

Organochlorine pesticide residues in human breast milk in El-Gabal Al-Akhdar , Libya

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Abstract—The present study determined the residues of organochlorine pesticides (OCPs) in 40 samples of human milk collected from eight rural and urban regions in El-Gabal Al-Akhdar region –Libya, between March to December 2007. The ages of mothers ranged between 18 and 44 years. The OCPs were analyzed using Gas-Liquid Chromatography (GLC) with Flame Photometric and electron capture detectors. In this work, we have detected 7 pesticides from the dirty dozen (Stockholm Convention on Persistent Organic Pollutants, 2001) from all breast milk samples, including dieldrin, aldrin, endrin, chlordane, heptachlor, DDT, and BHC. Their mean concentrations were higher than the Maximum Residue Limit (MRL). The mean concentration of OCPs residues was higher in rural than urban regions. Low DDE/DDT ratio (1.026) found in this area indicates recent exposure to DDT. The present study showed higher OCPs residue patterns which points to the necessity of implementing a yearly monitoring program for organochlorine pesticide residues in human milk in El Gabal Al Akder area,Libya .

Key words: Organochlorine pesticides; Contamination; Breast milk; Libya

I. INTRODUCTION

Organochlorine pesticides (OCPs) are widespread compounds in the environment due to their persistence and highly lipophilic nature , and they accumulate in biological systems . Newborns are exposed to these OCPs across the placenta and through breast feeding. Perinatal exposure to these compounds may induce several adverse effects such as lower birth weight [1], neurodevelopmental delay [2] and disturbance of thyroid hormone status [3]. DDT has been suggested to be neuroendocrine disruptor as well as a functional teratogen in humans [4 and 5]. Dieldrin was also recognized to have estrogenic hormonal activity in animal studies. In the present study, several OCPs were analyzed in human breast milk from 40 mothers to identify the major pesticide compounds found in the samples.

II. MATERIALS AND METHODS

40 samples of human milk were collected from women living in four urban Cities (El Beida, El Bleng, El Marg and Shahat) and four rural areas (El-wasita, Omar El-Mokhtar, El Hania, and El-Faidia) . 5 mothers from each area were asked to provide breast milk one month after the delivery. The ages of mothers ranged between 18 and 44 years. The breast milk sample was taken directly into a clean chemical-free glass bottles with Teflon seals. These samples were frozen at -15°C until analysis. Each mother completed a questionnaire to provide personal information such as maternal age, number of births, occupation, educational background, food intake, and place residence .

Gas liquid chromatography analysis was performed using Hewlett Packard 6890 series plus gas liquid chromatography. Flam photometric and electron capture detectors were used to detect Organochlorine residues in milk samples according to the method of Suzuki et al., 1979[6] .

Data analysis was performed using the statistical program SPSS. Analysis of variance (ANOVA) was also used to determine if significant difference existed between means, depending on calculated and table F values at 0.01 and 0.05 levels.

III. RESULTS AND DISCUSSION

A total of 40 mothers were successfully enrolled in this study. Table I showed the presence of detectable levels of 10 organochlorine pesticides in mother's breast milk . These OCPs were β -BHC , δ – BHC , Heptachlor , Dieldrin , Endrin , Aldrin , Hepta epoxide , p, p'-DDT , o, p'-DDT , and p, p'-DDE . α -BHC residue was not detected in all samples of the breast milk collected from the 8 studied areas in El Gabal Al Akhdar .The mean concentration of the tested OCPs residues was higher in rural regions than in urban cities. Their concentrations decreased as follow: B-BHC > P, P' – DDE > Heptachlor > P, P' – DDT > Dieldrin > δ BHC > Endrin > O, P' – DDT > Aldrin > Hepta epoxide.

TABLE I. BHC AND DDT CONCENTRATION LEVELS (μ G/G LIPID) IN HUMAN MILK FROM RURAL AND URBAN AREAS OF EL GABAL EL AKDAR (LYBIA). (N = 40)

	B-BHC	δ -BHC	\sum BHC	O'-P'-DDT	P-P'-DDT	P-P'-DDE	\sum DDT
Rural							

El-Wasita	0.059	ND	0.059	0.011	0.044	0.046	0.101
Omar El Mokhtar	0.059	0.024	0.083	0.019	0.023	0.012	0.054
El-Hania	ND	0.014	0.014	0.011	ND	0.030	0.041
El-Faidia	0.060	ND	0.060	ND	ND	0.024	0.024
Mean	0.059	0.019	0.078	0.031	0.067	0.112	0.210
Urban							
El-Beida	ND	0.008	0.008	0.011	ND	0.011	0.022
El-Bleng	ND	ND	ND	ND	ND	0.015	0.015
El-Marg	0.059	ND	0.059	ND	ND	ND	ND
Shahat	ND	ND	ND	ND	ND	0.010	0.010
Mean	0.059	0.008	0.067	0.011	ND	0.036	0.047
Total Means	0.118	0.027	0.145	0.042	0.067	0.148	0.257

ND = NOT DETECTED (LESS THAN 1 NG/UL)

All mothers had detectable levels of P,P'-DDT, except for five samples from El Marg city. El Wasita had the highest mean levels, followed by El Hania, El Faidia and Omar El Mokhtar rural areas (Table 1). In the tested urban cities, the residue levels were significantly lower than rural areas. The highest mean levels were at El Bleng city (0.015 µg/g lipid), followed by El Beida city (0.011), and Shahat city (0.010). The mean residue level from El Wasita rural area was 4 times higher than El Beida city breast milk samples.

As would be expected, the metabolite P, P'-DDE was lower than P, P'-DDT. It was 0.044 µg/g lipid at El Wasita and 0.023 at Omar El Mokhtar rural area. Four samples from five was found to contain measurable level of P, P'-DDT at El Wasita, in Omar El Mokhtar only one sample could be measured, while the concentration levels of P, P'-DDE (30 samples) were not detected (ND) in the other regions.

The O, P'-DDT levels were much lower than their P, P' counterpart. Omar El Mokhtar mother's breast milk contain the highest mean levels of O, P'-DDT, followed by El Wasita breast milk samples and El Hania samples. The O,P'-DDT residue levels of the 20 samples from El Faida, El Bleng, El Marg and Shahat were not detected, while only one sample from five in El beida city was detected (Table I). The mean \sum DDT residues in the breast milk was higher in the rural areas (0.210) than in cities (0.047 µg/g lipid). The highest total DDT was found in breast milk of El Wasita (0.101), the lowest was found in Shahat city breast milk (0.010), while DDT residues were not found in the 5 samples from El Marg city. In fact. The total DDT residues in rural areas (0.210 µg/g lipid was 4.4 times the mean value (0.047) from urban cities.

Since using of these organochlorine compounds has been prohibited in the field in many countries in the 1970-1980s, our results reconfirmed their environmentally persistent nature, or reutilization of these compounds again. Low DDE/DDT ratio indicates recent exposure to DDT. While high ratio means high environmental persistence and continuous bioaccumulation. Our results confirm the recent exposure (DDE/DDT = 1.026). α -BHC, β -BHC and δ -BHC were also analyzed and found that β -BHC and δ -BHC were detected in the samples while α -BHC was not detected in any sample. The higher mean value for β -BHC and δ -BHC were 0.060 and 0.024 µg/g lipid, respectively. The total mean values ranged from 0.060 to 0.008 µg/g lipid. Presence of β -BHC isomer in all the samples indicates that BHC formulation was used in the past, β -BHC is more stable and less easily metabolized, being eliminated five times slower from the body than other isomers [7]. α -BHC concentration from the four villages and the four cities was not detected, this can be explained by the fact that this isomer is highly volatile and less persistent. The tolerance limit of δ -BHC and DDT in milk as prescribed by FAO/WHO [8] is 0.01 and 0.02 mg kg⁻¹. Comparing this results with the MRL values fixed by the codex alimentarius committee of FAO/WHO (2000), DDT and BHC showed higher values in all milk samples.

Data on OCP concentrations in human milk in 2007 at El Gabal El Akdar (Libya), summarized in Table II, were compared with other studies from European, Asian, American and Oceanian countries.

TABLE II. CONCENTRATION OF ORGANOCHLORINE PESTICIDE RESIDUES (µG/G LIPID) IN HUMAN MILK IN VARIOUS PARTS OF THE WORLD

Countries	α -BHC	β -BHC	δ -BHC	\sum BHC	P,p'-DDE	p,p'-DDT	\sum DDT	DDE///DDT	Refer.	N
China Beijing	-	1.18	-	1.18	1.72	0.24	1.96	7.17	[9]	60
Czech Republic	-	0.59	-	0.59	0.98	0.83	1.96	11.8	[10]	43
Central Taiwan	-	0.02	-	0.02	0.30	0.02	0.32	13.7	[11]	30
Egypt	0.01	0.11	0.02	0.14	0.14	0.01	0.15	14	[12]	31
India -Agra	0.03	0.04	0.05	0.12	0.06	0.05	0.17	1.2	[13]	32
Indo-nesia	-	0.09	-	0.09	0.28	0.06	0.34	46.6	[14]	70
Japan	-	0.21	-	0.21	0.27	0.02	0.29	13.5	[15]	49

Mexico	-	0.06	-	0.06	3.99	0.65	4.64	5.07	[16]	60
New Zealand	-	0.02	-	0.02	0.63	0.03	0.66	2.1	[17]	53
Russia	-	0.32	-	0.32	0.97	0.15	1.12	6.6	[18]	14
France	0.05	0.29	0.04	0.38	2.18	0.08	2.26	27.3	[19]	
Spain	0.03	0.23	0.01	0.27	0.60	0.01	0.61	60	[20]	
Libya	-	0.06	0.01	0.07	0.07	0.15	0.22	0.45	Present study	40

Total BHC and total DDT levels in the present study are less than those reported from developing countries and higher than those from developed countries. Surveys of OCPs in human milk from developing countries were carried out because of the concern about the use of these compounds for agricultural and sanitary purposes in recent years [21]. Based on the previous studies [21 and 22], the DDE/DDT ratios in human milk from China and Turkey were higher than that from Libya.

The present study is the first report of recent OCPs levels in human milk from Libya. We will attempt to calculate some parameters associated with exposure, and where these levels have been exceeded. In the present case, our data would be higher than the Maximum Residue Limit (MRL)

for β -BHC, δ -BHC, P, P'-DDT and P, P'-DDE. The concentration of OCPs in breast milk mainly depends on their accumulation in the maternal fatty tissue and their subsequent mobilization. Indeed, numerous studies around the World have used human breast milk samples to determine maternal body burden and lactational transfer of pesticides to infants.

In this work, we have detected 7 pesticides from the dirty dozen (Stockholm Convention on Persistent Organic Pollutants, 2001[26]) from all breast milk samples, including dieldrin, aldrin, endrin, chlordane, heptachlor, DDT, and BHC. Their mean concentrations were higher than the Maximum Residue Limit (MRL) as shown in table III.

TABLE III. COMPARISON OF PERSISTENT ORGANIC POLLUTANTS (POPs) IN HUMAN MILK BETWEEN LIBYA AND OTHER COUNTRIES ($\mu\text{G}/\text{G}$ LIPID).

Country	Dieldrin	Aldrin	Endrin	Heptachlor	Heptachlor epoxide	Reference
Indonesia	0.0400	ND	ND	ND	ND	[23]
Japan	0.0050	ND	ND	0.0370	ND	[24]
Taiwan	ND	ND	ND	0.0310	0.0039	[25]
Libya (Rural)	0.0192	0.0122	0.0181	0.0280	0.0052	The present work
(Urban)	0.0090	0.0030	ND	0.0020	0.0020	
MRL	0.0060	0.0060	0.0008	0.0060	0.0060	[8]

ND = Not detected (less than 1 ng/ul).

The present study showed higher OCPs residue patterns which points to the necessity of implementing a yearly monitoring program for organochlorine pesticide residues in human milk in El Gabal Al Akder area, Libya.

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