CHEMICAL CONTAMINANTS IN FOOD :
New appoaches in risk assessment

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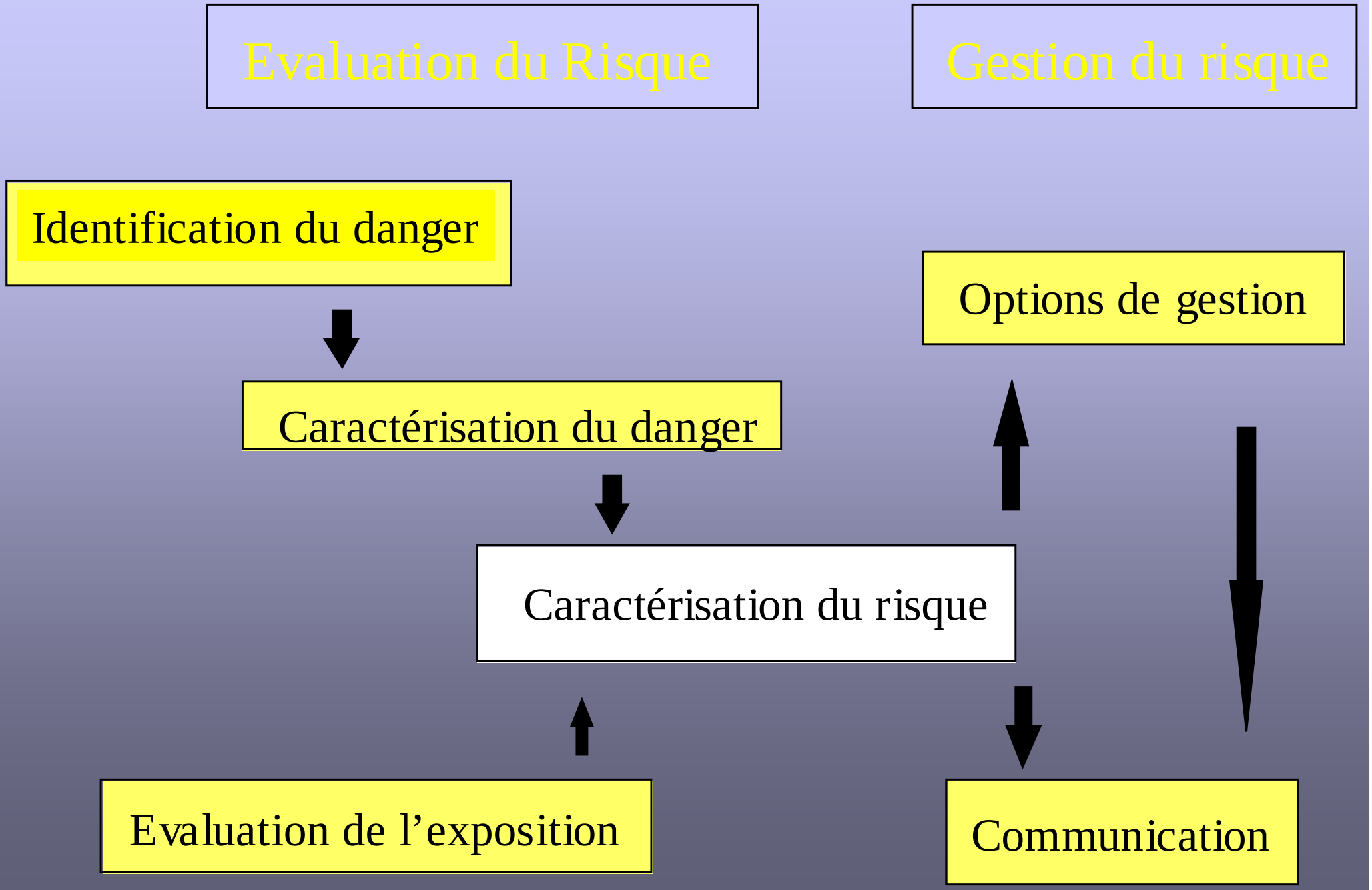
ANALYSE DU RISQUE



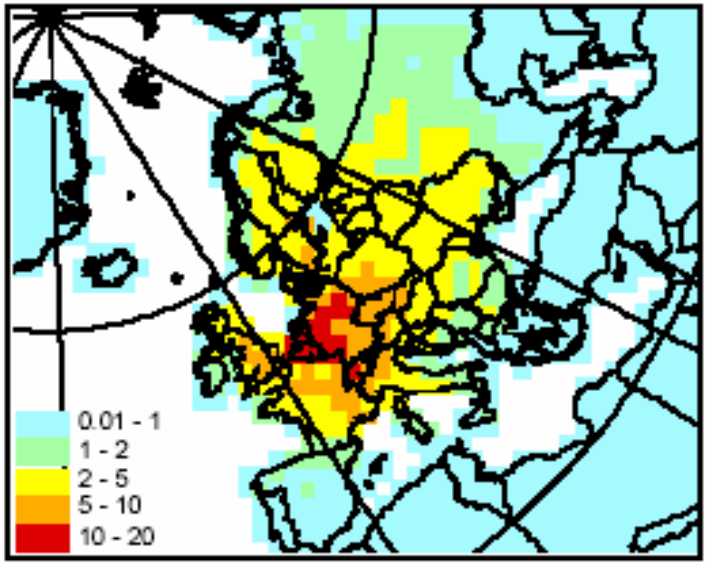
Revue des dangers dans les filières agro-alimentaires

MATIERES PREMIERES		TRANSFORMATION			PRODUITS FINIS
CULTURES	RECOLTES STOCKAGE	PROCESS Physiques	PROCESS Chimiques/Bio	EMBALLAGE STOCKAGE	DISTRIBUTION
Toxiques naturels -Antinutriments - Cancérogènes - Neurotoxiques - Antioestrogènes -Allergènes *OGM?* *Aux. de production* - Pesticides - Fertilisants - Antibiotiques - Hormones Contam. Sol, air, eau: -Industries -Environnement -Agriculture	*Contam. Naturels* -Mycotoxines *Contam. Chimiques* Matériels Récipients Stockage Transport *Corps étrangers* -Physiques -Biologiques	***Produits néoformés*** Lavage Blanchiement Broyage Epluchage Pressage Pasteurisation Stérilisation Congélation Lyophilisation Cuisson Extrusion Irradiation Pascalisation	Additifs Auxilliaires Arômes Chloration Sulfites Hydrolyse Fumaison Fermentation	***Migrats*** Bois Papier Plastique Métal Verre Palettisation Atmosph. Modifiée	Transport Stockage Etiquetage
	Previous cargo	***Produits de nettoyage***		***Pest-contrôle***	

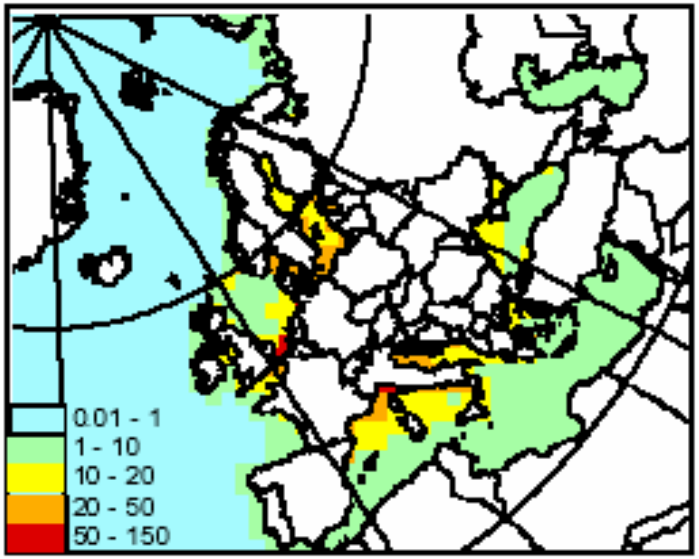
Interaction environnement (eau, air, sol)

TRANSFERTS

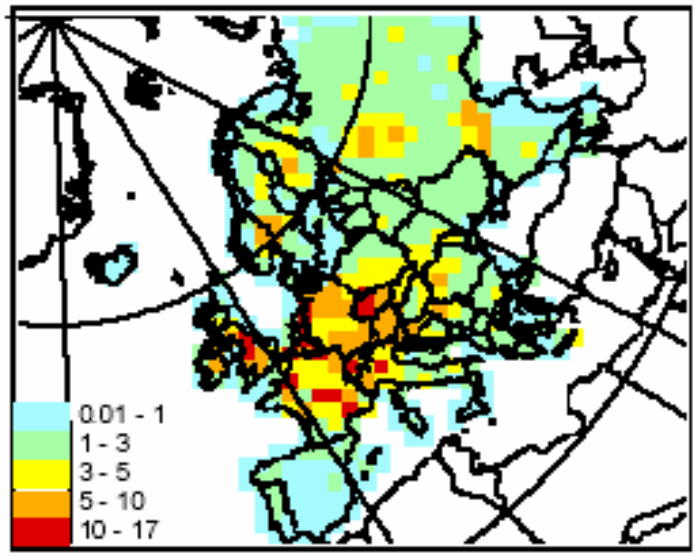
- **Dans la chaîne alimentaire**
- **Chez l'homme**



Levels in Soil (Transfer to eggs)



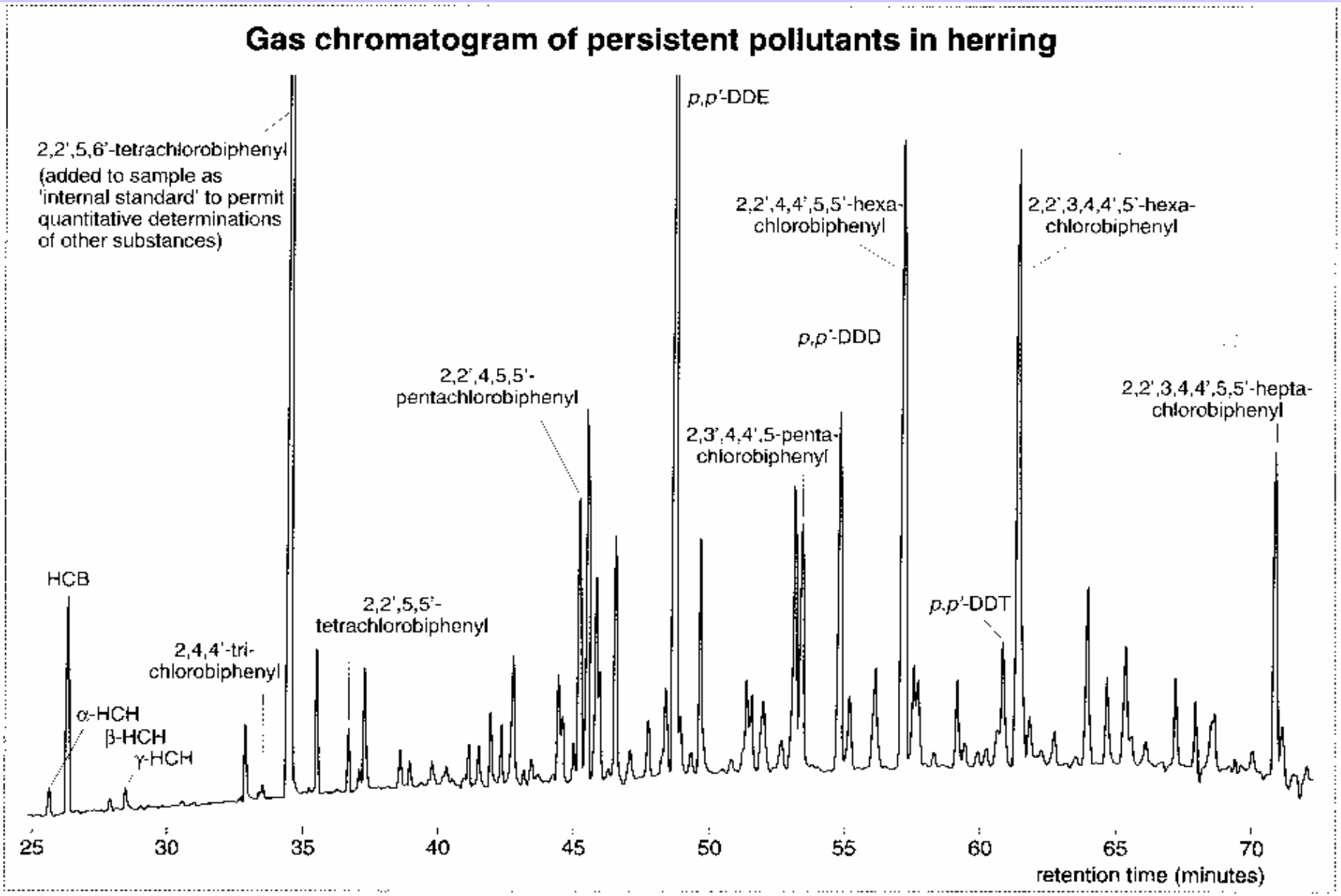
Levels in Sea (Transfer to Fish)



Levels in Vegetables (Transfer to meat and milk)

Spatial distribution of PCDD/Fs contamination in main environmental compartments in 1999

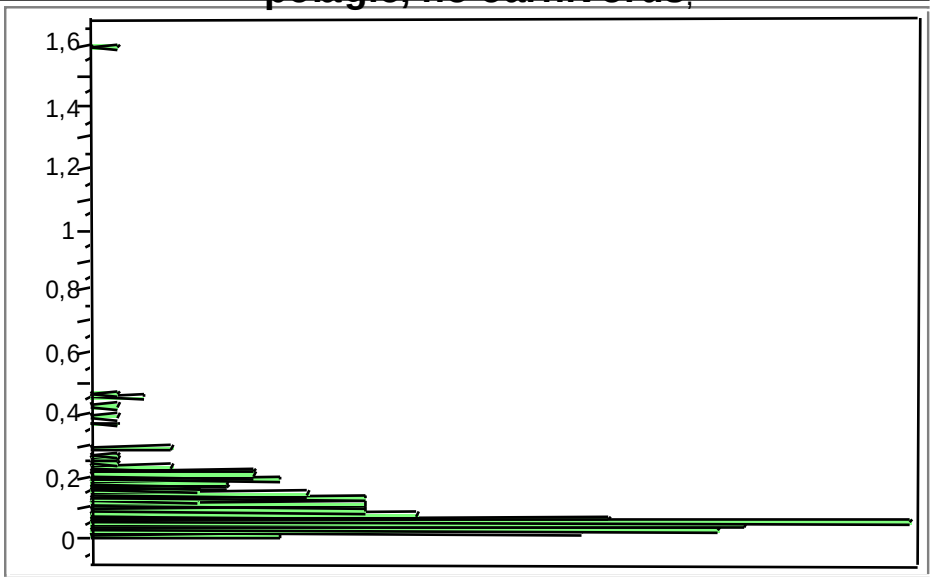
Gas chromatogram of persistent pollutants in herring



This is a typical gas chromatogram obtained from the regular analyses of Baltic herring carried out as part of Sweden's environmental monitoring programme — the sample in question was collected at Landsort in 1996. Normally, concentrations of the named substances only are determined in these analyses (see chapter 2 for explanations of the chemical names). The molecular structures of the PCB congeners included in this selection are also shown. Many of the unmarked peaks, too, correspond to PCBs. It may be noted that peaks are much narrower and thus easier to distinguish with today's analytical techniques than with those used in the 1960s (see p. 10). — From Institute of Applied Environmental Research, Stockholm University.

Distribution de la contamination en **Mercure** dans deux catégories de poissons pélagiques (mg/kg PF)

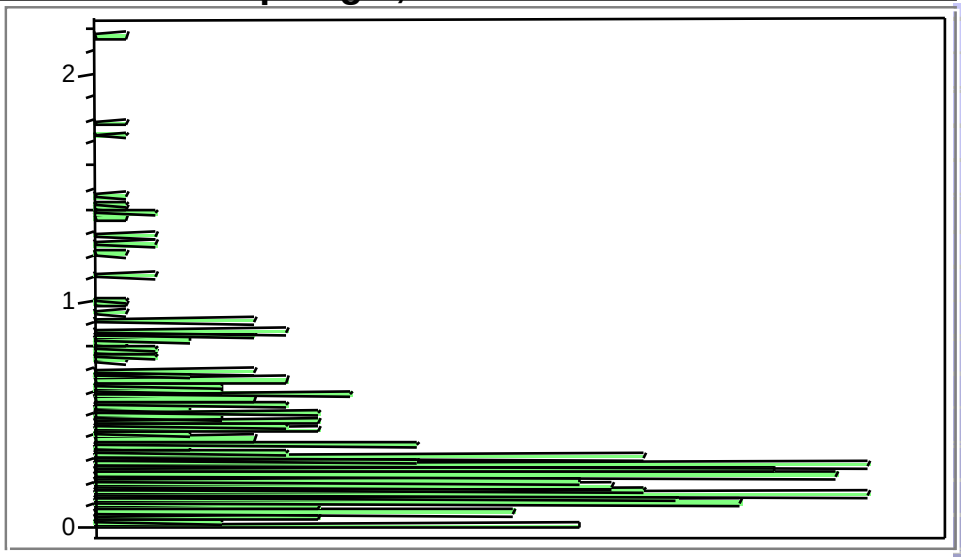
pelagic, no-carnivorus



Moments

Mean	0,1052263
Std Dev	0,1323601
Std Err Mean	0,0088437
upper 95% Mean	0,1226544
lower 95% Mean	0,0877982
N	224

pelagic, carnivorus

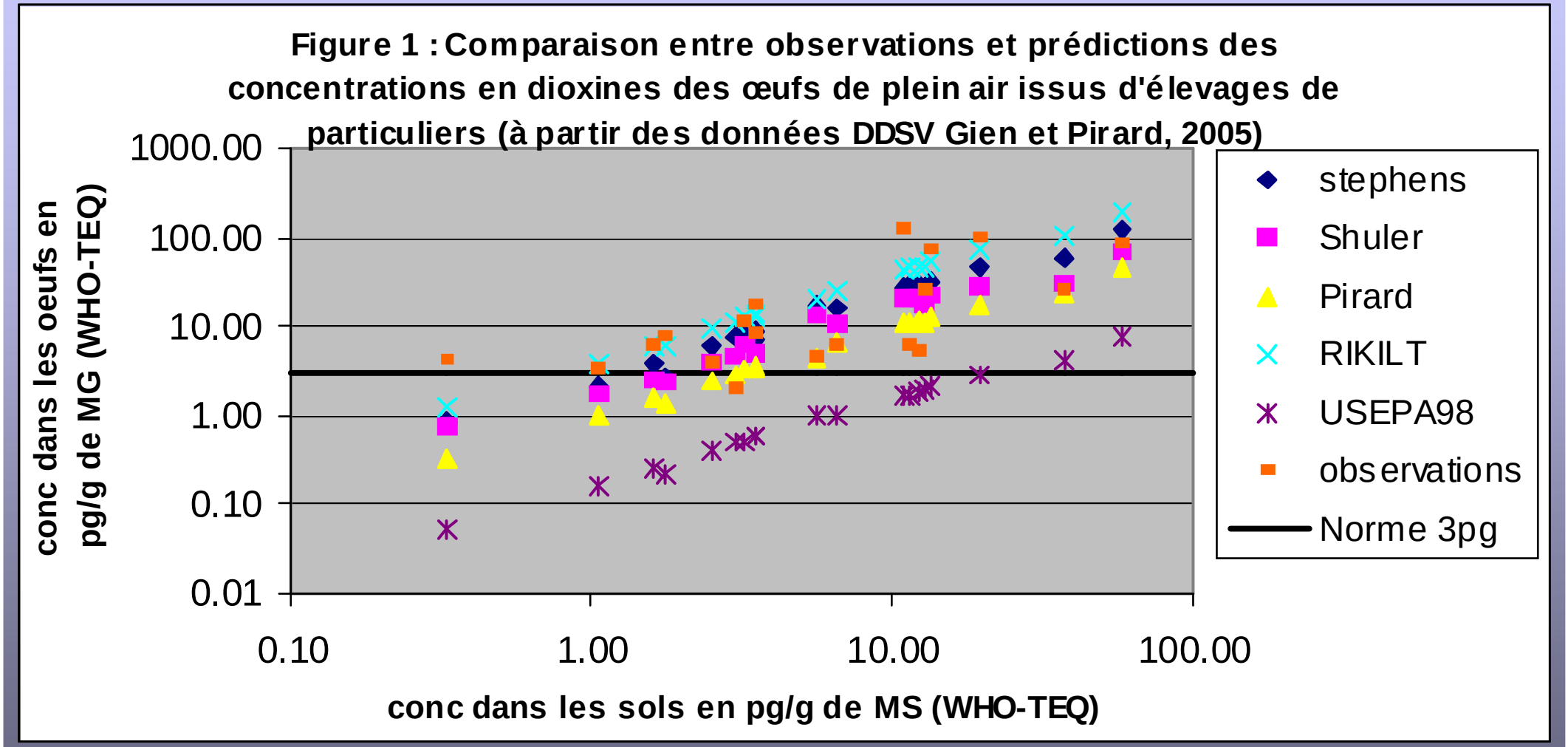


Moments

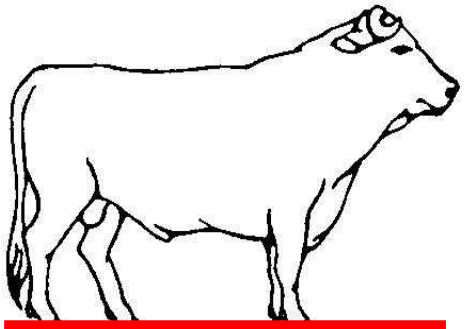
Mean	0,3578672
Std Dev	0,3153930
Std Err Mean	0,0157894
upper 95% Mean	0,3889087
lower 95% Mean	0,3268257
N	399

(DGAL/ AFSSA 2002)

Figure 1 : Comparaison entre observations et prédictions des concentrations en dioxines des œufs de plein air issus d'élevages de particuliers (à partir des données DDSV Gien et Pirard, 2005)

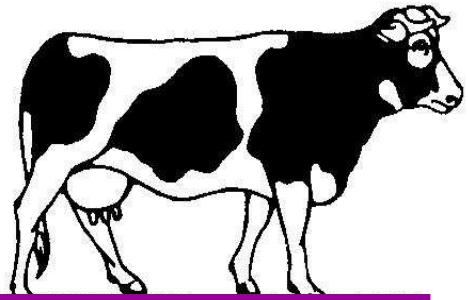


A modern menu for farm animals



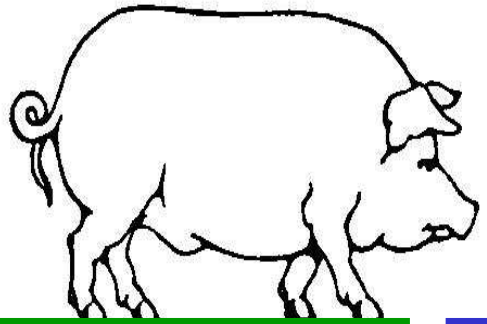
BEEF CATTLE

- Estradiol (implant for suckling calves or with beef starter)
- Melengestrol acetate (hormone feed additive)
- Androgens (hormone implants for male sex characteristics)
- Estrogens (hormone implants for female sex characteristics)
- Progestogens (male hormone implants for steers, heifers)



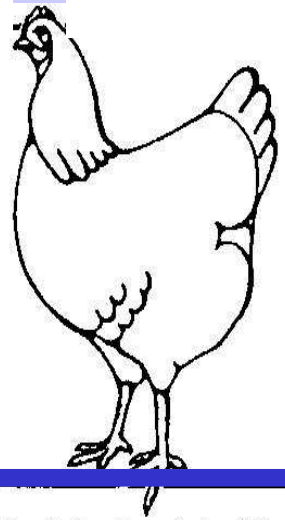
DAIRY COWS

- Oxytetracycline (with nonmedicated milk replacer)
- Chlortetracyclines (with cattle feed)
- Thiabendazole (with cattle feed)
- 10 other classes of feed additives and eight classes of implants
- BST, biotech hormone (pending)



HOGS

- Carbadox (feed additive with swine starter feeds)
- Oxytetracyclines (with swine feeds)
- Thiabendazole (with swine feed)
- 13 other classes of biological/chemical feed additives
- Dichlorvos (with swine finisher feeds)



POULTRY

- Arsanilic acid (with chicken or turkey starter feed)
- Clopidal (with young chicken feed)
- Amprollum plus Ethopabate (with broiler feeds)
- Phenothiazine (with laying hen feed)
- 18 other chemical and biological offerings

SUBSTANCES TOXIQUES
résultant des traitements appliqués aux aliments

Composés	Aliments	Effets
Lipides oxydés, stérols	**Aliments cuits**	**MCV**
A.G. Trans	**Huiles hydrogénées**	**MCV**
Chloropropanols	**HVP***	**Cancérogènes**
HAPs**	**Aliments cuits/fumés**	**Cancérogènes,**
Amines hétérocycliques polycycliques AHs	**viandes,poissons cuits**	**Cancérogènes**
. *Types IQ*	**Sauces, arômes de transfor.**	**Cancérogènes**
. *Carbolines*	**Aliments pyrolysés**	**«**
	Aliments cuits	
Produits de Maillard (MRPs)		
. *Mélanoïdines*,	**Aliments cuits**	**Mutagènes, néphrotox.**
. *Acrylamide*	**Amidon cuit**	**Neurotoxique, Cancérogène**
.*Furanes*	**Oses**	**Mutagènes.**
Carbamate d'éthyle	**Aliments fermentés**	**Cancérogène**
Nitrosamines	**Salaisons, farines de poissons, bières**	**Cancérogène**

*** Hydrolysed Vegetable Protein, **Hydrocarbures Aromatiques Polycycliques**

WWF

DETOX CAMPAIGN

Chemical Check Up

An analysis of chemicals in the blood of Members of the European Parliament

Contaminants des graisses humaines (EU/US)

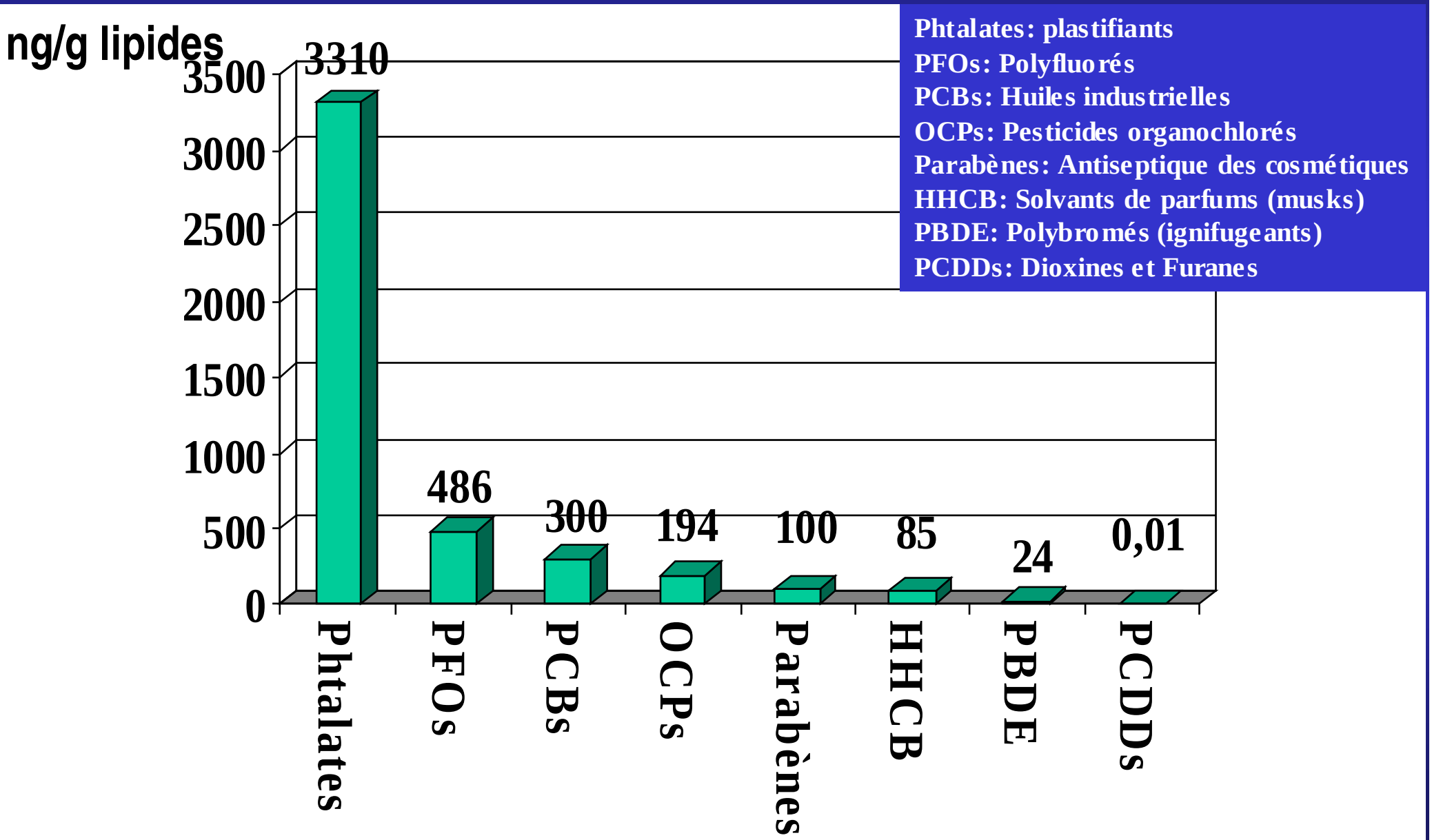
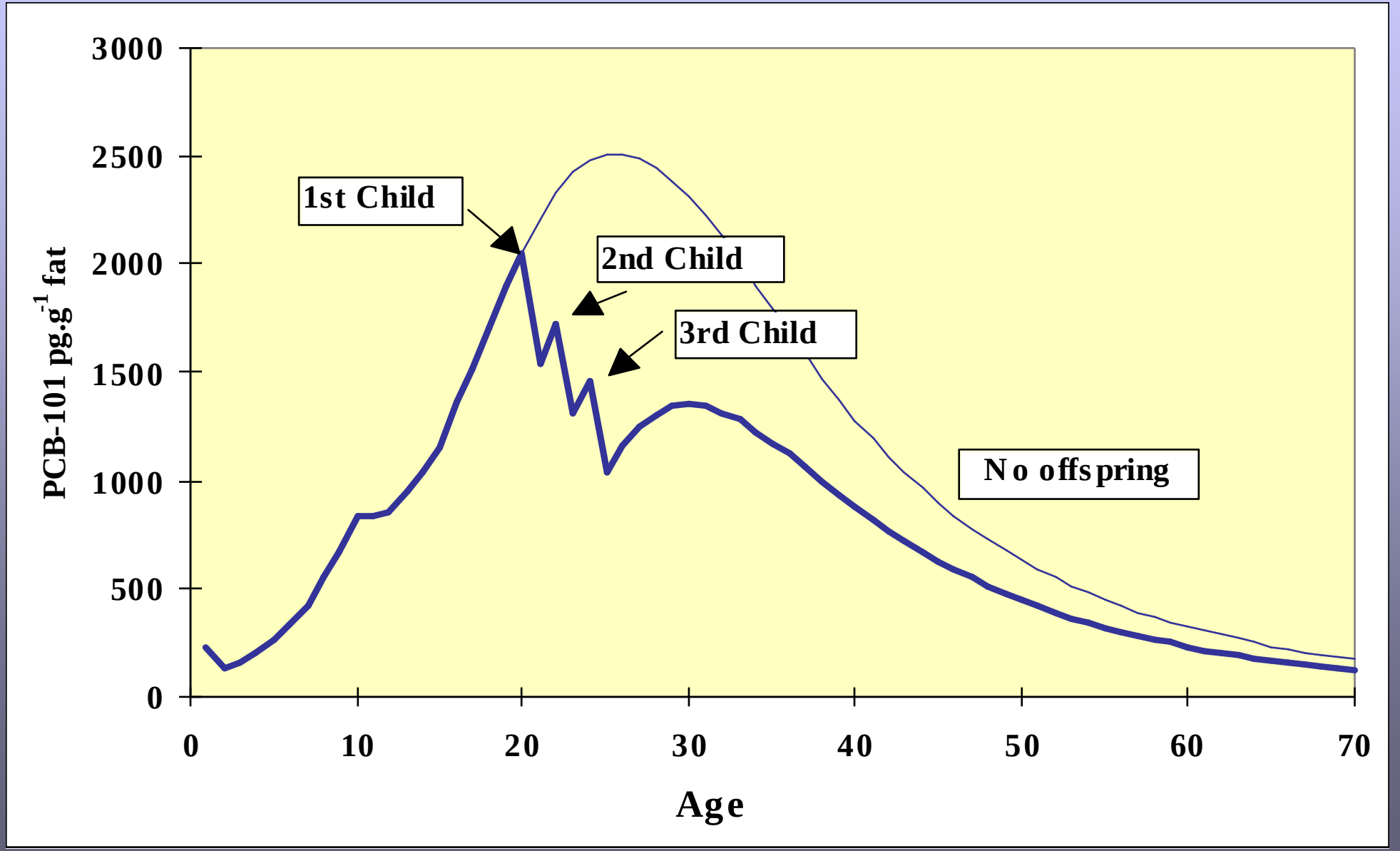


Figure 5: Effet de la multiparité sur la charge corporelle en PCB-101
Pour une femme née en 1950 et ayant 3 enfants agés de 20, 22 et 24 ans



Caractériser les Dangers

Caractérisation des dangers:
Tests toxicologiques du protocole OCDE

Toxicité Aigüe (Dose unique) → DL_{50}

Toxicité sub-aigüe ou sub chronique (28-90 jours) → Identification des dommages organes cibles, dose/réponse; NOAEL

Métabolisme & Toxicocinétique (Dose unique & répétées) → Absorption, métabolisme Concentrations sanguines et tissulaires, excrétion

Tests in vitro mutagenèse et clastogenèse → + / -

Toxicité chronique (exposition long terme 18-24 mois chez le rat) → Identification des dommages organes cibles, effets cumulés dose/réponse; NOAEL

Cancérogenèse (toxicité long terme a la dose maximale tolérée) → + / -

Repro-toxicité (Fertilité, tératogenèse foetotoxocité, lactation…) → Effets sur les males, les femelles, la conception dose/réponse

Identification des Dangers

Etudes Humaines

Epidémiologie

Travailleurs exposés

Expositions environnementales

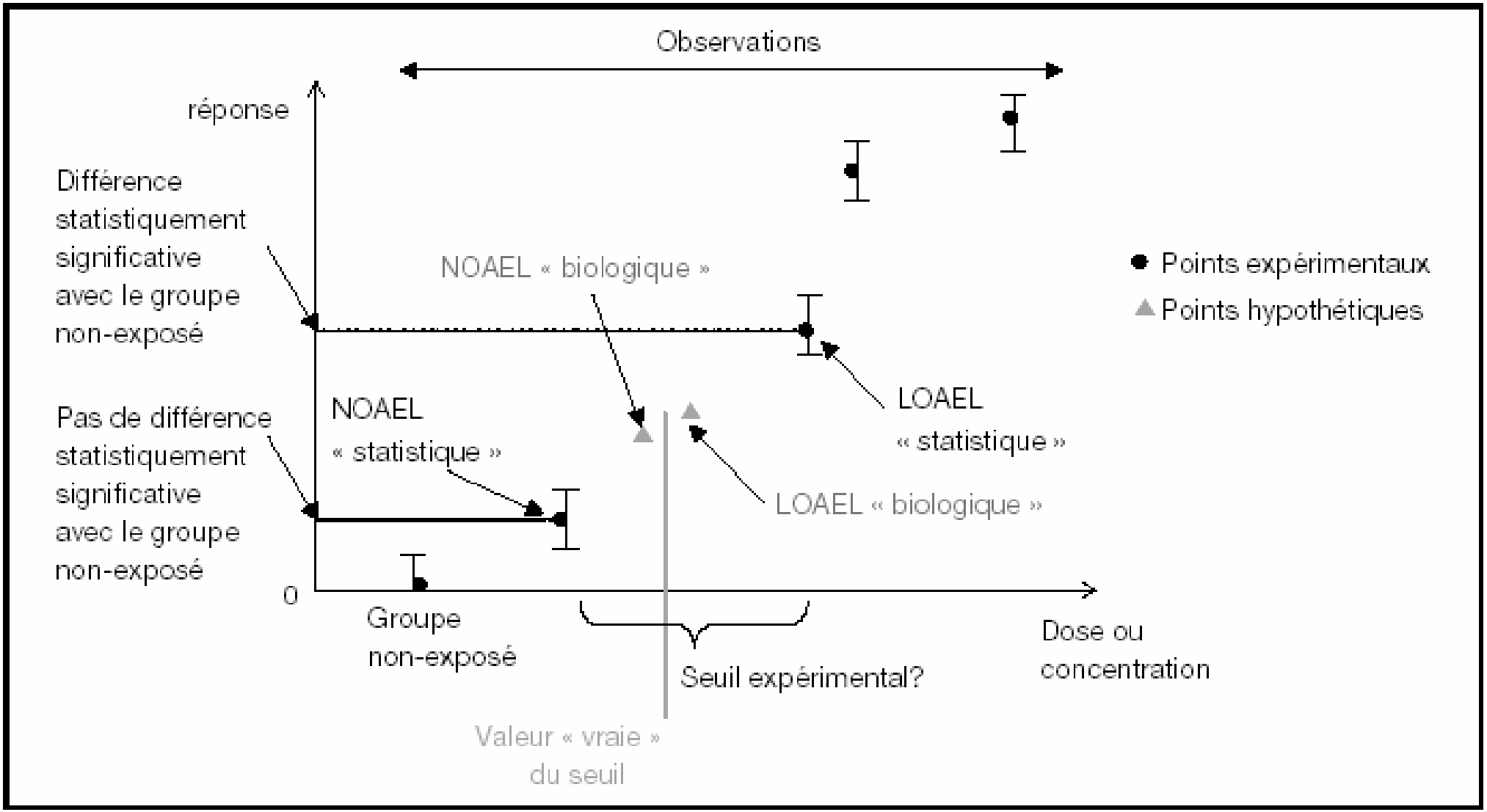
Accidents locaux
Fortes expositions

Populations générales
expositions proches du bruit de fond

Etablissement des VTRs

- **ARfD**
- **RfD, DJA/DJT**
- **DVS 10^{-6} 10^{-5} 10^{-4},**

FIGURE 1 : Effets à seuil, détermination de la dose critique par la méthode traditionnelle



Setting TRVs *(Toxicological Reference Values)*

Non cancer end points

Carcinogens

ARfD: Acute Reference Dose Neuro Tox/SF
RfD: Référence dose from 90 days study/SF

Non-génotoxic mechanisms

Génotoxic mechanisms

ADI/TDI = NOAEL 3-18 month / Safety Factor

No Threshold

Standard conditions: SF=100

Human data: SF<100

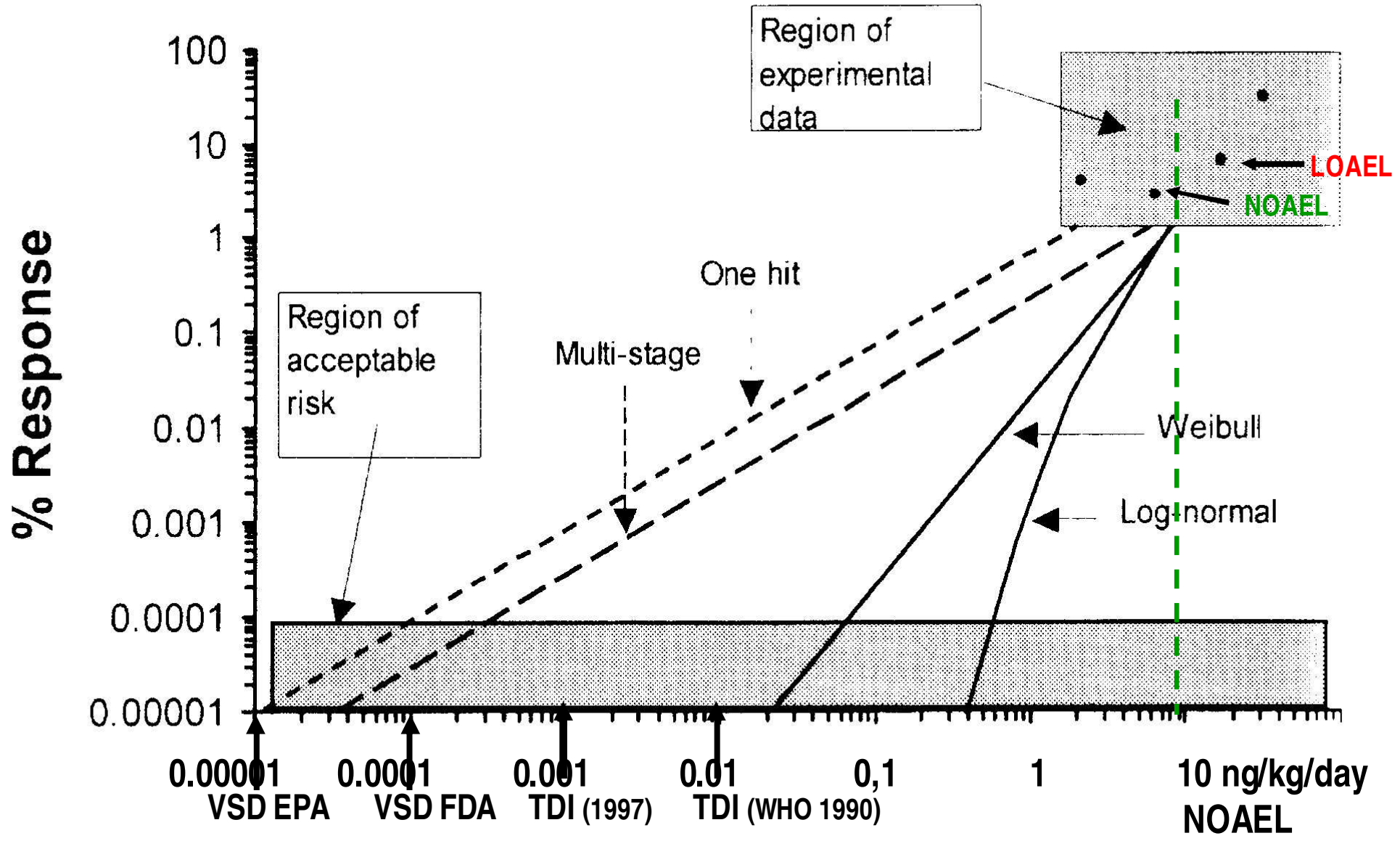
Critical tissues: SF>100

SF> 1000

-No TDI

-VSD ($10^{-5, -6, -7}$)
Virtually Safe Dose Tolerable Risk

Dose–response extrapolation

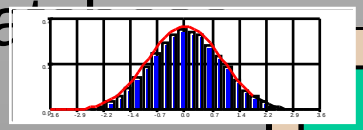


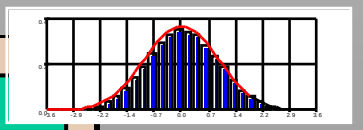
-Evaluer les risques

A) Exposition

Probabilistic modelling

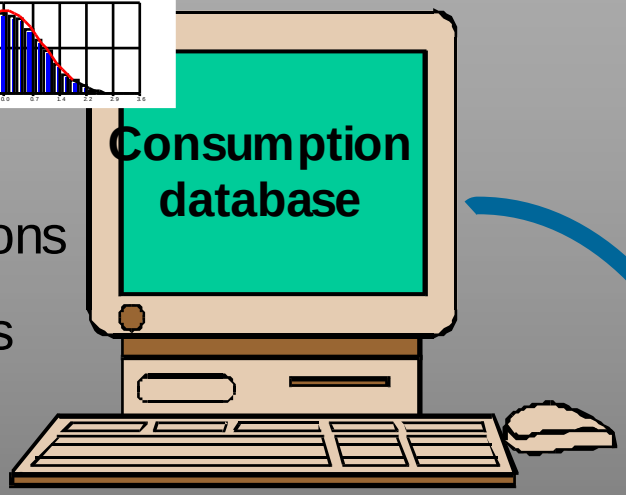
random sampling from a consumption and a compound da





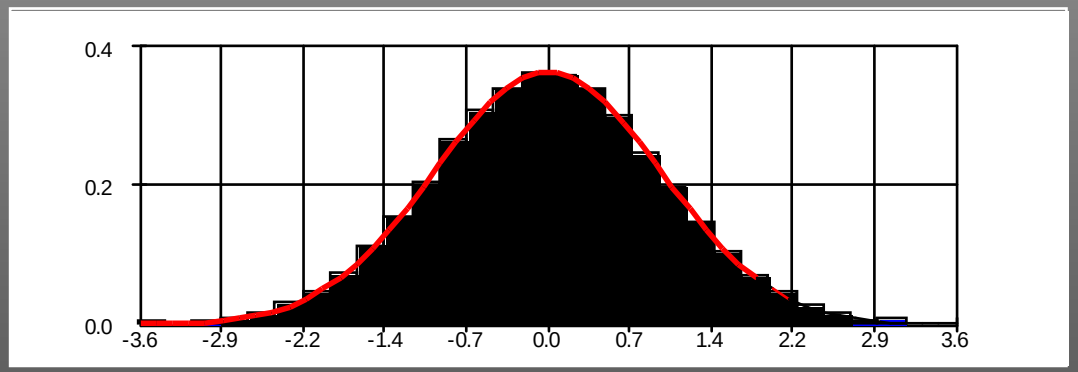
6250 persons

with 2 days



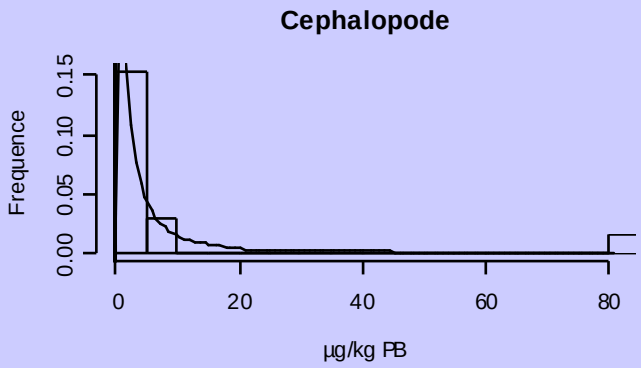
Monitoring

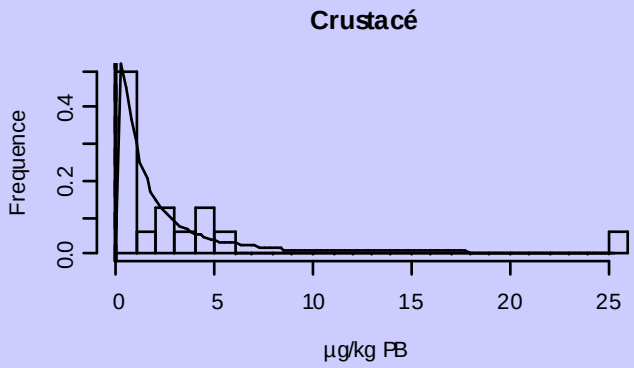
programme

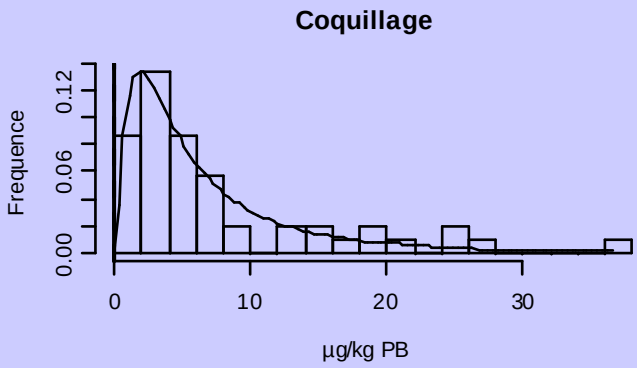


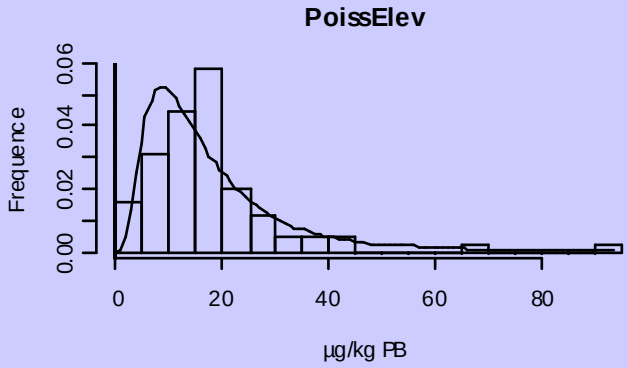
Result: distribution of exposure

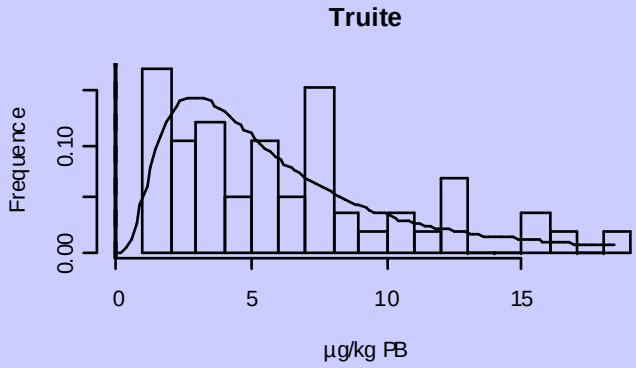
PCB Indicateurs

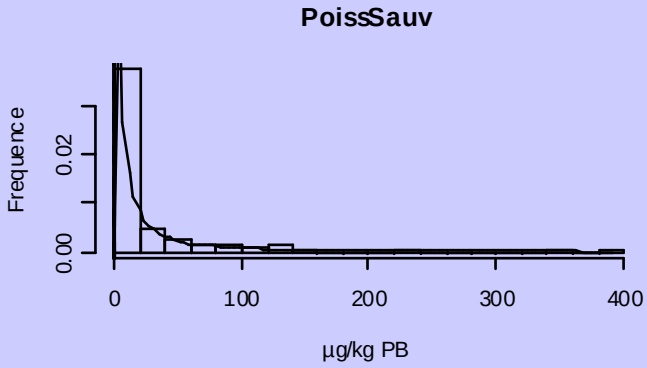


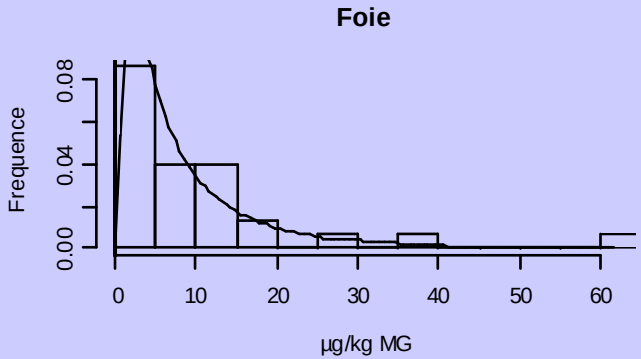


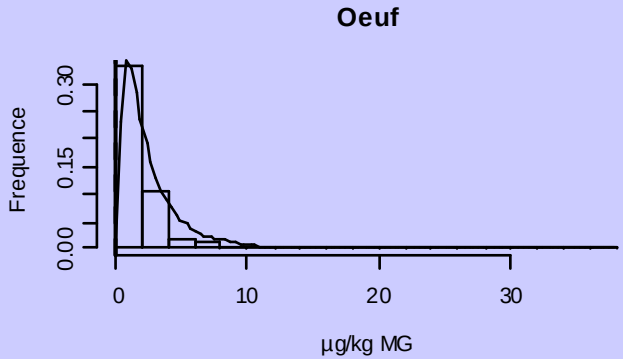


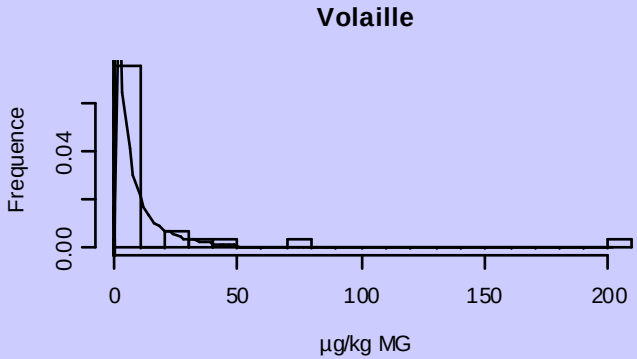






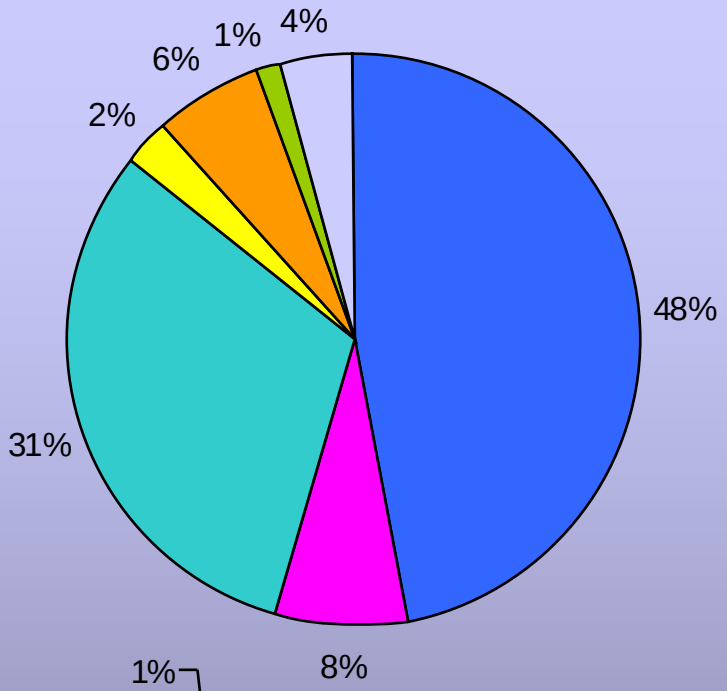


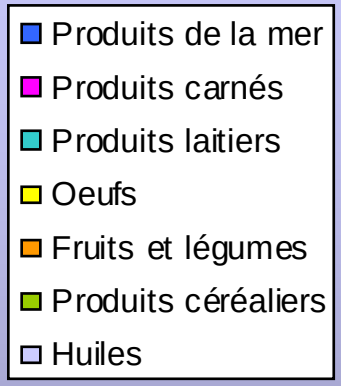




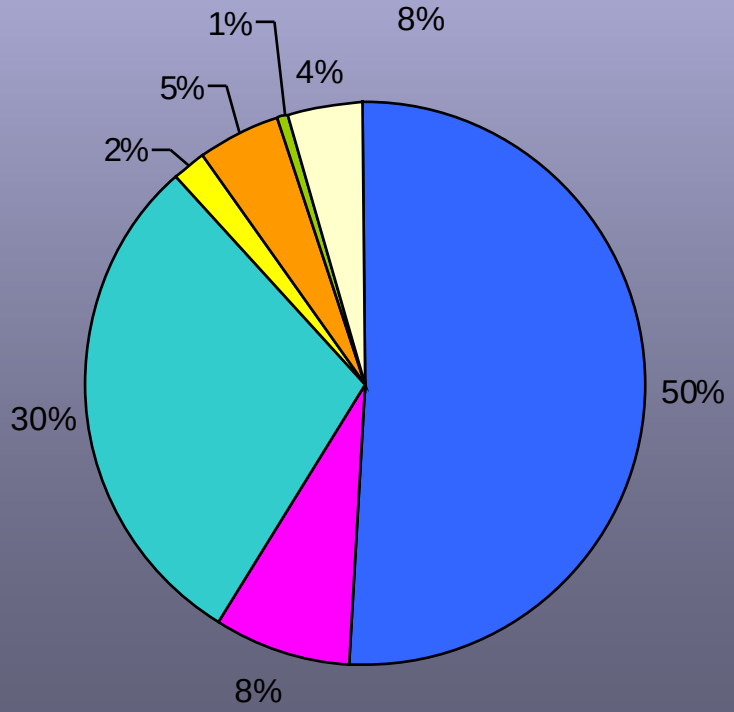
Courbes de fréquence pour les aliments d'origine animale en France (AFSSA 2004)

Contribution relative des 7 groupes d'aliments à l'exposition pour les adultes

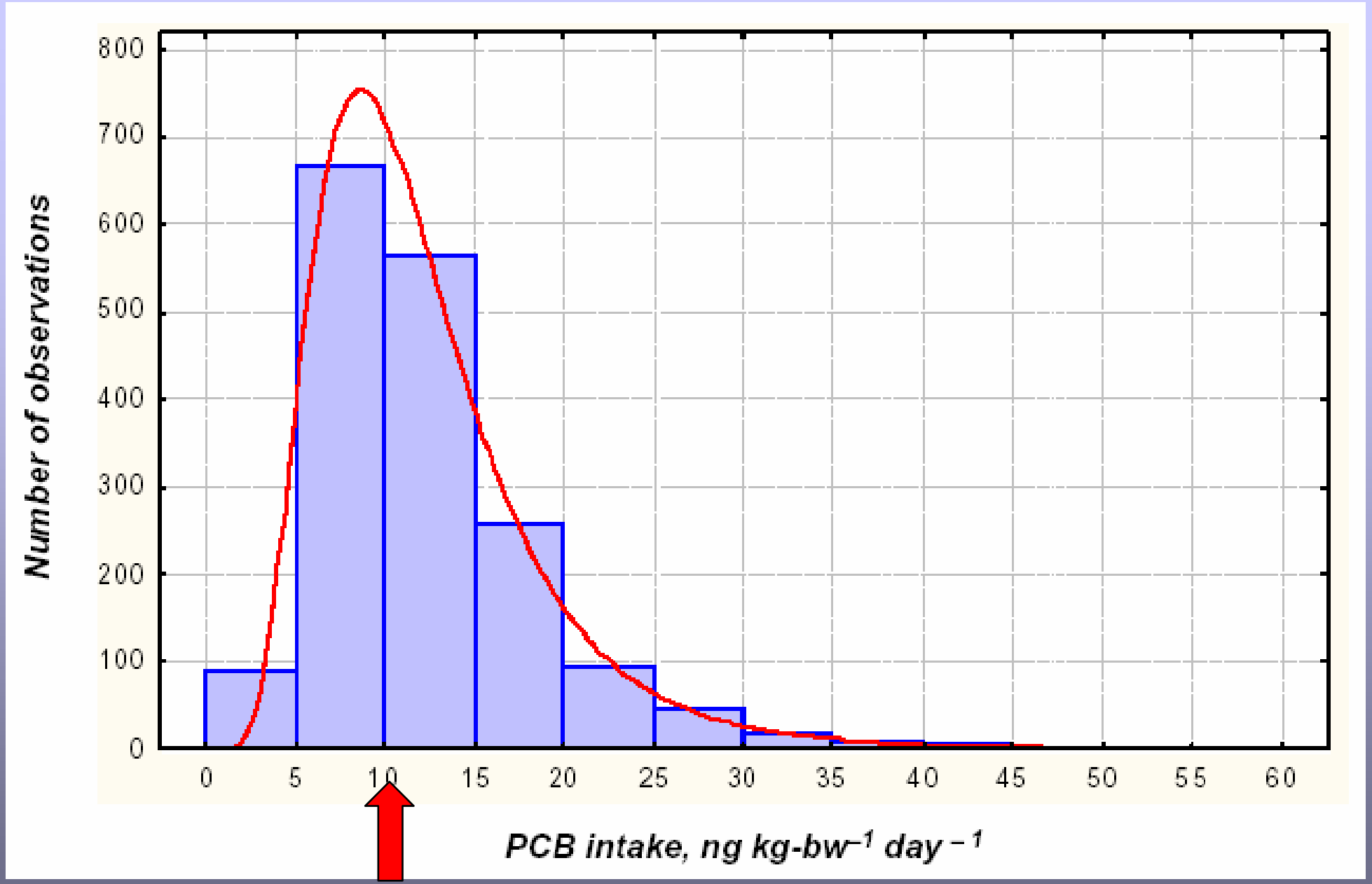




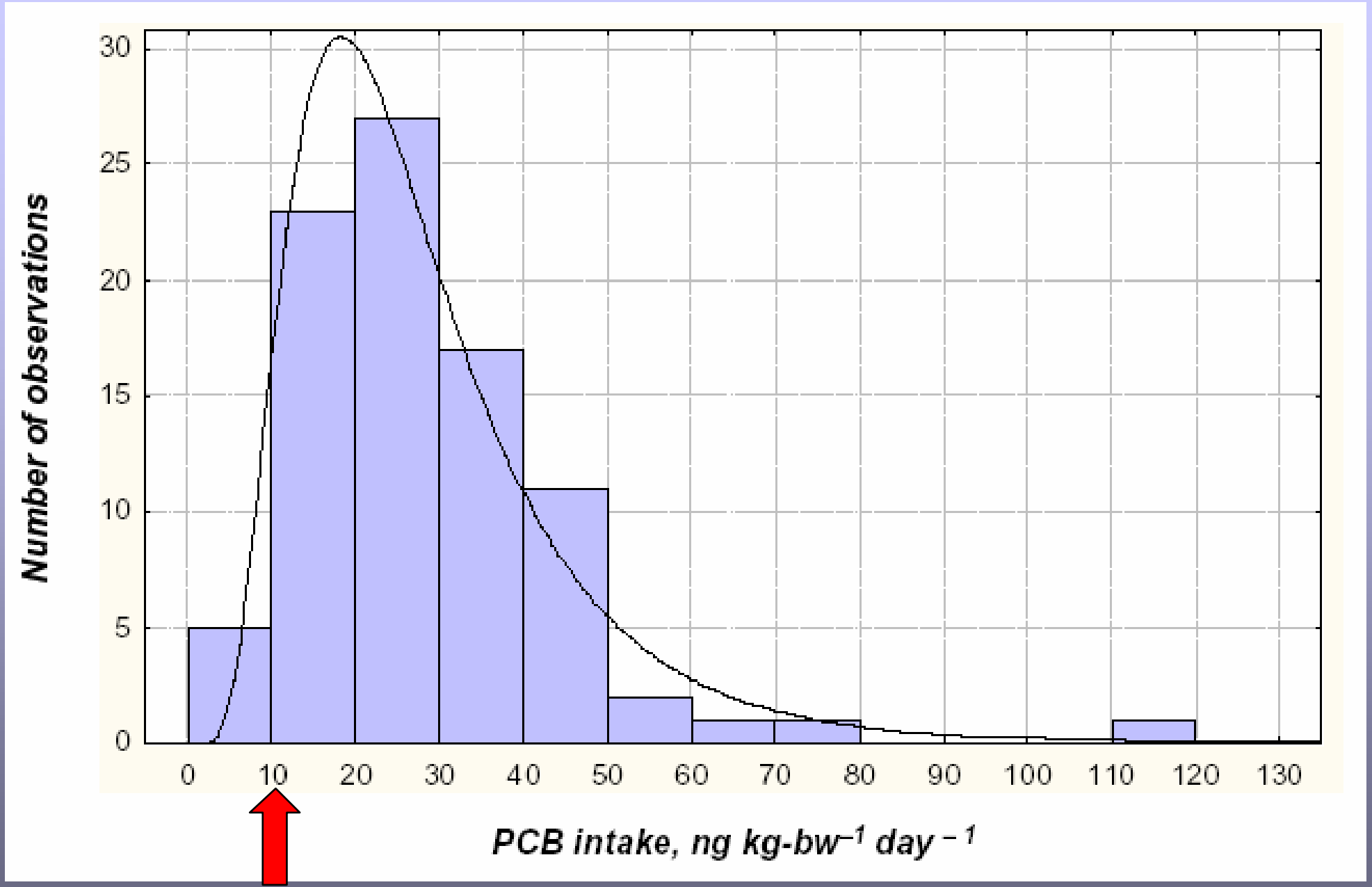
PCDD/F



PCB-DL



Log-normal frequency distribution showing the Σ_6(PCBs) intakes in
kg-bw–1 day–1 for 13-94 year old adults.



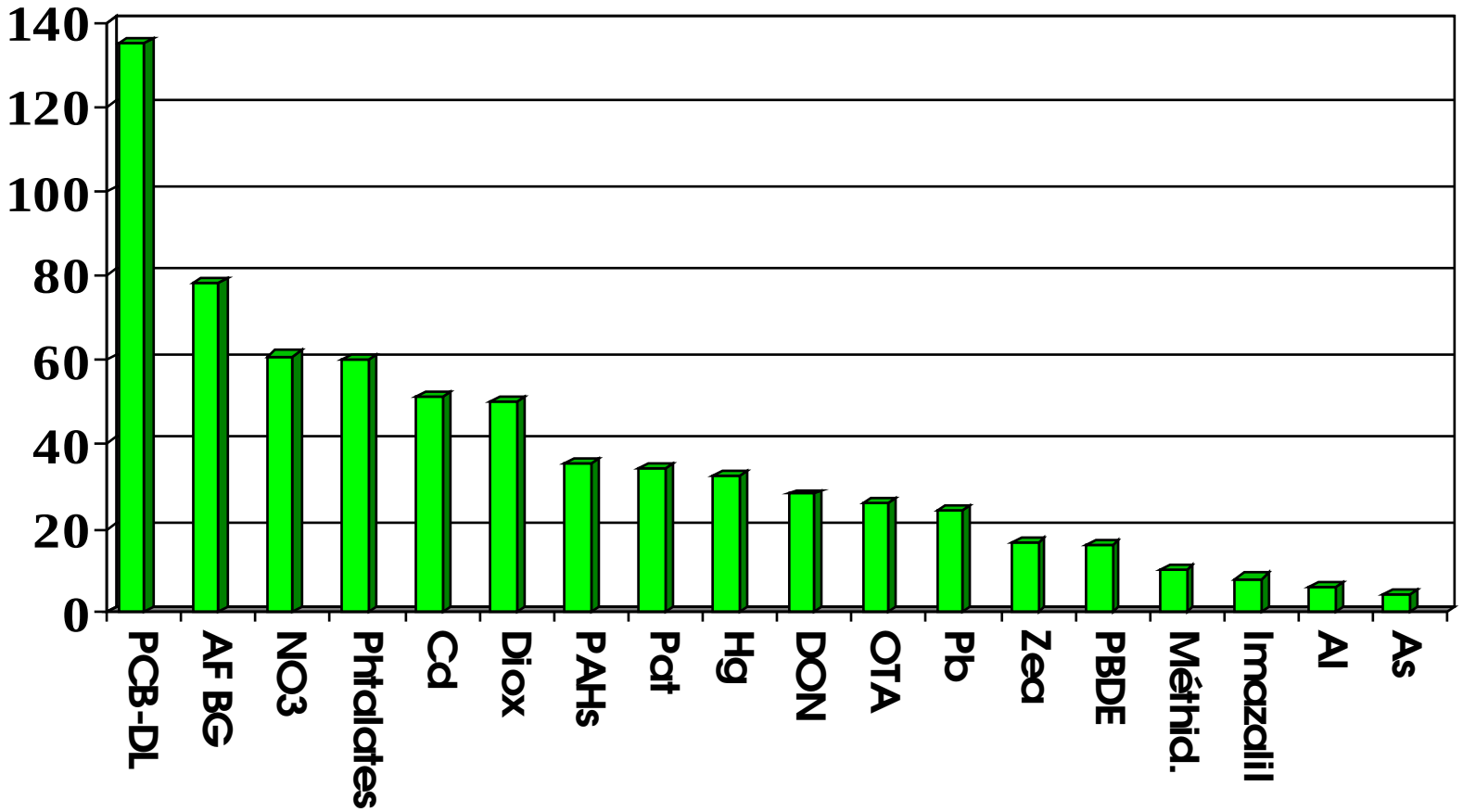
Log-normal frequency distribution showing the Σ_6(PCBs) intakes in kg-bw–1 day–1 for 0–6-year old toddlers (breastfeeding excluded)

-Evaluer les risques

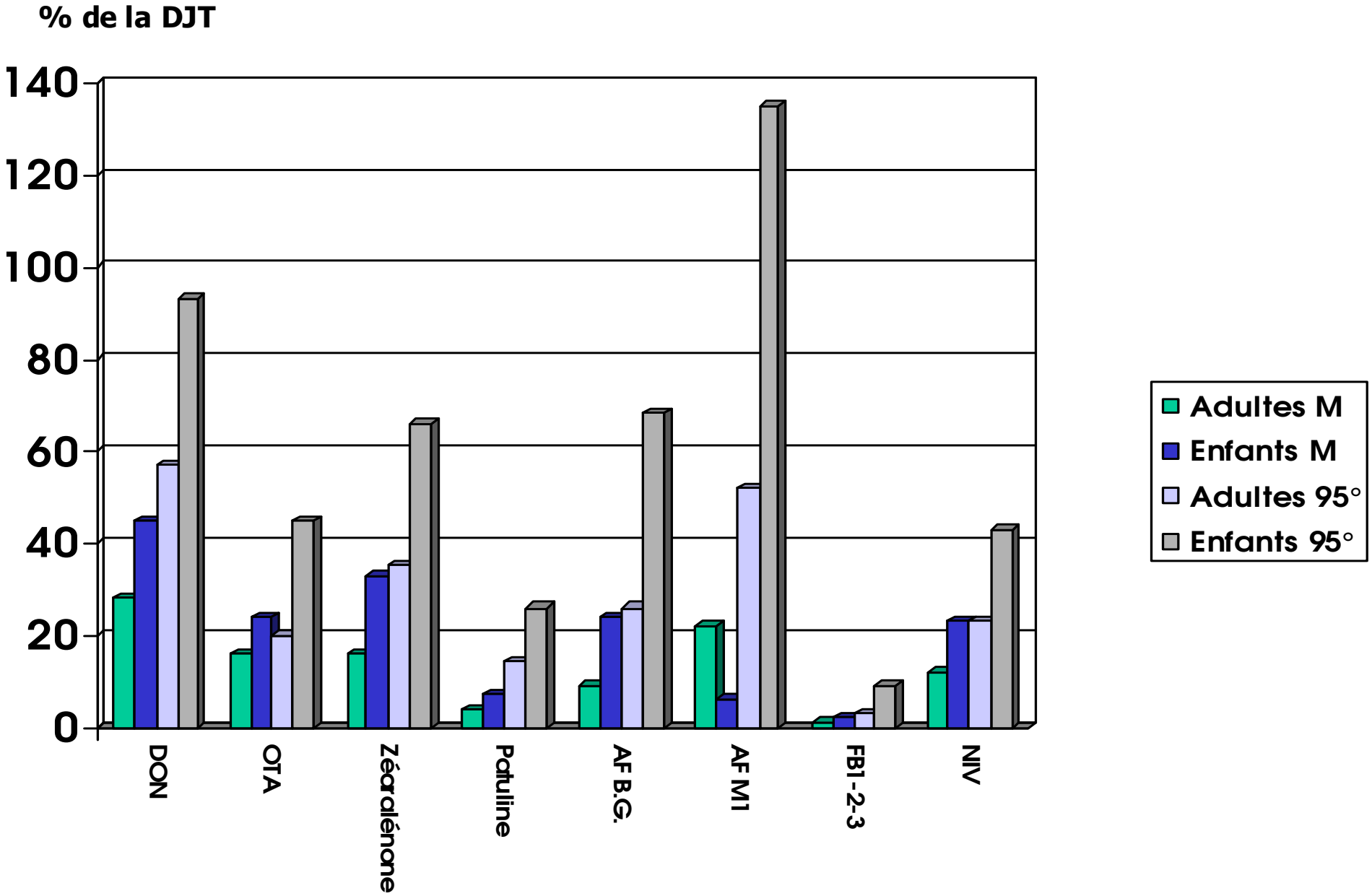
B) Hiérarchiser le risque

Exposition à quelques contaminants en France (*% de la DJT ou DVS* pour la moyenne de la population)*

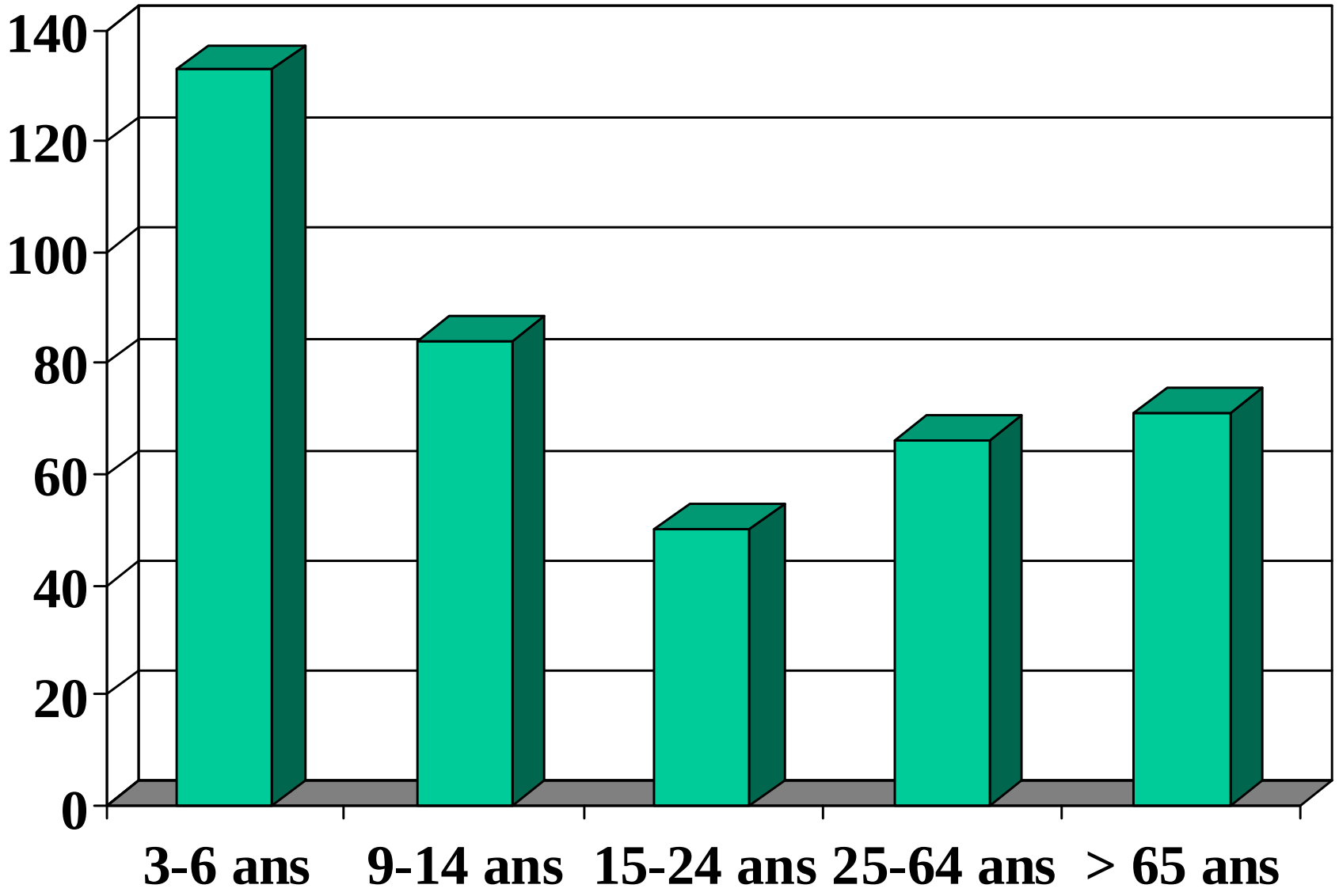
% de la DJA	Conclusions
< à 0,1%	NEGLIGEABLE
entre 0,1% et 10%	ACCEPTABLE
entre 10% et 100%	A SURVEILLER
> à 100 %	DANGEREUX



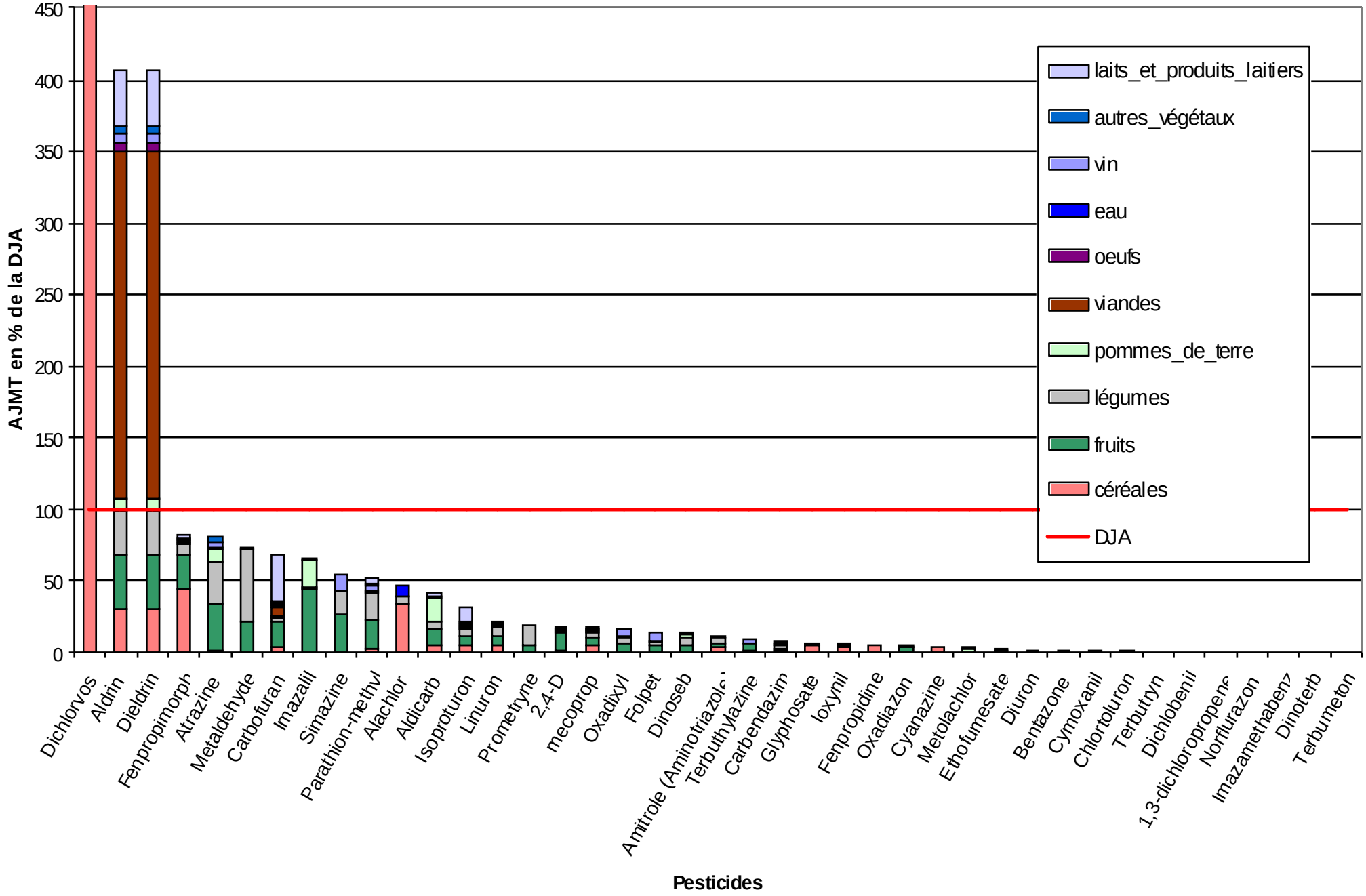
Expositions aux mycotoxines en France à partir d'une étude sur diète totale pour des adultes (plus de 15 ans) et des enfants (3 à 14 ans) moyenne et 95° percentile *(AFSSA 2006)*



Niveaux d'apports alimentaires en Hg-CH3 en France
en % DHTP au 95°percentile des consommateurs



ANNEXE 2 : Contributions des classes d'aliments sur la vie entière pour les 29 pesticides détectés à une teneur supérieure à la limite de qualité au moins une fois en 2001-2003 et ayant une DJA et des LMR.



Estimation des risques pour les cancérogènes alimentaires majeurs

Composés	QRA
PCBs	$2.\ 10^{-5}$
AFB1	$1\text{-}2.\ 10^{-5}$
DMNA	$1.\ 10^{-5}$
Dioxines	$5.\ 10^{-6}$
HAPs	$3.\ 10^{-6}$
OTA	$1\text{-}2.\ 10^{-6}$
AFM1	$0{,}5\text{-}1{,}5.\ 10^{-6}$

Risque total estimé: de 2000 à 10 000 cancers par an en France

a-t'on le droit de faire ce calcul???

Risk Management

Setting Max. limits

Application of Max. limits

Setting limits

TDI (mg/kg/d)

Toxicological credit (mg/person/d)

Σ of vectors of exposure

Water
(HWA)

Air
Max Limit
VLE

Main food contributors (from TDS)

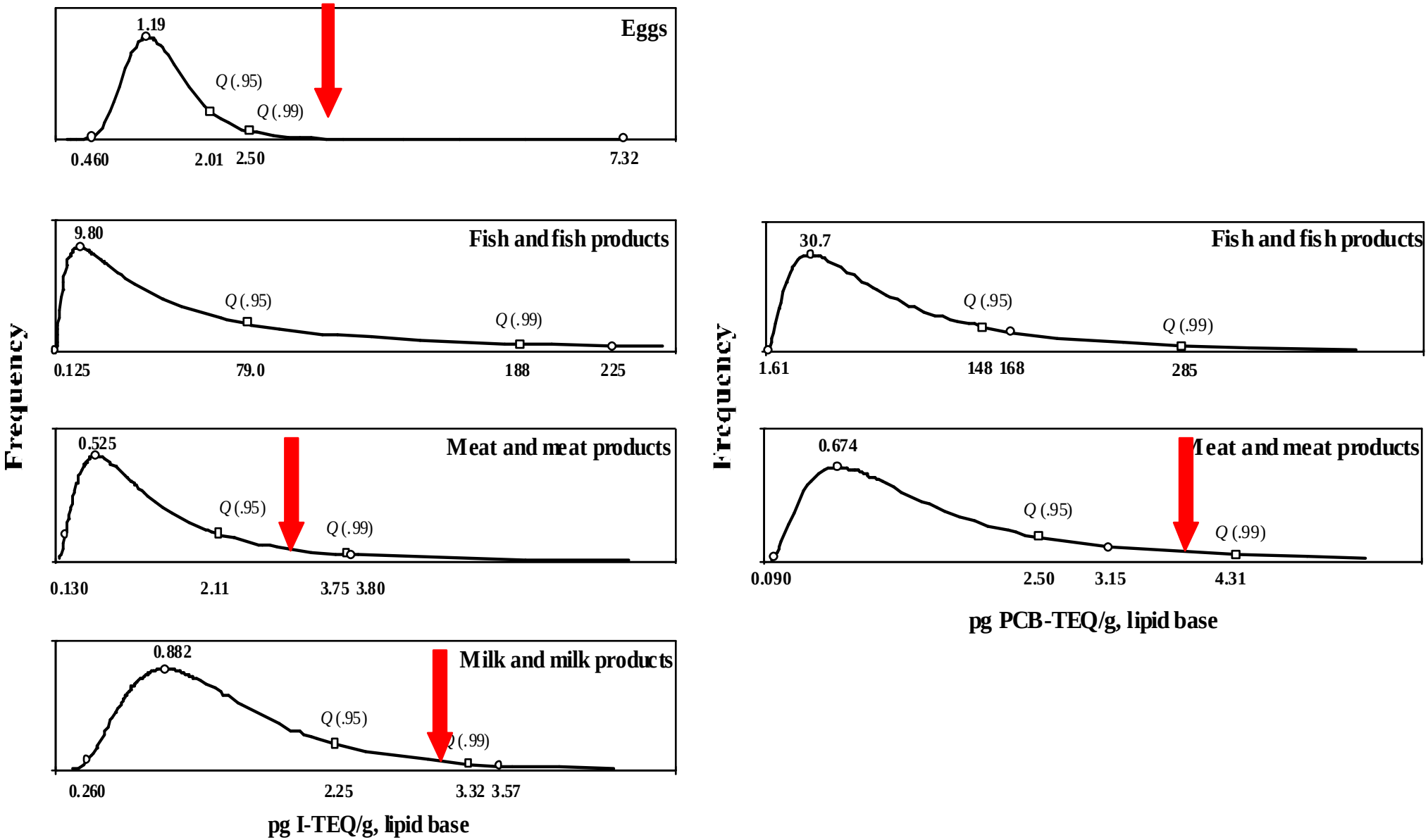
Food item A
Max Limit (MLR)

Food item B
Max Limit (MLR)

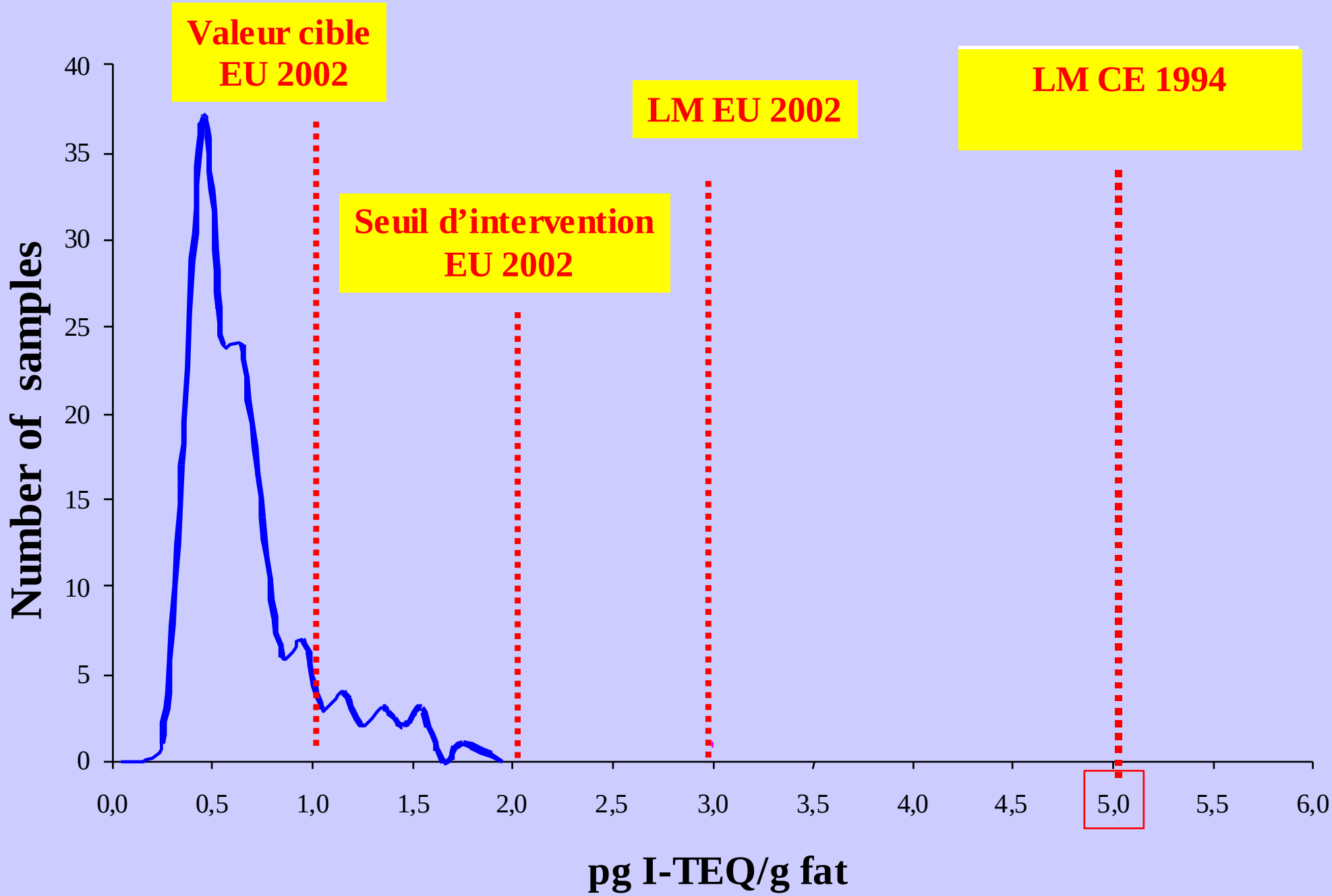
Food item N
Max Limit (MLR)

Palette des valeurs utilisables en gestion des risques

- Valeurs recommandées
- Valeurs guides
- Valeurs limites
- Seuils d’intervention
- Valeurs cibles



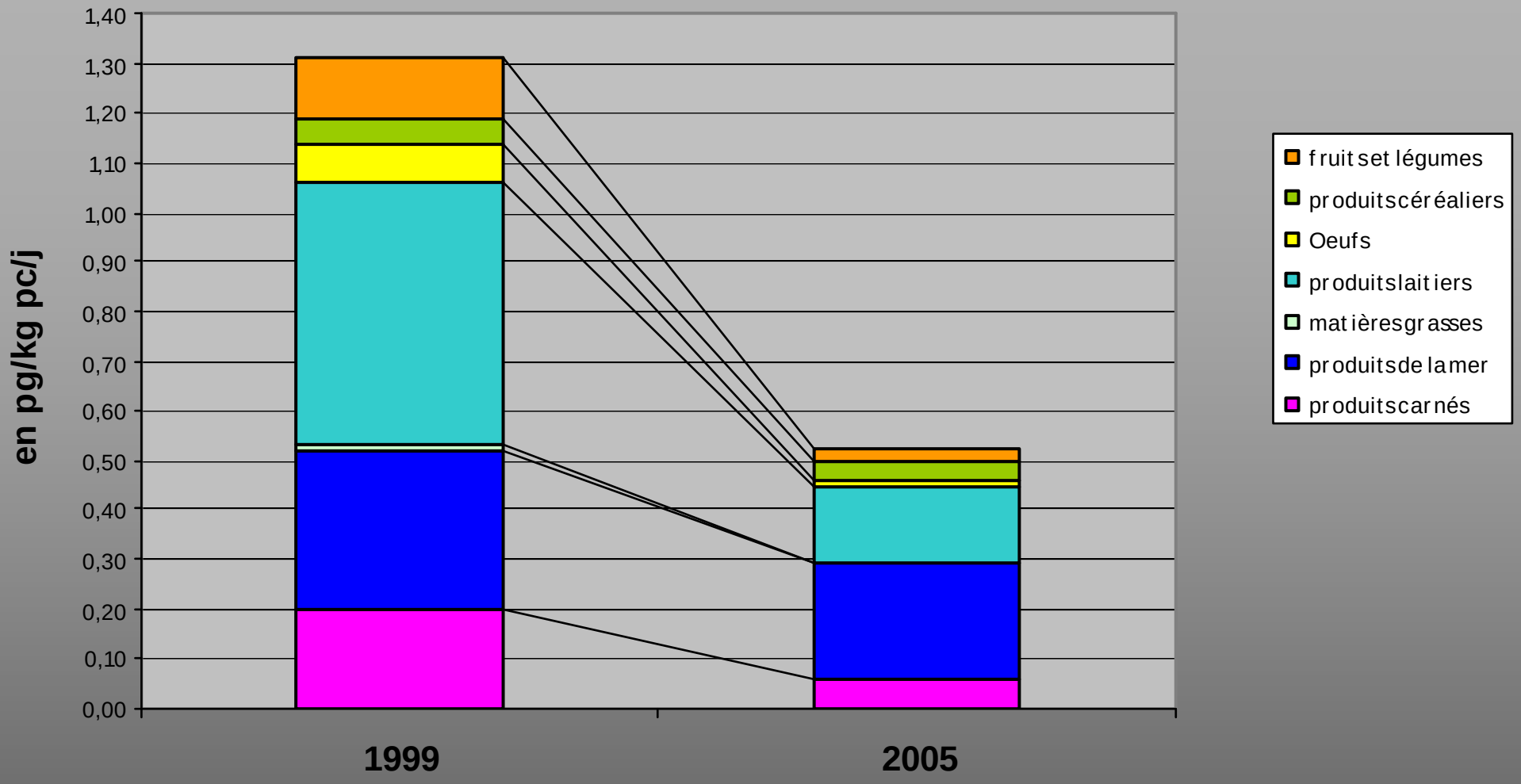
Frequency distribution curves of PCDD PCDF and dioxin like PCB concentrations in various foods of animal origin. The concentration figures identified by (o) are, from left to right, X_{min}, <X>, and X_{max}. The 95th and 99th percentiles are identified from left to right by (□). The range covered by the fish distribution is between one and two orders of magnitude greater than those of the other foods.



From Vindel et al 1999

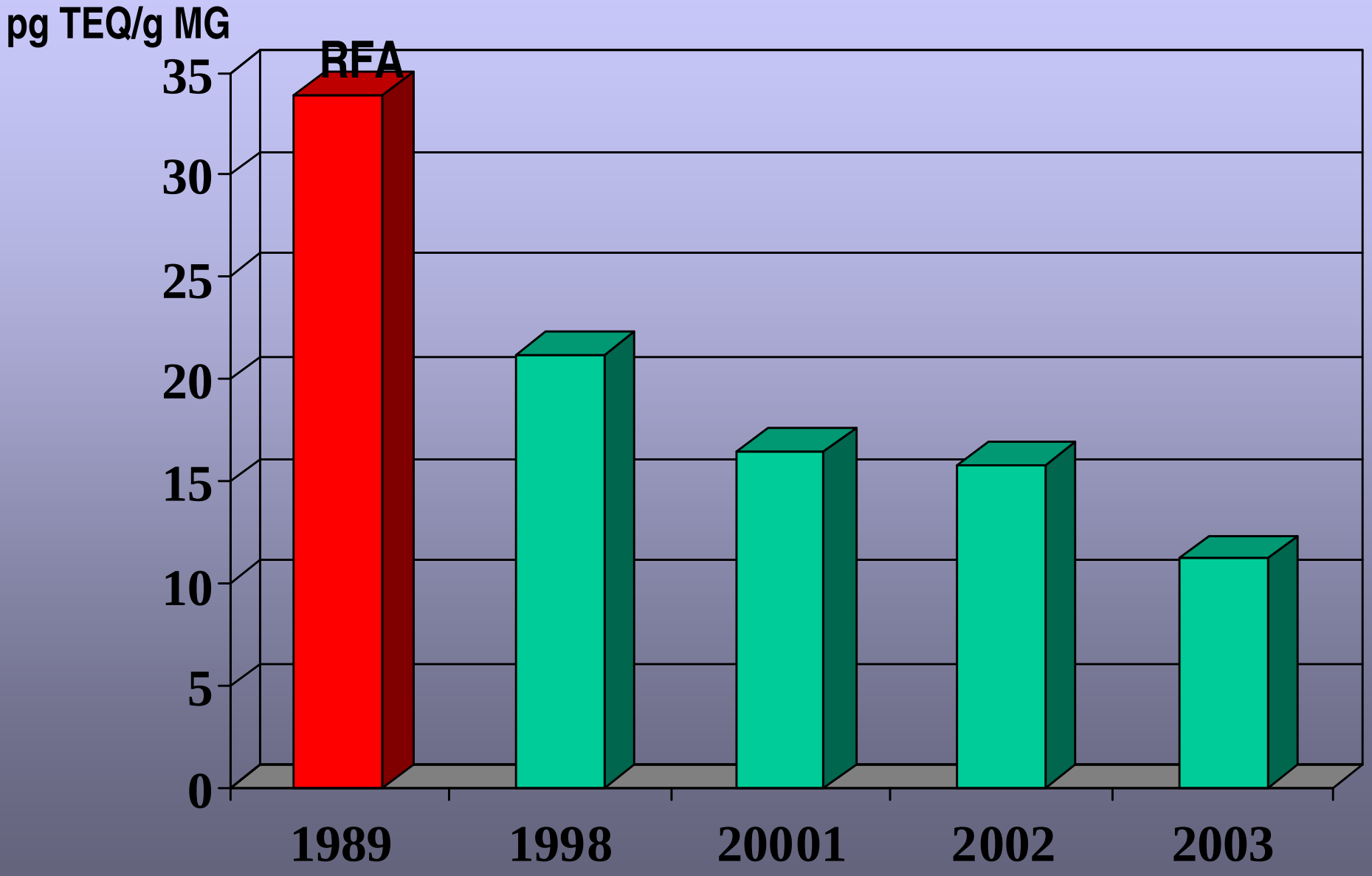
Conséquences des actions de gestion

- ***Reduction des sources***
- ***Application des limites max***
- ***Changement des habitudes alimentaires***

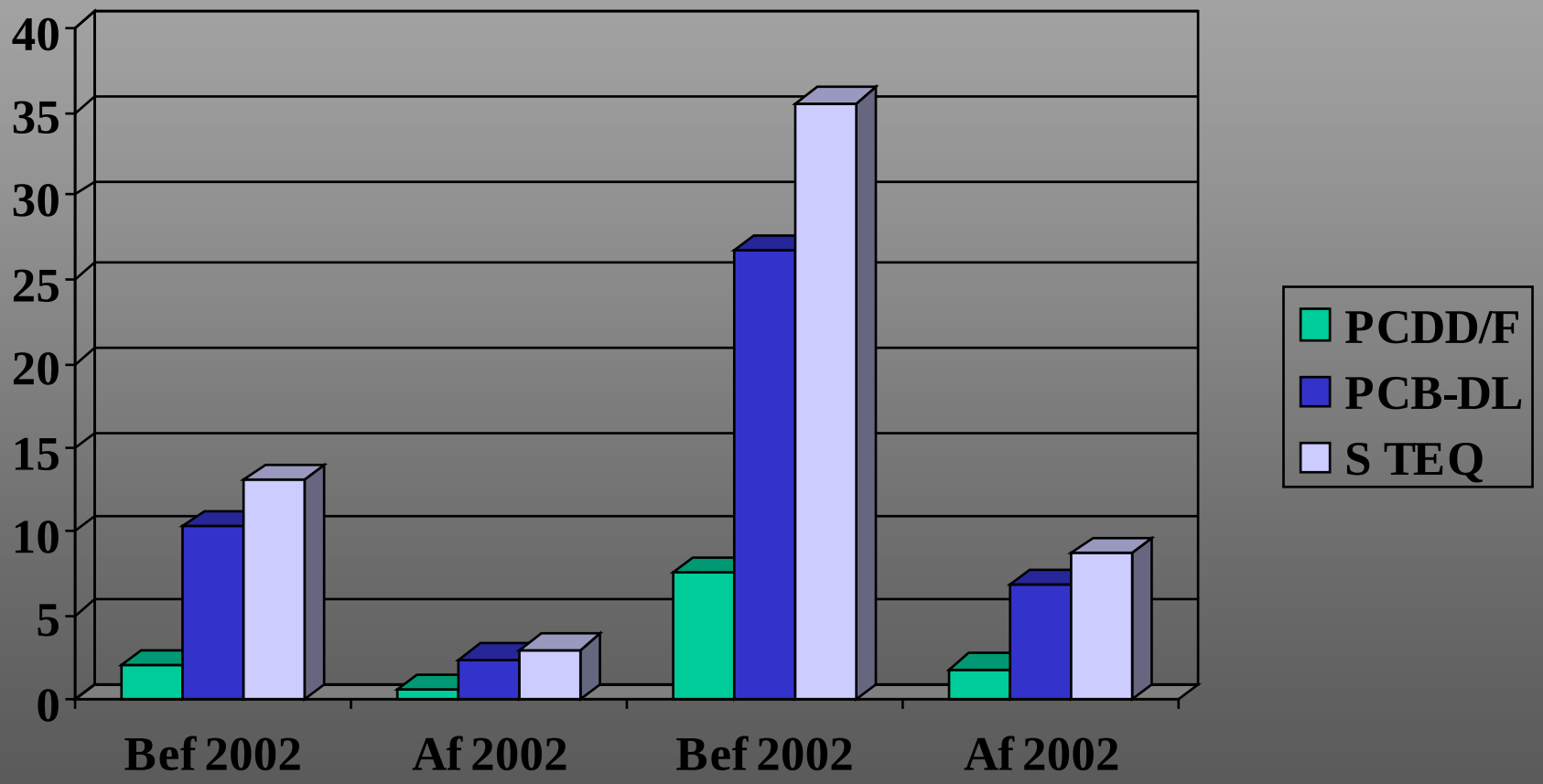


Temporal trend of Exposure to PCDD/F in French population

PCDD/F mesurés dans le lait humain en France



Fish oil contamination before and after EU Dioxin limits in 2002



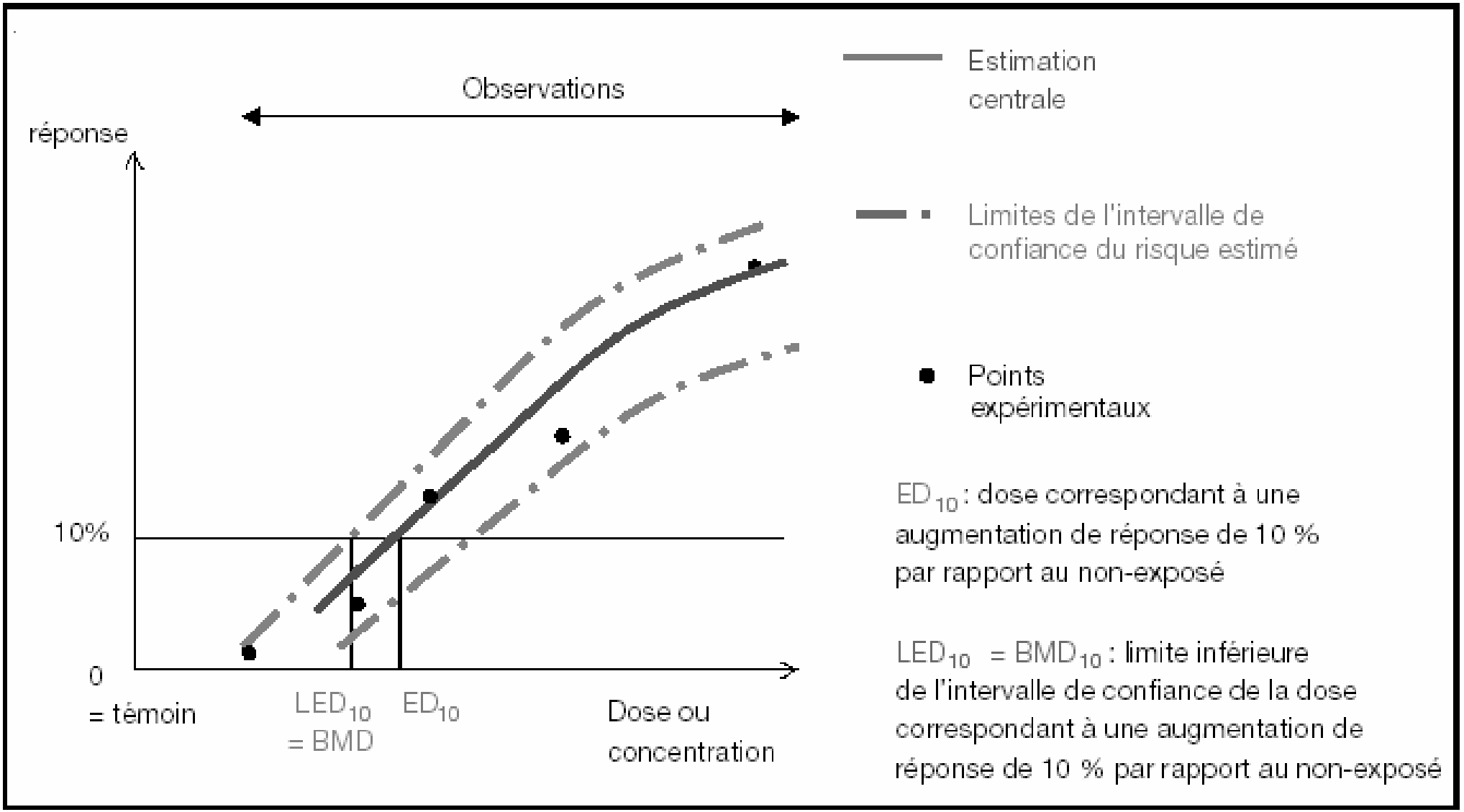
Mean *Maximum values*

Les nouveaux outils de l'Evaluation des risques

- **BMDL**
- **MOE**
- **MOBB**

BMDL

FIGURE 2 : Effets à seuil : détermination de la benchmark dose



- **Margin of Exposure (MOE)**
- **Margin of Body Burden (MOBB)**

Margin of Exposure MOE and of Body Burden MOBB

Effect (dose /kg/d)	NOEL/BMDL mg/kg bw/d	MOE	
		Mean Intake	High Intake
Acrylamide 0.001/4 mg	NOEL (Morpho) 0.2 NOEL (repro) 2 BMDL (cancer) 0.3	200 2000 300	50 500 75
Carbamate 0.02/2µg	BMDL (cancer) 0.3	25 000	250
AFB1 2.81 ng	BMDL (Cancer) 0.15 $x10^{-3}$	53	
PhIP 4.8 ng	BMDL (Cancer) 0.5	66 000	
DMNA 14 ng	BMDL (Cancer) 0.03	2100	
PCDD 0.5/1.8 pg TEQ	NOEL (Cancer) 100 ng*	200 000	55 000
PAHs 4/10 ng	BMDL 0.1	25 000	10 000

		/kg/d	Human Exp. /kg b.w./d	MOE	Maternal B.B. /kg b.w.	Human B.B. /kg b.w.	MOBB	MOBB (Corr.)
TCDD	**LOAEL** **NOAEL**	**150 pg** **50 pg**	**2 pg**	**75** **25**	**30 ng** **10 ng**	**5 ng***	**6** **2**	**12** **4**
Hum. Milk	**BMDL**				**1 µg/g fat**	**240 ng/g f**		**4**

Les nouveaux outils de l'Evaluation des risques

Approche unités de consommation par unité de risque

Bases for Risk calculations

TDI and CSF for contaminants in Fish		
Contaminants	**TDI mg/(kg.d)**	**CSF $(mg.kg^{-1}.day^{-1})^{-1}$**
PB-I	0,00001 (1)	1.0 (2)
DLC	0,00000000233 TEQ (3)	1.0×10^{4} (4)

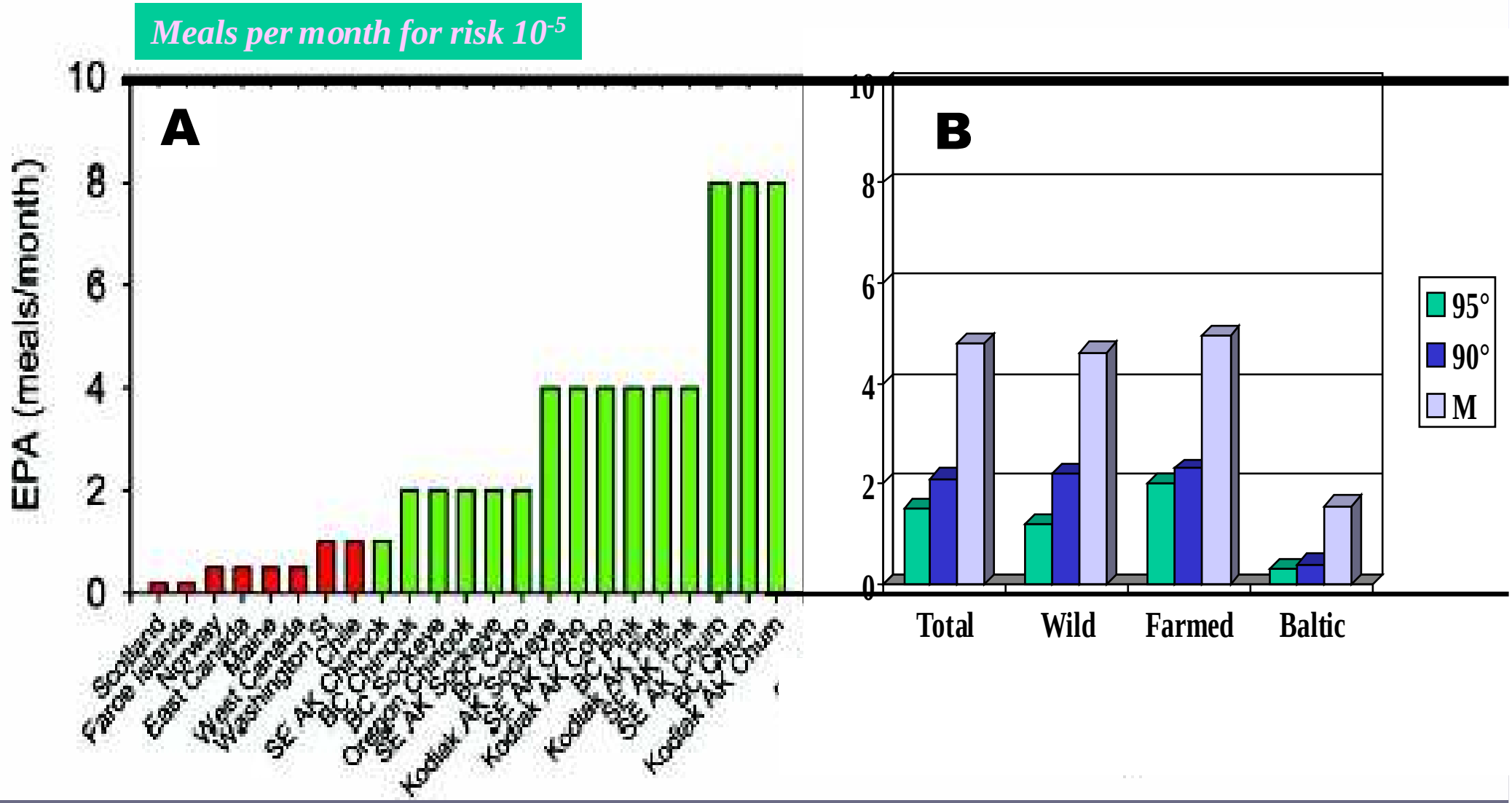
(1) F and NL, (2) EPA, (3) JECFA, (4) FDA

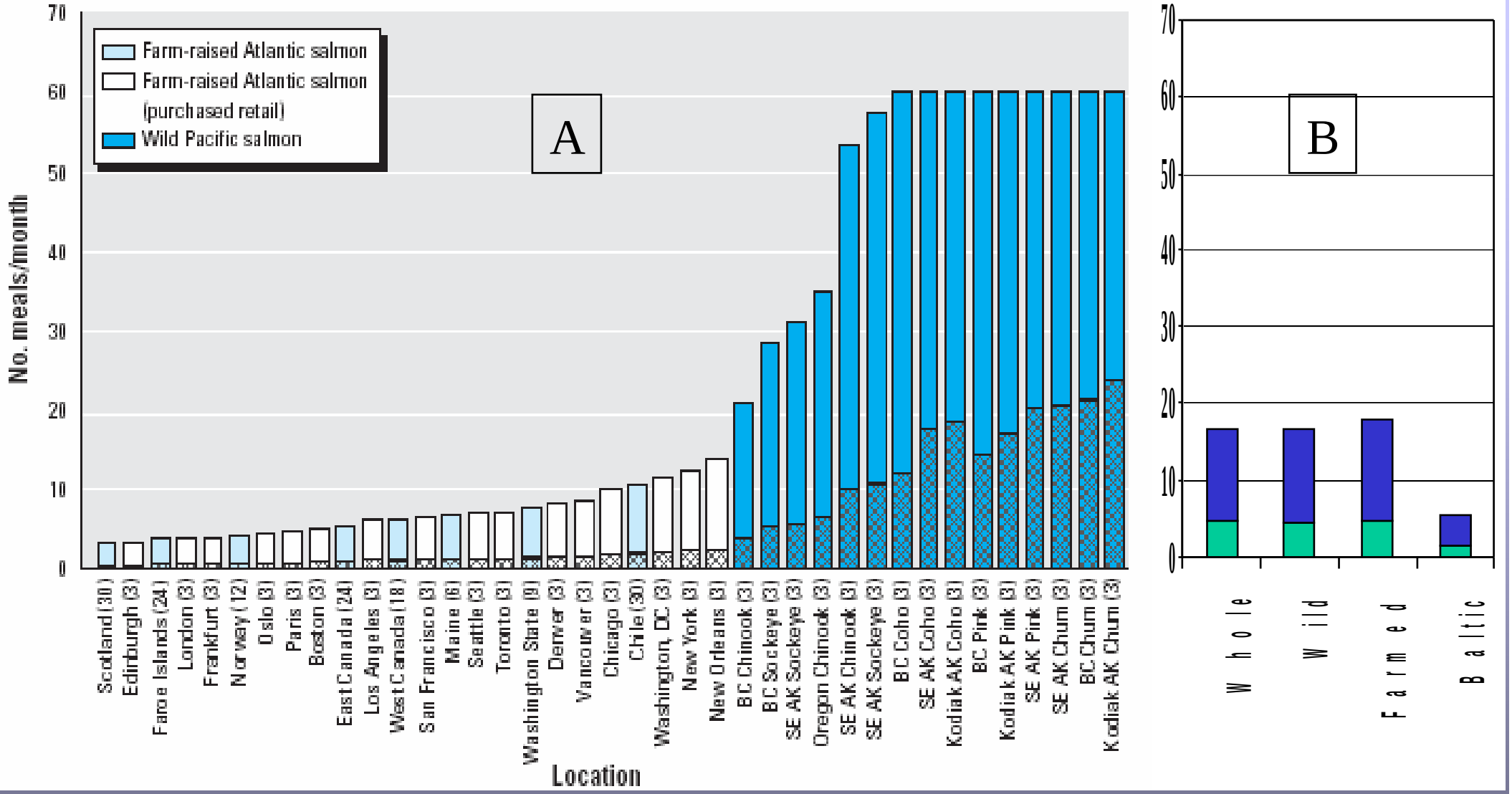
Meal/month = CSF 10^{-5} x 30 x 70/ (C x 227)

TDI x 30 x 70/ (C x 227)

RR= C x meal size / TDI x 70 x 0,5

Consumption advisories (in meals per month) based on cumulative risk assessment methods for PCBs, toxaphene, and dieldrin for (**A**) farmed (red) and wild (green) salmon and for (**B**) Fish marketed in Europe.





Risk-based consumption advice for Atlantic salmon purchased from farms, farmed Atlantic salmon
purchased from retail stores, and wild Pacific salmon. Solid bars indicate the number of meals per month to limit dioxin intake to 1 pg TEQ/kg/day, the lower end of the WHO TDI (1–4 pg TEQ/kg/day). Patterned bars indicate the number of meals per month to limit dioxin intake to 20% above the average (65 pg TEQ/day) U.S. adult intake level. Abbreviations: AK, Alaska; BC, British Columbia; SE, southeastern. Edible tissue levels of DLCs were reported

Les nouveaux outils de l'Evaluation des mélanges

- **Le concept de TEQ**

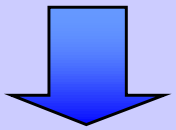
TEF - TEQ

Mixtures of PCDD, PCDF and PCB

"Dioxin-like" toxicity:
Concentration of toxic equivalents (TEQ)

$$TEQ = \Sigma[PCDD]_i\ TEF_i + \Sigma[PCDF]_j\ TEF_j + \Sigma[PCB]_k\ TEF_k$$

TEF: Toxic equivalency factors



I-TEF (NATO/CCMS, 1988)
WHO-TEF (WHO, 1998)

Composés Dioxine-Like

PCDDs (dioxins)	TEF
2,3,7,8-TCDD ('TCDD')	1
1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
OCDD	0.0001
PCDFs (furans)	
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
OCDF	0.0001

PCBs with no chlorine at *ortho* positions ('coplanar' PCBs)	TEF
3,3',4,4'-TCB	0.0001
3,4,4',5-TCB	0.0001
3,3',4,4',5-PeCB	0.1
3,3',4,4',5,5'-HxCB	0.01
PCBs with one chlorine atom at *ortho* position	
2,3,3',4,4'-PeCB	0.0001
2,3,4,4',5-PeCB	0.0005
2,3',4,4',5-PeCB	0.0001
2',3,4,4',5-PeCB	0.0001
2,3,3',4,4',5-HxCB	0.0005
2,3,3',4,4',5'-HxCB	0.0005
2,3',4,4',5,5'-HxCB	0.00001
2,3,3',4,4',5,5'-HpCB	0.0001

T = tetra (4 chlorine atoms)
Pe = penta (5 chlorine atoms)
Hx = hexa (6 chlorine atoms)
Hp = hepta (7 chlorine atoms)
O = octa (8 chlorine atoms)

PCB Indicateurs

CB 28, 52, 101, 138, 153 et 180

Tableau des équivalents oestradiol

Estradiol equivalence factors (EEF) calculated for xeno-estrogens in the ER-CALUX assay

Compound	EEF	Compound	EEF
17β-estradiol	1		
Alkylphenols:		*Phthalates:*	
4-nonylphenol	2.3×10^{-5}	Dimethylphthalate	N.c.
4-octylphenol	1.4×10^{-6}	Diethylphthalate	3.2×10^{-8}[a]
NP1E0	3.8×10^{-6}	Dibutylphthalate	1.8×10^{-8}[a]
NP2E0	1.1×10^{-6}	Butylbenzylphthalate	1.4×10^{-6}
NP4E0	1.1×10^{-7}[a]	Di(2-ethylhexyl)phthalate	N.c.
NP10E0	N.c[b]	Dioctylphthalate	N.c
NP1EC	N.c.	**Endosulfan**	**$1.0\ X\ 10^{-6}$**
NP2EC	N.c.	**Permethrine**	**$0 - 1.0\ X\ 10^{-7}$**
OP8/9EO	N.c.	**Bisphenol A**	**$7.8\ X\ 10^{-6}$**
Pesticides:			
op'DDT	9.1×10^{-6}	**DP6**	**4 X 10-6**
*o,p*DDE	2.3×10^{-6}	**CB 77**	**1x10-6**
Simazine	N.c.		
Atrazine	N.c.		
Desethylatrazine	N.c.		
Deisopropylatrazine	N.c.		

EEFS are ratio $EC50_{17\beta\text{-estradiol}}$:$EC50_{compound}$, unless indicated otherwise.

[a] Calculated based on EC10.

[b] Not calculated; no luciferase induction to the EC10 level observed.

LES HYDROCARBURES AROMATIQUES POLYCYCLIQUES

Les Toxicological Equivalent Fators (TEFs)

Ceux retenus par l'AFSSA découlent des TEFs proposés par Nisbet et LaGoy 1992

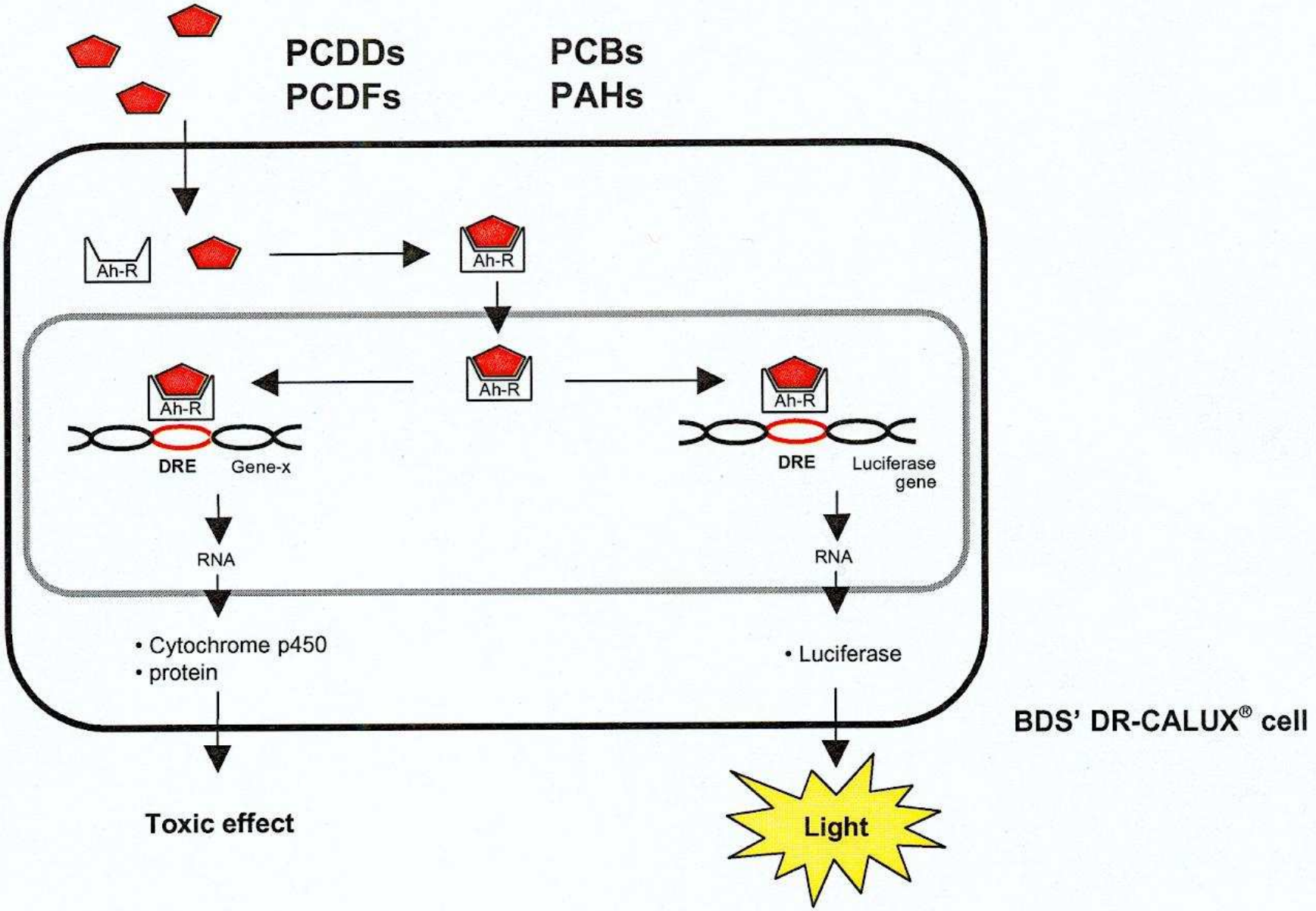
Composés	TEF	Composés	TEF
Benzo(a)pyrène	1	Anthracène	0,01
Dibenzo(a,h)anthracène	1	Benzo(g,h,i))pérylène	0,01
Benzo(b+j))fluoranthène	0,1	Fluoranthène	0,001
Benzo(k)fluoranthène	0,1	2-Méthylnaphtalène	0,001
Indéno(1,2,3-cd)pyrène	0,1	Naphtalène	0,001
Chrysène	0,01	Phenanthrène	0,001
Acénaphtène	0,001	Benzo(e)pyrène	0,001
Acénaphtylène	0,001		

Les nouveaux outils de l'Evaluation des mélanges

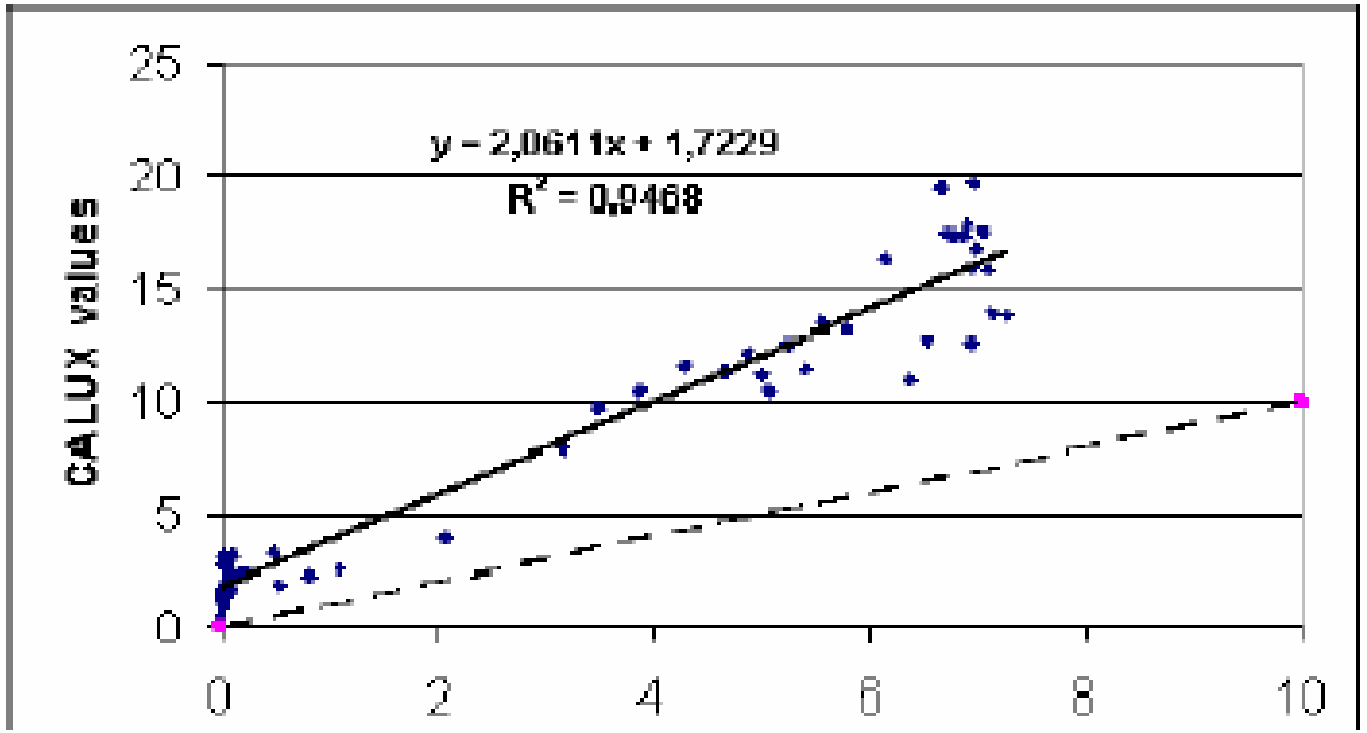
- **L'approche BIOESSAIS**

Test Calux pour la détection des dioxines et des oestrogénomimétiques

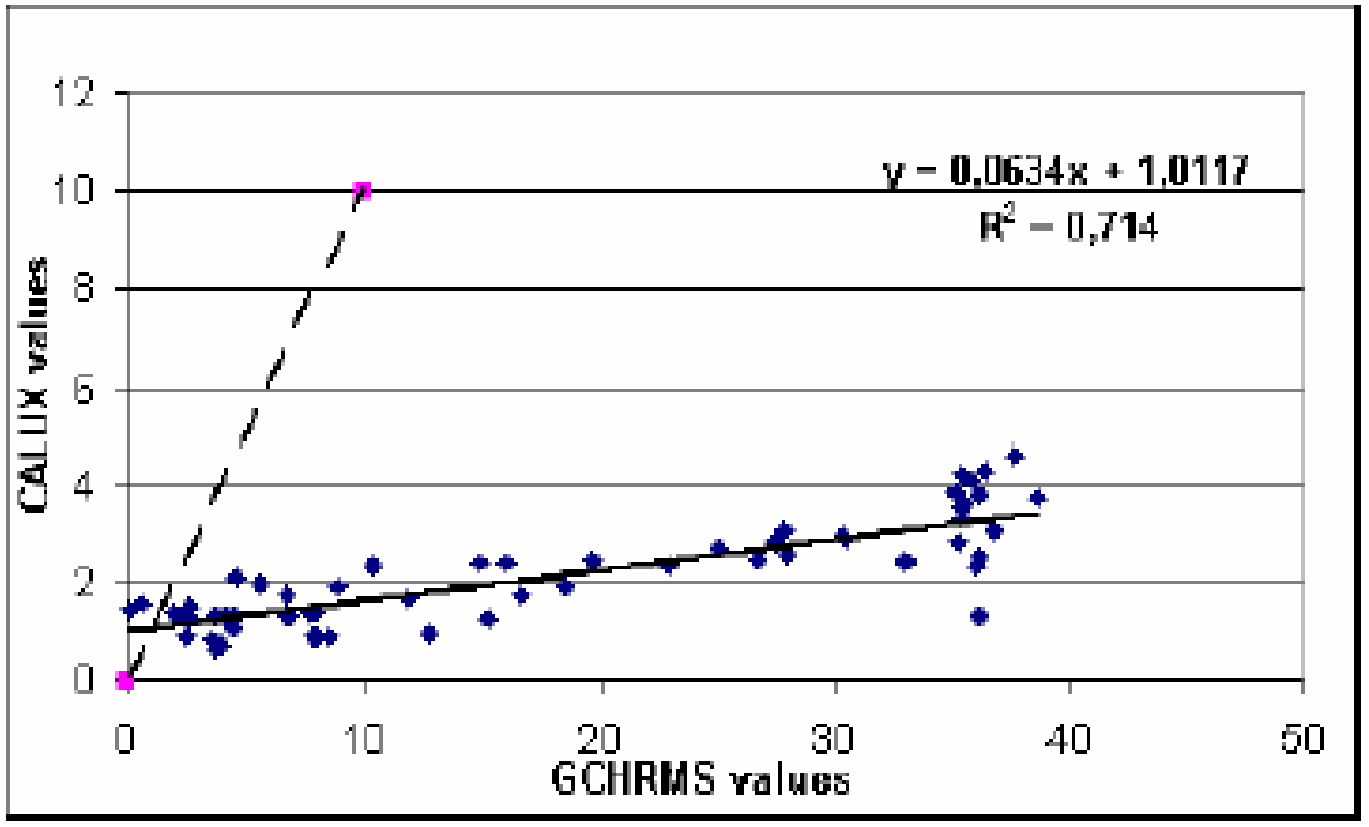
Cellulaire d'hépatome de rat H4IIE génétiquement modifiée



PCDD/F

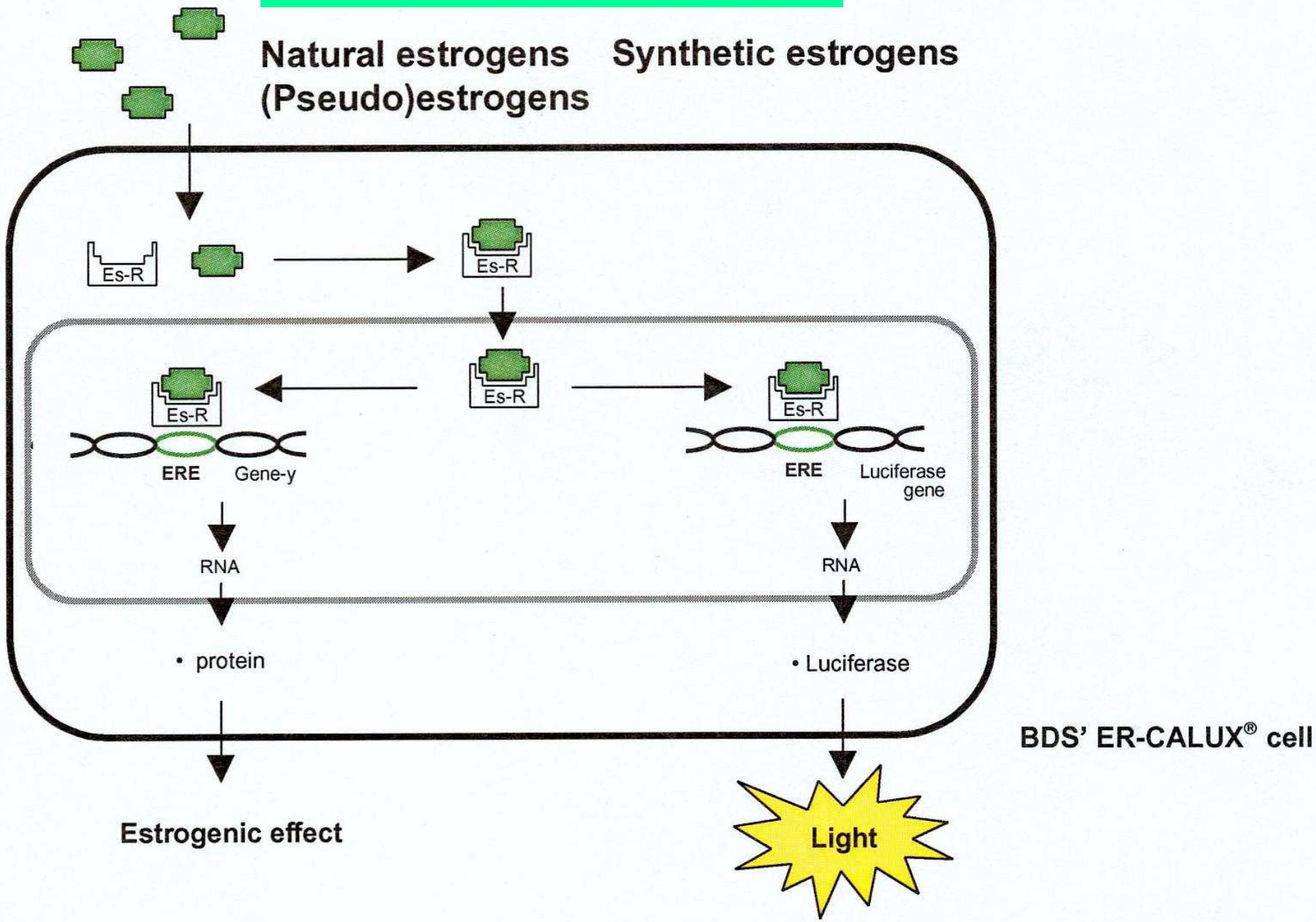

y = 2,0611x + 1,7229
R² = 0,9468
CALUX values
0
5
10
15
20
25
0
2
4
6
8
10

PCB-DL


y = 0,0634x + 1,0117
R² = 0,714
CALUX values
0
2
4
6
8
10
12
0
10
20
30
40
50
GCHRMS values

Test Calux pour la détection des oestrogéno-mimétiques

cells humaines T47D modifiées



Phtalates

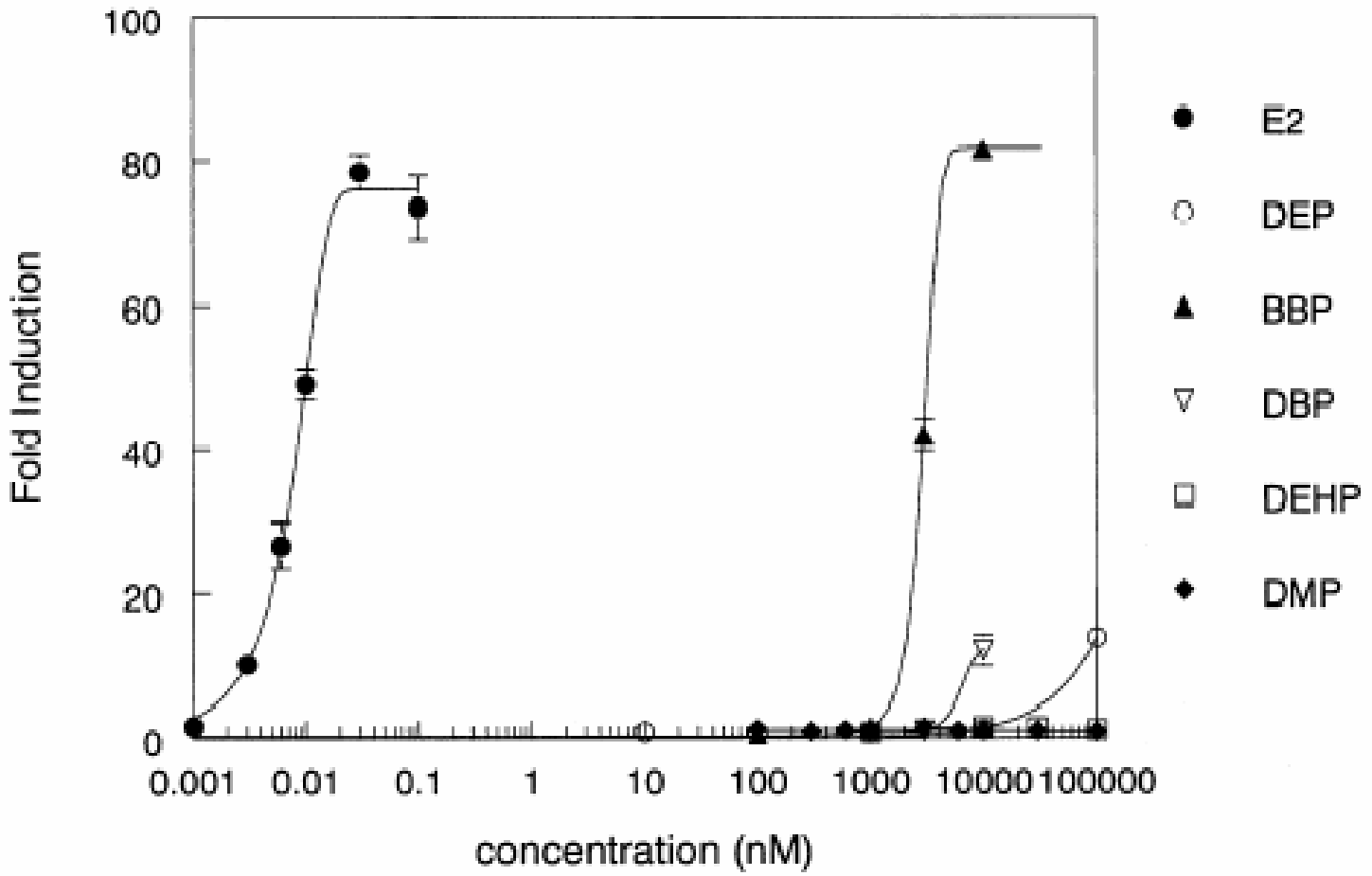
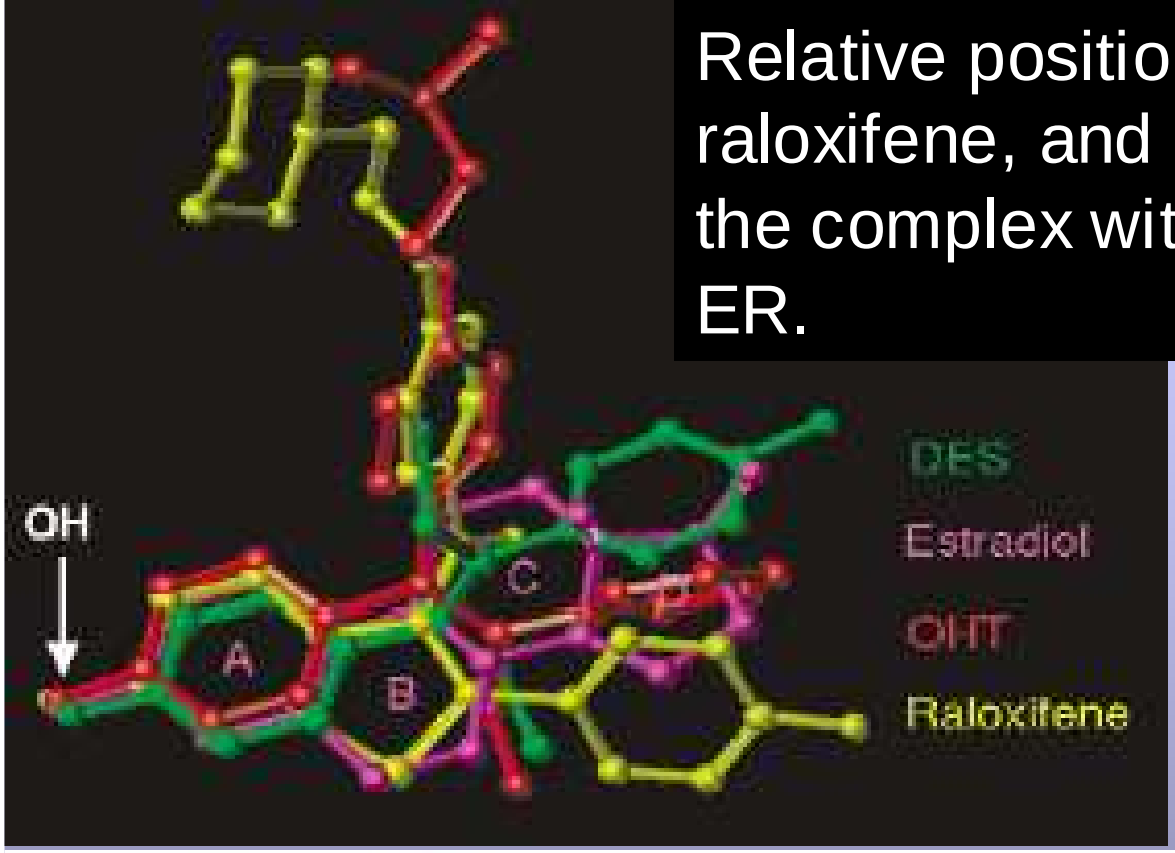


Fig. 3. Estrogenic activity (fold induction relative to control) in the ER-CALUX assays using T47D.Luc cells exposed for 24 h to estradiol (E2), diethylphthalate (DEP), butylbenzylphthalate (BBP), dibutylphthalate (DBP), dimethylphthalate (DMP) and diethylhexylphthalate (DEHP).

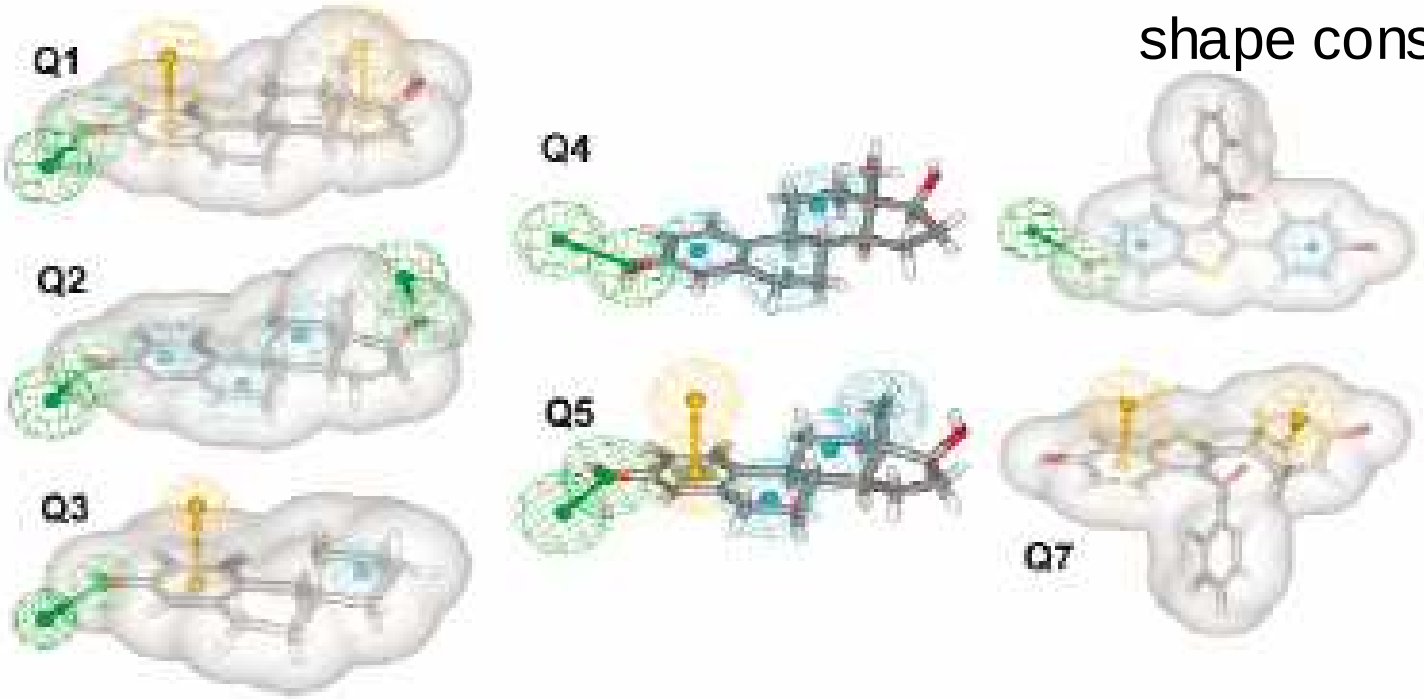
MODELISATIONS

- **QSAR**
- **Bénéfice Risque**
- **Toxi-risk**

Relative positions of estradiol (E2), DES, raloxifene, and 4-hydroxytamoxifen (OHT) in the complex with
ER.



Seven pharmacophore queries where green mesh balls represent H-bond acceptor sites, blue mesh ballsrepresent hydrophobic centers and yellow mesh balls represent aromatic centers. Solid white surfaces represent
shape constraint.



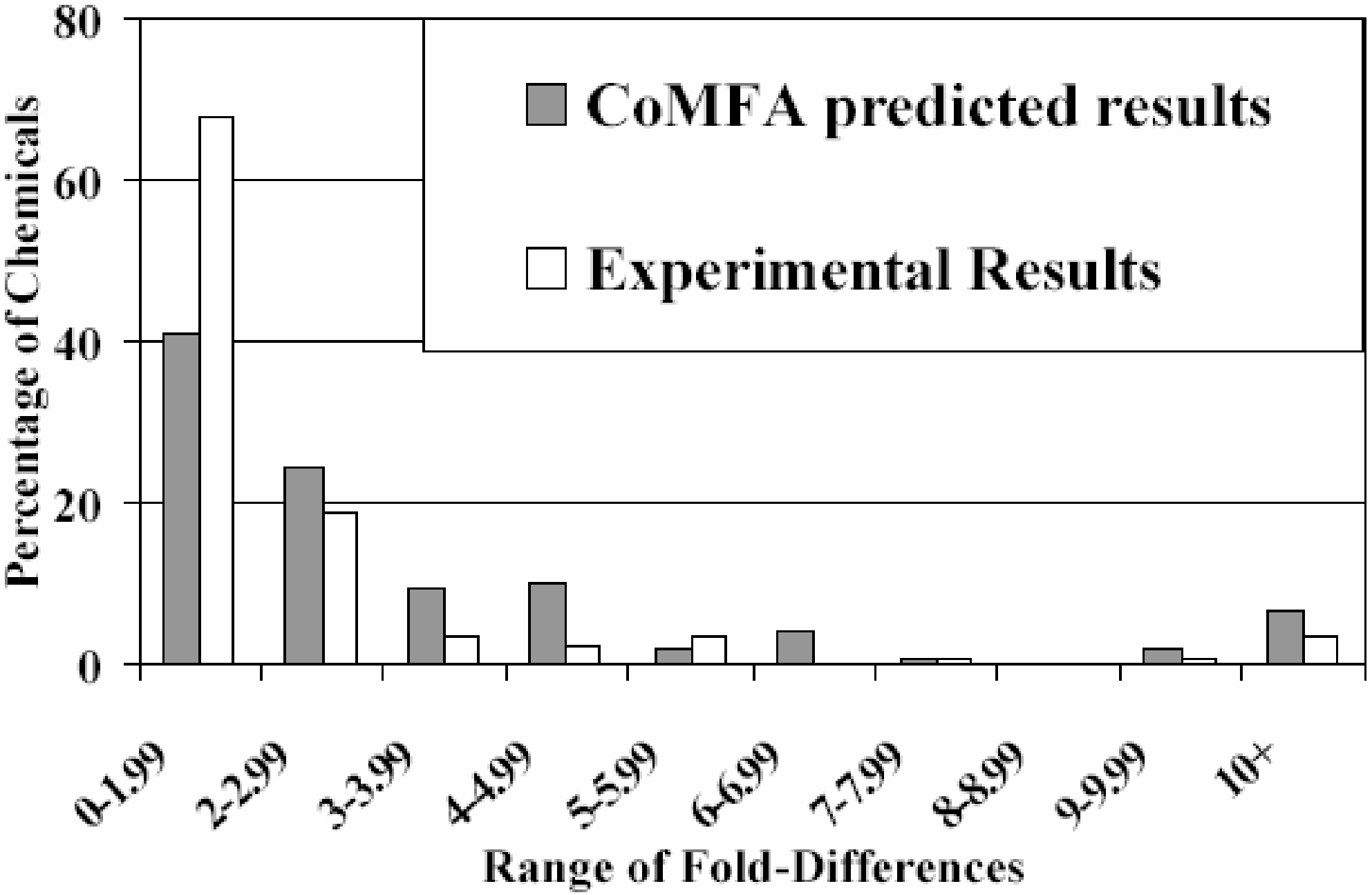


Figure 5. Fold differences for experimental measurements and CoMFA predicted results.

The benefit-risk ratio.

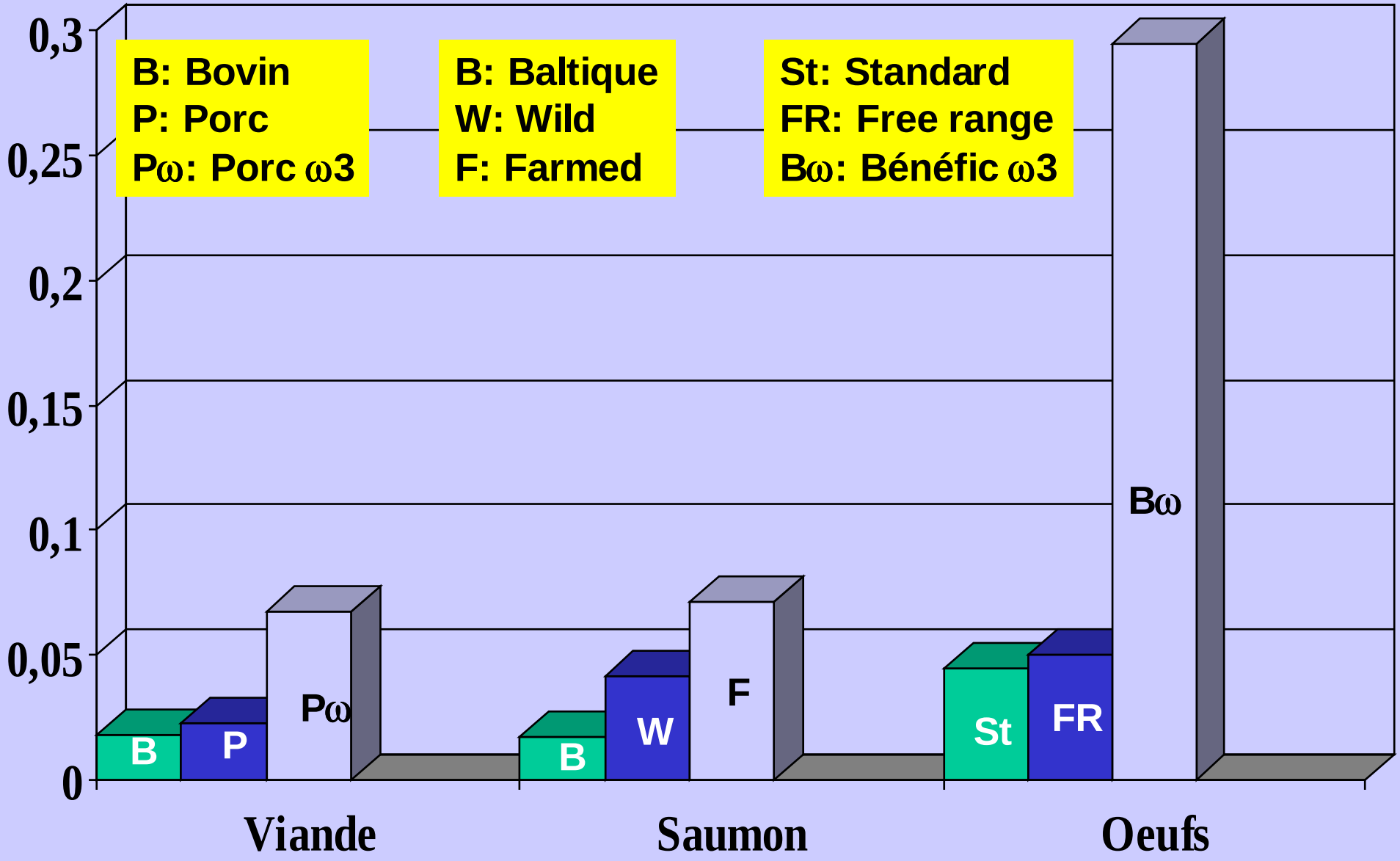
- Benefit cancer risk ratio (BCRR)
- Benefit noncancer risk ratio (BNRR)]

$$BCRR = \frac{\sum_{i-1}^{n} C_{N-3,i}}{\sum_{i-1}^{n} \sum_{k=1}^{K} C_{k,i}\, CSF_k/70 \times 10E-5}$$

$$BNRR = \frac{\sum_{i=1}^{n} C_{N-3,i}}{\sum_{i=1}^{n} \sum_{k=1}^{K} C_{k,i}/70 \times RfD_k}$$

C(N-3),i, and *Ck,i* are the concentrations of EPA+DHA and contaminant *k*, respectively (in mg/kg) from fish source *i*; the *CSFk* and *RfD* are the Cancer Slope Factor in (mg kg1 d1)1 and Reference Dose [mg/(kg d)] for contaminant *k*, and 70 is the weight in kilograms of a typical adult

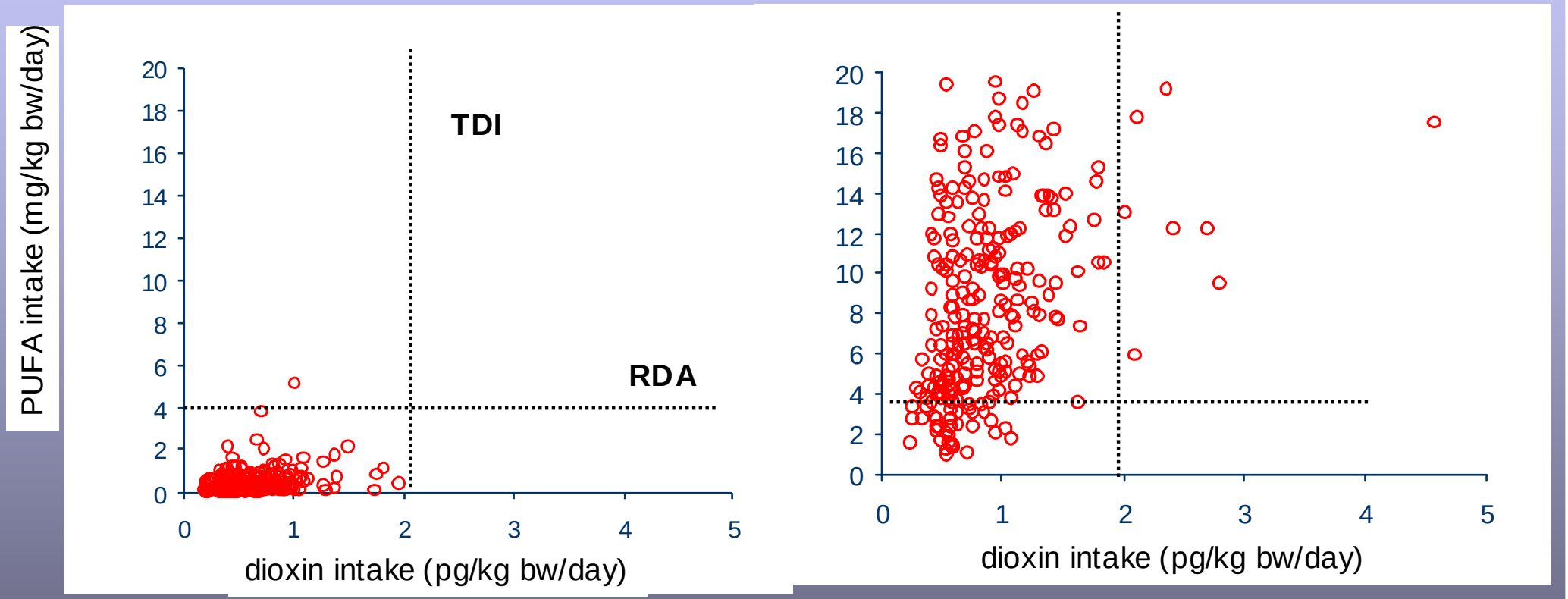
Equations Bénéfice / Risque calculées pour quelques aliments vecteurs d'oméga 3



Exposure distribution dioxins / PUFA

Present exposure NL

50% meat → salmon

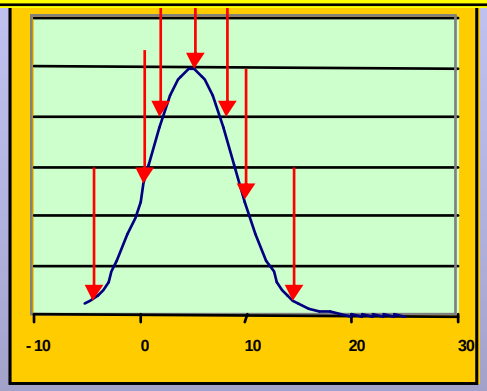


Anika de Mul, et al, RIKILT 2006

Schéma de principe de TOXIRISK

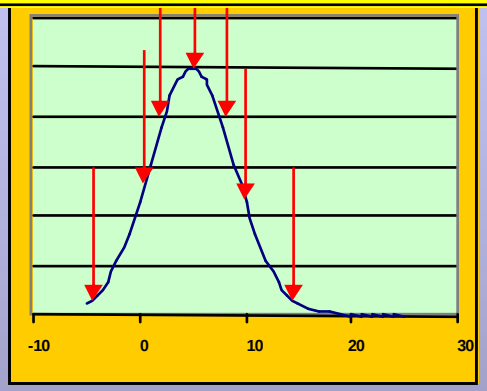
Soft

Base de données analytiques

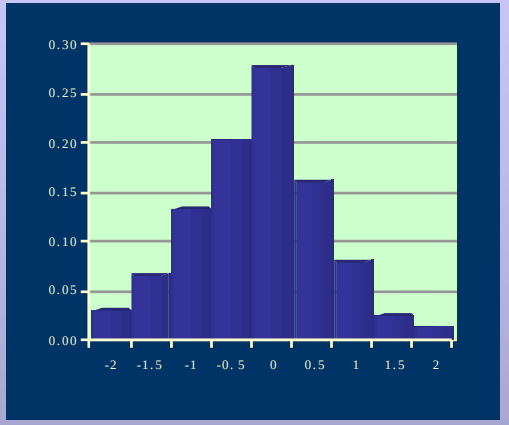


Contamination

Base de données Consommations



Consommation



Exposition

Base des Fiches Tox Toxico & Réglements

Gestion

- **Retrait**
- **Rappel**

Conformités

Risques

VTRs

TOXIRISK

La base de Données

- **La base Analytique**
  - Accessible par Aliments/Contaminants
  - Données statistiques, valeurs de référence
  - Origine bibliographique, enquêtes,

  complétée par les données publiées (SCOOP, INRA, AFSSA)
  - Données internes ou contribution à une base de données anonyme

TOXIRISK

La base de Données

- **Les données de consommation**
  - Par catégorie et sous catégorie d'aliments
  - Par catégorie de population
    - Age
    - Homme, femme
    - Consommateur, consommateur extrême
  - Valeurs statistiques : moyenne, 95eme percentile

TOXIRISK

Fiches Toxicologiques

- Actualisation
  - Toxicologique
  - Règlementaire
- Un large éventail de substances chimiques
- Alimenté et validé par un réseau d'experts

TOXIRISK

Utilisation pratique 1

- Assistance à la stratégie analytique
- Aide pour le cahier des charges, au plan de contrôle, au plan de surveillance
- Comparaison avec les standards, valeurs limites (conformité)
- Optimisation de la fréquence des analyses
- Comparaisons avec les banques de données
  - Officielles
  - Internes
  - Des acteurs de la filière

TOXIRISK

Utilisation pratique 2

- Évaluation du Risque
  - Calcul de l'exposition à partir des données de consommation
  - Identification des contributeurs moyens
  - Évaluation des vecteurs
  - Évaluation du risque par comparaison aux VTR (DJT,DJA, DVS, DHTP,…)

TOXIRISK

Utilisation pratique 1

- Gestion de Crise
  - Évaluation du Risque immédiate
  - Aide à la stratégie de gestion de crise
    - Retrait ou Rappel

  - Accès privilégié au réseau d’experts