sample.

The results of this study revealed that the pesticide concentration in serum between the two groups ranged from 0.006 to 0.130 ppm for BHC and 0.002 to 0.033 ppm for DDE. Prevention of Food Adulteration Act has set the tolerance limit as 0.01 ppm for gamma-HCH and 0.05 ppm. Earlier study on the residues of HCH and DDT (HCH an isomer of BHC) and DDT (the parent compound of DDE) in the blood samples of the general population of the different cities of India ranged from 0.022 to 0.49 for HCH (BHC) and the DDT (DDE) ranged from 0.02 to 0.71 (14).

In our study DDE levels in few samples were 10-15 folds higher than the control value, although the amounts of residues had been found slightly above the tolerance limit of the Prevention of Food Adulteration Act. Our observed values of the residual DDE and BHC are comparatively lower than the earlier reports from India, which may be due to the restriction on use of these pesticides in agriculture. However the toxicological implication of the current findings denotes that there is still a practice of using these banned pesticides BHC and DDE (18).

The results also show the detection of DDE,  $\alpha$ ,  $\beta$  and  $\gamma$  isomers of BHC, but  $\beta$  - BHC alone show higher rate of accumulation in the serum samples and contributing to higher percentages of residues in most of the cases. This is due to the use of technical BHC which has greater proportions of the  $\beta$  - BHC isomers used in this region.

High concentrations of BHC and DDE were noted both in the serum of agricultural and non-agricultural people. The others to the standard indicated that the high deviations (either BHC or DDE) were mostly associated with agriculturalist (table 1). However low deviations from agricultural groups were also observed which might be due to their least exposure to these pesticides. More over the increased level of the BHC in the non agriculturalists and agriculturalists irrespective of their exposure either direct or indirect shows that this Pesticide residue are highly accumulated in their serum by the contamination of their food by this pesticide rather than their exposure. The ealier studies on the residues of these pesticides in milk and infant foods showed increased residue

Table 1  
The Residual Level of BHC and DDE in Human Blood Serum of non agriculturalists and agriculturalists

Sample	Age	Sex	Occupation	Symptoms	BHC Concentration (ppm)	DDT Concentration (ppm)
Non agriculturalists						
1	23	M	Farm rice mill owner since 5 years no direct exposures	Cyst in hands	0.129 ± 0.003	0.016 ± 0.001
2	38	M	Coffee shop owner	Psoriasis	0.062 ± 0.007	0.009 ± 0.0001
3	59	M	Retired accountant in Electricity Board	Eczema in legs (7 years)	0.048 ± 0.009	0.018 ± 0.002
4	55	M	Poultry farm coolie	Itching in feet for 1 year	0.024 ± 0.004	0.026 ± 0.005
5	35	M	Cattle farm coolie for the past 10 years	Eczema in legs	0.023± 0.003	0.004 ± 0.0008
6	31	M	Agriculturalist for 10 yrs, mill watchman for past 3 years	Eczema	0.011 ± 0.001	0.007 ± 0.0009
7	40	M	Mason	Itching	0.051 ± 0.009	0.008 ± 0.0002
8	34	M	Carpenter	Eczema	0.011 ± 0.002	0.010 ± 0.003
9	51	M	Barber	Eczema	0.033 ± 0.009	0.012 ± 0.004
10	51	M	Pesticide spray supervisor for the past 10 years	Eczema	0.02 ± 0.003	0.033 ± 0.007
11	32	M	Poultry farm cattle man	Eczema	0.011 ± 0.003	0.01 ± 0.002
Agriculturalists						
1	25	M	Pesticide Sprayer for the past one year	Irritation all over the body	0.02 ± 0.001	0.024 ± 0.001
2	24	M	Pesticide Sprayer for the past 3 years	Fingers unfoldable after spraying	0.054 ± 0.008	0.010 ± 0.002
3	22	M	Agriculture from boy hood	Leucoderma	0.016 ± 0.0004	0.013 ± 0.002
4	55	M	Farmer, hand mixing of pesticides for 10 years	Itching	0.044 ± 0.007	0.017 ± 0.004
5	22	M	Agriculture for 5 years	Skin rash	0.020 ± 0.003	0.013 ± 0.001
6	40	F	Field worker for the past 8 years	Pain in joints	0.021 ± 0.004	0.008 ± 0.0003
7	50	M	Agriculture from boy hood	Eczema	0.029 ± 0.005	0.021 ± 0.004
8	32	F	Farm worker for the past 10 years	Eczema	0.031 ± 0.007	0.003 ± 0.0001
*9	33	M	Farmer for the past 4 years at present coolie in hills	Eczema	0.006 ± 0.0005	0.002 ± 0.0001
10	50	M	Farmer for the past 20 years	Eczema in legs	0.017 ± 0.004	0.026 ± 0.005
11	36	M	Load man - unloading of pesticide bags for the past 5 years	Psoriasis Scalp	0.061 ± 0.009	0.01 ± 0.002

levels beyond applicable limit. From 2,205 samples of bovine milk 85% of the milk samples contained HCH isomers (alpha, beta, gamma or delta) above the tolerance limits. In the case of gamma-HCH, 28% of samples were above the tolerance limit of 0.01 mg/kg. In the case of DDT, 82% of the milk samples were contaminated, about 37% of these have above the tolerance limit of 0.05 mg/kg as set out under the Prevention of Food Adulteration Act on a whole milk basis (19). This may be the reason for the persistence of these pesticides residues in both groups' agriculturalists and non-agriculturalists taken for our study.

In another study the authors have estimated blood serum

concentrations of BHC and DDT in pesticide sprayers and other people who had no direct exposure to pesticide. The pesticide sprayers had DDT concentrations above the tolerance limits. (20,21). Even though the BHC and DDE levels in few samples of our study were 10-15 folds higher than the control value, the concentrations were very low when compared to that report. Moreover clinical observations in the earlier study showed abnormal nerve conduction in few pesticide sprayers. However no such complaints were received from the blood donors of our present study, except a few agriculturists reporting skin irritation after the pesticide application. So it seems that there is a correlation between the clinical symptoms and the residual pesticide levels.

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