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Residues of HCH and DDT in food samples from hotels in Tamil Nadu

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ABSTRACT

To estimate the residues of HCH (BHC) and DDT in food, food samples were collected from hotels and restaurents in Coimbatore, Madurai, Trichi, Madras and Kamarajar districts of Tamil Nadu State, India and analysed by gas chromatography. Out of the five food groups viz., cereals and pulses, fruits and vegetables, milk and milk products, egg and meat and water and beverages, the fatty foods like milk, milk products, egg and meat were the main sources of these insecticide residues. These food items contribute more than 50 per cent of the residues. The average daily intake level was 0.25 μg of alpha HCH, 0.24μg of beta HCH, 0.19 μg of gamma HCH and 0.27 μg of DDT. These levels constitute only 0.08, 0.004, 0.003 and 0.004 per cent of the prescribed Acceptable Daily Intake (ADI) level of 0.005, 0.001, 0.01 and 0.02 mg / kg body weight / day for these compounds respectively. The results indicated that the intake of HCH and DDT through food is well below the ADI prescribed by WHO / FAO.

Key words: DDT, food samples, HCH, India, pesticide residues, Tamil Nadu

INTRODUCTION

The two most important and widely used chlorinated hydrocarbon insecticides in India are HCH /BHC (hexachloro cyclo hexane / benzene hexa chloride) and DDT (dichloro diphenyl trichloro ethane). Although these two insecticides are highly effective against many pests and are of low cost, the environmental pollution caused by them resulted in debate among the policy makers on production and use of these pesticides. Over the past few years the public concern has increased for the growing problem of pesticide residues in the environment. In Tamil Nadu, a number of studies have been conducted to identify and quantify the level of contamination of food items by HCH (BHC) and DDT. The earlier studies have indicated widespread contamination of most of the commonly used food commodities like rice (Kannathasan and Regupathy 1992), ground nut and sesame oil (Krishnamoorthy and Regupathy 1990), eggs (Regupathy and Kuttalam 1992) and bovine milk (Regupathy and Kuttalam 1989a; Mercy and Regupathy 1989a) by HCH and DDT.

Monitoring studies alone cannot be relied to ascertain the intake of pesticide residue because the residues may be degraded or lost at various stages of processing, cooking etc. (Visweswaraiah and Jayaram 1972; Awasthi 1987; Rao 1990). Among the different routes of exposure of humans to pesticides, food is responsible for more than ninety per cent of the total intake (Kaphalia *et al.* 1985). Entry of pesticides into the human system is also confirmed by the presence of these compounds in human breast milk (Regupathy and Kuttalam 1989b; Mercy and Regupathy 1989b). In the present study, the intake of HCH and DDT residues through food was assessed in plate meal samples collected from hotels and restaurents of major cities of Tamil Nadu, India.

Abbreviations: ADI- Acceptable Daily Intake, DDT- Dichloro Diphynyl Trichloro ethane, EDI - Estimated Daily Intake, HCH (BHC) Hexachloro cychohexane

MATERIALS AND METHODS

a. Sample collection

The study area included the urban head quarters of four districts viz., Coimbatore, Madras (presently called Chennai), Trichi and Madurai as well as the rural areas of Coimbatore and Kamarajar districts, the high and low pesticide consuming parts of Tamil Nadu, respectively (DA 1997). For collection of food samples (plate meals) five different hotels/ restaurents from urban areas and ten hotels from rural areas were selected. The volunteers were selected on the spot and requested to dine for the whole day in the same hotel / restaurent. Whatever the item of food consumed by the volunteer at break fast, lunch and dinner, the same item and quantity was collected as one food sample. Immediately after the collection, the samples were separated into different categories of food items, in different containers, as given below:

1. Cereals and pulses : Rice + wheat + flour + bread +pulses etc.
2. Fruits and vegetables : Fruits + vegetables (both raw and cooked) + juice etc.
3. Milk and milk products: Milk + curd + cheese + ghee + butter + ice cream etc.
4. Eggs and meat : Egg + mutton + chicken + pork + fish etc.
5. Water and beverages : Water + tea + coffee + soft drinks etc.

Food samples were brought to the laboratory within 48 hours of collection and stored under refrigeration until analysis. On the day of analysis, each category of the samples were separately homogenised/ shaken thoroughly to achieve desired homogenity, from which sub-samples were collected for the analysis.

b. Analysis

Sub-samples (100 g fresh weight) of cereals and pulses, fruits and vegetables were extracted with 100 and 50 ml portions of acetronitrile by blending for 3 minutes each time. The combined extract taken in a separateing funnel was diluted with 600 ml of five per cent aquous sodium chloride solution and partioned in to 100 ml of n-hexane twice. The sub-samples (100 g fresh weight) of milk and milk products, meat and egg were extracted in 2 : 1 v/v n-hexane + acetone mixture by blending. The hexane layer was then separated by washing twice with 300 ml portions of 5 % aquous sodium chloride solution. The sub-samples (one litre) of water and beverages were extracted twice with 100 ml n-hexane by liquid-liquid partitioning.

The pooled hexane layer (for each group of food items separately) was dried by passing through anhydrous sodium sulphate, condensed under vacuum and cleaned up using sulphuric acid digestion method (Kapoor *et al.* 1981). The final determination was done with Chemito model 3800 Gas Chromatograph equipped with ^{63}Ni electron capture detector. The operating conditions were as follows:

Column : Chromatopack (6' long x 0.25"dia.) packed with 1.5 % OV 17 + 1.95% QF 1 on 80/100 mesh chw/ Hp.

Temperature: Oven - 200°C; injector - 220°C; detector base - 240°C; detector source - 260°C.

Carrier gas : Nitrogen at 60 ml/ min. flow rate.

The estimated daily intake (EDI) was calculated by dividing the residue intake per day by body weight of the volunteers and expressed as µg / kg body weight / day. The EDI values were compared with Acceptable Daily Intake (ADI) expressed as mg / kg body weight / day (FDA 1991).

RESULTS AND DISCUSSION

The sensitivity of the instrument and the limit of detectability for different isomers of HCH and DDT are given in Table 1. HCH and DDT contamination in diet is mainly contributed by the non-vegetarian food items like milk and milk products, meat and eggs (Table 2). This is mainly due to the lipophilic nature of these chlorinated hydrocarbon insecticides. Cereals and pulses also contributed to the dietary intake significantly, because these items formed the major portion of the food consumed (Fig. 1). There was no significant difference in the intake levels of the HCH and DDT residues among urban and rural volunteers (Table 3). The total amount of residue in a single day diet of an adult dining in hotels in the present study was 0.25 µg of alpha HCH, 0.24 µg of beta HCH, 0.19 µg of gamma HCH and 0.27 µg of DDT complex. The estimated average daily intake of alpha, beta and gamma HCH was 0.004, 0.004 and 0.003 µg/kg body weight/day. The delta HCH residue was below detectable level in all the samples analysed. The intake level of DDT complex was 0.004 µ g/kg body weight/day.

The contribution of water and beverages in the dietary intake of HCH and DDT was below the detectable level. Considering the ADI prescribed by

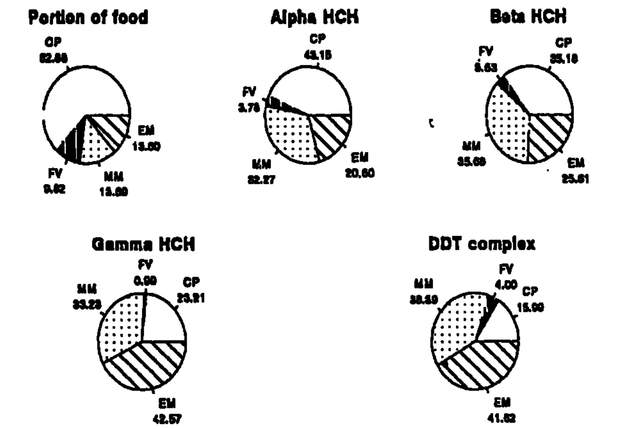
Table 1. Sensitivity and limit of detectability for HCH and DDT.

Compound	Sensitivity (ηg)	Detectable limit 1 x 10^{-4} (ppm)
1. Alpha HCH	0.01	1
2. Beta HCH	0.02	2
3. Gamma HCH	0.01	1
4. Delta HCH	0.05	5
5. DDT complex	0.20	20

Table 2. Residue levels of HCH and DDT in different food items (mean of 40 samples).

Food item	α HCH	β HCH	γ HCH	DDT complex
1. Cereals and pulses	0.1083	0.0838	0.0445	0.0424
2. Fruits and vegetables	0.0095	0.0084	0.0019	0.0106
3. Milk and milk products	0.0810	0.0850	0.0637	0.1018
4. Egg and meat	0.0522	0.0610	0.0816	0.1104
5. Water and beverages	BDL'	BDL	BDL	BDL
Total	0.2510	0.2382	0.1917	0.2652
EDI (µg/kg body wt./ day)	0.0042	0.0040	0.0032	0.0044
EDI to ADI as %	0.08	0.40	0.03	0.02

'BDL- Below Detectable Level.



CP - Cereals and Pulses, FV - Fruits and Vegetables, MM - Milk and Milk products, EM - Eggs and Meat

Fig. 1 Contribution (%) of different food items to the total residue level.

Table 3. Residue levels of HCH and DDT in food samples from different sites.

	Rural*			Urban**		
Chemical	Coimbatore	Kamarajar	Coimbatore	Chennai	Madurai	Trichy
1. α HCH	0.2557	0.2261	0.2828	0.2223	0.2614	0.2575
2. β HCH	0.2612	0.2408	0.2424	0.2232	0.2224	0.2388
3. γ HCH	0.2045	0.1403	0.2214	0.1863	0.1995	0.1971
4. DDT Complex	0.2695	0.1292	0.3281	0.2884	0.3238	0.2520

*Means of 10 values **Means of five values

FRG (for alpha and beta HCH) and Codex Alimentaries Committee (for gamma HCH and DDT complex) (ICMR 1993), the intake levels are very safe, constituting only 0.02 to 0.40 per cent of the prescribed ADI (Table 2).

In conclusion, the levels of HCH and DDT residue intake in the present study, were below the levels of risk. When comparing with the intake levels reported earlier for these chemicals (Gupta *et al.* 1982; Kashyap *et al.* 1994) there was a reduction in the intake level in the present study. However, these levels are much higher when compared to the reports from other countries (Corneliussen 1972; Dick *et al.* 1978; GEMS 1982; Fields 1988). Though gamma HCH alone is insecticidal, the technical material contains about 13 per cent of the gamma isomer, 68 per cent of two alpha stereoisomers and small quantities only of beta and delta isomers. All these three isomers (α, β and δ isomers) are environmental pollutents. Exposure to these chemicals has been already proved to be associated with pancreatic cancer and other health problems in humans (David *et al.* 1992). Considering this, the Government of India has banned the production and use of HCH and DDT (Gazette Notification: F.No.17-7/91 - PP.I, Department of Agriculture & Cooperatives, Ministry of Agriculture, New Delhi, 8 June 1995). However, there is an increasing need to create awareness among the users not to abuse the technical HCH and DDT, which were already produced and still available in the market.

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