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Environmental Contamination and Toxicology

Organochlorine Residues in Human Adipose Tissue of the Population of Zaragoza (Spain)

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The concentration of organochlorine substances in human adipose tissue has proved to be a good indicator of the evolution of a population's exposure to such substances (Anderson, 1985). Large variations have been found in different populations with different products, which are related either to the presence of environmental residues from agriculture or industry in water or foodstuffs in the areas studied, or to direct exposure in the work environment (Dale and Quinby, 1963, Quinby et al., 1965, Fournier et al., 1972, Vioque and Saez, 1976, Dejonckheere et al., 1978, Jensen and Clausen 1979, Siddiqui et al., 1981, Amarowicz et al., 1989). It has also been repeatedly observed that these concentrations decreased as a direct result of widespread rigorous control or prohibition of these substances from the 1970s onwards (Brevik and Bjerk, 1978, Abbott et al., 1981, Abbott et al., 1985, Jani et al., 1988).

This paper's object is to check the current situation in the city of Zaragoza, Spain, with regard to the concentration in human adipose tissue of HCB, ß-HCH and pp-DDE, which are considered to be the major contaminants, and are taken *a priori* to be independent, and to discuss their possible sources.

MATERIALS AND METHODS

Fat samples were taken from the abdominal wall from 168 corpses subjected to judicial autopsy in the Forensic Institute in the city of Zaragoza in the years 1988-89. The sample consists of 123 men and 45 women, aged between 16 and 95, with a mean of 51.51±21.42. The cause of death was natural in 38 cases, violent in 124 cases and unknown in the remaining 6.

The samples, approximately 0.5 g, were kept at -20°C until processing. Analysis of HCB, ß-HCH and pp' DDE were performed by grinding the tissues with Na2SO4. The residues were extracted with hexane (Merck 4371) in a Soxhlet apparatus. A clean-up procedure with Na2SO4 was applied according to Veierov and Aharonson (1980). A Hewlett-Packard 5890 gas chromatograph - 3396A data integrator with an electron-capture detector and a 1.5 % SP-2250 / 1.95 % SP-2401 stationary phase was used for quantitative analysis. Aldrin was used as internal standard and results were expressed in ppm (µg/g) on a lipid basis. HCB was analysed in all the samples, pp-DDE in 140 and ß-HCH in 101 cases, and detectable concentrations of each compound were found in each of the samples studied.

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Table 1 . Fat tissue concentration (ppm) related to sex

		N	mín.	máx	mean	g.m.	S.D.	S.E.
ß HCH	Men	74	.01	2.24	.46	.33	.41	.05
	Women	27	.06	3.39	.74	.51	.69	.13
	TOTAL	101	.01	3.39	.53	.37	.51	.05
pp' DDE	Men	104	.14	12	2.83	2.11	2.33	.23
	Women	36	.09	8.62	3.35	2.39	2.33	.39
	TOTAL	140	.09	12	2.96	2.18	2.33	.20
HCB	Men	123	.20	17.37	2.47	1.83	2.49	.22
	Women	45	.40	14.70	4.27	3.22	3.15	.47
	TOTAL	168	.20	17.37	2.95	2.13	2.79	.22

RESULTS AND DISCUSSION

Table 1 summarises the results by sex. The three substances were found in higher concentrations in women, the difference being statistically significant for ß-HCH and HCB. Planas et al. (1988) found a higher concentration of PCB in women (298 samples), Camps et al. (1989) reported higher concentrations of a variety of organochlorine substances in women, although the difference was only significant in the case of ß-HCH (87 cases). Similar disparities have been observed in other countries; Amarowicz et al. (1989) reported a greater concentration of DDE and DDT in men in Poland (36 cases) whereas Abbott et al. (1981) found no significant differences in 4 studies involving 66, 248, 201 and 236 cases, performed at intervals in Great Britain during the 1960s and 70s. A national study to evaluate the different levels of body loading of HCB in the USA between 1974 and 1983, involving a total of 6115 samples, found no differences between the sexes in each of the populations studied, although there was a slightly higher concentration in men in the overall sample (Robinson et al., 1986). Therefore, it would appear that the hypothetical correlation between sex and the accumulation of organochlorine compounds in adipose tissue needs to be reconsidered on the basis of a better definition of the characteristics of the samples.

Our study also reveals a clear positive correlation with age (Figures 1-3), which is usually well-explained by the longer exposure time, since the initial hypothesis is that these products reach the general public through residues in water and food, and are accumulative.

The concentrations of HCB and pp-DDE was independent of the cause of death (natural or violent), and although the concentration of ß-HCH is higher in the group of natural deaths, this can be attributed to the fact that this group's age is higher. A search of the literature leads to no conclusions in this respect (Radomski et al., 1968; Unger et al., 1984; Mes et al., 1985).

A positive correlation ($p=0.0001$) is found between the concentrations of the three contaminants, and this has also been reported by other authors, who attribute it to the existence of a single source (Planas et al., 1988).

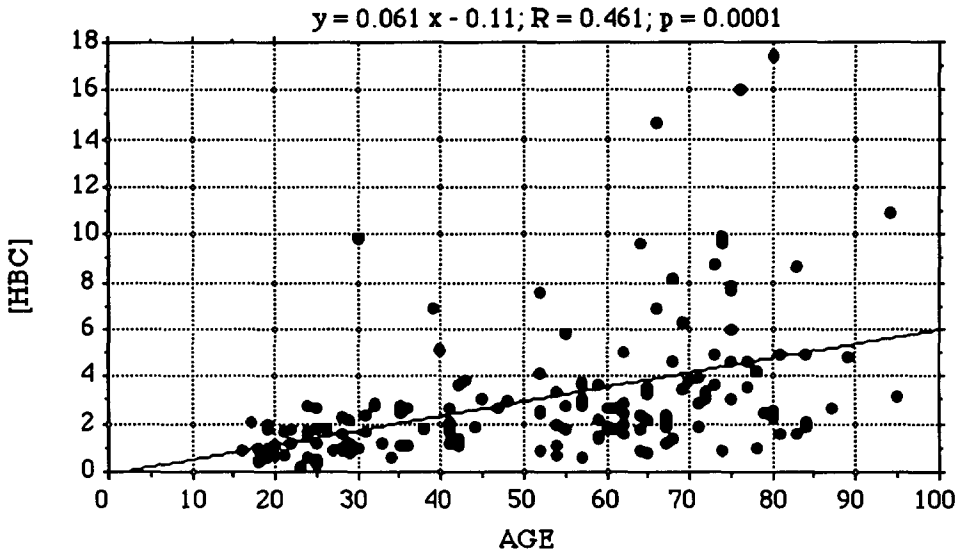

Figure 1. [HCB] (ppm) correlation with age

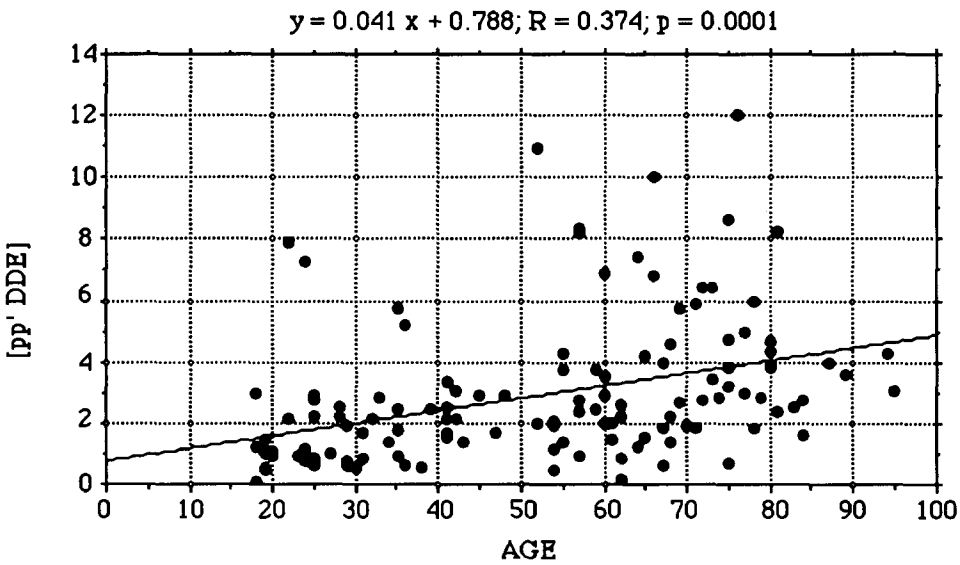

Figure 2. [pp' DDE] (ppm) correlation with age

In comparison with other series over the last 15 years, the concentrations of pp-DDE and ß-HCH are intermediate among those reported for other countries, which range from 6.50 ppm reported for Belgium (Dejonckheere et al. 1978) and 1.41 in Poland (Amarowicz et al.1989) for pp-DDE and 1.3 ppm in India (Jani et al., 1988) and 0.013 in Poland(Amarowicz et al., 1989) for ß-HCH. The average concentration of HCB

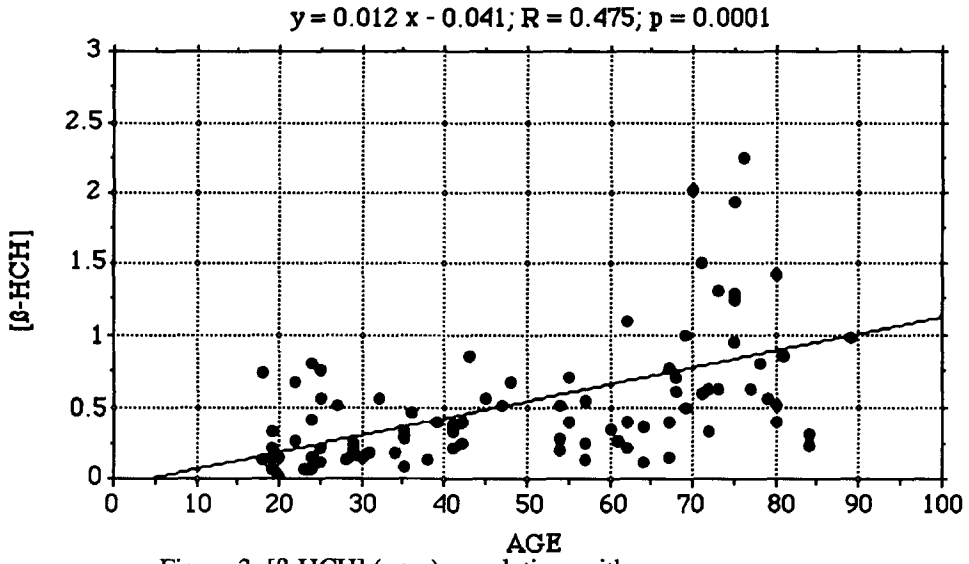

Figure 3: [ß-HCH] (ppm) correlation with age

found here is clearly above the habitual levels in other countries: 0.053 in the US (Robinson et al., 1986), 0.19 ppm in the UK (Abbott et al., 1981), 0.25 ppm in Norway (Brevik and Bjerk, 1978) and 1.36 ppm in Belgium (Dejonckheere et al., 1978).

Recent studies in Spain report high figures.The high concentration of HCB is particularly striking, and its origin is unknown. In a sample of 87 individuals in a predominantly agricultural area between Zaragoza and Barcelona, the following concentrations were found: 2.99 ppm of HCB, 6.27 ppm of pp-DDE and 3.06 ppm of ß-HCH (Camps et al., 1989). To-Figueras et al. (1985) highlighted a concentration of 5.55 ppm of HCB, together with 8.06 ppm of pp-DDE and 1.19 ppm of ß-HCH in Barcelona, which fell to 2.88, 5.93 and 1.98, respectively, for the population of Catalonia as a whole (Planas et al., 1988). The population of Zaragoza is intermediate between these two, as it has 600,000 inhabitants, a moderate level of industry, and is surrounded by agricultural areas, both dry-land farming and market gardens, which supply it. The concentrations found in the present sample were slightly lower than those above, although they are still higher than the figures quoted in the literature.

The above data appear to indicate that big city residents overall are more exposed to these contaminants. This would support the hypothesis that HCB is of urban origin, but leaves doubts as to the specific sources of the other two which, in principle, come from agriculture and via the food chain (Geyer et al., 1986).

The question of possible metabolic interconnections between HCH and HCB, which could contribute to the correlation between their concentrations, and has been discussed by several authors (Chadwick et al., 1975; IARC, 1979; Engst et al., 1979a, b; Gopalaswamy and Aiyar, 1984), remains to be clarified.

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