CHIRAL INDUSTRIAL POLLUTANTS IN HUMAN SAMPLES

Shen H[1,3*], Main KM[1], Skakkebæk NE[1], Toppari J[2], Schramm K-W[3,4]

[1]University Department of Growth & Reproduction, Rigshospitalet, Blegdamsvej 9, DK-2100, Copenhagen, Denmark

[2]Departments of Physiology and Paediatrics, University of Turku, Kiinamyllynkatu 10, FI-20520, Turku, Finland

[3]GSF-Forschungszentrum für Umwelt und Gesundheit, Institut für Ökologische Chemie, Ingolstädter Landstrasse 1, 85764 Neuherberg, Germany

[4]TUM, Wissenschaftszentrum Weihenstephan für Ernährung und Landnutzung, Department für Biowissenschaften, Weihenstephaner Steig 23, 85350 Freising, Germany

*corresponding author: shq0199@yahoo.com

Introduction

Many industrial pollutants are chiral compounds and they are released into the environment as racemic mixtures. These include some endocrine disruptors like technical DDT, technical chlordane, toxaphene, PCBs, HCHs, nonylphenol and phthalates. Physical processes (leaching, volatilization, and atmospheric deposition) and abiotic reactions (hydrolysis and photolysis) are believed to be unaffected by the chiral form[1], whereas biotransformation and biodegradation are not. The enantiomeric ratios (ERs) thus contain information of biotansformation or biodegradation of these chiral pollutants. Therefore, chiral pollutants, for example, α-HCH, have been used as a versatile tool for process studies[2]. We measured ERs of some chiral pollutants in human tissues to understand their possible fate in human tissue.

Materials and Methods

Some chiral compounds (α-HCH, *cis*-heptachloroepoxide (*c*-HE), oxychlordane (OXC)) were analyzed by HRGC-HRMS in 65 milk samples and 112 placenta samples from Turku, Finland, and 65 milk and 168 placenta samples from Copenhagen, Denmark. The samples were collected in a human birth cohort study described in detail in Boisen's report[3]. The study was approved by the local ethics committee and conducted according to the Helsinki II declaration. The sample collection, preparation, cleanup procedures and HRGC-HRMS analyses for organochlorine pesticide and chiral compounds have been described elsewhere[4].

Results and Discussion

Only the data that could be quantified are shown in the table. Similar to our recent report in placenta[4], plots of the ER *vs.* (+)- or (-)-enantiomer concentration of α-HCH and *c*-HE showed that the ERs changed depending on the isomer concentrations. Contrary to *c*-HE, no trends in ER-concentration plots were found for OXC. Due to the enantiomeric selective accumulation of the chiral pollutants in fatty depot and the low level of recent uptake from the environment, we propose the following equation to interpret the concentration trends of the ER-isomer

plots. Here C_{uptake} and C_s represent the recent uptake and the fatty tissue depot of the chiral pollutants, respectively.

$$ER = C_+ / C_- = (C_{uptake\,+} + C_{s+}) / (C_{uptake\,-} + C_{s-})$$

The change of ER may reflect the balance between residuals from historical exposure and current exposure from the environment.

The results (**Table**) showed that the ER deviated from the racemic ratio (ER = 1) more in placenta than in milk for *α*-HCH and *c*-HE in Danish samples and for *α*-HCH in Finnish samples. The ER of OXC in placenta and milk were nearly the same. ER differences between paired placenta-milk samples suggested a tissue specific pollutant biotransformation. It has been reported that there is an enantiomer specific estrogenic activity of (+), (-)- o,p'-DDT *in vitro*[5], which may also be found with other chemicals that have endocrine disrupting activity. In the cohort study[6], we found that the absolute concentrations of *c*-HE and OXC enantiomeric isomers were higher, but not significantly, for cryptorchid boys than controls. The enantiomeric median ratio for OXC (cases/controls) was 1.36/1.28 and for *c*-HE 2.48/2.19 (p=0.103 and p=0.467, respectively). It is interesting to note that case samples had higher levels of *c*-HE with higher ERs. This means that case mothers have been exposed more heavily than control mothers to *c*-HE in the past.

Table: ERs difference in paired milk-placenta samples

Compound	Cohort	Milk	Placenta	N	p-Value
α-HCH	Denmark	0.59	0.82	41	<0.0001
	Finland	0.47	0.78	43	<0.0001
c-HE	Denmark	1.95	2.24	40	0.018
	Finland	1.98	2.13	31	0.19
OXC	Denmark	1.30	1.37	38	0.37
	Finland	1.39	1.23	28	0.14

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