



Presence of organochlorine pesticides in breast milk samples from Colombian women



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HIGHLIGHTS

- ▶ Chlorine pesticides were quantified in breast milk samples collected in Colombia.
- ▶ For the study, 32 women were recruited in the city of Bogota.
- ▶ 4,4' DDE concentrations ranged between <25 and 14948 ng g⁻¹ (median = 126 ng g⁻¹).
- ▶ 4,4' DDE average concentration was similar to the results from other countries.
- ▶ Results suggest no significant changes in pesticide concentration during lactation.

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ABSTRACT

The presence of Organochlorine Pesticides (OCPs) in biological and environmental samples has been studied for decades in many countries. Nonetheless, studies in Latin American countries like Colombia have been scarce. Determining the presence of OCPs in breast milk will be of relevance to assess exposures, potential health risks, and for surveillance among Latin American populations.

Thirty-two breast-feeding mothers were selected to voluntarily participate in the study. Breast milk samples were analyzed for 10 OCPs (α -, β -, γ -, δ -HCH, Heptachlor, α -, γ -Chlordane, 4,4' DDT, 4,4' DDE, 4,4' DDD). Milk samples were analyzed using liquid–liquid extraction, followed by sulfuric acid clean-up, and quantified using GC/ μ ECD. Results were confirmed by GC/MS. OCPs concentrations were normalized using fat content. In all but one sample, 4,4' DDE was quantified in concentrations ranging between <17 and 14948 ng g⁻¹ (ng of OCP per g of lipids), with a mean value of 203 ng g⁻¹. One woman had 4,4' DDE concentrations that were orders of magnitude above the average concentrations observed worldwide. Concentrations of 4,4' DDE in a second breast milk sample collected in a different time period of lactation from a sub-group of 13 women from the original participants, showed no statistically significant difference with the concentrations found in the first sample. Based on the results obtained from the Persistent Organic Pollutants Global Monitoring Plan report of 2009 of the Stockholm Convention, Colombia ranks fourth from bottom to top in terms of 4,4' DDE average concentrations.

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1. Introduction

Persistent Organic Pollutants (POPs) are a group of chemical compounds used in agriculture and industry, which degrade very slowly in the environment and bioaccumulate and biomagnify in the trophic chain (EPA, 2002). Due to their ubiquity, ecological

impact, and potential toxicological effects, the Stockholm Convention on Persistent Organic Pollutants was adopted in May 2001 (POPs, 2001). Some Organochlorine Pesticides (OCPs) are included in the treaty. OCPs are lipophilic, non-polar compounds that tend to accumulate in the adipose tissue of living organisms, including humans (EPA, 2002). After being absorbed by the body, most OCPs are partially dechlorinated, oxidized, and conjugated in the processes of metabolic biotransformation of exogenous substances (EPA, 2002). However, the highest proportion of absorbed compounds is accumulated in adipose tissue of individuals, without major changes in their molecular structure (Skaare and Polder,

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Table 1
Standard reference material assay.

Analyte (OCP)	SRM 1954 (ng kg ⁻¹) ^a	Our lab (ng kg ⁻¹) ^a	% Difference
α HCH	N.A.	N.A.	N.A.
β HCH	829 ± 38	814.2	2%
γ HCH	588 ± 34	386.3	34%
δ HCH	N.A.	N.A.	N.A.
Heptachlor	N.A.	N.A.	N.A.
γ Chlordane	377 ± 9	252.1	33%
α Chlordane	496 ± 11	469	5%
4,4' DDE	8120 ± 350	7781.5	4%
4,4' DDD	425 ± 15	381.4	10%
4,4' DDT	703 ± 74	341.2	51%

^a The concentration is given ng of OCP per kg of milk.

1990; EPA, 2002; Waliszewski et al., 2002; Lucena et al., 2007; Mead, 2008; Polder et al., 2008).

During the production of breast milk, the human body uses lipids from the adipose tissue, and accumulated OCPs in the adipose tissue can migrate to breast milk (LaKind et al., 2009). The World Health Organization (WHO) has conducted four worldwide biomonitoring campaigns of POPs in breast milk (WHO, 2007).

Currently, there is no historical information characterizing the Colombian population in terms of breast milk concentrations of any of the POPs listed in the annexes of the Stockholm Convention. Although the use and production of the vast majority of OCPs is banned in many countries since the 1970s, exposure continues today (Jaga and Dharmani, 2003; Lucena et al., 2007). Specifically for Colombia, regulations regarding the use of OCPs began in 1974 and they were completely banned in 2001.

The aim of this study was to assess the concentration of OCPs in breast milk in a sample of women in Bogotá, Colombia. The results of the study will serve as the basis for surveillance biomonitoring in Colombia. The study describes the analytical technique developed to quantify OCPs in breast milk, the application of the tools required to implement the WHO surveillance protocol, and analyses the changes in OCPs concentrations during lactation.

2. Materials and methods

2.1. Study background

This study followed the guidelines established by the United Nations Environment Programme (UNEP) and the World Health

Organization (WHO) in the Fourth WHO-Coordinated Survey of Human Milk for Persistent Organic Pollutants (WHO, 2007). Since this Protocol was developed for surveillance purposes, it intentionally excludes samples from women who may have been exposed to POPs in uncommon situations. The idea is to collect and analyze samples from a population reproducible in time, recruiting women who represent the levels of environmental exposures of the general population, to be able to compare the results of this study with others, and to establish a baseline for future biomonitoring campaigns.

2.2. Target chemicals

Ten OCPs listed in Appendix A of The Stockholm Convention were analyzed in this study. These were 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, α-HCH, β-HCH, δ-HCH, γ-HCH, Heptachlor, α-Chlordane, and γ-Chlordane. The POPs listed in Appendix A are the compounds with more severe restrictions.

2.3. Participant selection and recruitment

The women who voluntarily participated in the study were progressively recruited performing a non-probability convenience sampling. Recruitment was conducted among participants of breast-feeding and growth programs in Fontibón Hospital in Bogotá.

Thirty-two (32) women participated in the surveillance program. From a sub-group of 13 women from the initial participants,

Table 2
Characteristics and dietary habits of the participating mothers.^a

Characteristics	Mean (min–max) % of participants				
Years living in Bogotá	20 (10–30)				
Participant (mother) is Colombian	100%				
Participant (mother) received breast-feeding	86%				
Work outside the home	64%				
Infant age at 1st sample collection (days)	31 (15–58)				
Age mother (years)	23.3 (18–30)				
Height mother (cm)	156.3 (149–166)				
Weight mother before pregnancy (kg)	55.9 (45–72)				
Body mass index (BMI) of mother before pregnancy (kg cm ⁻²)	22.8 (18.2–27.6)				
Mothers with increased weight comparing weight before pregnancy against weight at time of sampling	43%				
4,4' DDE concentrations (ng g ⁻¹ lipids)	203 (8.5–1176)				
<i>Dietary habits</i>					
Consumption of (%)	Fish	Sea-food	Milk and dairy products	Meat and poultry	Eggs
Never	11	93	4	0	4
<Once a week	25	7	0	0	0
Once a week	39	0	3	0	14
Twice a week	21	0	0	3	18
>Twice a week	0	0	0	11	14
Daily	4	0	93	86	50

^a All results in Table 3 exclude women that did not completely fulfilled WHO criteria.

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