Organochlorines in male bovine adipose tissue in Sweden 1991-97

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Introduction

The Swedish control program for PCB and chlorinated pesticides in beef was initiated in the early seventies. The substances included in the control are PCB, hexachlorocyclohexane (α- and γ-isomers), hexachlorobenzene, dieldrin, p,p'-DDT, p,p'-DDD, and p,p'-DDE. Although production and use of these compounds in many cases were severely restricted in the seventies, foodstuff still contains measurable levels of many of these substances.

The increased interest regarding substances with the potential to disrupt endocrine function have again put a focus on the persistent organochlorines. For instance, several experimental studies have shown that organochlorines may act as mimics of the female sex hormone, oestrogen (1). Moreover, organochlorines are still suspected to affect the reproduction of highly exposed vertebrates in different parts of the world (1). As a consequence, it has been proposed that these compounds may be a threat to the human reproductive system, but this hypothesis has still not been proven. Thus, it is important to continue monitoring levels of organochlorines in food and exposure of humans.

Here we report the results of the beef control program from 1991 to 1997. Time trends as well as possible regional differences in levels are studied in male bovines.

Materials and Methods

Adipose tissue from male bovines were arbitrary sampled from all slaughter houses in Sweden, based on last years production. Generally 30 to 60 samples were taken each year. Totally 268 animals were examined and 261 of them were slaughtered before they had reached an age of 25 months. The other 7 bulls were slaughtered at higher ages and since

these older bulls would exert an unreasonable strong influence on the estimation of model parameters in the statistical analysis they were excluded from further analysis.

Sweden was geografically divided into the following six regions (south to north):
Region 1: Skåne and Blekinge
Region 2: Halland, Småland and Gotland
Region 3: Västergötland and Dalsland
Region 4: Östergötland, Sörmland and Närke
Region 5: Värmland,Västmaland and Uppland
Region 6: Dalarna, Gästrikland and northern parts of Sweden

Analysis of polychlorinated biphenyls (congener CB 153), hexachlorobenzene (HCB), hexachlorocyclohexane (alpha-isomer) and *p,p'*-DDE were performed using the methods described by Linder et al. (2), Jensen et al. (3) and Vaz (4). In case of levels below the detection limit, half of the detection limit was taken as an estimated value.

Multiple regression analysis was performed to describe the relationship between the dependent variable (levels of organochlorines) and the independent variables (age at slaughter (months), year at slaughter and region of slaughter). The levels of organochlorines were logarithmically transformed (natural base) to stabilize the variance when the regression analysis was performed. The different regions of Sweden, which are qualitative variables, were introduced into the multiple regression model as dummy (indicator) variables.

Table 1. Levels of PCB, HCB, alpha-HCH and p,p'-DDE in male bovine adipose tissue in Sweden 1991-1997. Mean±SD (median).

Year	CB 153 (μg/kg fat)	HCB (μg/kg fat)	alpha-HCH (μg/kg fat)	p,p'-DDE (μg/kg fat)
1991	8.2±8.7 (5.2)	4.0±2.1 (3.5)	1.4±0.9 (1.1)	6.4±6.0 (3.5)
1992	14.0±28.2 (6.2)	3.9±1.4 (3.9)	1.4±0.7 (1.2)	5.9±4.7 (4.0)
1993	9.5±11.9 (5.1)	3.5±1.7 (3.2)	1.1±0.6 (1.0)	8.3±16.7 (3.8)
1994	7.7±8.7 (4.2)	3.6±1.8 (3.4)	0.8±0.5 (0.7)	8.8±12.5 (4.8)
1995	3.9±3.0 (2.4)	3.5±2.3 (2.8)	0.8±0.5 (0.7)	7.0±11.0 (2.6)
1996	13.9±61.7 (2.0)	2.9±1.1 (2.8)	0.8±0.4 (0.8)	3.6±3.9 (2.0)
1997	2.7±2.1 (1.9)	3.3±2.1 (2.7)	0.7±0.5 (0.6)	4.4±5.4 (2.4)

Results and Discussion

The levels of CB 153 and p,p-DDE were somewhat higher than those of HCB and α-HCH (Table 2), but the average levels rarely exceeded 10 μg /kg fat. However, in some cases the level of CB 153 in bovine adipose tissue reached levels >100 μg/kg fat. The reason for the high levels of PCB in a few samples cannot be determined from our results. Studies from USA have, however, shown that incidences of high PCB levels in beef and cow's milk may be due contamination of feed in silos coated with PCB-containing material (5). Leakage of

PCB-contaminated hydraulic oil from old equipment into feed during processing could also be a source of contamination.

The average age of the sampled animals varied between 19 and 22 months during the sampling period. The levels of organochlorines were not significantly related to the age of the animals, when differences in levels due to year of slaughter and region of sampling were accounted for in the model (Table 2). This was probably due to the short life span of the animals studied (13-25 months), and to the fact that the animals grow rapidly during early age in life. It is possible that the results would have been different with a wider life span.

Table 2. Effects of age at slaughter, year of slaughter and region of sampling on the level of organochlorines in adipose tissue from 261 male bovines studied by multiple regression[a]

	CB 153[b]		HCB[c]		α-HCH[d]		p,p'-DDE[e]	
	Coeff	P	Coeff	P	Coeff	P	Coeff	P
Constant	-4.782	0.000	-5.498	0.000	-6.611	0.000	-6.143	0.000
Age	-0.041	0.066	-0.018	0.130	-0.012	0.444	-0.004	0.793
Year	0.151	0.000	0.0366	0.014	0.143	0.000	-0.078	0.004
Region 1	1.115	0.000	0.423	0.000	0.117	0.417	1.514	0.000
Region 2	0.456	0.032	0.243	0.021	0.305	0.039	0.873	0.000
Region 3	0.187	0.389	0.139	0.194	0.097	0.522	0.33	0.082
Region 4	0.223	0.329	-0.011	0.920	0.143	0.368	0.532	0.008
Region 5	0.562	0.023	0.156	0.195	0.078	0.647	0.464	0.027

[a]the levels of organochlorines were logarithmically transformed before statistical analysis. The regression coefficients are indicated lower (-) or higher (+) for values of the given organochlorine relative to that recorded in region 6.

[b]entire model; R^2=25.0% and p-value<0.001

[c]R^2=14.5% and p-value<0.001

[d]R^2=19.2% and p-value<0.001

[e]R^2=30.8% and p-value<0.001

The statistical analysis of the data indicate that the levels of all organochlorines decreased between 1991 and 1997, when differences in levels due to age and the region of sampling had been controlled for in the statistical model (Table 2). This is in accordance with the time trends of organochlorines in other foodstuffs, such as fish (6), and breast milk (4) in Sweden.

Interestingly, there also seemed to be a clear difference in the levels of organochlorines in bovine adipose tissue between the southern (region 1 and 2) and the northern part of Sweden (region 6), when sampling year and age of the animals were accounted for in the model. Thus the levels of PCB, HCB and p,p'-DDE are higher in region 1 and 2 than in region 6. It is too early to determine the reasons for this regional difference in organochlorine levels. Hypothetically, it may be due to a general south to north decrease in

environmental load of organochlorines in Sweden, or to regional differences in feeding regimes of male bovines in Sweden.

Thus, our results show that the levels of some organochlorines, with the potential to be endocrine disrupters, have decreased in adipose tissue from male bovines during the last decade in Sweden. However, the levels appears to somewhat higher in the southern parts of Sweden than in the northern parts of the country. If this also results in a higher body burden of organochlorines in individuals with a high beef consumption living in the southern parts of the country has to be determined.

References

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