



## Feeding Fats Safety



# Levels of PAHs and PBDEs in animal tissues and rate of transfer from feed

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**Marie-Hélène DEVIER and Hélène BUDZINSKI**

Laboratoire de Physico- et Toxicochimie de l' Environnement  
LPTC-ISM, UMR 5472 CNRS, Université Bordeaux I,  
<http://www.ism.u-bordeaux1.fr>

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### Polycyclic Aromatic Hydrocarbons (PAHs)

Mainly anthropogenic compounds → 2 principal sources :

Pyrolytic Origin

Petrogenic Origin

Transport discharges



Industrial effluents

Atmospheric deposition



Petroleum activities  
(exploitation, transport, oil spill ...)

### PAH sources in food :

**Non-processed food:** environmental pollution (human and industrial activities); quite marginal route (background contamination), except when using contaminated oils/fats and cereals.

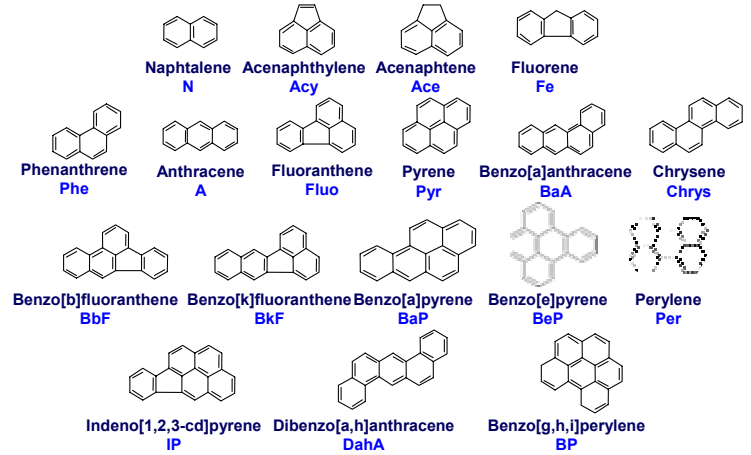
**Processed food:** packaging and heat processes (smoking, grilling, contact with hydrocarbon-based materials, smoking-flavour agents and wood smoke, ...)

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**Polycyclic Aromatic Hydrocarbons (PAHs)**

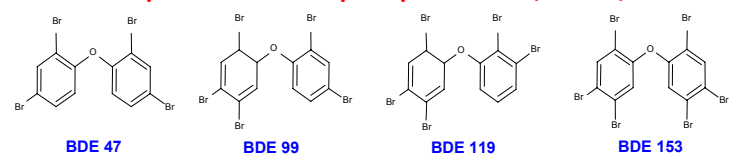


- EPA priority pollutants; ubiquitous, persistent, lipophilic;
- Biological activity : carcinogenic and mutagenic for some of them
- BaP : commonly used as a marker of PAH in food (highest carcinogenic potential)




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**Polybrominated Diphenyl Ethers (PBDEs)**



- Flame retardants
  - Polymers for textile backing, electrical & electronic equipment
  - Plastic housings esp. office equipment
  - Cushions; mattresses; carpet padding
- commonly used (209 congeners)
- chemically similar to PCBs
- Animal studies show:
  - Nervous system toxicity
  - Reproductive and developmental disruption
  - Endocrine disruption

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### DIOXIN trial

#### PBDE determination in the Dioxin trial :

- to check the absence of PBDEs, since the oil added to experimental feed was from fish origin (high PBDE levels found in aquatic species, in particular fishes)
- if present, to take into account PBDE levels for the interpretation of the potential biological effects of dioxins



**PBDEs never detected in all kinds of samples !**

DIOXIN trial					
OIL, FEED, MEAT & LIVER					
[PBDE] ng/g dw	BDE 47	BDE 99	BDE 119	BDE 153	TOTAL PBDE
High	<0.5	<0.5	<0.5	<0.5	<2
Low	<0.5	<0.5	<0.5	<0.5	<2

(in duplicates, for the High and Control level)

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### PAH contents (PAH and SPIKE trial)

#### PAH contents in feed

(n=3)	PAH trial					
	RABBIT			CHICKEN		
	High	Medium	Low	High	Medium	Low
[N, Ace, Acy, Fe]	41	16	5	72	35	5
[Phe, A, Fluo, Pyr, BaA, Chrys]	98	58	24	168	99	6
[BF, BeP, BaP, Per, DA, IP, BP]	14	8	3	31	20	2
<b>TOTAL</b>	<b>153</b>	<b>81</b>	<b>32</b>	<b>271</b>	<b>153</b>	<b>13</b>

#### SPIKE trial

(n=3)	CHICKEN			
	DP4	DP3	DP2	DP1
Phe	837	405	187	<2
Fluo	826	408	192	1.1
Chrys	860	423	196	0.5
BeP	613	310	153	0.2
BaP	811	403	190	0.2
<b>TOTAL</b>	<b>3947</b>	<b>1949</b>	<b>918</b>	<b>1.9</b>
C theo (each)	1200	600	300	0.0

#### PAH contents in meat & liver

PAH & SPIKE trials	
[PAH] ng/g dw	Meat & Liver
N	nd
Acy	<0.1
Ace	<0.1
Fe	<0.1
Phe	<4.0
A	<0.1
Fluo	<0.5
Pyr	<2.0
BaA	<0.1
Triph + Chrys	<0.1
BbF + BkF	<0.1
BeP	<0.1
BaP	<0.1
Per	<0.1
IP	<0.1
DahA + DacA	<0.1
BP	<0.1
<b>TOTAL</b>	<b>&lt;8</b>

(n=5)

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## PAH contents (PAH and SPIKE trial)

**PAH contents in meat & liver**

PAH & SPIKE trials	
RABBIT & CHICKEN	
[PAH] ng/g dw	Meat & Liver
N	nd
Acy	<0.1
Ace	<0.1
Fe	<0.1
Phe	<4.0
A	<0.1
Fluo	<0.5
Pyr	<2.0
BaA	<0.1
Triph + Chrys	<0.1
BbF + BkF	<0.1
BeP	<0.1
BaP	<0.1
Per	<0.1
IP	<0.1
DahA + DacA	<0.1
BP	<0.1
<b>TOTAL</b>	<b>&lt;8</b>

**PAH contents in plasma**

(n=3 for High, n=1 for control)

[PAH] ng/g	PAH trial				SPIKE trial	
	RABBIT		CHICKEN		CHICKEN	
	High	Low	High	Low	DP4	DP1
N	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Acy	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ace	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Fe	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Phe	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluo	<0.1	<0.1	0.1	<0.1	0.1	<0.1
Pyr	0.2	<0.1	0.2	<0.1	0.2	0.2
BaA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Triph + Chrys	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BbF + BkF	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BeP	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BaP	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Per	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
IP	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
DahA + DacA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BP	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<b>TOTAL</b>	<b>4</b>	<b>10</b>	<b>16</b>	<b>&lt;4</b>	<b>4</b>	<b>&lt;4</b>

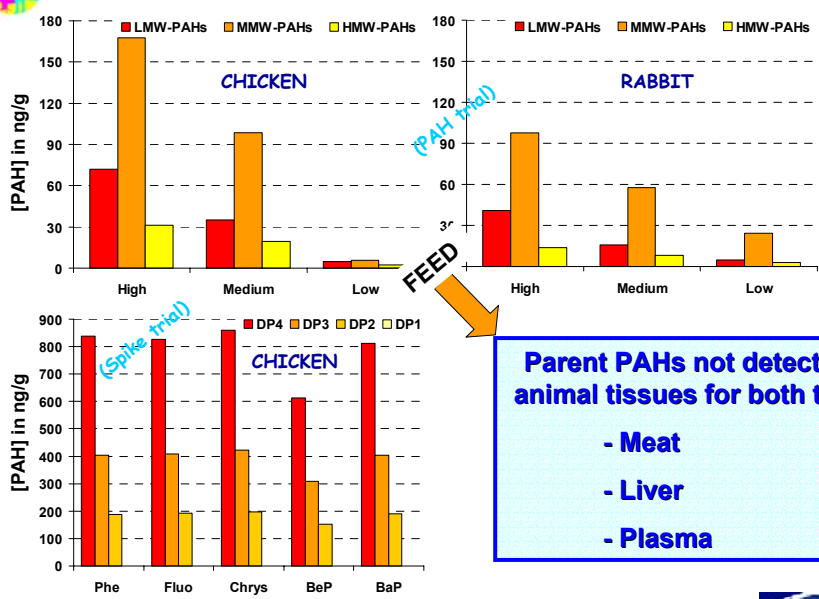
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## PAH contents in feed (PAH and SPIKE trial)



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### PAH contents in animal tissues (PAH and SPIKE trial)

PAH contents in meat & liver:

Even at extremely high concentrations in feed, PAHs are not accumulated in meat & liver of animals (despite their lipophilic properties), but actively metabolized.

→ No transfer of PAHs from feed to animal tissues.

(PAHs also not detected in plasma samples)



Use of PAH metabolites as markers of PAH exposure

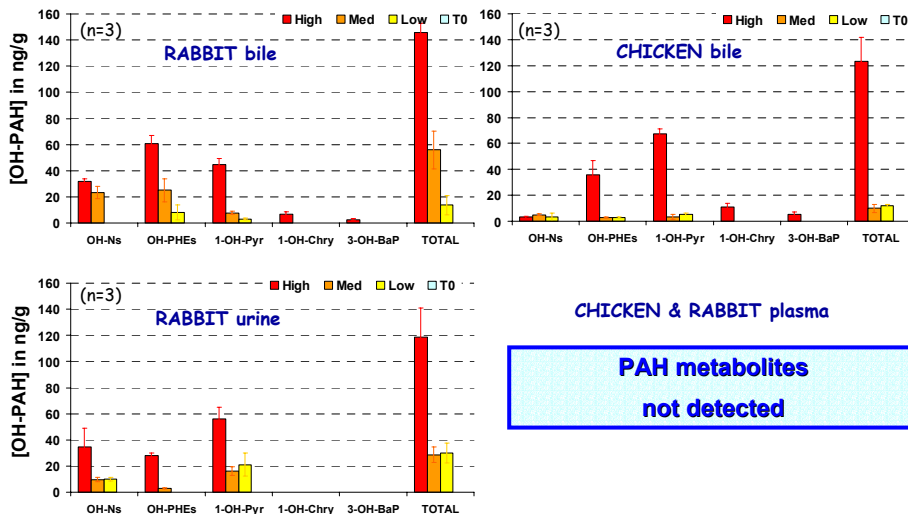
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### PAH metabolite (OH-PAHs) contents (PAH trial)



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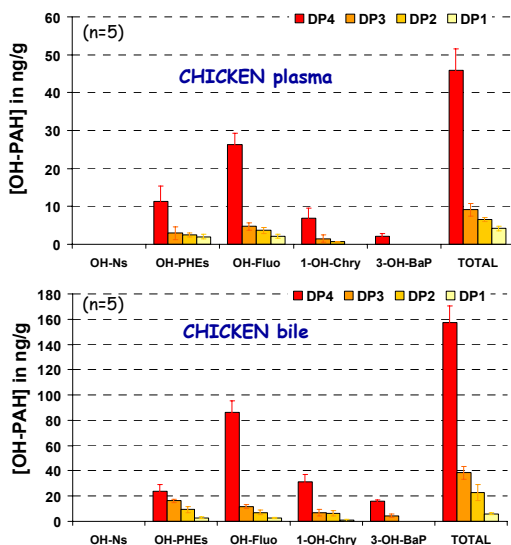




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### PAH metabolite contents (SPIKE trial)



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### PAH metabolite contents

PAH exposure is now clearly evidenced by the appearance of their metabolites in animal biological fluids (bile, plasma & urine):

#### PAH trial :

Significant levels of all metabolites for the high level of exposure

#### Spike trial :

- Significant metabolite levels (of all spiked PAHs) for the highest level of exposure (DP4)

- Their appearance at significant levels (DP4) in plasma raises question of their likely accumulation in tissues and organs, and consequently, of their potential biological impact.

- PAH metabolite levels are not correlated to PAH exposure levels

(quite the same levels and profiles for both trial, despite the important difference in PAH exposure from feed)

→ probably due, at very high levels of exposure, to : competitive metabolites of PAHs in highly exposed chickens, affected physiological state of animals (lowering metabolic processes), great influence of environmental factors (temperature, ...) & the need for normalizing concentrations in bile to biliary protein contents, ...

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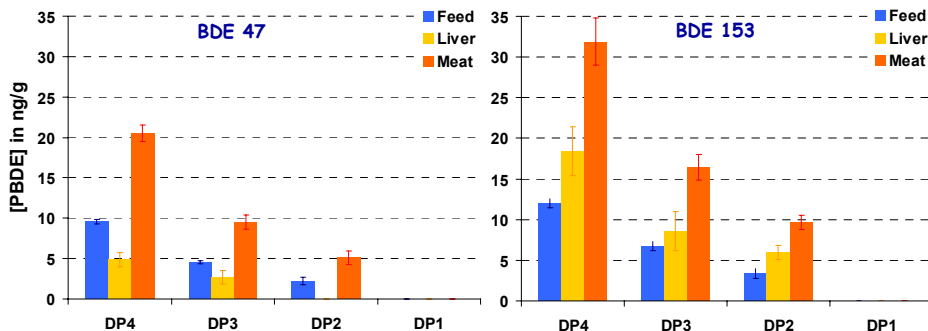
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### PBDE contents in feed and animal tissues (SPIKE trial)

(n=3 for feed;  
n=5 for meat & liver)

[PBDE] in ng/g	Feed theo	SPIKE trial					
		BDE 47			BDE 153		
		Feed	Liver	Meat	Feed	Liver	Meat
DP4	12	10	5	21	12	18	32
DP3	6	5	3	10	7	9	16
DP2	3	2	<0.5	5	3	6	10
DP1	0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5



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### Main conclusions and opening questions

#### PAHs in animal tissues :

No transfer to animal meat, even with highly contaminated feed  
→ Use of PAH metabolites as biomarkers of PAH exposure

#### PAH metabolites :

Mainly a qualitative approach (hard to quantify, need for normalized evaluation)

No representative of the physiological state of animals  
but if present in plasma (body circulation): potential biological impact  
So why not follow them in meat ? : still an analytical challenge !

#### PBDEs in animal tissues :

As PCBs, bioaccumulated

PBDE transfert to animal meat correlated to PBDE contents in feed

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