

EFFECT OF ORGANIC MATTER QUALITY ON NDL-PCBS SEQUESTRATION: RELATIVE BIOAVAILABILITY ASSESSMENT USING JUVENILE PIGLET.

M. Delannoy, A. Fournier, G. Rychen, C. Feidt

URAFPA, Université de Lorraine, INRA: USC 340, 2 Avenue Forêt de Haye – 54 518
Vandoeuvre-lès-Nancy, France – France
matthieu.delannoy@univ-lorraine.fr

INTRODUCTION

Exposure assessment of polychlorinated biphenyls (PCBs) contaminated soils is a critical issue in terms of human health, especially since little reliable information on transfer of PCBs to humans *via* involuntary soil ingestion is available. Indeed, young children with their hand-to-mouth activity may be exposed to contaminated soils. Recommendation for soil and dust ingestion among the general population of children 3 to <6 years old was set to 200 mg/day (U.S. EPA., 2011). The relative bioavailability (RBA) approach which relies on the ratio of the bioavailability of a compound in one exposure context to that in another appears to be a valuable way to perform this exposure assessment. Considering assessment of children exposure after ingestion it appears that three animals are particularly used and pertinent to model children: rats, monkeys and swine. Juvenile swine seems to be a fitter digestive model of children than the rodent one since gastrointestinal absorption could differ between this species, especially considering metallic ions (Casteel et al., 2006). This model is also currently used in assessing validation of bioaccessibility tests like Unified BARGE Method (Denys et al., 2012). The current study addresses the impact of soil organic matter (OM) condensation on relative bioavailability (RBA) of sequestered non dioxin like PCBs (NDL-PCBs).

METHODS

Assessment of the dose-response linearity

Eight young swine male were orally exposed during 10 days one of the four levels of a corn oil spiked by Aroclor 1254 to achieve 190, 560, 940 and 1 310 ng NDL-PCB.Kg⁻¹ of Body Weight (BW) per day. Concentrations in adipose tissues, liver and muscles were determined for each congener. NDL-PCBs were analysed by GC-MS after extraction and purification. Quantification and assessment of extraction performance was realized using respectively ¹³C-labelled NDL-PCBs before extraction procedure and ¹³C-labelled 111-PCB after purification.

Incidence of condensed OM on RBA

Three artificial soils (AS) were prepared according to OECD guideline 207 (OECD, 1984). One standard soil (SS), containing no organic matter, and three amended versions of this SS with fulvic acid (FA), activated carbon (AC) and sphagnum peat (SP) were prepared to obtain 1% organic carbon.

This study involved seventeen juvenile male swine as a physically close model of young children. Animals were randomly distributed into 5 contaminated groups (3 replicates) and a control one (C) (2 replicates). During 10 days, the piglets were fed AS or a corn oil spiked (SO) with 19 200 ng of Aroclor 1254 per g of dry matter (6 000 ng/g of NDL-PCBs) to achieve an exposure dose of 1 200 ng NDL-PCBs.Kg⁻¹ of BW per day. After 10 days of oral exposure, NDL-PCBs concentrations in adipose tissue, liver and muscles were determined by GC-MS as described previously. Variance analyses were performed on NDL-PCBs levels in tissues as repeated measures using mixed procedure of SAS software.

RESULTS AND DISCUSSION

Assessment of the dose-response linearity

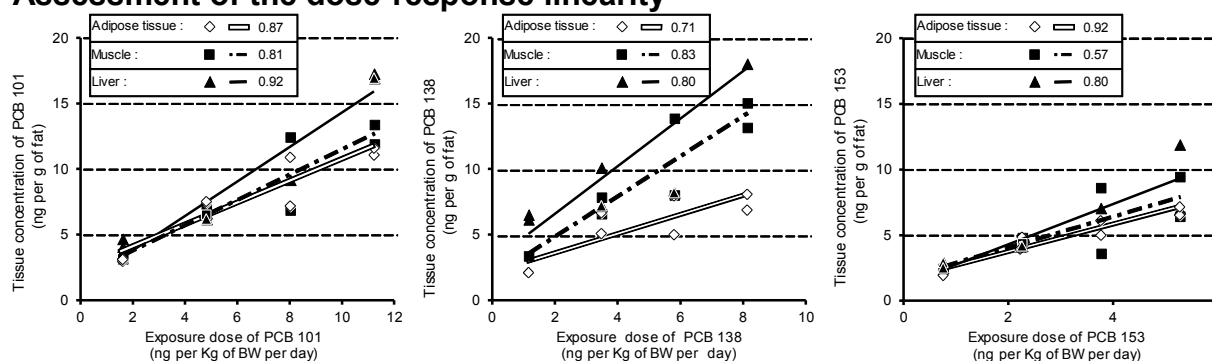


Fig. 1. Dose-response relationships of NDL-PCBs in liver, muscle and adipose tissue to the amount ingested originating from spiked oil.

PCB28 congener levels measured in each tissue were below the LOQ. Most of regression analyses for other congeners demonstrated significant linear relationships between the administered doses and the levels measured in adipose tissue, liver and muscle ($R^2 > 0.70$) in a range of dose of 190 ng to 1310 ng I-PCB. This result validates the use of NDL-PCBs concentrations to assess their relative bioavailability in AS. Indeed, it is known that ample variability exists between individuals among applied doses (U.S. EPA., 2007). This variability tends to increase as the dose increases, resulting to a rise of variance.

Incidence of condensed OM on RBA

Significant difference demonstrated that highly condensed OM strongly retained NDL-PCBs whereas less condensed didn't provide a sufficient retention and were assimilated throughout the digestive tract of the piglets. Since OC content was the same between FA, SP and AC soils, this study reveals that the quality of the OM pilots the retention of PCBs during the digestive process in piglets.

CONCLUSION

Characteristic of the OM pilots the retention of PCBs during the digestive process in piglets. It appears that condensed OM strongly reduces bioavailability whereas the less condensed one does not seem to have a significant effect. These elements are of great interest for further investigations in terms of risk assessment in contaminated areas.

REFERENCES

- Casteel, S.W., Weis, C.P., Henningsen, G.M., Brattin, W.J. (2006) Estimation of relative bioavailability of lead in soil and soil-like materials using young swine. *Environ. Health Perspect.* 114:1162–1171.
- Denys, S., Caboche, J., Tack, K., Rychen, G., Wragg, J., Cave, M., Jondreville, C., Feidt, C. (2012) In vivo validation of the unified barge method to assess the bioaccessibility of arsenic, antimony, cadmium, and lead in soils. *Environ. Sci. Technol.* 46:6252–6260.
- OECD (1984) Test n° 207 earthworm acute toxicity test, In: *Section 4: Effects on Biotic Systems, Guideline for Testing of Chemicals*, OECD Publishing Paris. pp. 1-9.
- U.S. EPA., 2007. Estimation of relative bioavailability of lead in soil and soil-like materials using in vivo and in vitro methods (Guidance and technical report No. OSWER 9285.7-77), U.S. Environmental Protection Agency, Washington, DC.
- U.S. EPA., 2011. Exposure factors handbook 2011 edition (Final) (No. EPA/600/R-09/052F). U.S. Environmental Protection Agency Washington, DC.