Chemosphere, Vol.25, No.12, pp 2017-2022, 1992
Printed in Great Britain

0045-6535/92 $5.00 + 0.00
Pergamon Press Ltd.

PARTITIONING OF DIOXIN AND DIBENZOFURAN CONGENERS BETWEEN PLASMA AND CELL FRACTIONS OF BLOOD FROM 10 ADULT MALE PATIENTS †

Arnold Schecter (1), John J. Ryan (2) and John D. Constable (3)

1. Dept. of Preventive Medicine, College of Medicine, SUNY-HSCS, 88 Aldrich Ave, Binghamton, NY 13903 USA. 2. Health and Welfare Canada, Ottawa, Canada. 3. Harvard Medical School, Massachusetts General Hospital, Boston, MA., USA.

ABSTRACT

We previously characterized levels of dioxin and dibenzofuran congeners in adipose tissue and plasma fraction of blood collected from 20 adult males, using paired specimens. It has been found that the 2,3,7,8-TCDD level reported on a lipid basis was similar, although not identical, in plasma lipid and in adipose tissue lipid from the same patients, however, higher levels of the more chlorinated dioxins and dibenzofurans existed in plasma lipid as compared to adipose tissue lipid. This study reports measurements from ten individuals' blood cell fraction and compares this to the plasma fraction and to adipose tissue lipid. In all cases where readily detectable amounts of PCDD/Fs were found, a minimum of 85% was in the plasma fraction and less than 15% in the cellular component. Congeners varied in percentage for each component.

INTRODUCTION

Previous studies found that the majority of dioxins in human blood are found in plasma and a small percent, varying by congener, is found in red blood cells (1). This study attempts to verify or refute that finding, under real life circumstances with blood separation performed in a hospital blood bank (2). This routine hospital centrifugation and fraction separation leads to less complete separation of plasma from cells than occurs under more rigorous laboratory conditions. Selected samples of cells were analyzed and are compared with the previous plasma and adipose findings from 10 adult male patients.

METHODS

Blood (450 grams +/- 41 g) was collected in the usual fashion by the Blood Bank of the Massachusetts General Hospital, in one "unit" plastic blood bags containing 63 ml of citrate anticoagulant and separated by centrifugation into "plasma fraction" (plasma plus anticoagulant) and "red cell fraction" (estimated by the Massachusetts General Hospital Blood Bank to be usually 30 % plasma with anticoagulant and 70 % red and white blood cells). The

† Presented at the Dioxin 1991 Conference

blood was then frozen and shipped for analysis. Outpatient fat biopsy was also done at the same time and the fat was also frozen and shipped with the blood. The procedure for adipose tissue and blood plasma analysis has been previously published and will only be referenced here (3-5). For each blood sample we calculated the total amount in the plasma fraction and the cellular fraction and, from these two numbers, the percentage in each blood portion.

RESULTS

The dioxin and dibenzofuran levels are presented in table form on the following pages, by patient individually and in summary. These findings confirmed our expectations and previous findings, that most of the PCDD/Fs are to be found in the plasma rather than the cell fraction. Because less than 10% of PCDD/Fs are found in red cells, plasma-cell ratios cannot be given for all congeners. 1,2,3,7,8-PeCDF, 1,2,3,4,7,8,9-HpCDF, and OCDF are not reported because of their low levels in the red cells.

The mean values we find here in the plasma are 54% to 90%, varying by congener. The adipose tissue levels, previously reported (2), are also presented for comparison.

CONCLUSIONS

Our findings differ somewhat from that of Kahn et al (6) as their studies were not on a lipid basis, as well as Patterson (7), who initially focused on 2,3,7,8-TCDD. In a more recent publication, Patterson et al. found an average of 9% of PCDD/Fs in the red blood cell (8). We conclude, from this study and previous work (9-13) with human adipose tissue and whole blood, that measurement of dioxins and dibenzofurans in adipose tissue, human milk, whole blood, plasma, and by inference, serum, can be useful to estimate dioxin body burden and document previous intake of these compounds. The usual medical means of collecting samples seems adequate for such purposes, given even the best laboratory coefficient of error for PCDD/F analysis and for lipid analysis. However, for congener comparisons, it is important to be aware of the tissue sampled and make appropriate extrapolations. We see no reason to recommend one tissue or blood fraction over another at this time in using dioxin analysis to demonstrate body burden.

REFERENCES

1. Patterson, DG. Jr, Fürst, P., Henderson, LO., Issacs, SG., Alexander, WE., Turner, WE., Needham, LL., and Hannon, H. Partitioning of in vivo bound PCDDs/PCDFs among various compartments in whole blood. *Chemosphere*, 19:135-142 (1989).

2. Schecter, AJ., Ryan, JJ., Constable, JD., Bangert, J., Fürst, P., Wilmers, K. and Oates, RP. Partitioning of 2,3,7,8-chlorinated dibenzo-p-dioxins and dibenzofurans between adipose tissue and plasma lipid of 20 Massachusetts Vietnam veterans. *Chemosphere*, 20:951-958 (1990).

3. Schecter, AJ., Ryan, JJ. Blood and Adipose Tissue levels of PCDDs/PCDFs over three years in a patient after exposure to polychlorinated dioxins and dibenzofurans. *Chemosphere*, 18:635-642 (1989).

4. Patterson, DG. Jr, Holler, JS., Lapeza, CR. Jr, Alexander, LR., Grace, D., O'Connor, R., Smith, SJ., Little, JA., and Needham, LL. High-resolution gas chromatographic/high resolution mass spectrometric analysis of human adipose tissue for 2,3,7,8-tetrachlorodibenzo-p-dioxin. *Anal. Chem.*, 58:705-713 (1986).

5. Patterson, DG. Jr, Hampton, L., Lapeza, CR. Jr, Bolser, WT., Green, V., Alexander, L., and Needham, LL. High-resolution gas chromatographic/high resolution mass spectrometric analysis of human serum on a whole weight and lipid basis for 2,3,7,8-