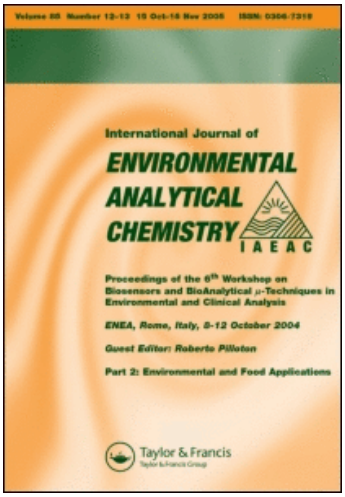

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Storage of DDT and BHC in Adipose Tissue of Indian Males

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Storage of DDT and BHC in Adipose Tissue of Indian Males

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Adipose tissue of 50 human subjects (10 to 60 years old) were taken from autopsy cases and analysed by gas-liquid chromatography equipped with an electron capture detector ($^3H+$) for determination of storage levels of BHC (benzene hexa chloride), DDT (dichlorodiphenyl trichloroethane) and its metabolites DDE and DDD in human body fat. The data is reported according to age (length of exposure), dietetic habits and area of residence of the subjects. The results show relatively moderate exposure to DDT and BHC. Levels of residues were slightly higher in non-vegetarian and rural residents than those of their counterpart vegetarian and urban inhabitants. The study suggests that DDT levels in human adipose show a decreasing trend as compared to earlier report of Dale *et al.*[1] of highest body burden of pesticides being present in indians.

KEY WORDS: DDT, BHC, storage levels, adipose tissue, gas-liquid chromatograph.

INTRODUCTION

Pesticides in different tissues are indicative of the total body burden of the chemicals and levels of exposure to them. They may gain entrance to the human body through the intestine subsequent to ingestion, through the lungs as a result of air-borne pesticide laden dusts, vapours and aerosols; by penetration through the intact skin, and rarely by absorption directly into the blood stream through broken skin. Irrespective of the route of entry, food chain contamination, environmental exposure and the lipophilic nature of organochlorine pesticides and their ability to get deposited in adipose tissue are factors influencing their build-up in human tissues.

A number of investigators have revealed the occurence of organochlorine insecticides in human body fat in different parts of the world.[2-10] Their presence has been detected in adipose tissue of Indians.[1,11] Residue levels of BHC and DDT have been determined in human fat of 50 autopsy samples (all males) collected in 1979 in the present study to

compare with the levels found earlier and to obtain additional information about DDT and BHC pollution.

MATERIALS AND METHODS

Subcutaneous adipose tissue of the abdomen from 50 autopsy cases of sudden death due to accidents or natural catastrophies were collected in aluminium foil from King George's Medical College, Lucknow, India, wrapped and then taken to laboratory for analysis.

Extraction and cleanup of the specimens were performed by the method of Dale *et al.*[12] briefly described below:

1 gm. of adipose tissue was chopped and homogenised in 5 ml of formic acid with the help of a Potter Elvehjem homogeniser. The content was transferred to a 25 ml clean dry conical flask and the homogeniser was rinsed thrice with 1 ml of hexane which were pooled in the same conical flask. 2 ml of more *n*-hexane was added in the conical flask and were shaken for 1 hour at 40°C in a mechanical shaker. Loss of *n*-hexane due to evaporation was accounted for by weighing the flask before and after shaking. The content of the flask was centrifuged at 2000 rpm for 5 minutes in a refrigerated centrifuge and the hexane fraction was collected.

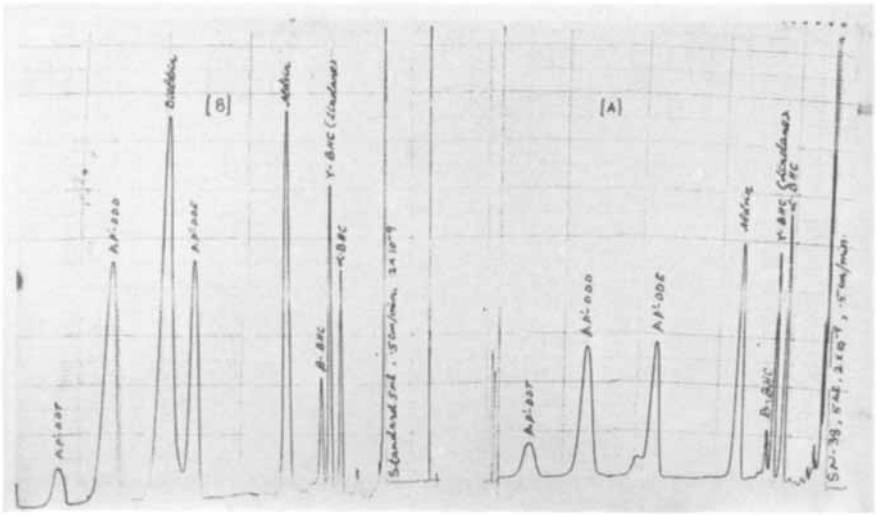
Cleanup of extracted sample with fuming H_2SO_4 and analysis on gas liquid chromatograph "Varian Aerograph-2400" were done as described by Saxena *et al.*[13].

Special care was taken to avoid glass-ware contamination by pesticides. Reagents and chemicals used were of Anal "R" grade and checked against electron capture detector contamination prior their use. Standards were obtained from Poly Science Corporation, Illinois, U.S.A.

Residues detected were further confirmed by thin layer chromatography.

RESULTS AND DISCUSSIONS

Analysis of human adipose tissue for pesticide residues is a useful approach in assessing pesticide contamination of food stuffs and the environment. Table I represents the range and average levels of pesticide residues found in adipose tissue of the general population of India. Analysis of the data with respect to age (length of exposure) showed higher accumulation of all the pesticides except β-BHC in the 26 to 40 years old group. It must be mentioned, however, that the number of samples in this group is far too inadequate to be statistically significant (Table II). Similar to the age study, residues were generally higher in non-vegetarian (Table III) and rural inhabitants (Table IV) than in their counterparts, vegetarian and urban respectively. These findings are not surprising when



Chromatogram showing analysis of (A) sample and (B) standard on Varian Aerograph-2400.

TABLE I
DDT and BHC levels in adipose tissue of general population (ppm)

Pesticides detected	Range	Arithmetic mean	±S.E.
α-BHC	0.123–1.521	0.923	±0.081
β-BHC	0.062–0.853	0.383	±0.023
γ-BHC	0.721–3.012	1.230	±0.249
Total BHC	0.977–5.820	2.536	±0.412
p,p′-DDE	0.260–3.812	2.134	±0.291
p,p′-DDD	0.025–0.451	0.221	±0.025
p,p-DDT	0.162–2.821	1.565	±0.761
Total DDT	0.345–6.952	3.920	±1.523
Ratio of DDE to total DDT residue		0.544	

Levels are reported on wet tissue basis in parts per million (ppm).

TABLE II

Comparison of mean concentration of DDT and BHC in adipose tissue of general population according to age group in ppm.

Age group (years)	Number of Sample Tested	Pesticides detected							
		α-BHC	β-BHC	γ-BHC	Total BHC	p,p′-DDE	p,p′-DDD	p,p′-DDT	Total DDT
10–25	10	0.80 ±0.08	0.27 ±0.02	1.00 ±0.22	2.07 ±0.38	1.90 ±0.27	0.16 ±0.02	1.44 ±0.50	3.10 ±1.41
26–40	15	1.23 ±0.09	0.36 ±0.02	1.50 ±0.28	3.10 ±0.51	2.70 ±0.34	0.30 ±0.03	1.92 ±0.92	4.91 ±2.1
41–60	25	0.90 ±0.08	0.40 ±0.02	1.15 ±0.25	2.44 ±0.44	2.00 ±0.31	0.20 ±0.02	1.46 ±0.71	3.67 ±1.56

TABLE III

Comparison of mean concentration (ppm) of DDT and BHC in adipose tissue of general population according to their dietetic habits

Dietetic habits	Number of subjects	Pesticides detected							
		α-BHC	β-BHC	γ-BHC	Total BHC	p,p′-DDE	p,p′-DDD	p,p′-DDT	Total DDT
Vegetarian	21	0.87±0.08	0.37±0.02	1.07±0.22	2.32±0.38	2.01±0.31	0.22±0.07	1.50±0.72	3.73±1.42
Non-vegetarian	29	1.00±0.01	0.40±0.02	1.35±0.26	2.74±0.41	2.32±0.36	0.25±0.08	1.60±0.78	4.16±1.86

TABLE IV

Comparison of mean concentration (ppm) of DDT and BHC in adipose tissue of general population according to their area of residence

Area of residence	Number of subjects	Pesticides detected							
		α-BHC	β-BHC	γ-BHC	Total BHC	p,p′-DDE	p,p′-DDD	p,p′-DDT	Total DDT
Urban	30	0.90 ±0.08	0.37 ±0.06	1.22 ±0.24	2.47 ±0.40	2.00 ±0.28	0.21 ±0.02	1.50 ±0.75	3.71 ±1.50
Rural	20	0.95 ±0.07	0.40 ±0.06	1.24 ±0.24	2.58 ±0.41	2.21 ±0.30	0.23 ±0.02	1.64 ±0.77	4.08 ±1.53

one takes into account that non-vegetarian meals comprising eggs and mutton etc. are more contaminated with pesticides than those of vegetarian meals.[14, 15] No plausible explanation can be offered for the related high level of residues in the rural population. One factor that might be responsible for the difference between the rural and urban population could be the increasing use of chlorinated pesticides in the pest control in agriculture.

Taking into account how slowly stored DDT is converted to DDE in the body, the dietary content of preformed DDE would seem to represent the main source of adipose tissue stored DDE in the general population.[16] On the other hand, higher tissue levels of DDE than DDT in the general population (Table I) may be due to a less efficient mechanism for DDE excretion. The rate of decay of DDE is only one eighth of the DDT.[17] The relatively high DDD concentration may be attributed to any one or a combination of the following factors.[10]

a) Bio-chemically, DDT is dechlorinated in the human body to DDD, and then either metabolised to water soluble and excretable DDA, or excreted directly as DDD.

b) Some postmortem changes, probably anaerobic metabolism by micro organism.

c) Synthesis of DDD from DDT on the chromatographic column. The on-column conversion of DDT to DDD was found to be 38 to 45%.[10]

The age, and residential differences (Table II and IV) as person to person variation in DDT and BHC levels may be due to non-dietary exposure and individual differences in the dynamics and metabolism of pesticides.[18] The ratio of average level of DDE to that of total DDT was 0.544 (Table I), which shows moderate consumption of animal foods, relatively short duration of exposure to moderate levels of DDT, and *in vivo* formation of DDE.[19]

The data obtained on chlorinated pesticide residues, DDT and BHC, in adipose tissue of Indian population show lower concentrations than those of some other countries (Table V) and decreasing trend of DDT pollution in India.

It is generally accepted that organochlorine insecticides are less acutely toxic, but of greater potential for chronic toxicity, than the organophosphate and carbamate insecticides.[20] DDT and BHC accumulation in adipose tissue may be taken as serious, since, when the energy requirement of the body is not satisfied, the fat depots serve as a chief source of energy and are metabolised. Pesticides stored in them are thus mobilised and may come suddenly in direct circulation in sufficient amount to cause some ill effects. However, with regard to concentration of DDT and BHC detected in Indian adipose tissue, computation from the

appropriate derivations[21, 22] show that their acceptable daily intake by the general population is lower than that recommended by the World Health Organisation[23] as the safe limit.

TABLE V
DDT and BHC levels in apidose tissue of peoples in different countries (ppm)

Sl. No.	Country	Year Year	Total DDT	Total BHC
1.	Germany	1958–1959	2.3	NA†
2.	Hungary	1960	12.4	NA
3.	France	1961	5.2	1.19
4.	Israel	1963–1964	19.2	NA
5.	United Kingdom	1965	2.6	0.16 g
6.	Australia	1965	1.7 g	Na
7.	Holland	1966	2.0	0.1 g
8.	New Zealand	1966	5.3	NA
9.	Denmark	1966	3.1	NA
10.	Italy	1966	10.1	0.06
11.	(a) Canada	1966	3.8	0.07
11.	(b) Canada	1973	4.5	NA
11.	(c) Canada	1977	3.59	2.36
12.	Japan	1974	3.6	2.36
13.	Iran	1974–1976	8.13	0.26
14.	U.S.A.	1966	9.5	0.44
15.	Poland	1966–1967	13.4	NA
16.	Pakistan	1970–1971	25.0	0.48
17.	(a) India	1964	25.1	1.7
17.	(b) India (Present Study)	1979	3.9	2.5

†NA indicates that concentration was not determined.
Reference no. for above tables are: 1 to 6.

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