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Chlorinated Pesticide Residues in Milk Samples From Banaskantha District of Gujarat

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ABSTRACT

A survey carried out during 1986-87 on organochlorine pesticide residues in 36 milk samples from Banaskantha district of the Gujarat State revealed the presence of alpha-α, beta β and gamma-γ isomers of HCH, while DDT existed in the forms of p, p'-DDE, p, p'-TDE and p, p'-DDT. The mean and range values in ppm were 0.77 (0.16 to 2.60) and 0.34 (0.11 to 0.81) for Σ HCH and ΣDDT on fat basis respectively. The mean concentration of Σ DDT was lower than the tolerance limit of 1.25 ppm established by the World Health Organisation. However, 44 per cent of the samples exceeded the limit of 0.2 ppm for γ-HCH prescribed by Codex Alimentarious Commission.

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INTRODUCTION

The per hectarage usage of pesticides in India is the lowest in the world (336 g) though the accumulation of such chemicals e.g. DDT, in the body tissue of an average Indian is the highest (12.8 to 31.0 ppm) in the world (Gupta, 1987). This is probably due to indiscriminate use of cheaper and easily available persistent chemicals like DDT and HCH in the present day agriculture as well as for the control of household pests. Unfortunately long persistence and fat soluble properties of these chemicals have resulted into a considerably higher levels in the milk. This warranted extensive surveys in various countries of the world for pesticide residues in milk (Downey, 1972). The limited work, however, carried out in Inida also revealed high levels of DDT in milk (Agnihotri *et al*, 1974; Dhaliwal and Kalra, 1977 ; Khandekar *et al.*, 1981; Patel *et al.;* 1989).

The aim of the present study was to ascertain the levels of organochlorine pesticide residues in an area where comparatively pesticide consumption is lower vis-a-vis other district of the State.

MATERIALS AND METHODS

Sampling

Thirty-six bovine milk samples were collected directly from farmers of different villages of Banaskantha District of the Gujarat State and Livestock Research Station (LRS) of Gujarat Agricultural University during October, 1986 to February, 1987. Samples with preservative (5% saturated aqueous potassium dichromate containing 1% amyl alcohol) were immediately transported to the laboratory and kept in deep freeze until analysed.

Chemicals

All chemicals used were of analytical grade and were distilled in glass apparatus before use. The suitability of the reagents was

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checked by running reagent blanks. Organochlorine pesticide standards (all > 95% purity) were procured from the US Environmental Protection Agency, North Carolina.

Extraction and clean-up

For extraction and clean-up of the samples, miniaturised method of Stijve Tjakko (1983) was adopted. Two gramme of homogenised milk samnple was mixed with 5 g of activated Florisil (100-120 mesh) and a free flowing powder was obtained. The mixture was transferred to the chromatographic column containing 3 g of standardised Florisil (3% water) in light petroleum. Elution was performed with 35 ml of light petroleum-methylene chloride (4:1 v/v). The eluate was concentrated and residues were dissolved in 5 ml of iso-octane for GLC analysis.

Estimation

The pesticide residues were detected, identified and estimated by gas chromotograph (Varian, model 3700) equipped with Ni^{63} electron capture detector. Two different columns were used in order to confirm the results.

The operating parameters of the chromatographic analysis were as follows :

Column : (i) Pyres, 2 mm internal diameter. 200 cm long, packed with 1.5 % OV-17 + 1.95% QF-1 on 80-100 mesh Chromosorb W (HP)

(ii) Pyrex, 2 mm internal diameter, 200 cm long packed with 10 % DC-200 on 80-100 mesh Chromosorb W (HP)

Temperature (°C) Column -210 detector-300 injector-250

Carrier gas : Nitrogen, 40 Psig.

Injection volume : 2 - 6 μ.

The residues in the samples were identified by reference to retention times of chromatographic peaks of standards. Quantitative estimations were done by comparing the peak heights of the sample with peak heights of the standard. The average recoveries of the isomers of HCH and DDT compounds ranged from 80-110%. The data do not include corrections for percentage recovery.

RESULTS AND DISCUSSION

The data presented in Table 1 indicated range and mean of HCH and DDT residues. ΣHCH residues were the highest (1.20 ppm) in Ratanpur milk while, Σ DDT residues were the highest (0.38 ppm) in Merwada milk. Of the various isomers of HCH, the extraneous residue limit (ERL) has been established only for the γ-isomer which is 0.1 ppm according to the United Nations Food and Agricultural Organisation (FAO/WHO, 1973) and 0.2 ppm according to the Codex alimentarious commission (Anon., 1978). Forty seven per cent samples contained γ-HCH at levels higher than 0.1 ppm while, 44 per cent samples exceeded the limit of 0.2 ppm. DDT residues were below the ERL of 1.25 ppm (FAO/WHO, 1973) in all the samples. Duggan and Duggan (1973) reported that only 5 out of the 1141 samples of dairy products analysed in the USA contained DDT residues above 2 ppm. The overall result from most European countries also demonstrated that the level of DDT in butter was negligible (Downey, 1972). Butter samples from Tehran region of Iran showed 0.053, 0.034 and 0.037 ppm DDE, DDD and DDT residues respectively (Hashemy-Tonkabony and Assadi-Langaroodi, 1979). Kalra *et al.* (1983) reported that butter fat samples from Gujarat were more contaminated by ΣHCH residues than Punjab samples. Jadhav (1986) reported that 4.52% milk samples contained DDT more than 1.25 ppm.

The presence of α-HCH, γ-HCH and p, p'-DDE were detected in all the samples whereas, p, p'-TDE and p, p'-DDT were present

TABLE 1

DDT and HCH residues (ppm) on fat basis in milk samples from Banaskantha district.

Location	*No. of Sample*	*Residues (ppm)*							
		αHCH	*ß-HCH*	*γHCH*	*Σ-HCH*	*p,p'-DDE*	*p,p'-TDE*	*p,p'-DDT*	*Σ-DDT*
LRS	8	0.15*	0.15	0.18	0.47	0.16	Tr	0.17	0.32
		(0.11-0.23)**	(0.09-0.27)	(0.11-0.37)	(0.34-0.75)	(0.10-0.28)	(Tr)	(Tr - 0.53)	(0.11-0.81)
Merwada	8	0.20	0.28	0.25	0.72	0.16	0.10	0.12	0.38
		(0.04-0.36)	(0.12-0.50)	(0.10-0.71)	(0.32-1.51)	(0.09-0.25)	(0.07-0.13)	(Tr - 0.20)	(0.25-0.58)
Jalotra	7	0.20	0.20	0.17	0.57	0.18	0.11	0.09	0.37
		(0.06-0.29)	(Tr-0.55)	(0.09-0.21)	(0.16-1.00)	(0.12-0.24)	(Tr-0.19)	(Tr-0.20)	(0.21-0.58)
Mumanvas	6	0.24	0.42	0.28	0.94	0.16	0.09	0.10	0.35
		(0.10-0.34)	(0.26-0.75)	(0.16-0.47)	(0.54-1.40)	(0.11-0.28)	(0.01-0.17)	(0.7-0.13)	(0.23-0.56)
Ratanpur	7	0.47	0.51	0.23	0.20	0.16	0.06	0.06	0.28
		(0.15-1.34)	(0.18-0.99)	(0.06-0.37)	(0.54-2.60)	(0.11-0.31)	(Tr-0.10)	(Tr-0.15)	(0.17-0.56)

* Arithmetic mean ** Range Tr. Discernible but less than 0.01 ppm, p,p'-TDE and 0.02 ppm p,p'-DDT

TABLE 2

Incidence, arithmetic mean and range of HCH isomers and DDT and its derivatives in milk.

Insecticide residues	*Incidence (%)*	*Arithmetic mean ± SEM (ppm)*	*Range (ppm)*
α-HCH	100	0.25 ± 0.04	0.04-1.34
ß-HCH-	97	0.30 ± 0.04	Tr - 0.99
γ-HCH	100	0.22 ± 0.02	0.06-0.71
Σ-HCH	100	0.77 ± 0.08	0.16- 2.60
p,p'-DDE	100	0.16 ± 0.01	0.09-0.31
p,p'-TDE	72	0.07 ± 0.01	Tr- 0.19
p,p'-DDT	75	0.11 ± 0.02	Tr- 0.53
Σ-DDT	100	0.34 ± 0.03	0.11-0.81

Tr : Traces (< 0.02 ppm in case of β-HCH, <-0.01 ppm in case of p,p'-TDE and < 0.02 ppm in case of p,p'-DDT).

in 72 and 75% of the samples, respectively (Table 2). The residues of HCH comprised mainly α - and β-isomers. These results are in line with the results reported in cow's milk in Japan (Tanabe, 1974). White grubs and termite are the major pests of this region. For the control of these pests farmers use HCH/lindane which might have resulted in higher residues in milk due to contaminated animal feed/fodder. Moreover, coating insecticides on the body of the animals is a common practice followed in order to protect animals from insect attack. This could also lead to the absorption of pesticides in the body through the skin of animals.

In India, technical grade BHC contains predominantly α- isomer whereas, presence of γ - isomer is only 13%. Among the isomers, α-= and γ - degrade more repidly than the β-isomer (Brooks, 1974). The insecticidal activity of technical HCH is due to γ-isomer, which is readily degraded than the more hazardous α-and β-isomer (Vettorazzi, 1975), thus the replacement in the use of technical HCH with lindane (99% γ-HCH) is advantageous. In the present survey the high levels of α- and β-isomer of HCH are of serious concern.

The contamination with excessive residues of HCH in the milk samples of this area is a matter of serious concern. Hence, regulatory measures should be taken for proper use of these pesticides on crops, animals and house-hold pests.

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