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# Organochlorine Insecticide Residues in Dairy Milk Samples Collected in Lucknow, India

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Food-chain contamination with persistent pesticide residues is a global concern due to associated human health hazards (Loganathan and Kannan, 1994). Pesticide residues have been reported in food grains, vegetables, fruits and animal products in market samples from time to time (Kaphalia et al, 1990). However, because of their special significance in the human diet, particularly for children, contamination of milk and milk products has been viewed with greater concern (Dhaliwal, 1990). These products constitute about 10% of the total diet among Indians. A survey sponsored by the FAO through the Ministry of Health, Government of India, during 1980s showed DDT and HCH in milk at 0.19-216 and 0.12-40 μg/g fat respectively with more than 60% samples contaminated above the MRL (Kalra and Chawla 1985). More recently, a multicentric study conducted by the Indian Council of Medical Research on samples of dairy milk collected from rural and urban areas of 12 states showed 80% of samples contaminated with DDT and HCH; median values were more than those reported from most other countries (Kalra et al., 1999). Uttar Pradesh, the most populous state in India, comprised of 83 districts with Lucknow, the capital of U.P. alone is habituated by more than 2.5m residents. Although, data for pesticide contamination of milk collected in U.P. is available but in view of its large population a district wide study may better reflect the state with regard to contamination of dairy milk by persistent pesticides. In the present study, milk samples from booths of two different dairies in Lucknow were collected and analysed for the presence of persistent organochlorine insecticide residues to ascertain the extent of contamination in Lucknow and compared with pesticidal contamination of dairy milk in other states of India.

## MATERIALS AND METHODS

Milk samples (500 ml in duplicates) from each of the two main dairies (coded as A and B) marketed through milk booths in Lucknow were collected daily for twenty days and immediately transported to laboratory under ice-cold condition and stored at 4°C until analysed, generally within 48 hrs. At the time of processing samples were thoroughly shaken for breaking the fat globules. Extraction was carried out following the method as described by Kapoor et al., (1981) briefly involved extraction with acetone + hexane (1:1, v/v) followed by

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treatment with concentrated sulphuric acid for clean-up. The cleaned concentrated extract was used for the estimation of organochlorine insecticides by gas-liquid chromatograph, Nucon 5765, equipped with an electron capture detector ($^{63}Ni$) and Pyrex glass spiral column 6 m long; 4 mm i.d. packed with a mixture of 1.5% OV-17+1.95% OV-210 on chromosorb-W (80/100). The operating conditions of GLC were: Column temp. 180°C; Injector temp. 250°C; Detector temp. 250°C; Carrier gas was IOLAR grade- 1 nitrogen (99.9%) further purified by passing through silica gel and molecular sieve to remove moisture and oxygen respectively; Flow rate 60 ml/min; chart speed 0.5 Cm/min. Recovery of residues from spiked samples was 84-95%. Identification was confirmed by TLC. Results were not corrected for recovery.

## RESULTS AND DISCUSSION:

It is clear from the Table 1 that all the samples of milk from Dairy A and Dairy B were contaminated with persistent organochlorine insecticides DDT and HCH. Significantly none of the samples from two dairies has total DDT above the

Table 1. Organochlorine insecticides detected in milk samples of dairy A and dairy B (ppm) in Lucknow

| Pesticides | Dairy A | | | | Dairy B | | | |
|---|---|---|---|---|---|---|---|---|
| | % Positive | Range | Mean | Above MRL(%) | % Positive | Range | Mean | Above MRL(%) |
| α-HCH | 100 | 0.005-0.127 | 0.067 | 70% | 100 | 0.028-0.089 | 0.059 | 60% |
| β-HCH | 100 | 0.003-0.139 | 0.078 | 80% | 100 | 0.020-0.115 | 0.068 | 100% |
| γ-HCH | 100 | 0.007-0.061 | 0.025 | 70% | 100 | 0.009-0.067 | 0.022 | 90% |
| δ-HCH | 100 | 0.003-0.015 | 0.007 | None | 100 | 0.004-0.009 | 0.006 | None |
| Total HCH | 100 | 0.019-0.295 | 0.177 | 70% | 100 | 0.088-0.277 | 0.155 | 80% |
| p,p'-DDT | 90 | 0.001-0.011 | 0.005 | - | 100 | 0.002-0.010 | 0.006 | - |
| o,p'-DDT | 100 | 0.001-0.012 | 0.003 | - | 100 | 0.001-0.005 | 0.002 | - |
| p,p'-DDE | 100 | 0.005-0.010 | 0.007 | - | 100 | 0.005-0.010 | 0.007 | - |
| p,p'-TDE | 90 | 0.001-0.011 | 0.005 | - | 100 | 0.002-0.013 | 0.007 | - |
| Total DDT | 100 | 0.010-0.030 | 0.020 | None | 100 | 0.014-0.033 | 0.023 | None |

Data represents the mean of twenty samples each from the two dairies in Lucknow; Total HCH, the sum of α–, β–, γ–, δ– isomers; Total DDT, sum of p,p'-DDT +o,p'-DDT+p,p'-DDE+p,p'-TDE

maximum residue limit (MRL) of 0.05 mg/kg in milk as set by codex alimentarius (FAO, 1986). However, total HCH level was higher than 0.10

mg/kg (MRL) established by government of India under prevention of food adulteration act (Anonymous, 1992), both in samples of Dairy A and Dairy B. The levels of α, β, γ isomers separately were also above their prescribed MRL of 0.05, 0.02 and 0.01respectivley (Table 1). A comparison of the present data with those of our similar study conducted in Lucknow (U.P.) in 1981 (Saxena and Siddiqui 1982) suggest a 50% decline in DDT residue and more than three times increase in HCH level (Table 2) reflecting the usage pattern of DDT and HCH in India. DDT contamination of milk samples collected from Lucknow (present study) was lower than reported from Punjab, Haryana, Madhya Pradesh,

Table 2. A comparison of pesticide residue level in dairy milk from different states in India.

| Place/location | Year | DDT | HCH | Reference |
|---|---|---|---|---|
| Himachal Predesh | 1997 | 0.091 | 0.037 | Kalra et al., 1999 |
| Haryaya | 1997 | 0.022 | 0.051 | Kalra et al., 1999 |
| Madhya Predesh | 1997 | 0.042 | 0.056 | Kalra et al., 1999 |
| West Bengal | 1997 | 0.021 | 0.170 | Kalra et al., 1999 |
| Bihar | 1997 | 0.041 | 0.179 | Kalra et al., 1999 |
| Tamil Nadu | 1989 | 0.02 | 0.18 | Kannan et al., 1992a |
| Kerala | 1997 | 0.030 | 0.082 | Kalra et al., 1999 |
| Delhi | 1992-93 | 0.017 | 0.09 | Mukherjee & Gopal 1993 |
| Andhra Pradesh | 1997 | 0.207 | 0.563 | Kalra et al., 1999 |
| Punjab | 1980-81 | 0.24 | 0.04 | Singh, 1982 |
| | 1997 | 0.111 | 0.067 | Kalra et al., 1999 |
| Uttar Predesh | 1980-81 | 0.04 | 0.05 | Saxena & Siddiqui 1982 |
| | 1997 | 0.030 | 0.234 | Kalra et al., 1999 |
| Maharashtra | 1991-93 | 0.020 | 0.094 | Dethe et al., 1995 |
| | 1997 | 0.080 | 0.049 | Kalra et al., 1999 |
| Gujarat | 1990 | 0.063 | 5.19 | Kashyap et al., 1994 |
| | 1997 | 0.091 | 0.073 | Kalra et al., 1999 |
| Karnataka | 1991 | 0.0229 | 0.1090 | Awasthi & Ahiya 1995 |
| | 1997 | 0.047 | 0.179 | Kalra et al., 1999 |

Values are in ppm; only mean given; DDT means sum of its isomers and metabolites; HCH means sum of α–, β–, γ–, δ – isomers.

Maharashtra, Gujarat, Bihar, Andhra Pradesh, Karnataka and Kerala but higher than that of Delhi, Tamil Nadu and West Bengal (Table 2) probably indicating the regional differences in the application of this pesticide. Likewise contamination of milk samples with total HCH was much less than that of Gujarat and Andhra Pradesh comparable to Bihar, West Bengal, Karnataka and Tamil Nadu and higher than that of Delhi, Kerala, Maharashtra and Madhya Pradesh (table 2). Evidently, there is a general decline in DDT and a build-up of HCH residues in dairy milk samples from different regions in India.

The organochlorine insecticides DDT and HCH which were banned or severely restricted for use in many countries, constituted the bulk of pesticides consumed

in India for about five decades (Parmar and Dureja, 1990). While agricultural use of DDT was banned, the manufacture and use of technical grade HCH has been banned in India since April 1997 (Kalra et al., 1999). Still dairy milk and its products were shown to have a high incidence of contamination with organochlorine insecticide residues in India (Kannan et al., 1992). As the presence of DDT and HCH in cattle feed in India has already been reported (Battu et al., 1989) it seems to be the main source of organochlorine contamination of dairy milk samples in the present study. Being lipophilic in nature, low amounts of these residues in feed are bioconcentrated resulting in unacceptable levels in dairy milk. In addition, spraying of DDT and HCH to control mosquitoes in cattle sheds of the two dairies may be expected to contribute significantly towards contamination of dairy milk. Breast milk of Indian vegetarians was reported to contain higher amounts of DDT and HCH residues than that of non-vegetarians and fish eaters whereas reverse trend was noticed in several countries in North America and Europe (Kannan et al, 1997) primarily due to greater consumption of dairy products by vegetarians. Data of this study together with those of others (Mukherjee and Gopal, 1993) reporting above MRL levels of DDT, aldrin, dieldrin, and γ-HCH in dairy products suggest periodic monitoring of dairy products to prevent excessive exposure of humans to organochlorines. In the context of two dairies in Lucknow that caters to the milk and milk products requirement of a sizable chunk of 2.5 million Lucknow residents, steps to mitigate the cattle feed contamination with organochlorines is the need of the hour.

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