Persistent organochlorine in human breast milk from Al-Sharkia Governorate, Egypt

Sherif H. Abd Al-Rahman
Pesticides Residues and Environmental Pollution Dept., Central Agricultural Pesticide Laboratory, Agricultural Research Center. Giza 12618, Egypt.

ABSTRACT

In the present study, 23 human breast milk samples were collected in January 2009 from Fakous city, Al-Sharkia Governorate, Egypt. The samples were analysed for organochlorine pesticides such as dichlorodiphenyltrichloroethane (DDT) and its metabolites, α, β, and γ-hexachlorocyclohexane (HCH) isomers. The average concentrations of HCHs and DDTs were 225 and 1315 ng/g lipid respectively. There was no significant difference between the levels of OCP and mother age, while there was a significant difference and correlation between the levels of OCP and the number of times the mother had breast fed (primiparous and multiparous) (p < 0.05). The results suggested that DDT is still entering the environment depending on the observed ratio of DDE/DDT. The levels of OCP in human milk recommended that we need to do more regular pollutant monitoring programs.

Key word: Persistent organochlorine, Pesticide, Human milk, Egypt

INTRODUCTION

The worldwide production and use of organochlorine compounds (OCPs) since the 1950s has resulted in their widespread occurrence in the environment. Their chemical properties such as lipophilicity and persistency lead to bioaccumulation and biomagnifications in the fatty tissues of biological specimens, and within the food chain bring on a high degree of contamination in the organisms at the top of the food chain (Tanabe et al., 1984; Kucklic and 1998; Hoekstra et al., 2003). Bioaccumulation of these compounds has been related to serious toxic threats. For example, DDE has been reported to be responsible for several abnormalities in wildlife such as eggshell thinning in fish-eating birds (Lundholm, 1997), reproductive failure of seals and fish-eating birds (Reijnders, 1986). The bioaccumulative nature and endocrine disrupting potential of OCPs on humans and wildlife has been a matter of great concern.

OCPs have serious environmental and health hazards. Based on the reports of their toxicity and adverse harmful effects to wildlife and humans, many organochlorine pesticides were banned or restricted from use or trade by the Ministry of Agriculture. Since 1980 DDT and lindane have been officially prohibited from agricultural use in Egypt, and in 1996 a Ministerial Decree prohibited the import and use of 80 pesticides including aldrin, dieldrin, endrin, chlordane, heptachlor, DDT, toxaphene, mirex, lindane, endosulfan, pentachlorophenol, and heptachlor epoxide. Due to the great concern in protecting the human health and environment from POPs, Egypt signed the Stockholm Convention on Persistent Organic Pollutants (POPs) in 2002 and ratified it in 2003. Nonetheless, many of the pesticides banned or withdrawn from developed markets are still produced and sold in developing country markets (Wood MacKenzie Consultants Ltd., 1994).
Organochlorine pesticides concentrations in human milk have been used to assess trends in OCP pollution since the early 1970s and in particular to evaluate the success of the ban of OCPs in numerous countries (Smith, 1999; Jaraczewska et al., 2006; Szyrwinska and Lulek, 2007). Most studies consistently show peak concentrations of OCPs in the 1970s or early 1980s with a subsequent decrease in the concentrations (Newsome et al., 1995; Schade and Heinzow, 1998; Noren and Meironyte, 2001; Bates et al., 2002). Few studies have reported that daily intake for organochlorine pesticides for most infant and people were above the acceptable daily intakes established by FAO/WHO. As a result it remains unclear whether the decrease in OCP concentrations in human milk samples observed after the ban in the 1980s has continued or is approaching a steady state. This fact emphasizes the need for more detailed study on the accumulation of OCPs in human milk. In the present study, human breast milk samples were collected from one City, Fakous in Al-Sharkia Governorate, Egypt. The main objective of this study was to determine the concentrations of persistent OCPs, such as DDTs and HCHs, and to evaluate the status of contamination in Egypt in comparison with other countries.

**MATERIAL AND METHODS**

**Human milk collection**

Human breast milk samples were collected in January 2009 from 23 mothers in Fakous City, Al-Sharkia Governorate Egypt. Among the donors, (9) were primiparous and (14) were multiparous with average ages of (20 and 32) years. Fakous is one of the largest cities in Al-Sharkia with its main economy based on agriculture.

Breast milk samples were collected in clean 50 ml polypropylene centrifuge tubes with PTFE caps, kept in ice immediately after collection, and transferred to the Central Agricultural Pesticides Lab., Pesticide Residues and Environmental Pollution Department.

Informed consents were obtained from all donors. Questionnaires on dietary aspects and lifestyle were completed. The questions, concerned lifestyle factors, occupation, number of children, length of the lactation period, exposure to pesticides in the field and the use of the pesticides in home.

The pesticide standards for organochlorine pesticides were obtained from Dr. Ehrenstorfer Laboratories (Germany). Petroleum ether, diethyl ether, n-hexane, acetonitrile, anhydrous sodium sulfate, and methylene chloride were purchased from Merck (Germany). Florisil (PR Grade, 60–100 mesh) was purchased from BDH (England). All solvents were of pesticide residue grade. Florisil was activated at 130 °C overnight and cooled to room temperature in a desiccator.

**Sample preparation**

Procedures for extraction of pollutants and lipids from milk described by (Johansen et al., 1994) were used with minor modifications, while the clean-up procedure was that described by (Covaci et al., 2001). All samples were thawed and homogenized by shaking the milk for at least 5 min. An accurate amount of milk 10 g, was weighed and control samples were spiked with OCP standards (5ng α-HCH, 5ng of β-HCH, 5ng of γ-HCH, 2ng of p,p-DDT, 2ng of o,p-DDT, 2ng of p,p-DDE and 2ng of o,p-DDE) for recovery. After that 1 ml of formic acid was added to all samples. The extraction performed with 2×20 ml n-hexane/dichloromethane (5:1, v/v) by vortex shaking for 1 min. The organic layer was then subjected to clean up
onto a cartridge containing 1 g florisil. Complete elution of OCPs was realised with 10 ml n-hexane followed by 10 ml dichloromethane. The final eluate was concentrated first with a rotary evaporator and further under nitrogen to near dryness. The extract dissolved by 5 ml n-Hexane when preparing for injection. Lipid determination was carried out on a separate aliquot of milk, by extracting 5 g milk with 2×5 ml n-hexane/diethyl ether (1:1, v/v) for 2 min. The organic layer was transferred to a Petri-dish and evaporated. Lipids were gravimetrically measured after keeping the dish at 105 °C for 1 h.

**Quantification**

A Hewlett Packard (USA) 7890 gas chromatograph (GC) with a micro-electron capture detector (µECD) was equipped with a HB-5 capillary column (30m × 0.25mm i.d., 0.25µm film thickness). Nitrogen was used as carrier gas at a constant flow of 2.5 ml/min and Nitrogen as make-up gas (60.0 ml/min). One micro-liter was injected in the splitless mode. The temperature program applied was 120 °C held for 1 min, further by 20 °C/min to 180°C held for 2 min, further by 5 C/min to 220 °C, held for 5 min, and finally further by 3 °C/min to 245 °C, held for 30 min. injection port at 270°C. The detector temperature was 290°C. The limit of detection (LOD) and limit of quantitation (LOQ) were calculated based on the method reported by (JAN MOCAK et al., 1997). The LOD ranged from 0.001 – 0.005 µg/g lipid, LOQ was 0.01 µg/g for p,p-DDE, p,p-DDT, 0.03 µg/g for α-HCH and γ-HCH and 0.04 µg/g for β-HCH, and the recoveries of OCPs from spiked samples were ranged from 87.5 % to 102 % across three spiking concentrations.

**Questionnaires**

Based on a self-administered dietary questionnaire, (Sasaki et al., 1998; Sasaki et al., 2000), which was modified for dietary habits, questions were asked about lifestyle factors, height and weight, occupation, past and current exposure to pesticides, smoking habits, status of breastfeeding, residence history, food consumption frequencies, per week or per monthly and the approximate amount of certain food items in one meal such as marine or freshwater fish, meat, eggs, cow’s milk and so on.

**Statistical analysis procedures:**

The data was subjected to statistical analysis by a two-way ANOVA test using SPSS software for Windows version 10.0. Statistically significant differences between organochlorine levels and mothers’ age, and number of children were tested by Duncan’s multiple range (L.S.RD.) p ≤ 0.05.

**RESULTS**

**Characteristics of the participating women**

The characteristics of the women who participated in the study (n = 23) are summarized in Table 1. The mean age was 24 years, ranging from 20 to 32 years. Only 39.1% of the mothers were nursing their first child, while 60.9% were multiparous.

**Table 1: Characteristics of the women participating in the study**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age</td>
<td>23</td>
<td>24</td>
<td>24</td>
<td>20 – 32</td>
</tr>
<tr>
<td>No. of Children</td>
<td>23</td>
<td>1.9</td>
<td>2</td>
<td>1 – 4</td>
</tr>
<tr>
<td>Milk fat (% Lipids)</td>
<td>23</td>
<td>1.5</td>
<td>1.9</td>
<td>1.2 – 4.2</td>
</tr>
</tbody>
</table>
All women subjects were from rural areas. The results of the questionnaire revealed similar diets with low consumption of fish and relatively equilibrated amounts of animal meat and dairy products. Breast milk samples (5 g) were used for lipid measurements for all 23 subjects (Table 1). The mean fat content of the human milk samples ranged between 1.2 – 4.2%.

Breast milk is an ideal medium for assessing exposure to OCPs (Wong et al., 2005), where they sequester in adipose tissue, serum and breast milk and equilibrate at similar levels on a fat basis (Hooper, 1999), so we analysed the chemical contamination status mainly on a lipid basis because the liposolubility rate is thought to be a major factor influenced by rates of accumulation and elimination from tissues and organs (Parham et al., 1997), and because the existing differences depend principally on lipid content of the tissues (Henriksen et al., 1998).

The present study is one of few reports on OCPs contamination in breast milk from Egypt. This study found organochlorine pesticides in the studied breast milk samples at various concentrations. The results of this study showed that p,p-DDE, p,p-DDT and β-HCH were the major OCPs found in human milk samples from Fakous, Sharkia, Egypt. The contaminants at the highest levels of were p,p-DDE (2980 ng/g Lipid), p,p-DDT (1962 ng/g Lipid). While the HCH were observed in moderate concentrations ranging (nd-23 ng/g Lipid), (nd-17 ng/g Lipid) and (0.4-760 ng/g Lipid) for α-HCH, γ-HCH and β-HCH respectively.

**Distribution pattern of OCPs in human breast milk**

The distribution pattern of the OCPs in human milk found was similar to the pattern previously observed in other studies which was reported by (How-Ran Chao et al., 2006; Sudaryanto et al., 2006; Mueller et al., 2008) to follow the order of DDTs › HCHs. While the distribution pattern in the studies by Subramanian et al., 2007; Tsydenova et al., 2007; Behrooz et al., 2009 followed the order of HCHs › DDTs.

We found no significant differences between the levels of OCPs and age among all age groups. While there is significant difference between levels of OCPs and number of breast-feedings, high levels were also observed among a group of women who had one-child primiparous. It is noteworthy that participants with the highest levels of DDE also had the highest levels of p,p-DDT and β-HCH. This association between DDE and β-HCH in the same subjects suggests that participant mothers in this study were exposed to high levels of environmental contamination and accumulation of these pesticides in fat bodies.

The DDE: DDT ratio can be used to indicate whether DDT is still entering the environment. A ratio of DDE:DDT is indicative of DDT entering the environment (Harris et al., 1999), however, the ratio is not accompanied by high residue levels. The ratio of DDE:DDT, which presented in this study and residue levels suggested that the DDT is still being used in agriculture in Sharkia Governorate, where the samples were collected. Generally DDTs were detected at higher concentrations which ranged between (nd-2980 ng/g Lipid), followed by HCHs (nd-212.15 ng/g Lipid).

Among HCH isomers, β-HCH was the predominant isomer contributing 93.9% of the total HCHs (Fig.1). In addition, the ratio between different HCH isomers changes from lower tropic level in food chains to...
human milk. However, in some individuals of the present study, α-HCH exceeded over 50% of the total HCHs, indicating that technical HCH is still being used recently. The average values of (α-HCH & γ-HCH) /β-HCH ratios in the present study are (1/15).

In general, this study found that OCPs levels in human breast milk had no significant association with maternal age among all age groups (p>0.05), while there is significant association with the number of breast feeding ((p < 0.05), (primiparous and multiparous) mother and milk lipid content. (Fig.1).

Comparison of samples from Egypt with other countries

Comparison of OCP levels between different countries is presented in Table 2. For Egypt mean concentration of sum-HCHs in the total sample set was 225 ng/g lipid (Table 2). This was comparable to levels found in breast milk samples from India (Mumbai), Malaysia, Russia (Murmansk and Barents region) and higher than the results from Jakarta, Purwakarta, Bogor, Lampung, Norway by 16, 7.5, 20, 32 and 16 times respectively. While the levels of the sum-HCH concentration in human milk from China (Hong Kong, Dalian and Shenyang), Iran (Nour, Countryside of Nour and Noushahr), Turkey, Russia (Irkutsk region, Kola peninsula and Murmansk), Buryatia were higher than what we are found in human milk samples by 4, 6, 25, 13, 11, 25, 2, 10, 3.5, 4 and 3.6 times, respectively. The data in Table 2 showed that the mean concentration of sum-DDTs in total samples was 1315 ng/g lipid in Egypt. This finding was comparable with the levels found in breast milk samples from India (New Delhi and Chennai), Purwakarta, Bogor, Malaysia, Russia (Murmansk and Barents region). The concentration of DDTs found in human milk samples from China (Hong Kong and Dalian), Iran (Noushahr), Turkey, Russia (Irkutsk region) were higher than the concentrations we found by 2, 1.5, 2, 3, 2 and 1.5 times, respectively. While the level of DDTs we found in human breast milk samples was higher than the concentration levels found in breast milk samples from India (Mumbai), China (Shenyang), Jakarta, Philippines, Norway, Belgium, Russia (Kola peninsula, Murmansk and Buryatia) by 3, 3, 1.5, 2, 8, 12, 8, 1.5, 1.5 and 2 times, respectively.
DISCUSSION
Organochlorine pesticides were widely used in agriculture and pest control until research and public concern regarding the hazards of their use led to government restriction and bans. In Egypt, the use of these compounds has been officially banned for about 30 years. Despite restrictions and bans on the use of many organochlorine pesticides, they continue to persist in the environment. In fact, in many ways, human have become reservoirs for these substances.

Public concern about the adverse environmental and human health impacts of organochlorine contaminants led to strict regulations on their use in developed nations more than two decades ago. Nonetheless, DDT and several other organochlorine pesticides are still being illegally used for agriculture in many developing countries and have led to the contamination of foodstuffs, especially those having a high fat content such as meat and meat products which

<table>
<thead>
<tr>
<th>Country</th>
<th>Year of collecting</th>
<th>N</th>
<th>ΣHCH5</th>
<th>ΣDDT5</th>
<th>ΣCHL5</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>2000</td>
<td>28</td>
<td>225</td>
<td>1815</td>
<td>-</td>
<td>This study</td>
</tr>
<tr>
<td>India</td>
<td>2000</td>
<td>8</td>
<td>720</td>
<td>430</td>
<td>55</td>
<td>Kunrak et al., 2002</td>
</tr>
<tr>
<td>New Delhi</td>
<td>2005-2006</td>
<td>21</td>
<td>340</td>
<td>1500</td>
<td>26</td>
<td>Devanathan et al., 2009</td>
</tr>
<tr>
<td>Mumbai</td>
<td>2005-2006</td>
<td>26</td>
<td>220</td>
<td>450</td>
<td>34</td>
<td>Devanathan et al., 2009</td>
</tr>
<tr>
<td>China</td>
<td>2002-2003</td>
<td>12</td>
<td>4500</td>
<td>1200</td>
<td>73</td>
<td>Subramaniam et al., 2007</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>1999</td>
<td>132</td>
<td>950</td>
<td>2870</td>
<td>-</td>
<td>Wong et al., 2002</td>
</tr>
<tr>
<td>Delian</td>
<td>2002</td>
<td>1</td>
<td>1400</td>
<td>2100</td>
<td>16</td>
<td>Kunrak et al., 2004</td>
</tr>
<tr>
<td>Shandong</td>
<td>2002</td>
<td>550</td>
<td>870</td>
<td>-</td>
<td>6.7</td>
<td>Kunrak et al., 2004</td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jakarta</td>
<td>2001</td>
<td>16</td>
<td>14</td>
<td>630</td>
<td>2</td>
<td>Sudaryanto et al., 2006</td>
</tr>
<tr>
<td>Surabanya</td>
<td>2002</td>
<td>19</td>
<td>30</td>
<td>1100</td>
<td>7.7</td>
<td>Sudaryanto et al., 2006</td>
</tr>
<tr>
<td>Bogor</td>
<td>2005</td>
<td>15</td>
<td>11</td>
<td>1200</td>
<td>1.8</td>
<td>Sudaryanto et al., 2006</td>
</tr>
<tr>
<td>Lampung</td>
<td>2003</td>
<td>6</td>
<td>7</td>
<td>1000</td>
<td>3.5</td>
<td>Sudaryanto et al., 2006</td>
</tr>
<tr>
<td>Iran</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naur</td>
<td>2006</td>
<td>3003</td>
<td>2680</td>
<td>2</td>
<td>-</td>
<td>Behroz et al., 2009</td>
</tr>
<tr>
<td>Countryside of Naur</td>
<td>2006</td>
<td>2555</td>
<td>1571</td>
<td>-</td>
<td>-</td>
<td>Behroz et al., 2009</td>
</tr>
<tr>
<td>Novi Luka</td>
<td>2006</td>
<td>5742</td>
<td>3363</td>
<td>-</td>
<td>-</td>
<td>Behroz et al., 2009</td>
</tr>
<tr>
<td>Malaysia</td>
<td>2003</td>
<td>17</td>
<td>230</td>
<td>1600</td>
<td>23</td>
<td>Sudaryanto et al., 2005</td>
</tr>
<tr>
<td>Philippines</td>
<td>2004</td>
<td>33</td>
<td>-</td>
<td>170</td>
<td>55</td>
<td>Malitsa et al., 2007</td>
</tr>
</tbody>
</table>

Developed countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Year of collecting</th>
<th>N</th>
<th>ΣHCH5</th>
<th>ΣDDT5</th>
<th>ΣCHL5</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey</td>
<td>1995-1996</td>
<td>460</td>
<td>2400</td>
<td>-</td>
<td>-</td>
<td>Cok et al., 1997</td>
</tr>
<tr>
<td>Norway</td>
<td>2000-2002</td>
<td>29</td>
<td>14</td>
<td>110</td>
<td>14</td>
<td>Foeld et al., 2008</td>
</tr>
<tr>
<td>Basauri</td>
<td>2006</td>
<td>197</td>
<td>12</td>
<td>156</td>
<td>7.8</td>
<td>O-ciles et al., 2008</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Year of collecting</th>
<th>N</th>
<th>ΣHCH5</th>
<th>ΣDDT5</th>
<th>ΣCHL5</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irkutsk region</td>
<td>1988-1989</td>
<td>2100</td>
<td>2000</td>
<td>18</td>
<td>-</td>
<td>Schecter et al., 2004</td>
</tr>
<tr>
<td>Kola peninsula</td>
<td>1993</td>
<td>800</td>
<td>860</td>
<td>46</td>
<td>-</td>
<td>Foeld et al., 1998</td>
</tr>
<tr>
<td>Marmsk</td>
<td>1999</td>
<td>858</td>
<td>1474</td>
<td>-</td>
<td>-</td>
<td>Foeld et al., 1998</td>
</tr>
<tr>
<td>Marmsk</td>
<td>2005</td>
<td>255</td>
<td>900</td>
<td>22</td>
<td>-</td>
<td>Foeld et al., 1998</td>
</tr>
<tr>
<td>Kemer region</td>
<td>1995-1997</td>
<td>520</td>
<td>1200</td>
<td>37</td>
<td>-</td>
<td>Foeld et al., 2005</td>
</tr>
<tr>
<td>Byravas</td>
<td>2004-2005</td>
<td>810</td>
<td>660</td>
<td>19</td>
<td>-</td>
<td>Tsydenova et al., 2007</td>
</tr>
<tr>
<td>Japan</td>
<td>1998</td>
<td>210</td>
<td>290</td>
<td>14</td>
<td>-</td>
<td>Kumaia et al., 2001</td>
</tr>
<tr>
<td>Japan</td>
<td>2001-2004</td>
<td>93</td>
<td>110</td>
<td>340</td>
<td>80</td>
<td>Kunrak et al., 2006</td>
</tr>
<tr>
<td>Germany</td>
<td>1995-1997</td>
<td>246</td>
<td>240</td>
<td>-</td>
<td>-</td>
<td>Schade and Heinzow, 1998</td>
</tr>
<tr>
<td>England</td>
<td>2001-2003</td>
<td>40</td>
<td>220</td>
<td>-</td>
<td>-</td>
<td>Kallast et al., 2004</td>
</tr>
</tbody>
</table>
contribute to the high dietary intakes of most of the organochlorines (Kannan et al., 1994). As a consequence, humans in this region are exposed to dietary levels of organochlorines at least 5–100-fold greater than those in more developed nations (Kannan et al., 1997).

This study was conducted to assess organochlorine pesticides levels in human breast milk among Egyptian women. The majority of participants in this study had high levels of DDE and β-HCH, this was expected because of the high organochlorine levels in food in Egypt (El-Dib and 1985; Nabawi et al., 1987; Dogheim et al., 1988; Dogheim et al., 1990; El-Gendy et al., 1991; Amr et al., 1995; Badawy et al., 1995). The correlation between organochlorine pesticides levels and number of children and prolonged lactation, suggests that breast feeding may modulate excretion of organochlorine pesticides and prolonged lactation may have reduced the body burden of organochlorine levels through breast milk transfer (Rogan et al., 1980; Rogan et al., 1986; Soliman et al., 2003).

The high human breast milk OCP levels in the majority of our study subjects, confirmed that the role of lactation prolongation in reducing OCP levels from human body (Rogan et al., 1980; Rogan et al., 1986). Our finding may also be supported by many studies from India, Croatia, United States and Egypt (Rogan et al., 1986; Nair et al., 1996; Laden et al., 1999; Soliman et al., 2003).

CONCLUSION

The study shows the presence of high levels of organochlorine pesticide in human milk in the Fakous, Sharkia Governorate. Total DDT concentrations were found to be higher than total HCH levels, which can be attributed to the illegal use of DDT in agriculture in Sharkia Governorate and/or earlier anti-malaria activities. The present data clearly indicates a significant bioconcentration of DDT and HCH residues in the breast milk, and the newborn is a recipient of this bio-concentrated form of pesticides. The result demonstrates that considerable amounts of DDT and HCH are transferred from the mother through breastfeeding. There were no significant differences between the levels of OCPs among the different age groups (p > 0.05). While there were significant differences between number of breast feeding (primiparous and multiparous) mothers (p ≤ 0.05). So a positive correlation between age and OC body burden is expected. Breast milk can be considered as a suitable indicator for monitoring the burden of the persistent lipophilic chlorinated pesticides in the human body. Government and other relevant agencies should educate farmers in Good Agricultural Practices (GAP) in the use of pesticides in agriculture. Regular monitoring of OCP levels in the environment should be conducted.

ACKNOWLEDGEMENTS

I thank the volunteers and staff of Primary Health Care Centre, Fakous city, Al-Sharkia Governorate, Egypt and I also thank Dr. Aziza H. Mohamady, Central Agricultural Pesticide Laboratory, Agriculture Research Center, Egypt for their assistance in samples collection.

REFERENCES


Hoekstra, P. F. and Hara., et al. (2003). "Trophic transfer of persistent organochlorine contaminants (OCs) within an Arctic marine food web from the southern Beaufort-Chukchi Seas." Environ Pollut 124(3): 509-22.


Kalantzi, O. I. and Martin., et al. (2004). "Different levels of polybrominated diphenyl ethers (PBDEs) and chlorinated compounds in breast milk from two U.K. Regions." Environ Health Perspect 112(10): 1085-91.


ARABIC SUMMARY

المركبات الكلورونية العضوية الثابتة في ألبان الأمهات بمحافظة الشرقية، مصر

شريف حسين عبد الرحمان

قسم بحوث متغيرات المبيدات وثلوت البيئة، المعمل المركز للمبيدات، مركز البحوث الزراعية، الدقي، مصر

في هذه الدراسة تم جمع عينة من ألبان الأمهات في يناير 2009 من المركز الصحي، بمدينة فاوس، محافظة الشرقية، مصر. وقد تم تدقيق بعض المبيدات الكلورونية العضوية الثابتة ونتائج تمثيلها مثل مركب داي كلوروراديا فينيل تراسي كلوروراذيبان (ددت) و نواتج تمثيله، وكذلك مركبات، مألقة، و جاما هكساكلوروروهكسان. وقد كان متوسط تركيز مركبات الهكساكلوروروهكسان وددت هو 245 و 1315 نانوجرام/جرام دهن على الترتيب. وقد لوحظ عدم وجود فرق معنوي في تركيز المبيدات الكلورونية بإختلاف العمر، بينما كان هناك فرق معنوي وارتباط بين تركيز المبيدات الكلورونية وعدد مرات الإرضاع (ولادة واحدة و عدة ولادات) للأم (معنوية >0.05). وتشير النتائج إلى أنه هناك احتمال أن هذه المركبات لازالت تدخل إلى البيئة في هذه المنطقة طبقا ل نسبة دادي / ددت. ومن خلال النتائج المتصول عليها ودراسة مستويات تركيز المبيدات الكلورونية العضوية توسيع الدراسة بأجراء المزيد من برامج تقصي الملوثات في البيئة بشكل دوري.