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DDT and HCH Residues in Dairy Milk of Gujarat

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ABSTRACT

Organochlorine pesticide residues were determined from 41 samples of milk collected from different dairies of Gujarat during 1986-87. Residues of both DDT and HCH were present in all the samples collected. DDT residues existed in the form of p, p' —TDE, p, p' —DDE and p, p' —DDT. HCH residues were mainly present as alpha–, beta– and gamma– isomers. Mean levels of ∑DDT and ∑ HCH were 5.55 μg g^{-1} ৭ g g^{-1} onand 2.93 fat basis respectively. Out of 44, 34 samples exceeded the extraneous residue limit of 1.25 μg g^{-1} for DDT. Majority of the samples indicated high levels of HCH residues.

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INTRODUCTION

Daily diet in India is reported to contain about 0.27 mg of DDT and level of accumulated DDT in the body tissue of an average Indian is the highest in the world, varying between 12.8 ppm and 31.0 ppm (Gupta, 1987). This seems to be on account of indiscriminate use of DDT. In India DDT and HCH accounted for 66 per cent of the total production of the pesticides during 1983-84, which was 35 per cent less than the annual demand of these pesticides (Anon., 1984 a b). However, due to lipophilic property and long persistence, residues of these chemicals have been detected in several food commodities. Milk being an important component of diet, extensive studies have been carried out for pesticide residues in various countries of the world (Downey, 1972). Limited work carried out in India has also indicated high levels of DDT in this commodity (Dhaliwal and Kalra, 1977; Khandekar *et al.*, 1981). However the data on HCH residues in India are lacking. The present study was therefore, carried out to assess the nature and extent of both DDT and HCH residues in the milk of different dairies of Gujarat State.

MATERIALS AND METHODS

Sampling

Forty one milk samples were collected from four popular dairies and the campus dairy of Gujarat Agricultural University, Anand, Gujarat in their original package of 500 ml from the respective market during Nov., 1986 to Feb., 1987. Name of the dairies are as under :

(i) GAU Dairy	Gujarat Agricultural University, Anand.
(ii) ABAD Dairy	Ahmedabad Dist.
(iii) AMUL Dairy	Kheda Dist.
(iv) Baroda ,,	Vadodara Dist.
(v) Dudhdhara ,,	Bharuch Dist.

Chemicals

Solvents were distilled in all glass apparatus before use. All other chemicals were of analytical grade and were used as such. The stability of the solvents was checked by running reagent blank.

Pesticide Standards

All the standards ($< 98\%$ purity) were obtained from the US Environmtntal Protection Agency, North Carolna and were used as reference standards.

Extraction and clean-up

Miniaturised method of Stijve Tjakko (1983) was adopted for extraction and clean-up of the sample . Two gramme of homogenised milk sample 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 residue was dissolved in 5 ml of iso-octane for GLC analysis.

Gas chromatographic analysis

The residues of pesticides were quantified on a Varian Gas-Chromatograph (Model 3700) equipped with a Ni^{63} electron capture detector. The identity of pesticide residues were confirmed on two different columns. Operating conditions were as follows :

Columns : (i) Pyrex, 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 μl.

The quantitation of pesticides were carried out by comparing sample peak heights with peak heights of the standards. Recoveries of the isomers of HCH and DDT compounds ranged from 80–110%. Data presented have not been corrected for recovery.

TABLE 1

Pattern of DDT and HCH residues ($\mu g\ g^{-1}$) on fat basis in milk samples from different dairies of Gujarat.

Dairy	*No. of Samples*	*∝ –HCH*	*β–HCH*	*γ –HCH*	*Σ HCH*	*p, p' –DDE*	*p, p' –TDE*	*p. p' –DDT*	*Σ DDT*
GAU	7	0.73*	0.75	0.24	1.72	0.26	ND	0.05	0.32
		0.55—1.08**	0.43—1.58	0.15—0.30	1.13—2.95	0.18—0.45	—	Tr —0.38	0.18—0.83
ABAD	9	0.68	0.44	0.76	1.88	0.53	0.67	0.73	1.93
		0.45—1.20	0.13—1.10	0.33—1.25	1.13—2.78	0.28—0.98	0.35—1.15	0.48—1.33	1.15—3.45
AMUL	7	0.70	1.19	0.49	2.38	0.91	1.31	1.06	3.28
		0.28—0.98	0.68—1.68	0.23—1.40	1.73—2.90	0.68—1.80	1.13—1.70	0.55—1.85	2.35—3.88
Baroda	10	1.66	2.64	0.67	4.97	1.33	2.76	1.70	5.79
		0.58—2.33	1.90—3.95	0.25—1.43	3.43—6.78	0.98—1.70	1.63—4.10	0.68—2.78	3.28—7.13
Dudhdhara	8	0.92	1.93	0.29	3.13	2.72	9.52	3.64	15.88
		0.65—1.38	1.15—3.35	0.25—.043	2.08—5.15	1.88—3.10	6.63—15.45	2.23—7.23	12.63—25.58

*Arithmetic maen ** Rang ND : Not detected. Tr : Discernible but less than 0.02 $\mu g\ g^{1-}$. p. p' —DDT

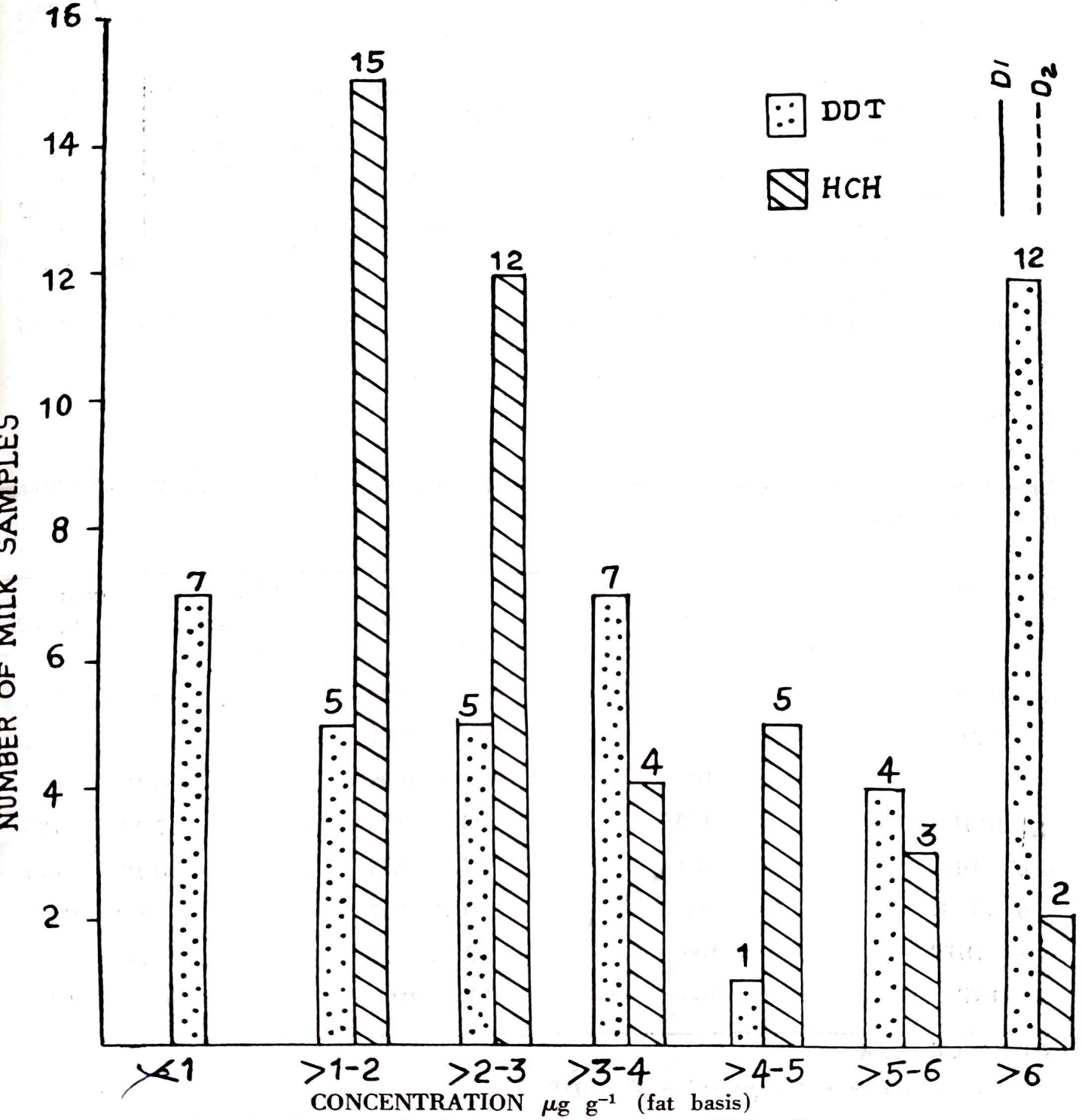

Fig. 1 : Frequency distribution of Σ DDT and Σ HCH residues in milk.

RESULTS AND DISCUSSION

Residues of both HCH and DDT were detected in all the samples (Table 1). Frank *et al.* (1970) also reported DDT residues in almost all the milk fat samples tested from Canada. Milk samples collected from Delhi area were contaminated with DDT residues in the range of 0.02 to 0.75 ppm (Agnihotri *et al.*, 1974). HCH and DDT have also been found to be the principal contaminants of dairy products in other countries (Downey, 1972).

Fig. 1 indicates that more than 2 $\mu g\ g^{-1}$ of Σ DDT and Σ HCH were found in 29 and 26 milk samples respectively. Kalra *et al.*, (1983) reported 57 and 27 out of 105 butter samples exceeding 2 $\mu g\ g^{-1}$ level for Σ DDT and Σ HCH respectively. The mean level of 2.93 $\mu g\ g^{-1}$ of Σ HCH and 5.55 $\mu g\ g^{-1}$ of Σ DDT found in milk samples in Gujarat (Table 2) exceeded the maximum level of

TALBE 2

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

Insecticide residues	*Incidence* (%)	*Arithmetic mean ± S. EM.* (*expressed as* $\mu g\ g^{-1}$)	*Range* (*expressed as* $\mu g\ g^{-1}$)
α—HCH	100	0.98 ± 0.08	0.28 — 2.33
β—HCH	100	1.45 ± 0.15	0.13 — 3.95
γ—HCH	100	0.51 ± 0.06	0.15 — 1.43
Σ—HCH	100	2.93 ± 0.23	1.13 — 6.78
p, p' —DDE	100	1.17 ± 0.14	0.18 — 3.10
p, p' —TDE	98	2.90 ± 0.57	ND —15.45
p, p' —DDT	100	1.47 ± 0.22	Tr — 7.23
Σ—DDT	100	5.55 ± 0.90	0.18 —25.58

ND : Not detected

Tr : Traces; less than 0.02 $\mu g\ g^{-1}$ p, p' —DDT

DDT and HCH residues reported by International Dairy Federation (Downey, 1972). However, the milk samples obtained from the cotton growing areas of Gautemala showed DDT residues as high as 15 $\mu g\ g^{-1}$ on fat basis (UNEP, 1978). Among the five dairies, the level of DDT in Dudhdhara milk showed the highest amount i.e. 15.88 $\mu g\ g^{-1}$ on fat basis.

Higher amounts of DDT observed in Vadodara and Bharuch dairy milk samples may probably due to very high amount of DDT being used on cotton and pigen pea. the byproduct of which are usually fed to lactating animals whereas in AMUL and ABAD dairies, the presence of DDT residues may be largely due to the application of the insecticide on vegetable crops, wastages of which are being fed to the animals.

The present analysis of dairy milk was carried out during winter season. The higher level of HCH residues in the milk samples could be mainly attributed to the feeding of vegetable byproducts to the lactating animals, which normally receive heavy application of HCH dust.

The major portion of DDT residues in the milk sample was in the form of p, p' –TDE (Table 1 and 2). This is in confirmation with the results obtained by Dhaliwal and Kalra (1978). Kalra *et al.*, (1983) also observed the same pattern in the butter samples of India.

Among the different isomers of HCH, α–and γ-isomers are degraded more readily than the β–isomer (Brooks, 1974). Data presented in Table 2 reveal that the residues of HCH in milk comparised mainly β–isomer which is comparable with the pattern of HCH isomers reported in cow's milk in Japan (Tanabe, 1974). Kalra *et al.*, (1983) reported that butter samples collected from the Gujarat State during 1981, showed the highest amount of 2.48 $\mu g\ g^{-1}$ Σ HCH and 6.633 $\mu g\ g^{-1}$ Σ DDT among the different states. The results are comaprable with the present findings of over all mean of Σ HCH 2.93 $\mu g\ g^{-1}$ and Σ DDT, 5.55 $\mu g\ g^{-1}$ (Table 2).

Out of 41 milk samples, 34 exceeded the extraneous residue limit of 1.25 $\mu g\ g^{-1}$ for ΣDDT (FAO|WHO, 1973). In case of HCH residues, the extraneous residue limit has been established only for the γ-- ismer, which is 0.2 $\mu g\ g^{-1}$ according to the Codex Alimentarious Commission (Anon., 1978). Forty milk samples were found to have more than 0.2 $\mu g\ g^{-1}$ of γ-HCH. Considering the fact that HCH has been found to be carcinogenic (Singh, 1987) higher amount of its residues in milk and milk products is a matter of serious concern.

These results indicate that there is a need to locate the source of contaminats for making milk and milk products free of such extraneous contaminants.

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