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## EXPOSURE TO PCB AND PCDD/F OF THE VEGETARIAN POPULATION IN FRANCE

G. Riviere<sup>1</sup>, S. Fleury<sup>1</sup>, N. Bemrah<sup>1</sup>

<sup>1</sup>French Agency for food, environmental and occupational health & safety (ANSES)

### Introduction

Vegetarian population is in constant evolution. Since the 70s, the number of studies concerning vegetarian diet dramatically increased. In the early 70s, about 10 publications per year were dealing with vegetarian diet, nowadays every year more than 300 scientific documents deal with this topic. However, it is very difficult to have a clear description of vegetarian population since most of the studies included non-representative vegetarian population. Based on the review by Guillocheau (1), the percentage of vegetarians in the population greatly varies depending on the countries. Whereas it is close to 2% in France, it reaches 8% in Germany and 31% in India.

A total diet study was run in France that provided baseline information on food contamination and trends of dietary exposure to chemicals in the general population (2). However, specific subpopulations as well as more sensitive or more exposed populations were not included (3).

In the present study, exposure to different persistent organic pollutants (PCB & PCDD/F) has been calculated for the vegetarian population and compared to that of the general French population. Additionally, the risk for the vegetarian population was characterized.

### Materials and methods

#### Contamination data

Contamination data generated in the context of the second French total diet study were used in the present study (2). Foodstuffs were prepared as consumed, mixed prior to PCB and PCDD/F analyzes. Each substance was measured in food known or supposed to contain it.

#### Consumption study

Consumption data of the vegetarian population were collected in the context of the NutriNet-Santé Study (4) investigating the relationship between nutrition and health outcome. The study targeted adult volunteers aged 18 years or more. The survey was performed using internet only. Volunteers directly recorded the quantity consumed when known or estimated portion sizes for each food and beverage previously listed based on photographs of portion sizes.

#### Risk characterization

The estimated exposures were compared to reference values in order to characterize the risk. In the present study, only dietary exposures were considered. Additional routes of exposure (dermal, inhalation) were not considered.

### Results and discussion

As one of the main contributor to dioxins, furans and PCB exposure are fish, vegan and non-vegan exposure were calculated. PCDD/F + PCB-DL exposures were calculated using the toxicological equivalent factors (TEF<sub>OMS2005</sub>). The selected health based guidance value was the monthly tolerable intake set by JECFA (5), 70 pg TEQ<sub>OMS</sub>/kg bw/month, ie, 2.33 pg TEQ<sub>OMS</sub>/kg bw/d for the sum of PCDD/F and dioxin like PCB. With regard to non dioxin like PCB, the health based guidance value set by Afssa at 10 ng/kg bw/d was selected (6).

#### Exposures of the vegetarian population

For the total vegetarian population, the average exposure to PCDD/F + PCB-DL was estimated at 0.201 pg TEQ<sub>OMS2005</sub>/kg bw/d (UB hypothesis). At the 95<sup>th</sup> percentile, exposure was 0.735 pg TEQ<sub>OMS2005</sub>/kg bw/d. Main PCDD/F + PCB-DL contributors were fish (21.9%) and cheese (16.1%). For PCB-NDL, exposure of the vegetarians was 0.969 ng/kg bw/d (4.75 ng/kg bw/d at the 95<sup>th</sup> percentile). Main PCB-NDL contributors were fish (47.3%) and mixed dishes (11.7%). Vegetarian mean exposures PCDD/F + PCB-DL and PCB-NDL were half those reported for the general French population (7). However, 95<sup>th</sup>

percentile values were close for both populations. For PCDD/F + PCB-DL, 95<sup>th</sup> percentile values were respectively 0.7 pg and 0.8 pg TEQ<sub>OMS2005</sub>/kg bw/d in the present study and for the general French population.

Vegan results:

Mean vegan exposure to PCDD/F + PCB-DL was 0.024 pg TEQ<sub>OMS2005</sub>/kg bw/d. At the 95<sup>th</sup> percentile, exposure was 0.081 pg TEQ<sub>OMS2005</sub>/kg bw/d. Main PCDD/F + PCB-DL contributors were oil (54.4%) and pizzas, quiches, savoury pastries and cakes (16.4%). Mean exposure to PCB-NDL was estimated to 0.068 ng/kg bw/d. At the 95<sup>th</sup> percentile, exposure was 0.26 ng/kg bw/d. Main PCB-NDL contributors were oil (42.6%) and pizzas, quiches, savoury pastries and cakes (27.7%). Vegan average exposure to PCDD/F + PCB-DL was 30 to 15 times lower than that of the general population average exposure.

Non-vegan results:

Non-vegan population showed a mean exposure to PCDD/F + PCB-DL of 0.213 pg TEQ<sub>OMS2005</sub>/kg bw/d. At the 95<sup>th</sup> percentile, exposure was 0.731 pg TEQ<sub>OMS2005</sub>/kg bw/d. Main PCDD/F + PCB-DL contributors were fish (21.6%) and cheese (16.7%). The average exposure to PCB-NDL was estimated at 1.08 ng/kg bw/d. At the 95<sup>th</sup> percentile, exposure was 5.40 ng/kg bw/d. Main PCB-NDL contributors were fish (47.8%) and mixed dishes (11.7%).

### Conclusions

This study showed that the vegetarian diet dramatically lowers the mean exposures to PCB and PCDD/F (as high as 15- to 30-fold lower for the exposure to PCDD/F of the vegan population), whereas this is less dramatic considering the 95<sup>th</sup> percentile values. This was expected considering the main contributors (food of animal origin) to the exposure of these contaminants (7).

### References

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### Exposure calculation

Dietary exposures to contaminants or nutrient intakes were calculated using the following formula:

$$E_i = \sum_{k=1}^n \frac{C_{i,k} \times L_k}{BW_i}$$

Where  $E_i$  is the exposure (or nutrient intake) of individual  $i$ ,  $n$  the number of foodstuff that has been consumed by individual  $i$ ,  $C_{i,k}$  the amount consumed of the food  $k$  (in g/day) by the individual  $i$ ,  $L_k$  the level of contamination in the food  $k$ ,  $BW_i$  the individual body weight (in kg) of the individual  $i$ .

Table 1 Exposure of the vegetarian and general populations to PCB and PCDD/F in France

	Vegetarian population		General population (7)
	Mean (95 <sup>th</sup> percentile)		Mean (95 <sup>th</sup> percentile)
	LB	UB	MB
PCDD/F + PCB-DL	0.186 (0.716)	0.201 (0.735)	0.400 (0.830)
PCB-NDL	0.969 (4.750)	0.969 (4.751)	1.83 (5.050)

LB, UB, MB: Little, upper and middle bound hypotheses