Comparison of Total Lipid Adjusted Levels and Profiles of PCBs in Human Blood and Adipose Tissue.

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Introduction

Numerous reports on concentrations of polychlorinated organic compounds (POC) in human tissues such as blood and adipose tissue are available in the literature. But the comparison is not trivial. The question often is, if it is possible to compare levels measured in blood with those measured in adipose tissue between individuals. The partitioning between human tissues has been investigated in several studies with partially varied results (1, 2, 3, and 4).

The objective of this study was to compare the profiles of 30 PCBs in three different tissues from the same individuals. This pilot study was performed within an on-going project where profiles of POCs are assessed with multivariate projection and regression analysis.

Chemical analyses

Plasma, adipose and breast tissues from two females (48 and 82 years) were collected at Örebro Medical Center. The lipids from 13 ml of plasma were extracted as described by Nygren et al. (5). The lipids were quantitatively extracted and determined gravimetrically. Further clean up was performed on a multisilica column consisting of H_2SO_4-silica, KOH-silica and neutral silica.
Recently, supercritical fluid extraction (SFE) has been introduced for the analysis of PCBs in human adipose tissue (6). The advantage of using SFE, except low solvent and time consumptions, is enhanced selectivity. The adipose tissue from the stomach region and the breast tissue, 1-2 gram, was extracted and cleaned up by supercritical fluid extraction coupled to liquid chromatography (SFE-LC) (6). The concentrated extracts were analysed on HRGC/MS (Fisons GC 8000, Fisons MD 800), operating in the electron impact (EI) mode and single ion recording (SIR). Procedure blanks with the same amount of adsorbents and solvents were simultaneously analysed for both methods.

Statistical evaluation

Since data for two persons were collected univariate statistics were applied. Logarithmic transformation was used to deal with chromatographic data with large ranges and positive skewness (2, 7). To compare patterns in PCB profiles between different tissues univariate regression analyses was used.

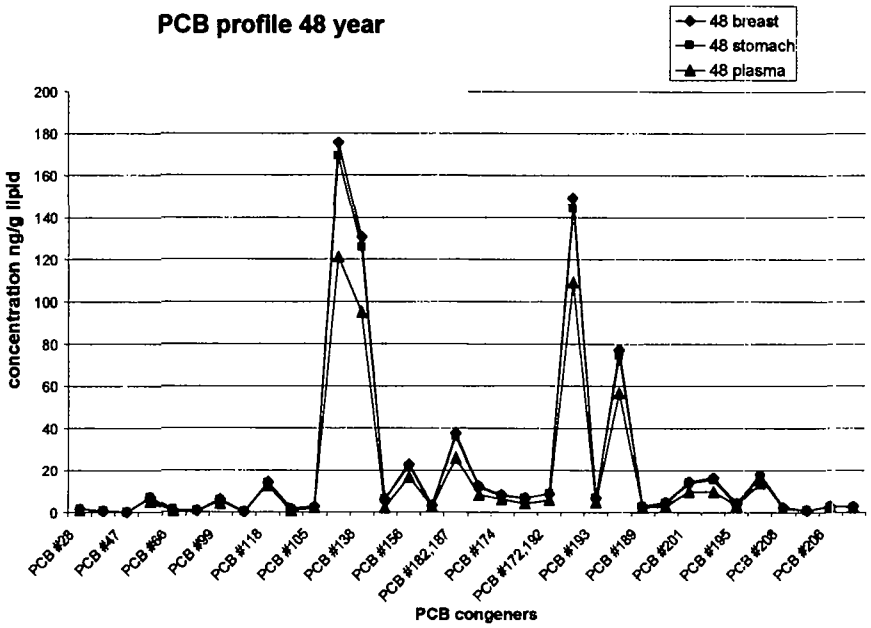

Figure 1. The lipid adjusted PCB-profile (tri through deca) of a 48-year-old female in breast, stomach and plasma.

Results and Discussion

The lipid-adjusted PCB-profile for a 48-year-old female is shown in Figure 1. The limit of detection was higher in plasma due to a lower amount of fat extracted. The amount of fat in the lipid samples was 1 g, whereas the amount of fat for the plasma samples was only 0.1 g. This is why not all of the PCBs found in breast and stomach tissue were detected in the plasma. PCB #52, #47, #110, #208 and #207 were below the limit of detection, i.e. did not exceed a signal to noise ratio of 3:1. In the blanks no detectable peaks were found. The recovery of internal standard spikes was over 80 % for all samples analysed. Since plasma is a matrix with high water content a method with high capacity to reduce water was applied. Partitioning in a separatory funnel with a two-phase system ($CHCl_3$ and MeOH) has proven to be quantitative. Disadvantages are relative high solvent and time consumptions. SFE is a fast and selective extraction technique but in this application is not suitable for plasma. For the breast and stomach tissues a separate lipid determination was done on a small column using

mc/hx (1:1) as the eluent solvent. H_2SO_4 on silica is a destructive method and hydrolyzes polar compounds like lipids and metabolites. Concern has also been given to if the SFE, as a non-destructive method yields dirty extracts due to lipid carry over. This however has not been observed with the used SFE-LC method.

No significant difference between the PCB concentrations in breast and adipose tissue was found. As expected the older individual (84) showed higher concentrations of PCBs. A correlation to age has been seen in other studies (8). For the plasma samples lower concentrations of PCBs were found. A strong correlation between the relative levels of PCBs in tissues and plasma was found for the two women. Regression analysis for the non-transformed data confirms with an R2 of 0.998, an almost perfect fit. A line coefficient of 0.72 was obtained for the values from breast and plasma from the 84-year-old. Similar results were obtained from the younger person, R2 of 0.998 and a coefficient of 0.71. Since the data contains some high values (PCB #138, #153, #170 and #180), all of which can bias the regression analyses, a log10-transformation was performed and resulting in an R2 of 0.96 and 0.98 respectively.

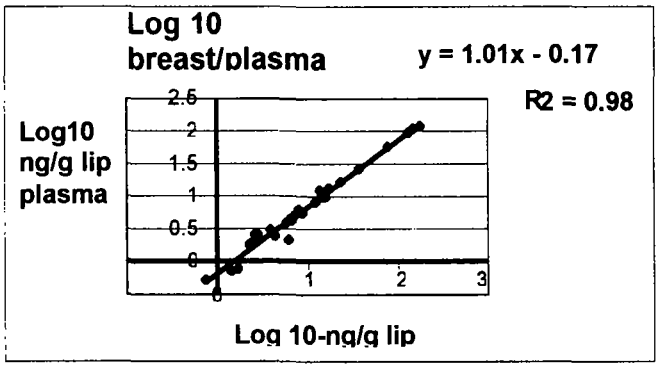

Figure 2. Regression analysis between concentration of PCBs in plasma and breast tissue for the 48-year-old female.

An explanation for the small absolute differences between plasma and adipose tissue samples could be different methods and different amounts of tissue used, affecting the lipid determination and the detection level.

Conclusion

Levels of PCBs in breast and stomach tissue were shown to be identical when normalised to lipid content. The PCB levels normalized to extracted lipids are 30% lower in the plasma than in the breast tissue. It can not be excluded that this difference origin from methodology like the lipid determination since the non-transformed line coefficients for plasma vs. breast tissue were similar for the samples. The data is also based on few samples. Either matrix will give full information of the PCB-profile present. SFE does not discriminate any PCBs in extraction efficiency nor demands further clean up of lipid containing extracts.

Acknowledgements

The author thanks "Cancer- och Allergifonden" and "IngaBritt och Arne Lundbergs forskningsstiftelse".

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