Bull. Environ. Contam. Toxicol. (1997) 59:403-406

Bulletin of Environmental Contamination and Toxicology

Levels of HCH Residues in Human Milk Samples from Delhi, India

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Received: 28 February 1997/Accepted: 21 May 1997

Hexachlorocyclohexane (HCH) is one of the most widely used organochlorine insecticides for agriculture and public health programs in India. The large-scale application of HCH over a number of years, coupled with its extreme stability and slow metabolism, has lead to environmental contamination and potential health hazards (Banerjee et al. 1996a). These residues find their ways into various food commodities forming an important source of dietary HCH and ultimate carry-over from food chain into human system (Ramachandran et al. 1984).

Monitoring of organochlorine pesticide residues has always been considered important for assessment of human exposure (Ramachandran et al. 1984; Zaidi et al. 1989). HCH-residues excreted in milk have been reported from different parts of the world (WHO 1991,1992); however, very few reports appeared from India (Krishnamurti 1984). In fact, there is no report on HCH-content in human milk from Delhi area where higher levels of these residues in human adipose tissue and blood have already been reported by us (Ramachandran 1984). We have, therefore, attempted a systematic study to monitor HCH-residues in human milk samples collected from various hospitals of Delhi, India.

MATERIALS AND METHODS

A total of sixty-one milk samples (l0-15 mL) over 5 mL of benzene were collected from lactating mothers (age group 20-30 yr) admitted to various hospitals of Delhi. The samples were frozen until analysis which was done within a week. Samples were brought to room temperature prior to the extraction and clean-up which was done essentially according to the procedure described by Kalra and Chawla (1981). Fat content of milk samples was determined by the method of Polishuk et al. (1977). Residues were finally dissolved in 0.5 mL hexane and 5µL were used in the gas chromatographic (GC) analysis. Packard gas chromatograph equipped with an electron capture detector and 1-mV strip chart recorder was used in the estimations. Quantitative analysis of HCH-residues in each sample was carried out by comparing the peak heights

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with those obtained from a chromatogram of a mixed insecticide standard of known concentration as reported earlier (Ramachandran et al 1984, Zaidi and Banerjee 1987, Zaidi et al. 1989).

RESULTS AND DISCUSSION

Apart from the excretion through urine and faeces (WHO 1991, 1992), breast milk represents an alternative major route of elimination of HCH in lactating women. Sixty-one milk samples were analyzed by GC and results are shown in Table 1. A large variation in individual values was observed. Alpha, beta and gamma-HCH were detected in 31, 58 and 55 milk samples respectively in varying proportion; whereas one sample showed either none or trace amounts of residues. Alpha and beta isomers were present in one sample, whereas beta and gamma isomers were present in 18 samples. Beta or gamma isomer was alone present in two samples each. The levels of alpha, beta and gamma HCH in whole milk were found considerably higher than those reported from other countries (WHO 1991, 1992). Such variation might be expected due to certain factors, viz, magnitude and frequency of applications, efficiency of absorption and excretion, age, and nutritional and socio-economic status.

Table 1. Levels of HCH-residues in human milk samples[a].

Residue	Whole milk (ppm)	Milk fat[b] (mg/kg fat)
Alpha-HCH	0.08±0.25 (0-1.86)	1.83±3.89 (0-17.38)
Beta-HCH	0.24±0.49 (0-3.22)	8.83±12.93 (0-62.13)
Gamma-HCH	0.06±0.11 (0-0.80)	2.31±3.08 (0-14.58)

a. Collected from lactating women within one week after delivery and analyzed for residue levels. Values represent mean ± standard deviation and range given in parenthesis.

b. Fat content of milk samples ranges from 1.30 to 7.00% with a mean of 3.70.

Results of the present study have shown an increased trend in the levels of total HCH and gamma-isomer of HCH (3.4 and 1.5 times higher respectively) than those reported from Lucknow city of India (Siddiqui et al. 1981). This seems obviously due to the continued use of HCH in India and its ultimate translocation to human beings through food chain. The highest level of HCH-content in human milk ever reported was from Ahmedabad city of India (Jani et al. 1988). During the present study it was observed that beta isomer accounts for the major residues of HCH excreted in milk and the results are in accordance with earlier reports (Siddiqui et al. 1981, Krishnamurti 1984, Jani et al. 1988). This may be due to continuing use of technical HCH in India, of which beta HCH is minor but most persistent in the environment.

Assuming an intake of 0.6 L milk per day by infant of average weight 3.36 kg, the average daily intake of total HCH determined during this study was about 0.065 mg/kg body weight which was nearly 5 times higher than the acceptable daily intake (0.012 mg/kg body weight/day) of total HCH reported earlier (Krishnamurti 1984). The higher contamination of HCH in human milk because of its high fat content (3%-4%) and lipophilic nature of pesticide attribute various problems of management of neonatal nutrition and health. The presence of HCH in mother's milk results in exposure of breast-fed infants to levels that are generally higher than acceptable daily intake and therefore of concern to public health problem in India. Although lower levels of exposure would be preferred, the present levels as determined in this study are not a limiting factor for the practice of natural breast-feeding. However, monitoring of HCH residues in food, the daily intake of the general population and their concentrations in human samples should continue.

The environmental contamination with organochlorine residues may be important etiologic factor in breast cancer and contribution of beta-HCH remained significant in this aspect (Mussalo et al. 1990; Wolff et al. 1993). Further, Newcomb et al. (1994) reported a reduction in breast cancer risk with duration of lactation linking elimination of organochlorines through breast-milk secretion as a possible mechanism. These pesticide residues may have deleterious effects on the immune system (Saha and Banerjee 1993; Banerjee et al. 1996a and 1996b) and increased amounts of organochlorines have been detected in certain cancerous tissues (Krieger et al. 1994). The potential adverse effects of alpha- and beta-HCH on humans and the environment cannot be balanced against benefits, since these isomers have no insecticidal action (WHO 1991, 1992). Their presence in the environment is a matter of serious concern. Though these values of alpha and beta isomers are several times higher than the acceptable daily intake of HCH, no harmful effects have ever been reported so far to produce injury to the infants who receive mother's milk solely as diet. The toxicological implications of the present level of HCH in milk during this study could not be assessed. However, the preventive measures should be adopted to reduce the body burden of HCH to avoid any forthcoming danger due to these pesticide residues.

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