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## Exposure assessment of sequestered organic compounds in polluted sites and soils: use of a juvenile animal model to estimate their relative bioavailability

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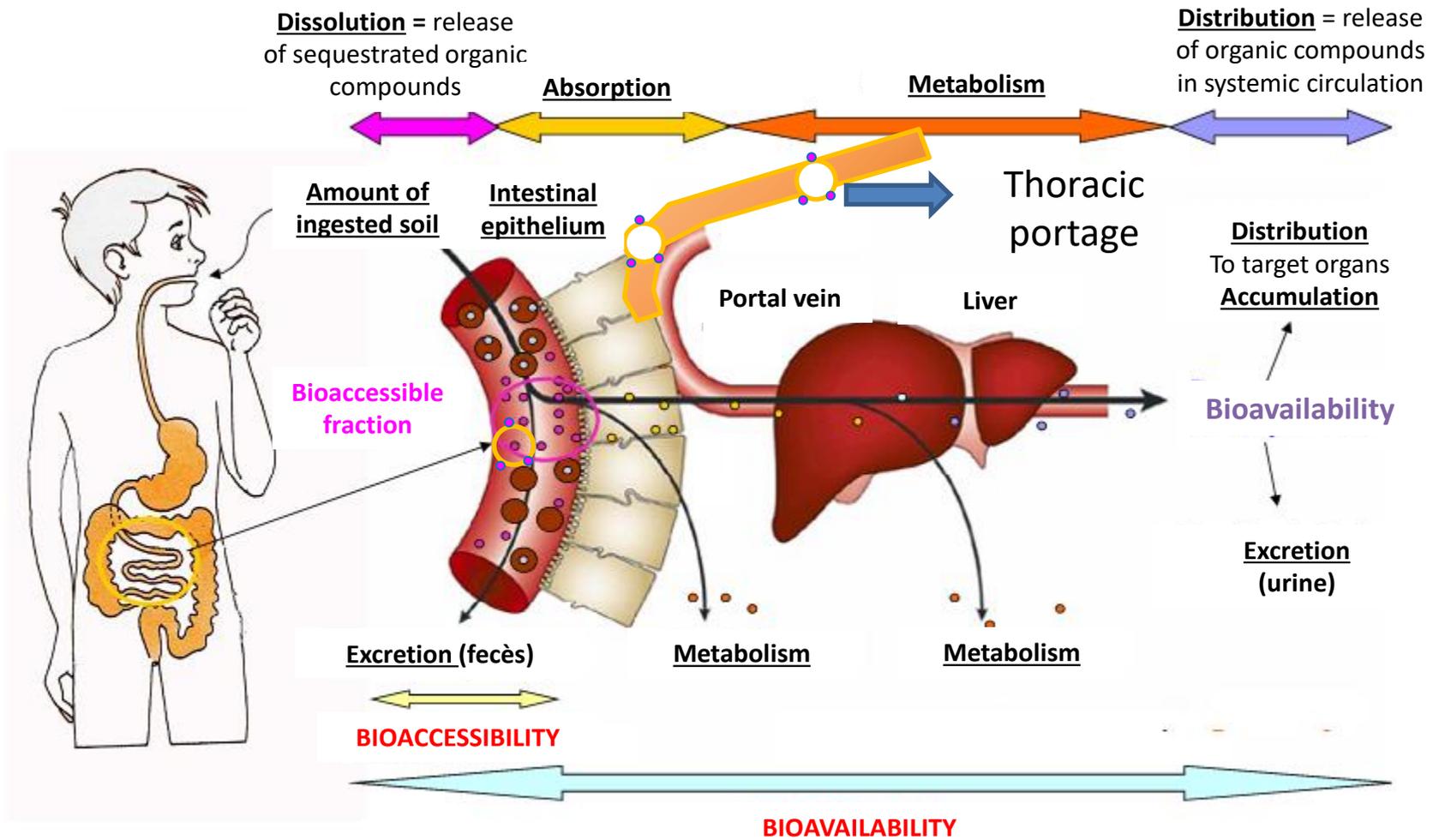
**EXPOSURE ASSESSMENT OF SEQUESTERED ORGANIC COMPOUNDS IN  
POLLUTED SITES AND SOILS: USE OF A JUVENILE ANIMAL MODEL TO  
ESTIMATE THEIR RELATIVE BIOAVAILABILITY.**

**MATTHIEU DELANNOY, AGNÈS FOURNIER, GUIDO RYCHEN, CYRIL FEIDT.**

**11<sup>TH</sup> JULY 2013 – SEGh LECTURE - TOULOUSE**

# I- EXPOSURE ASSESSMENT AND RELATIVE BIOAVAILABILITY

# I.1- Place of bioavailability in exposure assessment



● Ingested soil particles

○ Ingested toxic substance

● Dissolved toxic substance

○ Fraction of substance

● Metabolized fraction of substance

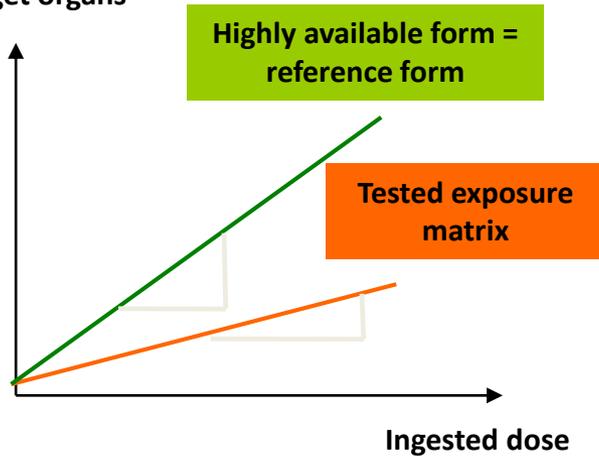
○ toxic

● Bioavailable fraction of toxic substance



# I.2- Relative bioavailability and comparison of exposure media

Concentrations in target organs



**BR = slope ratio**

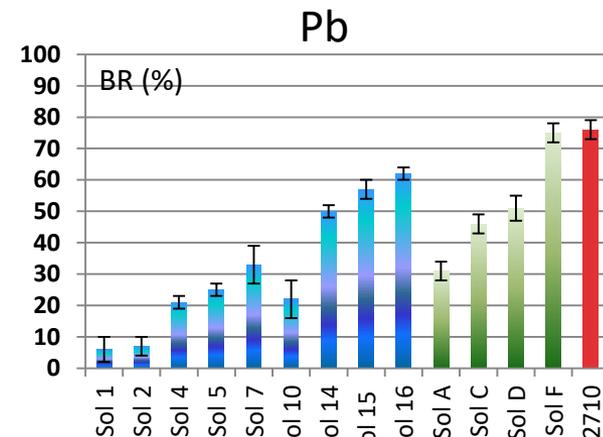
**Use in order to validate bioaccessibility methodology.**

## Validity criteria

- same dose-response pattern between exposure and reference media
- Assessment of relative bioavailability inside linearity domain of the dose response pattern

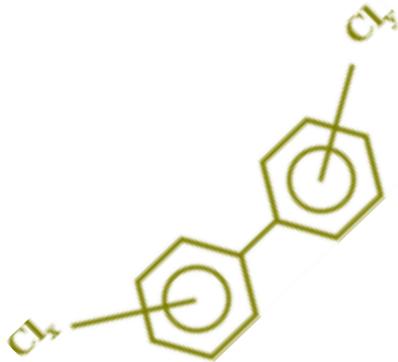
## Interests

- Based upon biological effects, target organs specialized in accumulation, metabolism, excretion of compounds
- Used by sanitary agencies



## **II- SOIL INGESTION AND ASSESSMENT OF ORAL-EXPOSURE TO NDL-PCBs**

## 1.2- Population at risk and NDL-PCBs hazard



- **Family of 209 congeners**
- **Bioaccumulative and ubiquitous (POPs)**
- **7 PCBs frequently retrieved in environmental matrices and foodstuff are basis of regulatory approaches**
  - PCB 28; PCB 52; PCB 101; PCB 118; PCB 136; PCB 153; PCB 180
- **2 different toxicity profiles: Dioxin like and non-dioxin-like**

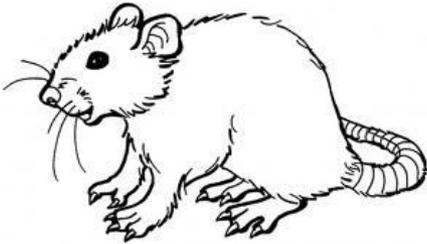
**Children (1-3 years) = population at risk**



- **Children behavior: *hand to mouth***
  - **Vulnerability**
    - Immature metabolism
    - Development phase
- ⇒ **Increased exposure and sensitivity to toxicity impairments.**

US-EPA (2011) : 200 mg/j of soil and/or dusts for children (0 à 6 years).

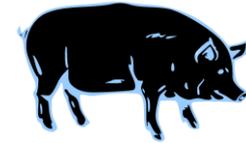
## II.2- Animal model for children animal exposure.



- Manipulation advantage
- Absorption mechanisms differs than those of human
- Coprophagia and intestinal and gastric pH differs to.



- Ethical consideration concerning manipulations of primates. Closest model to human.



- Adequate model of digestive tract of children.
- Slow development .
- Few coprophagia.
- Appropriate model according to environmental agencies. (USEPA, 2007)

## II.3- Soil and retention of NDL-PCBs.



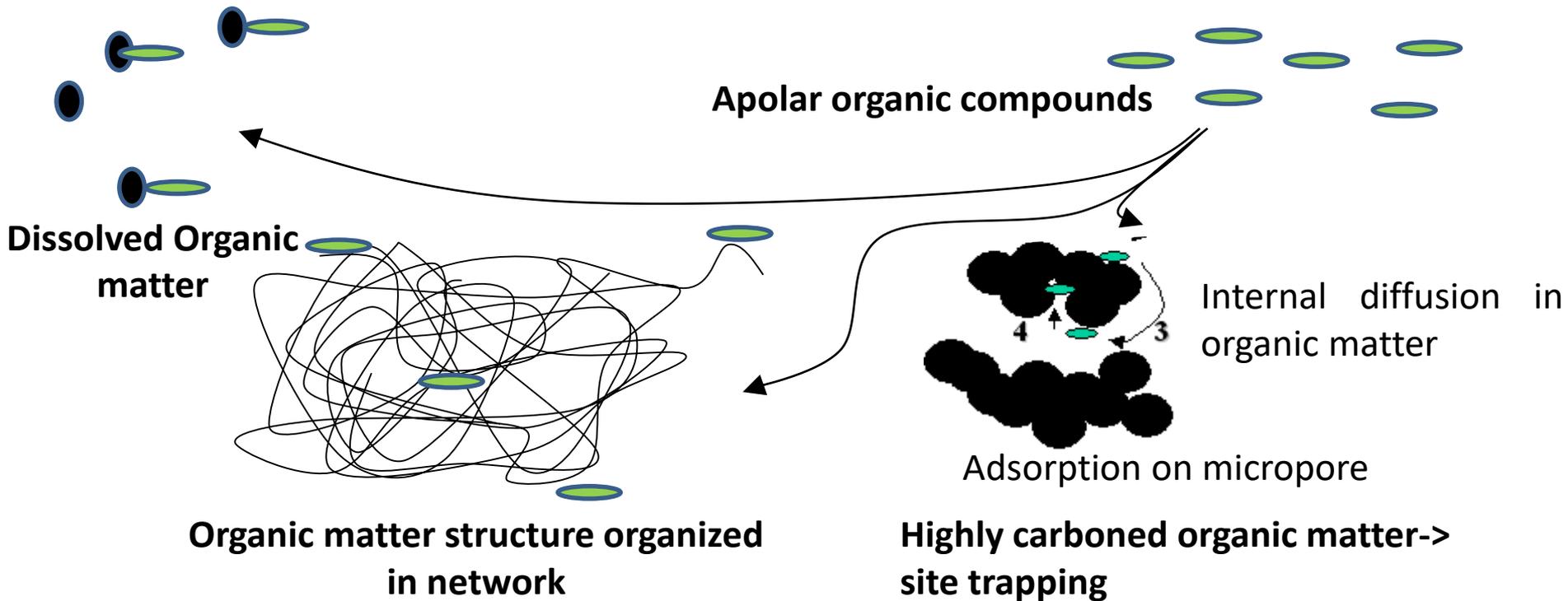
Characteristics of soil ↔ retention of NDL-PCBs through digestive process

-Determine **variation factors of bioavailability of NDL-PCBs contaminated soils.**

-Impact of these variation factors on NDL-PCBs relative bioavailability  
-Usefulness of these variation factors in risk assessment

## III- HYPOTHESIS AND OBJECTIVES OF THE STUDY

### III.1- Importance of organic matter – *schematic retention of organic compounds.*



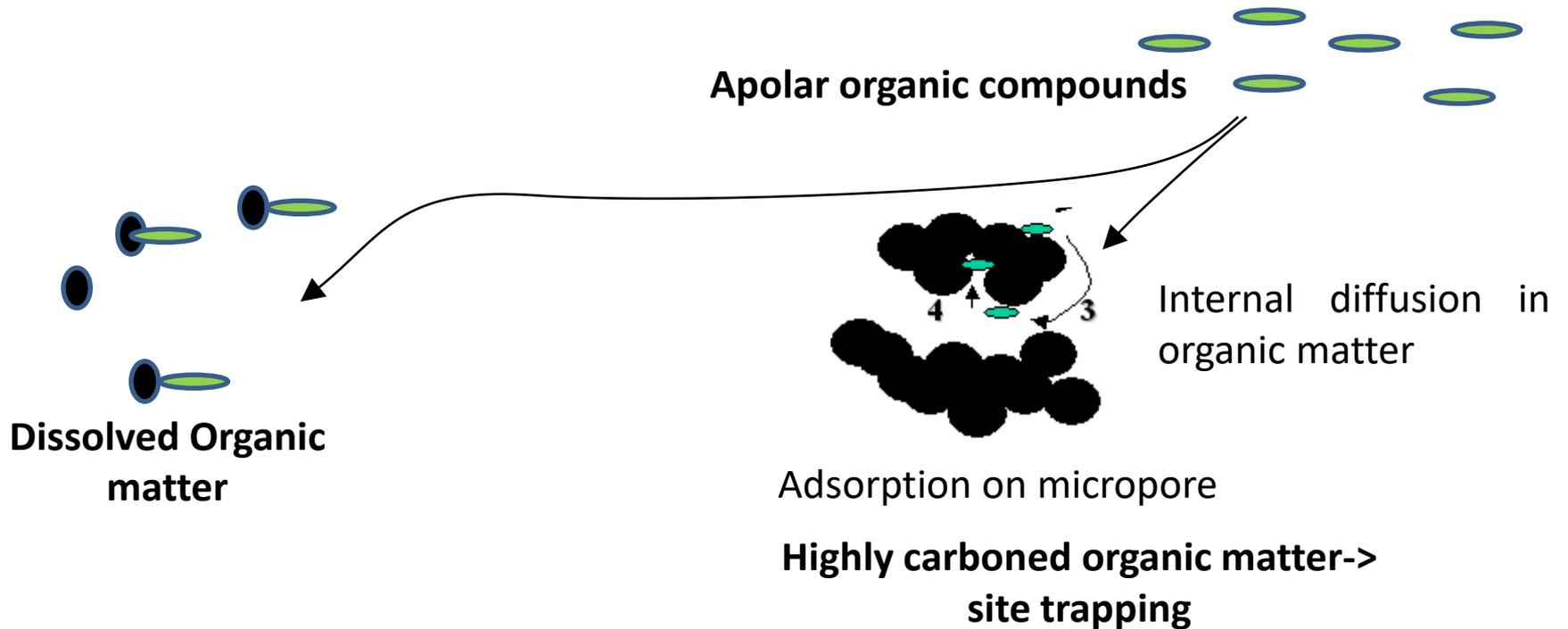
### condensation

Condensation of organic matter and behavior models of organic matter retention



Lack of *in vivo* data to perform an exposure assessment

### III.2- Importance of organic matter – *schematic retention of organic compounds.*



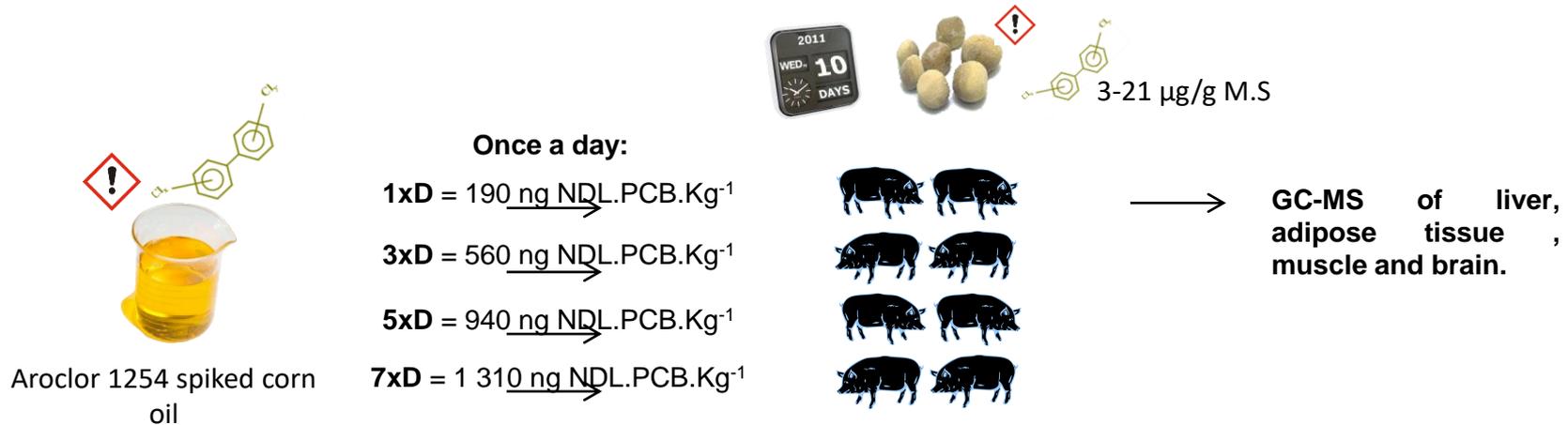
Weak retention of NDL-PCBs

Important retention of NDL-PCBs

## IV- ASSESSMENT OF LINEARITY

# IV.1- Assessment of linearity of dose-reponse pattern

## MATERIAL AND METHODS



4 groups (n=2) of castrated weaned piglets were exposed during 10 days;

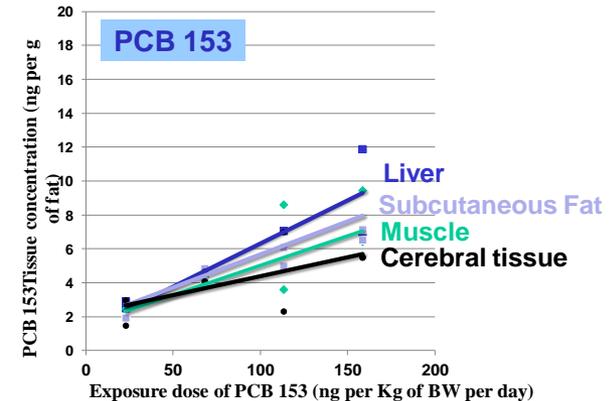
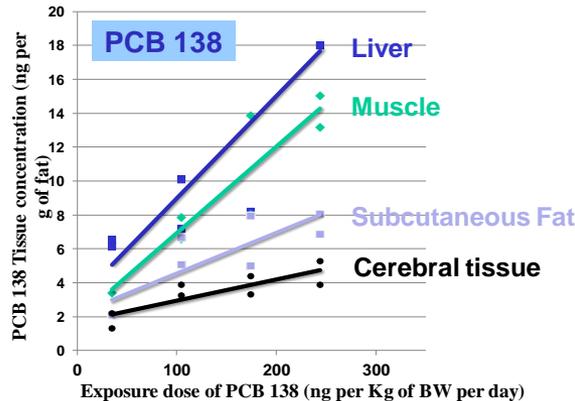
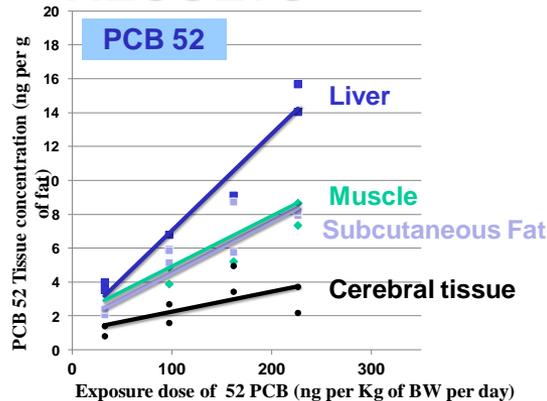
Biological matrices were selected :

- Adipose tissue** : lipophilic and bioaccumulative characteristics of NDL-PCBs.
- Liver** : metabolism.
- Brain** : neurological toxicity of NDL-PCBs

Sample : Highly perfused and importance in body weight

## IV.2- Assessment of linearity of dose-reponse pattern

### RESULTS



		PCB 52	PCB 138	PCB 153
Liver	slope (y/x .10 <sup>2</sup> )	57,0	51,0	60,3
	R <sup>2</sup>	0,96	0,78	0,80
	p	0,001	0,001	0,009
Subcutaneous fat	slope(y/x .10 <sup>2</sup> )	29,7	24,0	34,9
	R <sup>2</sup>	0,83	0,83	0,91
	p	0,002	0,001	0,000
Muscle	slope(y/x .10 <sup>2</sup> )	30,5	39,1	51,1
	R <sup>2</sup>	0,76	0,71	0,92
	p	0,010	0,005	0,049
Cerebral Tissue	slope(y/x .10 <sup>2</sup> )	1,18	1,26	51,1
	R <sup>2</sup>	0,43	0,71	0,43
	p	N.S.	0,009	N.S.

- Similar responses were obtained from all studied congener
- Linear regression is significant for liver, muscle and adipose tissue.**
- Higher concentrations were obtained in liver.
- Cerebral tissue doesn't provide a significantly relationship

→ **La linéarité de la relation dose-réponse semble significative pour le tissu adipeux, musculaire et hépatique.** Le niveau de concentration faible dans le tissu cérébral n'a pas permis de montrer la linéarité de la relation dans ce tissu.

# **V- IMPACT OF ORGANIC MATTER CONDENSATION ON RELATIVE BIOAVAILABILITY OF NDL-PCBS CONTAMINATED SOILS.**

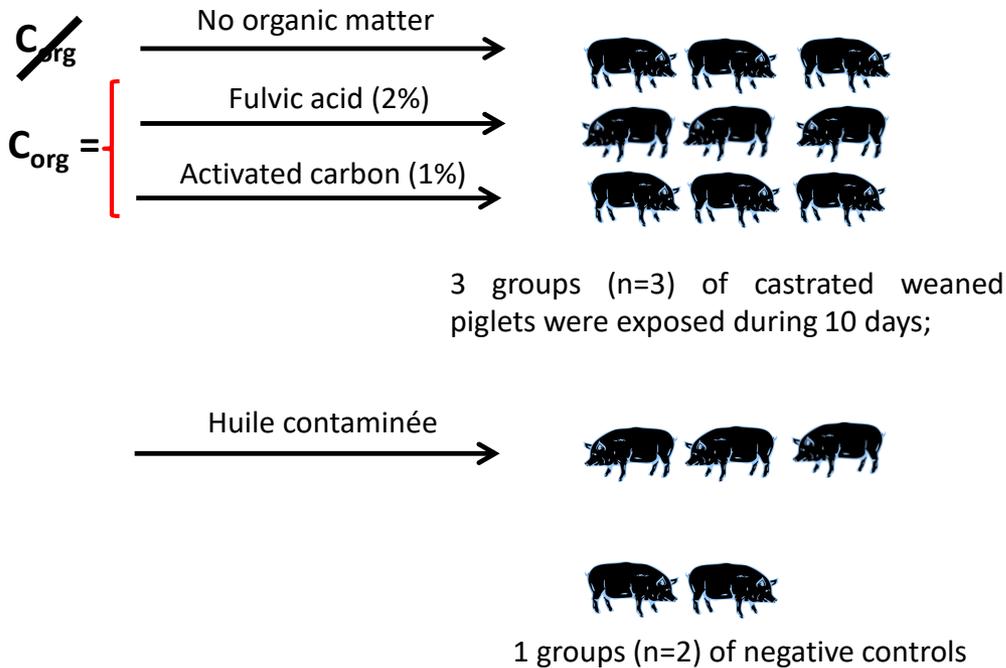
# MATERIAL ET METHODS



Artificial soil: 19,2µg of Aroclor 1254/g of D.M.



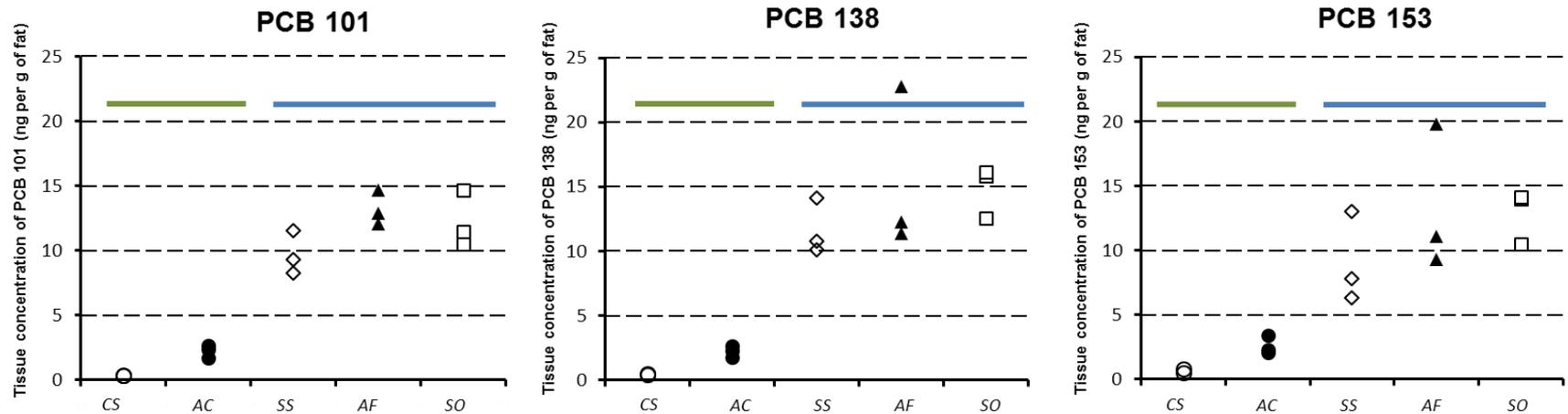
Spiked corn : 19,2µg of Aroclor 1254/g



GC-MS of liver, adipose tissue, muscle and brain.

## V.2- IMPACT OF ORGANIC MATTER CONDENSATION ON RELATIVE BIOAVAILABILITY OF NDL-PCBs CONTAMINATED SOILS.

### RESULTS



- Soil containing 1% of activated carbon presents a clear decrease of bioavailability Le sol contenant 1% de charbon actif **présente une nette diminution** de la biodisponibilité par rapport aux autres sols.
- Fulvic acid amendment doesn't seem to modify relative bioavailability of NDL-PCBs comparatively to standard soil

**MERCI POUR VOTRE ATTENTION**