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Reduction of PCB bioavailability by condensation of organic matter: assessment of linearity and concentrations in tissues of orally exposed piglets.

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► To cite this version:

Mathieu Delannoy, Thibault Duval, Agnès Fournier, Guido Rychen, Cyril Feidt. Reduction of PCB bioavailability by condensation of organic matter: assessment of linearity and concentrations in tissues of orally exposed piglets.. Society of Environmental Toxicology and Chemistry (SETAC). 23rd Annual Meeting of the Society of Environmental Toxicology and Chemistry (SETAC), May 2013, Glasgow (SCOTLAND), France. SETAC Europe 23rd Annual Meeting Abstract Book, Glasgow, 2013. hal-03945111

HAL Id: hal-03945111

<https://hal.univ-lorraine.fr/hal-03945111>

Submitted on 18 Jan 2023

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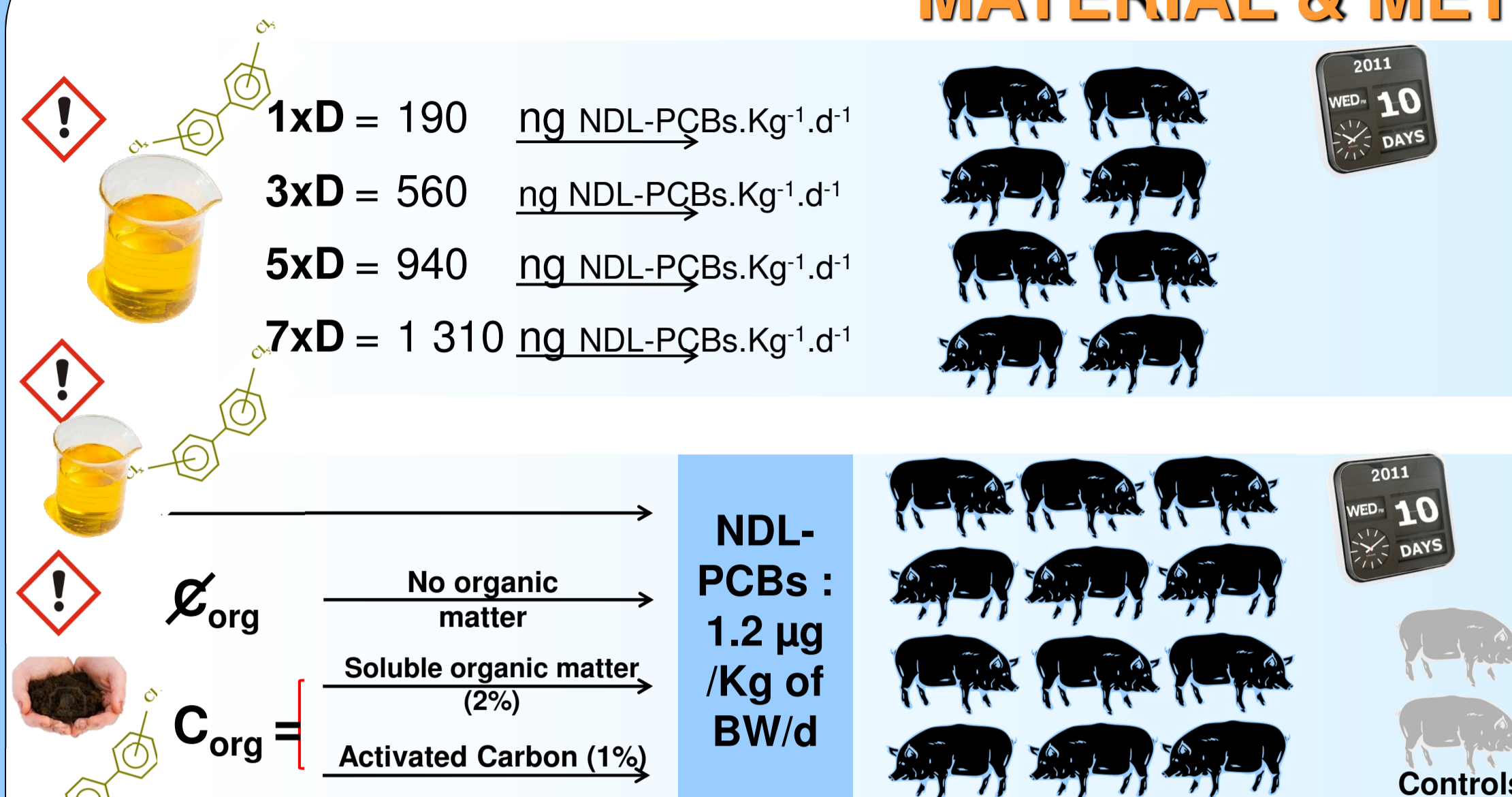
INTRODUCTION & OBJECTIVES

Exposure assessment to polychlorinated biphenyls (PCBs) from 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 (1-30 months) with their hand-to-mouth activity may be exposed to contaminated soils. The relative bioavailability (RBA) approach appears to be an **adequate method** to compare the **bioavailability of organic pollutants from different soils** (USEPA 2006).

NDL-PCBs are an emerging concern since they constitute the most abundant fraction of PCBs and seem to present neurotoxicity even at environmental doses. NDL-PCBs are laid down in European regulation No 1259/2011 (European Commission, 2011)

The current study addresses the impact of soil organic matter (OM) condensation on bioavailability of sequestered NDL-PCBs

MATERIAL & METHODS



Corn oil and artificial soils (OECD 1984) were spiked with Aroclor 1254.

Exposure doses were orally administrated through dough balls to castrated male piglets during 10 days.

Liver, adipose tissue, loin muscles and brain were secondly analyzed by GC-MS.

I- Validation of the NDL-PCBs concentrations in tissues as valuable end points

II- Incidence of condensation of organic matter on relative bioavailability.

Statistical analyses were carried out using SAS. I- dose-response pattern was assessed testing: (1) a quadratic model, (2) an exponential one and (3) a linear one. II- Variance analysis was performed using GLM procedure of SAS.

RESULTS & DISCUSSION

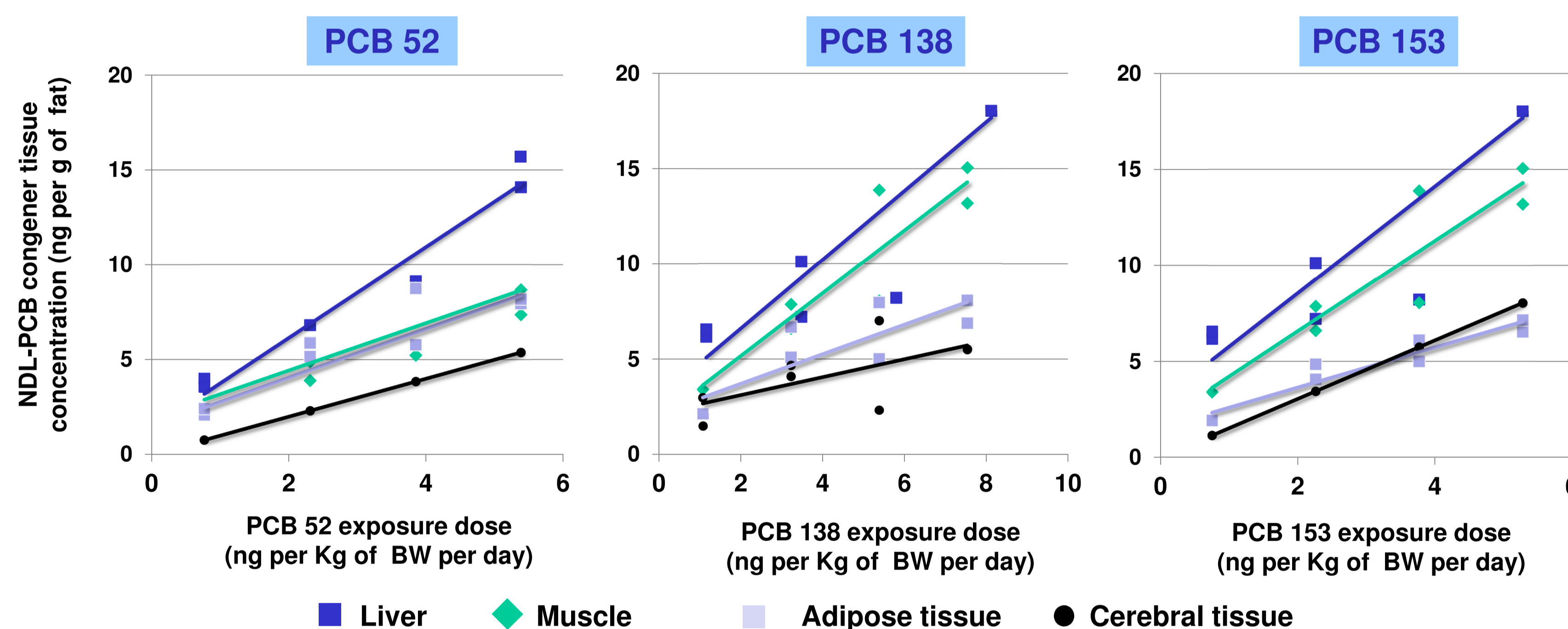
I- Validation of the NDL-PCBs concentrations in tissues as valuable end points

Dose response curves were obtained by linear regression. 3 NDL-PCBs were chosen for their representativeness of NDL-PCBs to illustrate dose-response relationships.

| | | PCB 52 | PCB 138 | PCB 153 |
|-----------------|-------------------------------|--------|---------|---------|
| Liver | Slope (y/x .10 ³) | 57,0 | 51,0 | 60,3 |
| | R ² | 0,96 | 0,78 | 0,80 |
| | p | 0,001 | 0,001 | 0,009 |
| Adipose Tissue | Slope (y/x .10 ³) | 29,7 | 24,0 | 34,9 |
| | R ² | 0,83 | 0,83 | 0,91 |
| | p | 0,002 | 0,001 | 0,000 |
| Loin muscles | Slope (y/x .10 ³) | 30,5 | 39,1 | 51,1 |
| | R ² | 0,76 | 0,71 | 0,92 |
| | p | 0,010 | 0,005 | 0,049 |
| Cerebral tissue | Slope (y/x .10 ³) | 1,18 | 1,26 | 51,1 |
| | R ² | 0,43 | 0,71 | 0,43 |
| | p | N.S. | 0,009 | N.S. |

Statistical Analyses of linear regression. Quadratic and exponential regression were not significant (data not shown).

(N.S. : no significant, p>0,05)



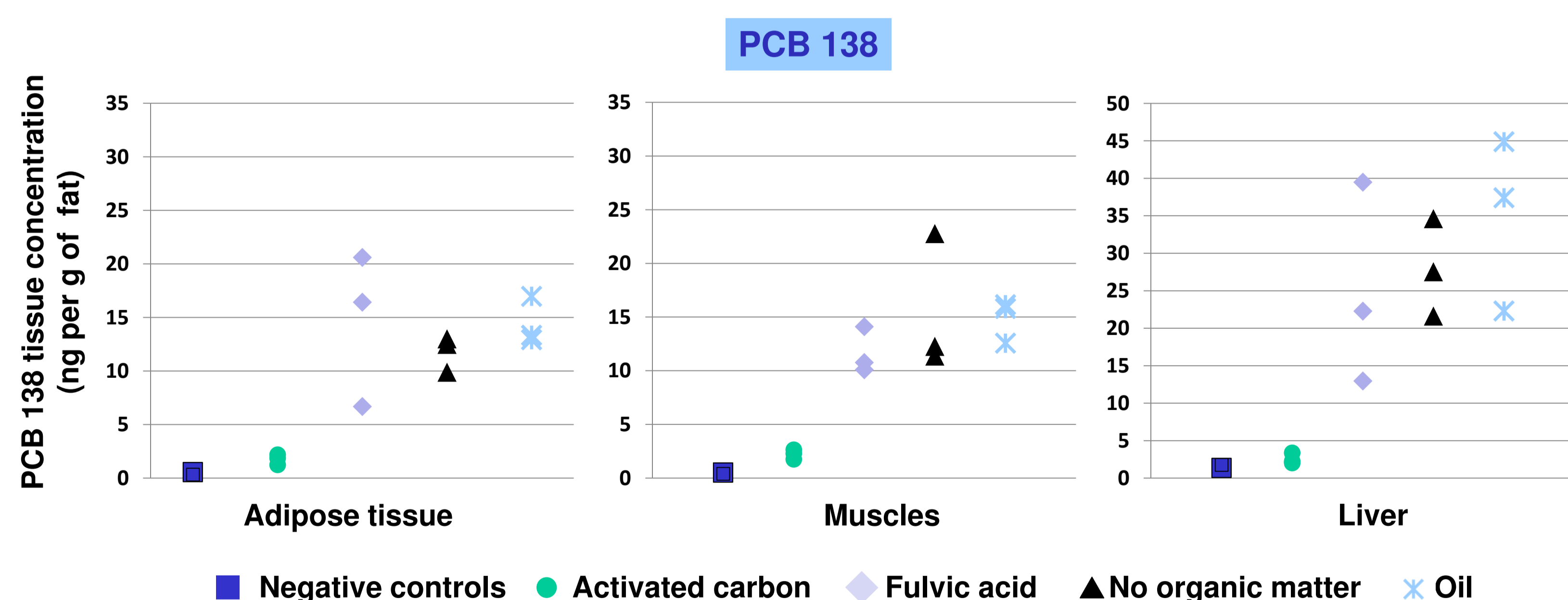
Levels of responses (ng NDL-PCBs / g fat) to increasing doses in the four target organs

Regression analyses for PCB 52, 101, 118, 138 and 153 **demonstrated significant linear relationships** between the administrated doses and the levels measured in adipose tissue (R²>0.77), liver (R²>0.77) and muscles (R²>0.71). Cerebral tissue shows no evidence of linear, exponential or quadratic relations.

The linearity of dose-response in the tested range of doses validates (i) **correspondence between the ingested doses and final concentrations of NDL-PCBs in liver, adipose tissue and muscles** and (ii) the **approach centered only on NDL-PCBs without considering their metabolites.**

II- Incidence of condensation of organic matter on relative bioavailability.

Results concerning PCB 138 are presented for their representativeness of NDL-PCBs.



Concentrations of PCB 138 in liver, muscles and adipose tissues (Unique exposure dose of 1.2 µg NDL-PCBs per Kg of body weight).

| Treatment | Liver | Muscles | Adipose tissue |
|-------------------|--------------------|---------------------|--------------------|
| Controls | 1.56 ^a | 0.467 ^a | 0.428 ^a |
| Activated carbon | 2.56 ^a | 2.24 ^a | 1.75 ^a |
| Fulvic acid | 24.92 ^b | 11.66 ^{ab} | 14.57 ^b |
| No organic matter | 27.94 ^b | 14.84 ^b | 11.79 ^b |
| Oil | 34.88 ^b | 15.48 ^b | 14.41 ^b |

Statistical analyses of PCB 138.

Values within column followed by a common letter do not significantly differ (p>0.05).

A significant treatment effect and **two distinct groups of treatments** were found: on one hand oil, standard soil and fulvic acid, on the other hand negative controls and activated carbon.

Condensation of organic matter appears to be a critical element in the reduction of bioavailability of NDL-PCBs.

CONCLUSION

- Organic matter plays a **major role in the retention of NDL-PCBs during the digestive process in piglets.**
- It appears also that **characteristics of the organic matter dramatically pilot the retention of NDL-PCBs** during the digestive not seem to have a significant effect.
- However implication in risk assessment to contaminated field-management needs to be further investigated. Indeed, it appears that condensed organic matter (activated carbon) strongly reduces bioavailability whereas the less condensed one (fulvic acid) does no more effect that standard soil.
- This apparent high retention by condensed organic matter could be scientifically interesting but implication in risk assessment to contaminated field-management needs to be further investigated.