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Organochlorine Pesticide Contaminants in Human Milk from Different Regions of Turkey

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The levels of organochlorine (OC) pesticides and their metabolites in human milk have been reported in studies for various countries during recent years (Collins et al. 1983, Noren 1983, Slorach and Vaz 1983, Mes et al. 1984). Determination of OC pesticide contaminants, mainly β-BHC, pp'DDE, pp'DDT and PCBs, in human milk provides a measure of exposure to these substances (Slorach and Vaz 1983).

Usage of OC pesticides started in Turkey in 1945. Beginning from 1979, restrictions were imposed on these pesticides, and since 1983 usage have been severely restricted. The amount of OC pesticides used in Turkey between 1976 and 1983 were reported as 2219, 2947, 2336, 764, 744, 701, 840 and 487 tons, respectively. Although the official figures for 1984 and 1985 are yet unavailable, it is estimated that total usage was about a hundred tons per year.

In this study we have attempted to determine the amount of OC pesticides, especially DDT and its metabolites and BHC isomers, in human milk samples obtained from regions having different environmental characters in Turkey.

MATERIALS AND METHODS

Samples of 163 human milk were collected from donors living in three different regions of Turkey for at least 5 years. Milk samples were collected from one of the breasts, at the end of the feeding, and between the 5th and 40th days of postpartum. The mean age of the donors was 26.5. Nearly all the donors except sixteen were nonsmokers. No data on the dieatary habits of the donors was available.

The regions were selected on basis of differences in their environmental characters:

Adana-Çukurova region (An agricultural district, it is estimated that about 70 % of all OC pesticides used in Turkey were consumed

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in this area); city of Ankara; Kocaeli region (Industrial region which has an OC pesticides plant. This manufacturing plant has been producing DDT and BHC since 1965. Its capacity is 2500 tons for DDT, and 4500 tons for BHC per annum. Since restrictions of usage, it is working under capacity).

2 ml of conc. H_2SO_4 was slowly added to the 2.5 g sample of milk and mixed acid and milk. op'DDD as an internal standard was also added to the milk sample. Then mixture was extracted with 4x2x2 ml of n-hexane. The n-hexane layer was withdrawn and cleaned up with 1-2 ml of conc. H_2SO_4. Combined hexane extracts were concentrated to appropriate volumes (Veirov and Aharonson 1980, Wickström et al. 1983).

Analysis was performed with a gas chromatograph equipped with ^{63}Ni electron capture detector. 1.5 % OV-17+1.95 % OV-202 was used as a stationary phase. Peak heights were used as the basis for quantification. Confirmation was routinely carried out using different column, 4 % SE-30+6 % OV-210 on Chromosorb WHP.

Fat content of the samples was analyzed by the Gerber test (Pomeranz and Meloan 1980).

The Mann-Whitney U test was used for statistical comparisons.

Standards of α-BHC, β-BHC, γ-BHC, pp'DDE, op'DDD and pp'DDT were obtained from U.S. Environmental Protection Agency (EPA). The pesticide standard mixture was kindly supplied by the Swedish National Food Administration.

RESULTS AND DISCUSSION

Results indicate that β-BHC, pp'DDE and pp'DDT are the main contaminants in human milk samples. PCBs have not been detected in our samples owing to limited sensitivity. Residues of pp'DDE and pp'DDT were present in all samples. Nearly all the BHC was present as the beta isomer but thirteen samples. Alpha and gamma isomers of BHC were present in some of the samples except seventy five samples and one hundred and thirty three samples, respectively. The results are presented in Table 1.

The mean fat content was 3.23 % but individual values ranged widely from 0.2 to 9.4 %.

Among the three regions, Adana is clearly the most highly polluted region. The median ΣDDT value for Adana was about three times higher than the values found in Ankara and Kocaeli. ΣDDT value distributions between Adana-Ankara and Adana-Kocaeli were statistically compared, and found as $p < 0.001$ for both comparisons.

Table 1. Levels of chlorinated hydrocarbon insecticides in human milk obtained from three different regions of Turkey (The median levels expressed as mg/kg fat)

REGION	α-BHC	β-BHC	γ-BHC	ΣBHC	pp'DDE	pp'DDT	ΣDDT
Ankara (n=61)	< 0.01[a] (0.02-2.25)[b]	0.92 (0.19-5.36)	< 0.01 (0.01-0.69)	0.97 (0.20-5.36)	2.71 (0.17-25.12)	0.42 (0.11-5.86)	3.66 (0.56-30.25)
Adana-Çukurova (n=52)	< 0.01 (0.03-0.42)	1.43 (0.19-7.73)	< 0.01 (0.10-0.70)	1.45 (0.19-7.83)	8.55 (1.39-25.52)	1.17 (0.22-8.72)	10.57 (1.87-30.38)
Kocaeli (n=50)	0.01 (0.02-0.17)	0.72 (0.02-2.47)	< 0.01 (0.01-2.09)	0.67 (0.12-2.64)	2.56 (0.87-15.62)	0.37 (0.08-1.95)	3.30 (1.09-19.37)

[a]Median level in milk samples below limit of detection

[b]Data within parentheses are ranges

In terms of BHC pollution, Adana was also the most polluted area. Samples taken from Kocaeli, where the pesticide plant is located, did not yield any higher organochlorine pesticide levels as compared with Ankara. This indicates that the principle factor causing exposure to these pollutants is bioconcentration, and that the industrial production of DDT and BHC do not itself cause extra increase in organochlorine pesticide levels in human milk.

The comparison of our results with the DDT levels of the other countries are presented in Table 2.

Since there is no pre-restrictional study made in Turkey using human milk, we are unable to make comparisons concerning the effect of restrictions on organochlorine levels in human milk. However, we might be able to make a statement using DDE/DDT ratios. According to our results these ratios are 7.23, 5.80, 7.75 for Adana, Ankara and Kocaeli, respectively. This ratio has been found lower in countries like China and India (2.3 for China, 3.5 for India) where DDT is still being used than in countries where DDT use has been severely restricted since early 1970's (7.4, 7.8, 9.4, 11.0 for Japan (1972), Belgium (1974), Sweden (1971) and United States (1974), respectively) (Slorach and Vaz 1983).

The reason for this is that, when the use of DDT is severely restricted, although the levels of this substance in vegetable foods fall rapidly, exposure to its major liposoluble metabolite

Table 2. Levels of DDT and its isomers in human milk in various countries (mean/median levels expressed as mg/kg fat)

COUNTRY	Year	pp'DDE	pp'DDT	ΣDDT	Reference
Belgium	1982	0.94	0.13	1.18	Slorach and Vaz(1983)
China	1982	4.4	1.8	6.71	Slorach and Vaz(1983)
Denmark	1982	0.97*	0.12*	1.08	Jensen (1983)
Hungary	1975/76	2.97	0.52*	3.55	Jensen (1983)
India	1982	4.8	1.2	6.55	Slorach and Vaz(1983)
Japan	1980/81	1.5	0.21	1.88	Slorach and Vaz(1983)
Poland	1979	8.7*	1.20*	9.98	Jensen (1983)
Sweden	1981	0.81	0.10	1.00	Slorach and Vaz(1983)
United Kingdom	1979/80	1.6*	0.11*	1.89	Collins et al (1983)
United States of America					
22 States	1979	1.6	< 0.10	1.88	Slorach and Vaz(1983)
Turkey	1984/85				
Ankara		2.71	0.42	3.66	
Adana		8.55	1.17	10.57	This study
Kocaeli		2.56	0.37	3.30	

*Mean

DDE still occurs through the consumption of animal food, which continue to accumulate this substance from the environment long-after the use of DDT has ceased. This means that DDE/DDT ratio will increase (Slorach and Vaz 1983). The DDE/DDT ratios we have found indicate that the expected effects of the restrictions has already become manifest in Turkey.

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