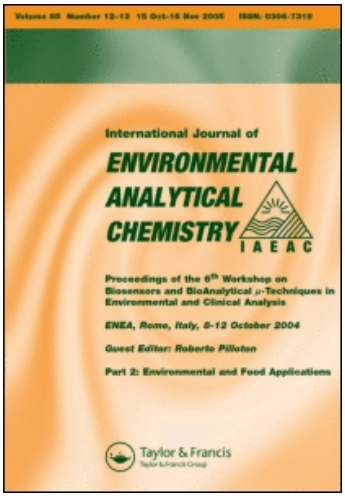

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Determination of Organochlorine Residues in Maternal and Cord Blood Plasma

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Organochlorine pesticide (OCP) residues determined in seventy-seven maternal and forty-eight cord blood plasma samples showed mean levels of total *p,p'*-DDT in maternal (pregnant), maternal (non-pregnant) and cord blood plasma to be 14.9, 6.8 and 7.6 mg/kg fat respectively. Mean levels of total HCH for the three sets of samples were 5.1, 2.4 and 1.5 mg/kg fat respectively while those for HCB were 0.6, 0.4 and 0.4 mg/kg fat respectively. The level of OCPs in the cord blood plasma reflects the degree of transplacental transfer of these contaminants from the mother to the developing foetus. The high levels of contaminants in the blood plasma of pregnant women could be attributable to more intensive use of aerosol insecticides during pregnancy.

KEY WORDS: Organochlorine residues, maternal and cord blood plasma, socioeconomic group.

INTRODUCTION

Organochlorine compounds have been found (though in very low levels) in different food materials and in biological systems in many countries of the world. The accumulation of these xenobiotics may reach toxic levels in various organisms including man, if adequate caution in their application is not exercised. In many countries, continuous monitoring of the levels of these contaminants in food,

man and his environment helps in the formulation of control measures to safeguard public health and the environment.

In many developing countries, control strategies are hardly ever based on scientific data. Consequently, such controls are never realistic and as such they are only minimally effective. Thus, organochlorine pesticides are still being sold freely in Nigerian markets without restrictions in spite of their ban or severe restriction in developed countries owing to their persistence in the environment.

Residue levels of these pesticides have been determined in various food materials,[1–3] body fat,[4] milk[5,6] and blood of the general population.[7] However, there are no data on the levels of these compounds in women during gestation and lactation periods.

Chlorinated hydrocarbons have been known to cause skin disorders and some deaths in children of nursing mothers exposed to these compounds.[8] Yusho disease, which was associated with accidental ingestion of oil contaminated with polychlorinated biphenyls (PCBs), resulted in stillbirths and various congenital malformations.[9] This study was undertaken to determine the levels of organochlorine residues in Nigerian women during gestation and the degree of transplacental transfer of these contaminants from the mother to the developing foetus.

Blood is a convenient tissue for use as indicator of human pesticidal burden because it does not cause any harm to the donor.

EXPERIMENTAL

Materials and reagents

Apparatus: A varian aerograph 3700 gas chromatograph equipped with ^{63}Ni electron capture detector was used. A glass capillary column (25 m × 0.25 mm id.) coated with SE 54 (1% vinyl 5% phenylmethyl silicone) was used with the following conditions:
Injector temperature 220 °C
Detector temperature 320 °C
Column was temperature programmed from 80 °C to 200 °C at 15 °/minute, 200 °C to 242 °C at 2 °/minute and then maintained at 242 °C for 10 minutes.
Type of injection: Splitless

Samples

Five to ten millilitres of 77 maternal (53 pregnant and 24 non-pregnant) as well as 48 cord blood samples were obtained in heparinized tubes from women of lower socioeconomic group at the time of delivery at the Central Hospital, Benin City, Bendel State of Nigeria. The samples were centrifuged at 400 rpm for twenty minutes and the plasma transferred to culture tubes. The age, parity, dietary habits and household use of pesticides were noted for each donor. All samples not extracted on the day of collection were kept frozen at $-15\,^{\circ}C$ prior to analysis.

Solvents and standards

All solvents were redistilled in an all-glass still and stored in amber glass bottles. The pesticide standards used were kindly supplied by Professor Soren Jensen of the Institute of Environmental Chemical Analysis, Wallenberg laboratory, University of Stockholm, Stockholm, Sweden.

Extraction and analysis

2–4 g plasma was weighed into a 15–20 ml culture tube and 6–12 ml hexane added. The tube was shaken mechanically for one hour and then centrifuged at 3000 rpm for five minutes. A known aliquot was transferred into a weighed tube and solvent removed at $45\,^{\circ}C$ in a stream of nitrogen. The residue was weighed to determine the fat content. The extracted lipids were redissolved in hexane (100 mg/ml) and treated with concentrated sulphuric acid. After centrifugation, the upper hexane layer was removed for chromatographic analysis.

The pesticide residues were quantified by direct comparison of peak height measurement for both standard and sample. Individual residues were confirmed by GC/MS analysis.

RESULTS AND DISCUSSION

The mean levels and ranges of organochlorine residues studied are shown in the Tables 1 and 2. All the donors had lived in the same urban centre for periods ranging from two months to twenty-seven

Table 1 Mean levels and ranges of organochlorine residues in maternal and cord blood plasma (mg/kg fat weight)

	Maternal plasma (pregnant) (53)[a]	*Maternal plasma (non-pregnant) (24)*[a]	*Cord plasma (48)*[a]
p,p'-DDE	7.4 (0.3–22.2)	4.0 (0.5–14.6)	3.6 (0.1–11.7)
p,p'-DDD	1.5 (0.0–6.0)	0.7 (0.1–2.6)	1.1 (0.2–2.8)
p,p'-DDT	5.9 (0.1–22.7)	2.1 (0.3–11.8)	2.9 (0.2–11.8)
$\frac{p,p'\text{-DDE}}{p,p'\text{-DDT}}$	1.2	1.9	1.2
Alpha-HCH	0.4 (0.0–1.4)	0.2 (0.1–0.5)	0.3 (0.1–1.1)
beta-HCH	3.8 (0.2–13.7)	1.1 (0.1–2.7)	1.6 (0.0–6.8)
gamma-HCH	0.8 (0.0–4.5)	0.2 (0.0–0.8)	0.5 (0.0–2.5)
Total HCH	5.1	1.5	2.4
HCB	0.6 (0.1–5.7)	0.4 (0.0–0.2)	0.4 (0.1–0.8)

[a]Number of samples analysed in each case.

years and are of the same age range 15–40 years and socioeconomic status. All the pregnant donors, except one, had had previous deliveries and parity ranged from 1–7 children. Their diet contained meat, fish and vegetables and they all used insecticides in aerosol spray as follows: 51% sprayed sleeping areas at least twice a week, 19% two to three times a week and 30% almost daily.

Results show a great deal of variation in residue levels among individuals though it is less pronounced on fresh weight basis. However, the mean levels of all compounds studied were higher for pregnant women than for non-pregnant women (14.9 versus 6.8 mg/kg DDT, 5.1 versus 1.5 mg/kg HCH and 0.6 versus 0.4 mg/kg HCB). Surprisingly, the mean levels for cord plasma, though lower than those for maternal plasma, (pregnant), were higher than those

Table 2 Mean levels and ranges of organochlorine residues in maternal and cord blood plasma (mg/kg fresh weight)

	Maternal plasma (pregnant) (53)[a]	*Maternal plasma (non-pregnant) (24)*[a]	*Cord plasma (48)*[a]
p,p'-DDE	3.9 (0.8–22.4)	3.1 (0.8–8.7)	1.6 (0.0–8.8)
p,p'-DDD	0.6 (0.1–3.3)	0.4 (0.1–1.2)	0.4 (0.1–0.9)
p,p'-DDT	3.0 (0.4–21.7)	1.5 (0.4–4.7)	1.4 (0.0–13.7)
$\frac{p,p'\text{-DDE}}{p,p'\text{-DDT}}$	1.3	2.1	1.1
Alpha-HCH	0.1 (0.1–0.4)	0.1 (0.1–0.2)	0.1 (0.0–0.4)
beta-HCH	1.3 (0.4–3.6)	0.9 (0.2–2.6)	0.5 (0.0–1.2)
gamma-HCH	0.3 (0.0–1.9)	0.1 (0.1–0.3)	0.2 (0.0–0.6)
Total HCH	1.8	1.2	0.8
HCB	0.3 (0.1–1.4)	0.2 (0.0–0.1)	0.2 (0.0–0.7)

[a]Number of samples analysed in each case.

for non-pregnant women (7.6 mg/kg DDT, 2.4 mg/kg HCH and 0.5 mg/kg HCB). This means that a high percentage of pesticide residues, accumulated by the mother, crosses the placenta to the developing foetus.

The residue levels obtained in this study are much higher than those obtained for the general population (0.9 mg/kg total DDT)[7] but are comparable to those obtained by Osibanjo and Jensen (14.9 mg/kg DDT)[10] for residents of Ibadan in Oyo State. The higher values obtained here could be due to more intensive spraying of pesticides against malaria attacks during pregnancy and also to higher dust levels in the homes of people of lower socioeconomic groups. Davies and Cater[11] found the levels of DDE in blood of children from poor homes to be higher than those of the general

population due to higher dust levels and poor sanitation. The values however compare favourably with levels reported by some developed countries between 1962 and 1973 when the use of organochlorine pesticides was either just banned or restricted in these countries.[12] It must be stressed that the present level of agricultural use of pesticides in Nigeria is far below those of the developed countries before the ban or restriction. This suggests that household use of pesticides contributes significantly to human contamination in Nigerian urban centres.

CONCLUSION

It is obvious from this study that pesticidal contamination is a problem in this country. The levels obtained call for measures to reduce the increase in human burden of organochlorine pesticides since controlled use has proved effective in countries where levels were high. The public, particularly pregnant and lactating mothers should therefore be educated especially in the area of nutrition, environmental sanitation and use of pesticides during pregnancy and lactation. Abstention from fatty foods and sea fish which contain high levels of pesticide residues and other toxic chemicals, as well as heavily polluted work or household environments is recommended.

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