

Analysis of Pesticide Residues in 290 Samples of Guatemalan Mother's Milk

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Chlorinated hydrocarbon pesticide residues have been detected in human milk collected in many areas of the world. Recent reports include analyses of samples from the following countries, among others:

France (LUQUET et al. 1972, GOURSAUD et al. 1971);

Germany (ACKER and SCHULTE 1970);

Russia (GRACHEVA 1970);

Australia (NEWTON and GREENE 1972);

New Guinea (HORNABROOK et al. 1972);

Canada (MUSIAL et al. 1974, RITCEY et al. 1972);

United States (WILSON et al. 1973, KROGER 1972, CURLEY and KIMBROUGH 1969);

Since these reports, with the exception of the one from New Guinea, come from highly developed nations, it seemed of interest to study chlorinated pesticides in human milk in Guatemala--a developing country where pesticides have been used extensively, and where mother's milk is a primary source of infant nutrition.

A previous study carried out by the Center for the Biology of Natural Systems (St. Louis) in Guatemala (OLSZYNA-MARZYS et al. 1973) reported abnormally high concentrations of DDT in samples of mother's milk from donors in three rural Pacific coast communities. In that survey of forty-six donors, total DDT was found to be as high as 12.2 ppm, 244 times the maximum permissible concentration for milk (0.05 ppm) established by WHO/FAO (WHO/FAO 1969). The average total DDT concentration in these samples was 2.36 ppm. This high average appeared related to the extensive agricultural use of pesticides on cotton grown near two of the communities, and to the residential spraying of DDT in

all three communities by the national malaria eradication service.

An objective of the present study has been to assess the significance of previous findings by collecting and measuring the DDT content of additional samples from the same three Pacific coast communities and from five other communities in Guatemala, both rural and urban.

EXPERIMENTAL METHODS

Milk samples were collected December 1973 - April 1974 from 290 lactating women by manual expression under supervision into laboratory-cleaned jars with aluminum foil lined caps. The samples were kept at dry-ice temperatures in transit to the analytical laboratory, at which time they were stored at -20° until analysis.

Aliquots (1-2 ml.) of the 290 milk samples were cleaned up by acetonitrile-hexane partition as described in Section 5,A (2) of the EPA Pesticide Analytical Manual (THOMPSON 1972); hexane extracts were analysed by GLC without prior Florisil fractionation. All analyses were run on a Varian Model 244510 Gas Chromatograph equipped with a high temperature Sc3H electron capture detector.

Glass columns (6' x 1/8" i.d.) packed with 1.5% OV-17 plus 1.95% OV-210 on Gas Chron Q (80/100 mesh) were used for quantitation (column temperature, 200°). Confirmation of identity of unknown substances was achieved by comparison of their retention times with those of known pesticides on this column and on a column (6' x 1/8" i.d.) of 5% QF-1 on Varaport-30 (100/200 mesh), column temperature 160°. Standard solutions of pesticides were prepared and used for both qualitative and quantitative purposes, and quantitation was achieved by comparison of peak heights. The following pesticides were found and measured in some or all of the samples: α -BHC, β -BHC, dieldrin, p,p'-DDE, o,p'-DDT, p,p'-DDD, and p,p'-DDT. The limit of detectability in this analysis was 0.001 ppm in whole milk for all of the measured pesticides.

RESULTS AND DISCUSSION

All of the 290 samples analysed showed measureable quantities of p,p'-DDT and p,p'-DDE. In addition, a large majority of the samples showed measureable o,p'-DDT and p,p'-DDD. The range and average values (Table 1) are expressed as ppm total DDT: p,p'-DDE and p,p'-DDD amounts were adjusted to their equivalent ppm DDT in making up the total.

TABLE 1

DDT Levels of 290 Mother's Milk Samples
from Eight Locations in Guatemala

<u>Location</u>	<u>No. of donors</u>	<u>Ppm total DDT in while milk</u>			
		<u>high</u>	<u>low</u>	<u>mean</u>	<u>st. dev.</u>
Livingston, Izabal	30	5.686	0.140	0.864	1.073
La Bomba, Chiquimulilla, Santa Rosa	31	1.864	0.089	0.587	0.423
Asuncion Mita, Jutiapa	31	2.506	0.051	0.490	0.457
Cerro Colorado, Escuintla	31	2.193	0.041	0.466	0.463
El Rosario Par- celamiento, Champerico	31	0.912	0.050	0.276	0.185
San Pedro Carcha, Alta Verapaz	30	1.310	0.003	0.273	0.343
Guatemala City	78	1.101	0.015	0.233	0.179
Nebaj, Quiche	28	0.183	0.005	0.035	0.038
All locations	290	5.686	0.003	0.378	0.503

The pesticide residues found in the present study do not approach the high levels found in 1970 (OLSZYNA-MARZYS et al. 1973); however, the overall average (0.378 ppm DDT) is above the range of average DDT levels (0.03 to 0.30 ppm DDT) typically found in Europe and North America (CURLEY and KIMBROUGH 1969, MUSIAL et al. 1974).

A pronounced difference also exists among the eight communities studied. This difference appears closely associated with the use of DDT by the National Malaria Eradication Service. However, agricultural and other contamination is involved as well. In most communities in malarious areas, the Servicio Nacional de Erradicacion de Malaria regularly sprays every home in order to control the mosquito vector. Although DDT was the most common malaria control agent used since the mid 1950's by the Service, they have recently begun replacing it with other pesticides, such as propoxur (Baygon).

Livingston, the community with the highest average DDT level (0.864 ppm), is the only community studied in which DDT had been sprayed in all homes up to and including 1974. It is important to note that there is no large-scale agricultural use of DDT around Livingston.

In La Bomba (0.587 ppm average DDT) the malaria control service used DDT until 1972, after which they switched to propoxur, a pesticide containing no DDT. Cerro Colorado (0.466 ppm average DDT) and El Rosario (0.276 ppm average DDT) have been sprayed with propoxur instead of DDT since 1970. La Bomba, Cerro Colorado, and El Rosario lie in the cotton producing belt where DDT (in compounds such as Toxaphene-DDT) is one of the many insecticides sprayed by airplane to control cotton pests. (These three Pacific coast communities are discussed in more detail below.)

The malaria control service discontinued all pesticide spraying in Asuncion Mita (0.490 ppm average DDT) in 1970. There never have been malaria control spraying programs in San Pedro Carcha (0.273 ppm average DDT), Guatemala City (0.233 ppm average DDT), or Nebaj (0.035 ppm average DDT); these three towns lie in highland, non-malarious areas.

To further assess the significance of these findings, it is of interest to examine changes in average DDT levels from 1970 to 1974 in the three Pacific coast communities sampled in both years. Table 2 shows the change in DDT levels from 1970 to 1974 for these towns.

TABLE 2

Comparison of DDT Levels in Samples of
Mother's Milk Obtained in 1970
and in 1974 from the Same Three
Pacific Coast Communities

Community	N	1970*		N	1974		Difference in mean DDT 1970 - 1974
		Mean DDT ppm	St. dev.		Mean DDT ppm	St. dev.	
La Bomba	9	1.11	0.80	31	0.59	0.42	0.52**
Cerro Colorado	8	3.06	1.81	31	0.47	0.46	2.59***
El Rosario	27	1.85	1.25	31	0.28	0.19	1.57****

*(OLSZYNA-MARZYS et al. 1973)

**p <.05, one tail T test

***p <.005, one tail T test

****p <.0005, one tail T test

Both El Rosario and Cerro Colorado show a significant drop in average DDT contamination levels between 1970 and 1974. The malaria service stopped using DDT in both of these communities in 1970.

In La Bomba, there is much less difference between the 1970 and 1974 DDT levels. The malaria service did not stop using DDT in La Bomba until 1972. Moreover, cotton was not extensively planted in the La Bomba area until 1972; thus agricultural use of DDT increased in La Bomba, somewhat offsetting the effects of discontinuing its use by the malaria control service.

Therefore, it seems probably that the extremely high levels of DDT contamination found in 1970 were the direct result of the semiannual application of DDT in every home by the malaria control service. A similar finding was reported by HORNABROOK et al. (1972) for seven districts in New Guinea. There human milk samples obtained from donors living in districts sprayed with DDT for malaria control averaged .242 ppm DDT, while milk from donors living in unsprayed districts of New Guinea averaged .011 ppm DDT.

Mother's milk is a primary source of infant nutrition in developing countries. Recent studies on DDT levels in newborns' blood suggest that there may be some correlation between high levels of pesticide in their blood and prenatal and neonatal health (O'LEARY et al. 1970, GRASSO et al. 1973). Further research is needed to evaluate the neonatal health implications of elevated pesticide levels in mother's milk and to evaluate actual and potential sources of this contamination.

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