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TOTAL DIET STUDIES IN FRANCE

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Contaminants in the food chain - 10 October 2024

Food safety research conference in Luxembourg

Plan

1. What is a total diet study?
2. History of the TDSs in France and implementation
3. Some results
4. Why do we need total diet studies ?

1. What is a total diet study?

What is a Total Diet Study ?

Objectives

- Evaluate the **contamination** of **foods** 'as consumed' by **chemical substances** of interest from a public health point of view
- Evaluate **chronic dietary exposure** of the population and the associated **health risk**
- **Public health tool** (regulatory and research)

Method

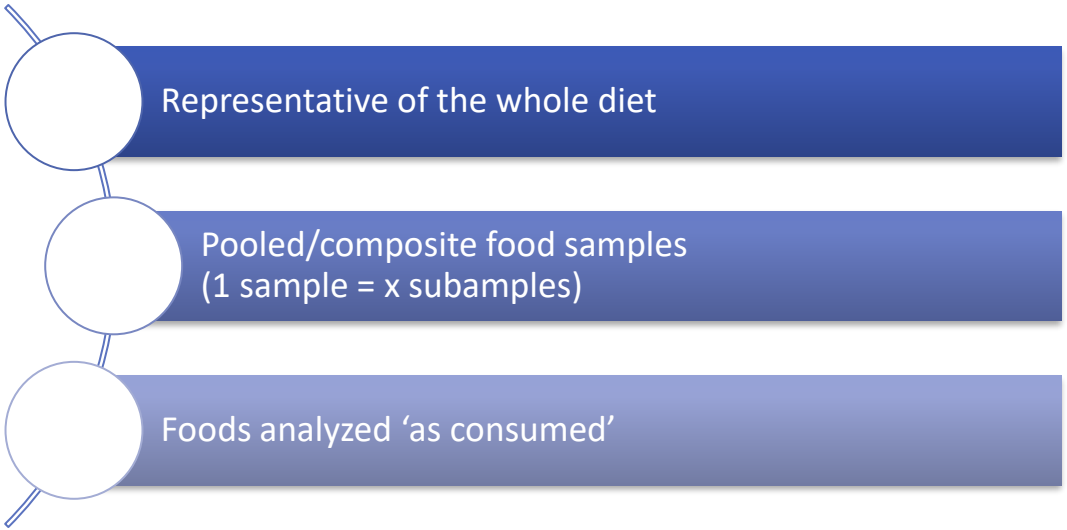
- **Food sampling** representative of the population diet and analysis of the food samples
- Combination of national food **consumption** data and food **contamination** data

World Health Organization

Food and Agriculture Organization of the United Nations

efsa EUROPEAN FOOD SAFETY AUTHORITY

3 main principles of a TDS



European Food Safety Authority, Food and Agriculture Organization of the United Nations, World Health Organization; Towards a harmonized Total Diet Study approach: a guidance document. EFSA Journal 2011;9(11):2450. https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2011.2450

Combine Food monitoring and TDS

Food Monitoring	Total Diet Study (TDS)
•Regulated foods analyzed	•**Whole diet** covered
•foods 'as purchased' / raw	•Foods **'as consumed'**
•Lower analytical sensitivity	•**Higher analytical sensitivity**
•**Analysis of single food items (more cost-intensive)**	•**Composite samples (more cost-effective)**
•**Acute or chronic** exposure assessment	•**Chronic** exposure assessment

Derived from Oliver Lindtner, BfR, 28.06.2019, Presentation of the Portugese TDS, Lissabon

2. History of the TDSs in France and implementation

Total diet studies in France

2001-2005

- **1st French TDS:** Adults and children over 3 y (INCA1, 1999)
- Around 2,300 products bought
- 39 chemicals analyzed, more than 40,000 analytical results

2006-2011

- **2nd French TDS:** Adults and children over 3 y (INCA2, 2009)
- Around 20,000 products bought
- 445 chemicals analyzed, more than 250,000 analytical results

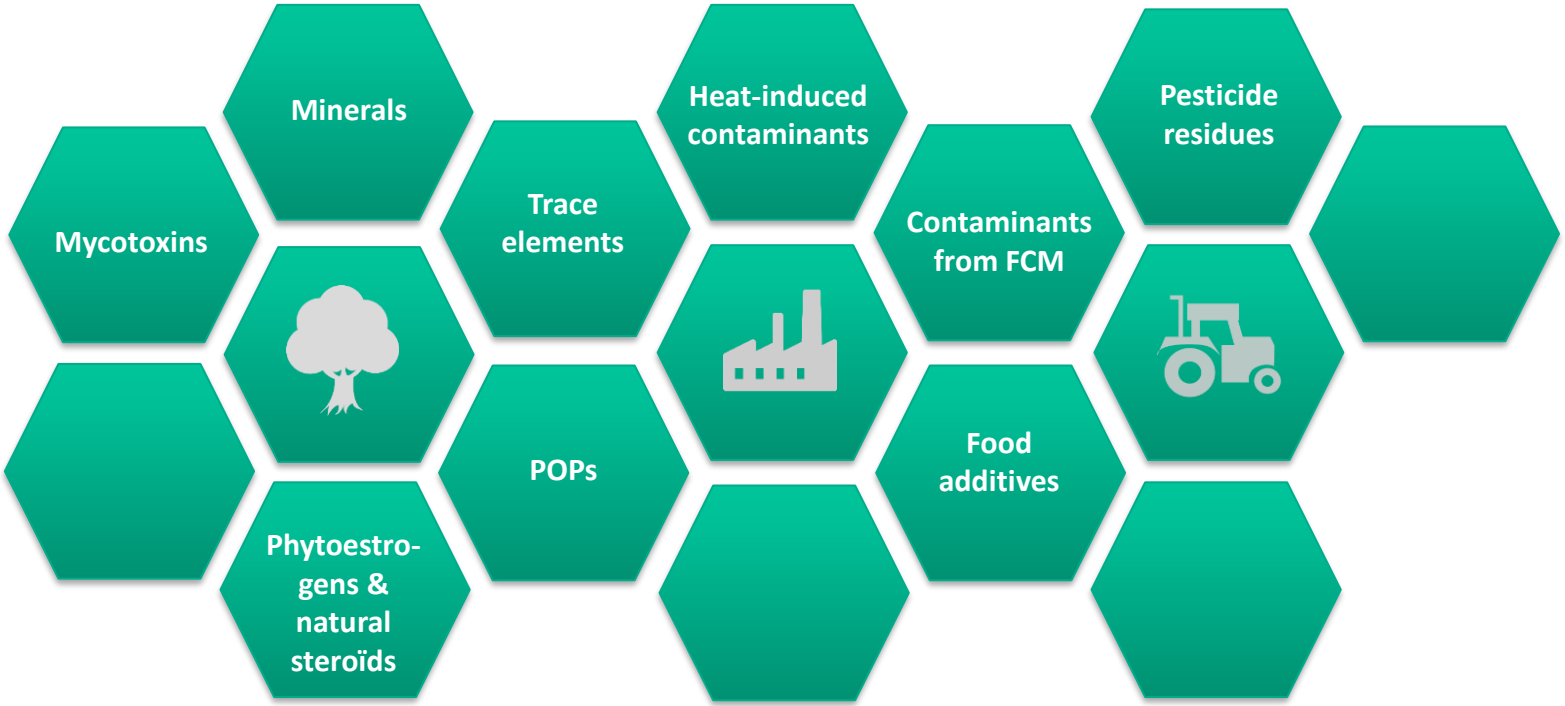
2010-2016

- **Infant French TDS:** Children under 3 y (Nutri-Bébé, 2005)
- Around 5,500 products bought
- 670 chemicals analyzed, more than 200,000 analytical results

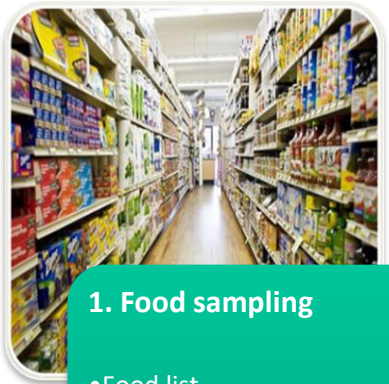
2019-20xx

- **3rd French TDS**: Adults and children over 3 y (INCA3, 2017)
- Around 8,600 products bought
- ~300 chemicals targeted

Hundreds of targeted substances



TDS implementation: 3 main steps



1. Food sampling

- Food list
- Sampling plan, representative of the food consumption in the country

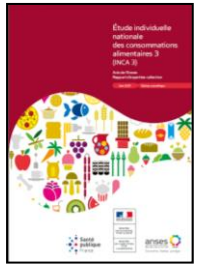
2. Analysis of composite samples prepared 'as consumed'

- Accredited laboratories
- Lowest possible analytical limits

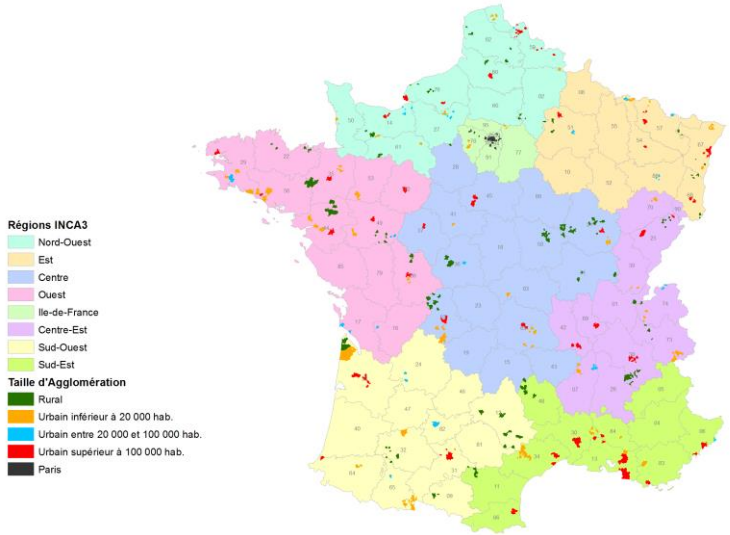
3. Evaluation of the population's exposure

- Exposure assessment
- Risk analysis
- Contributors to the exposure
- Recommendations

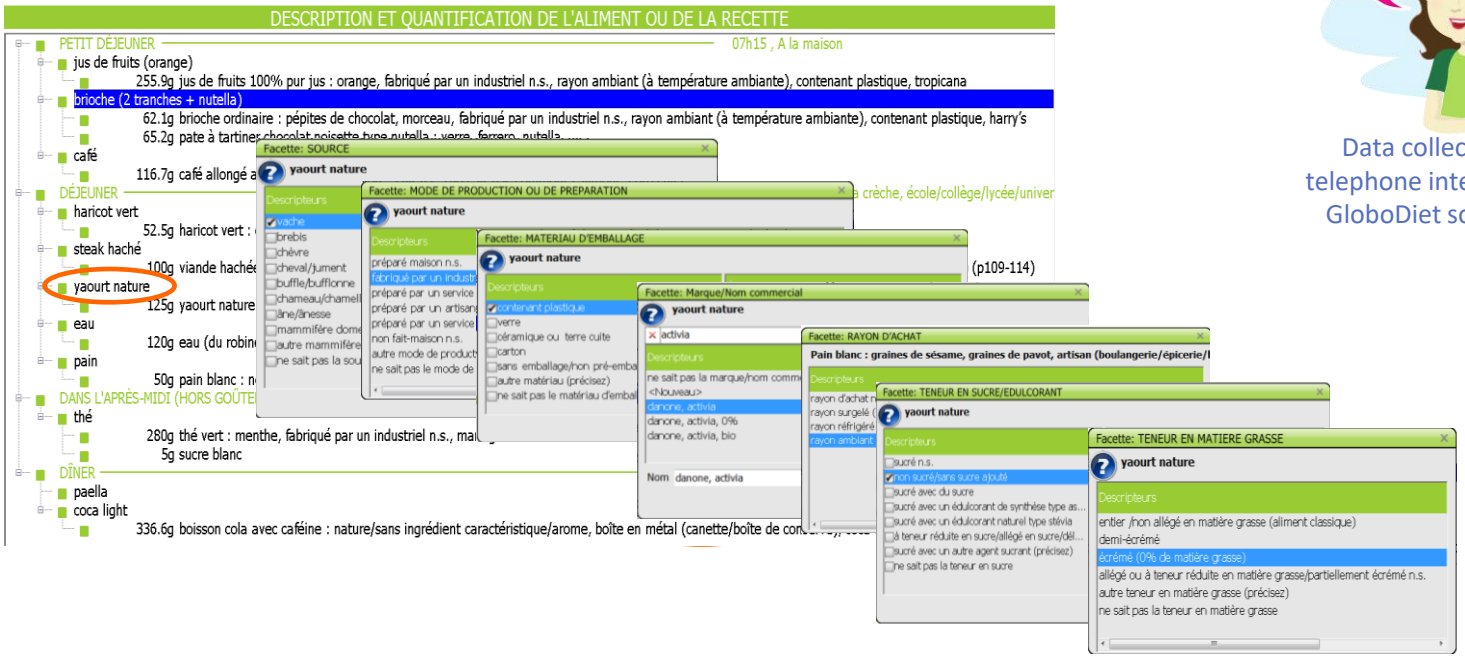
The last national consumption survey: INCA3



- **5 855 individuals** living in mainland **France**
  - **Children** (n = 2698) : 0 to 17 years old
  - **Adults** (n = 3157) : 18 to 79 years old
- Data collection on 18 months (feb 2014 – sept 2015) to take **seasonality** into account
- 4114 individuals: Collection of detailed data on individual food consumption (food & beverages) with a **predefined** and **standardised** detail level – **facets** / **descriptors** system
  - 2 or 3 non-consecutive days (2 weekdays + 1 weekend) (**EU MENU** EFSA) through **24h-recalls** (15-79 y) or **24h-records** (0-14 y)
  - Self-administrated long term **food propensity questionnaire** on ~60 foods or food groups



INCA3: Example of recording

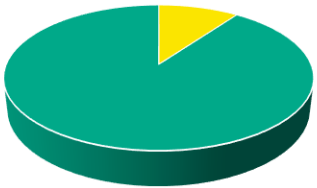


Data collection through telephone interview using the GloboDiet software (IARC)

3rd TDS: Selection of foods to collect

1
- The most commonly consumed foods by the population, adults & children, covering together 90% of the consumption
- At least 5% of consumers

2
- Known or supposed main contributors to exposure to at least one substance of interest (e.g. liver, fresh tuna, lemon…)



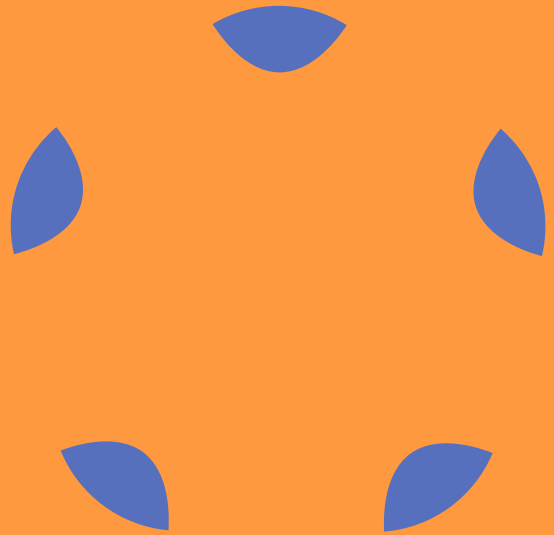
276 food items
> 95 % of mean individual consumption covered

Identification of foods and combination process

Example of food sample: Salmon

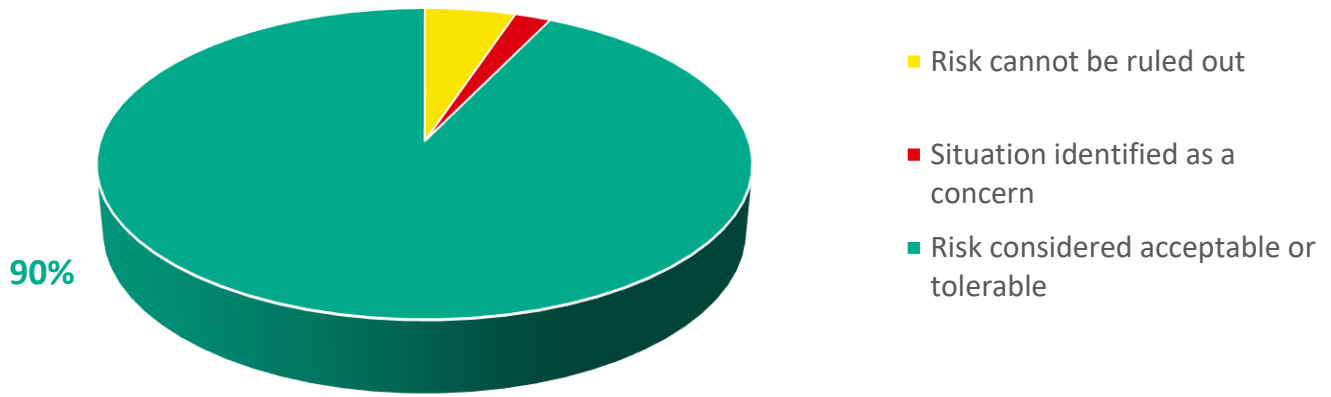
N°	Purchase place	Piece	Storage method	Packaging	Cooking method	Added	Utensil	Cooking level	Post preparation
1	Fishery	Fillet	Fresh	None	Sauteed with fat	Olive oil	Aluminium	Well done; skin grilled	None
2	Supermarket	Fillet	Fresh	Shrink-wrapped carton	Sauteed with fat	Unsalted butter	Non sitck	Medium rare; skin grilled	Remove skin
3	Supermarket	Fillet	Fresh	N/A	Microwaved	None	None	Well done; skin grilled	Remove skin
4	Supermarket	Thick slice	Fresh	Shrink-wrapped carton	Boiled	None	Ceramic	N/A	Remove skin
5	Supermarket	Thick slice	Fresh	Shrink-wrapped carton	Sauteed	None	Stainless steel	Medium rare; skin grilled	Remove skin
6	Supermarket	Steak	Fresh	None	Steamed	None	Non sitck	N/A	Remove skin and fishbones
7	Supermarket	Steak	Fresh	Shrink-wrapped carton	Roasted	Olive oil	Cast iron	Medium rare; skin grilled	Remove skin and fishbones
8	Supermarket	Fillet	Frozen	Box	Microwaved	None	Glass	Rare; skin slightly grilled	Remove skin
9	Freezer center	Fillet	Frozen	Plastic bag	Roasted	Unsalted butter	Non sitck	Well done; skin grilled	Remove skin
10	Supermarket	Fillet	Frozen	Box	Sauteed with fat	Margarine	Non sitck	Medium rare; skin highly grilled	Remove skin
11	Supermarket	Steak	Frozen	Box	Sauteed with fat	Salted butter	Stainless steel	Medium rare; skin highly grilled	Remove skin and fishbones
12	Supermarket	Steak	Fresh	None	Steamed	None	Stainless steel	N/A	Remove skin and fishbones

3. Some results



What we learnt from our TDSs

Out of more than 300 substances or families evaluated



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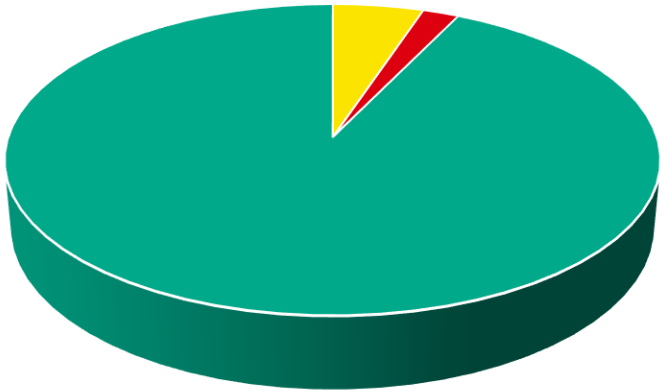


Infant TDS:

- Cr(III), inorganic Hg, Sb
- Most of the PFAS and brominated compounds
- Nivalenol, patulin, fumonisins, zearalenone
- 278 pesticide residues
- PAHs
- Subst. from food contact materials (Benzophenone, 4-MBP, nonylphenols, BADGE, phthalates)

2nd TDS:

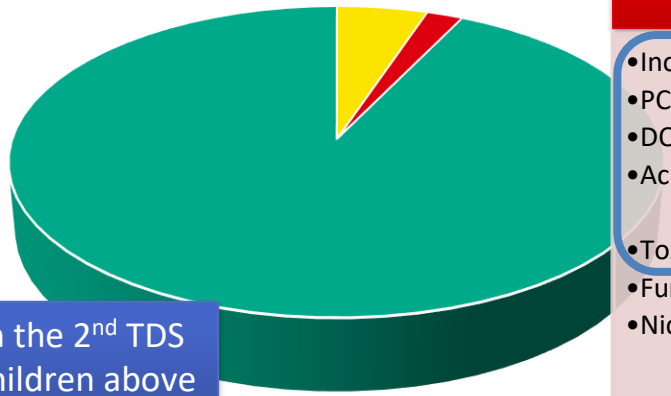
- Antimony, baryum, nickel, cobalt
- Most of the PFAS and brominated compounds
- OTA, aflatoxins, patulin, nivalenol, fumonisins, zearalenone
- 244 pesticide residues
- PAHs
- Annato, tartric acid, nitrites
- Phytoestrogens

→ **Keep the surveillance to confirm the results & Maintain efforts on reduction of food contaminations**

→ **Re-assess some HBGVs regarding new toxicological data**

What we learnt from our TDSs

Out of more than 300 substances or families evaluated



9 common with the 2nd TDS on adults and children above 3y

iTDS: 9 Substances: situation identified as a concern

- Inorganic As & Lead
- PCDD/Fs & PCBs
- DON & acetylated derivatives
- Acrylamide
- Toxins T2-HT2
- Furan
- Nickel

iTDS: 7 Substances: risk cannot be ruled out

- Aluminium, Cadmium, Methylmercury
- Cobalt, Strontium
- Selenium (>1 y only)
- Genistein (soy consumers ony)

2nd TDS: Example of results on dioxins and PCBs

Highly stable compounds that accumulate throughout the food chain

Effects on reproduction and developement + immuno

Found in animal products and fatty products

Levels have been reduced since the previous assessments

Exposure have been reduced since the previous assessments

Reflect the effectiveness of **management measures**

Sirot V et al. 2012, *Chemosphere 88*: 492-500.

Dioxins, furans and dioxin-like PCBs

Exceedance of the HBGV	2005 (Afssa)	2011 (2nd TDS)
Adults	20 to 28 % of the population	< 0,1 %
Children		< 1 %

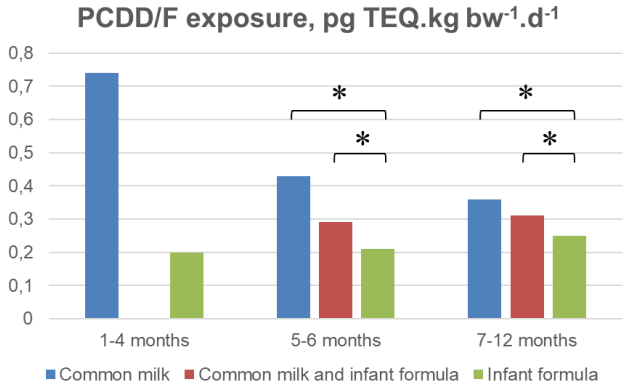
non dioxin-like PCBs

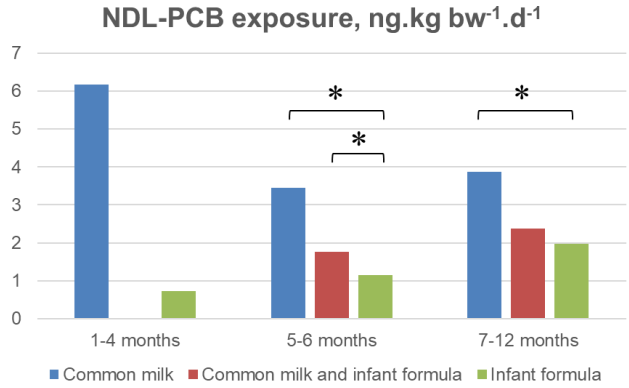
Exceedance of the HBGV	2007 (Afssa)	2011 (2nd TDS)
Adults	20 %	< 1 %
Children	58 %	< 3 %

Concordant with the biomonitoring results of the Esteban study (2014-16): **lowering of the blood levels for** PCBs in the general population compared to the ENNS study (2006-07) and UIOM study (2005)

iTDS: Identification of at-risk practices

- Infant TDS: **14%** of children consumed **common cow** milk before 1 year of age
- Total exposure to **PCDD/Fs** and **NDL-PCBs** higher than for children consuming infant formulae, and exceedance of **calcium** USL





→ Anses reminds to the population that *apart from beast milk, infant formulas are adapted to the needs of infants, and that common cow milk shouldn't be given before 1 year of age*.

Some analytical challenges (1/2)

- Example of pesticide residues in the 2nd French TDS: 283 active substances: high rate of left-censored data (>60%, until 100%)

(WHO, 2013)	Non-detects (0 < x < LOD)	Detected but non quantified results LOD < x < LOQ	Quantified results (LOQ > x)
Lowerbound (LB)	0	LOD	x
Upperbound (UB)	LOD	LOQ	x

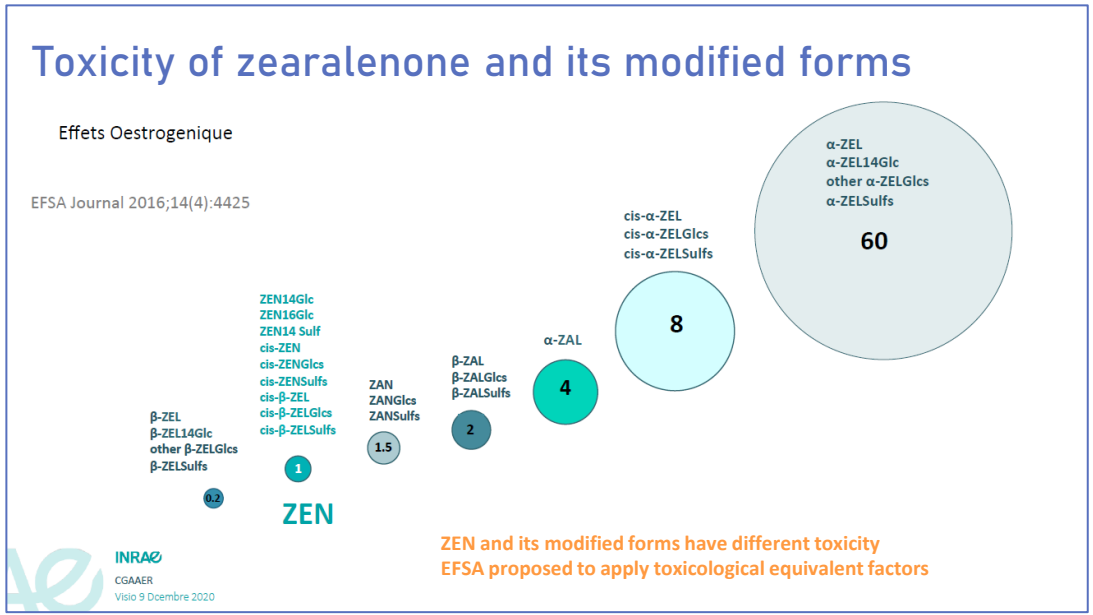
- Exposure = Consumption x Contamination / body weight
- Impossible to draw a conclusion as to risk related to dietary exposure for 9 substances: *Dithiocarbamates, Ethoprophos, Carbofuran, Diazinon, Methamidophos, Disulfoton, Dieldrin, Endrin, Heptachlor*

→ **Need to lower the analytical limits to meet the needs of the risk assessment**

Some analytical challenges (2/2)

Toxicity of the chemical depends on the form of the compound present in the food: trace elements (e.g. inorganic arsenic or MeHg in fish), mycotoxins, pesticide residues...

→ Specific analytical methods are necessary to quantify the different forms in all potential contributors



Source : I. Oswald, Inrae

4. Why do we need total diet studies?

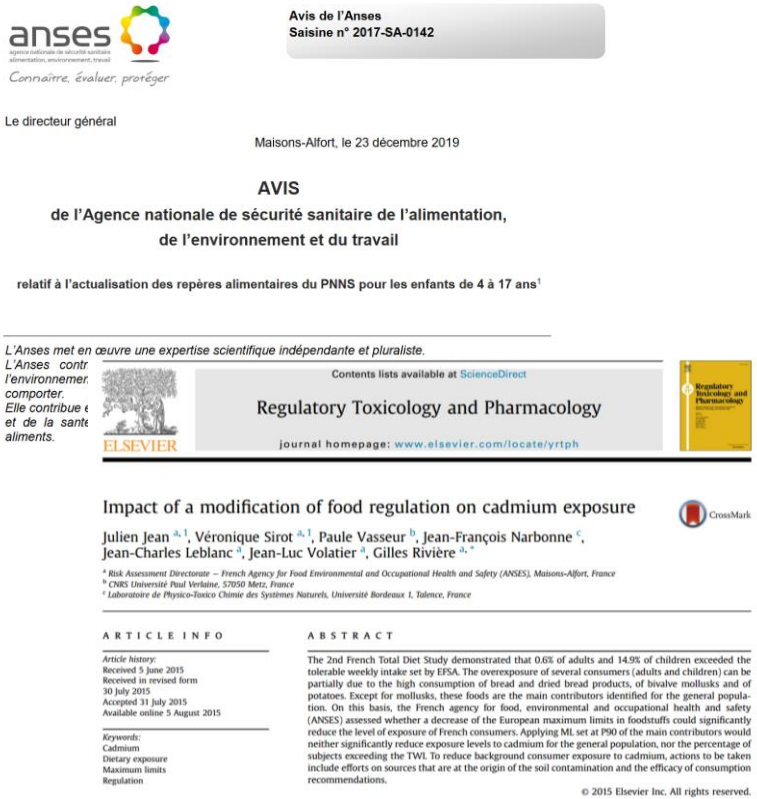
Examples of using the results

Requests from the Ministries:

- To update of the French food-based dietary guidelines
- To optimize the monitoring programs
- To prioritize (ranking) biological and chemical hazards to optimize food safety and risk management
- To model the effects on Cd exposure of different scenarios on changes of the regulation on Cd in foods
- To assess the risks and benefits of breastfeeding in France

FR and EU research projects:

- FP7 TDS-Exposure, ANR COCTELL, H2020 project Euromix, PARC (European Partnership for the Assessment of Risks from Chemicals, 2021-2027)



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Le directeur général

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relatif à l'actualisation des repères alimentaires du PNNS pour les enfants de 4 à 17 ans[1]

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Impact of a modification of food regulation on cadmium exposure

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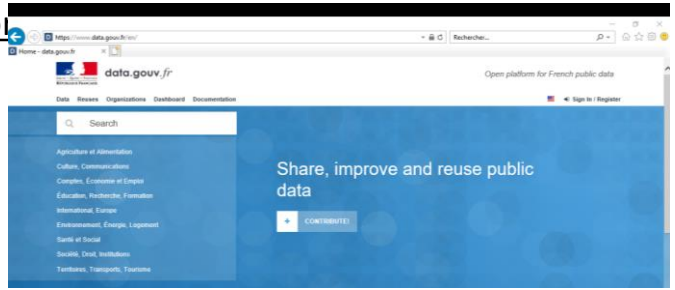
ABSTRACT

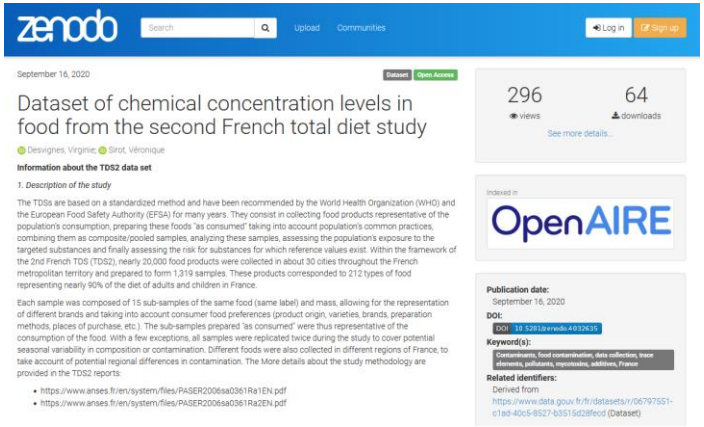
The 2nd French Total Diet Study demonstrated that 0.6% of adults and 14.9% of children exceeded the tolerable weekly intake set by EFSA. The overexposure of several consumers (adults and children) can be partially due to the high consumption of bread and dried bread products, of bivalve mollusks and of potatoes. Except for mollusks, these foods are the main contributors identified for the general population. On this basis, the French agency for food, environmental and occupational health and safety (ANSES) assessed whether a decrease of the European maximum limits in foodstuffs could significantly reduce the level of exposure of French consumers. Applying ML set at P90 of the main contributors would neither significantly reduce exposure levels to cadmium for the general population, nor the percentage of subjects exceeding the TWI. To reduce background consumer exposure to cadmium, actions to be taken include efforts on sources that are at the origin of the soil contamination and the efficacy of consumption recommendations.

A tool for risk managers and researchers

A major database: https://www.data.gouv.fr/en/; https://zenodo.or

- Average levels of contamination of foodstuffs





Cumulated and aggregated exposure

- TDS: numerous chemicals measured in the same foods

→ Possibility to identify the **mixtures** to which the population is exposed

Mathematical methods → **Clusters of individuals** with similar characteristics

& identification of mixtures **relevant on a health basis**, and **realistic** regarding the exposure

- *Crépet & Tressou. 2011. Bayesian Analysis, 6(1), 127:144*
- *Béchaux et al. 2013 Food Chemical and Toxicology, 59: 191–198*
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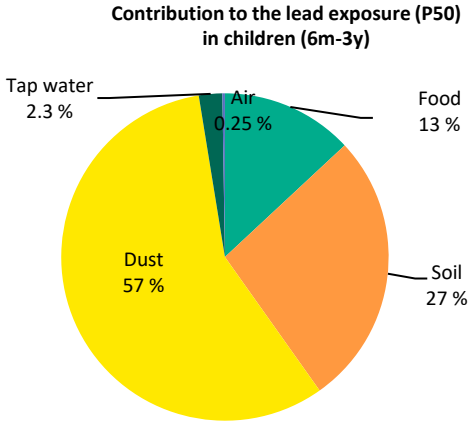

- Integration of **all exposure routes** for certain relevant substances (e.g. BPA, lead…). E.g. lead exposure of young children (food, dust, air, water)
  - *Vanacker et al. 2020. Environmental Research 182(4):109069*

Take home messages

- Situation considered **tolerable** or acceptable for **more than 90% of the substances** evaluated
- Update is needed in view of the last health-based guidance values
- For substances for which the risk cannot be excluded, **recommendations** for management or research measures

- A **major tool** for Anses, for the researchers, and for the Ministries, which allows to follow trends in food contamination and exposure
- Allow to give **priority** to food chemicals in order to **help risk managers** in the public health policies & to adapt management measures and regulation
- **Inform** researchers on priority research topics

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