



INTRODUCTION

OBJECTIVES

- To assess the contamination of several classes of hazardous organic compounds in edible insects.
- To explore possible differences in contamination between samples purchased in EU and Asia.
- To evaluate the chemical safety of edible insects through performing a dietary exposure risk assessment.

- To feed the continuously growing world population, edible insects are a valuable alternative to the rising demand for protein sources¹.
- Like other animals, insects might accumulate hazardous organic chemicals, such as persistent organic pollutants (POPs), phthalates and flame retardants (FRs), during the rearing process².
- Studies investigating the chemical safety of edible insects are still scarce.

MATERIALS and
METHODS

- Insects belonging to 6 orders (Orthoptera, Coleoptera, Lepidoptera, Hemiptera, Odonata, Hymenoptera, $n=35$) were purchased from 5 EU (AT, BE, FR, NL, UK) and 3 Asian (China-PRC, Republic of Korea-SK, Japan-JPN) countries.
- POPs and halogenated FRs (HFRs) were analyzed and quantified by GC/MS³; organophosphorus FRs (PFRs) and plasticizers were analyzed and quantified by LC-MS/MS.
- The estimated dietary intake (EDI) was calculated for an adult population.
- Hazard Quotients (HQ) and Carcinogenic Risks (CR) were estimated on calculated EDIs.



RESULTS and DISCUSSION

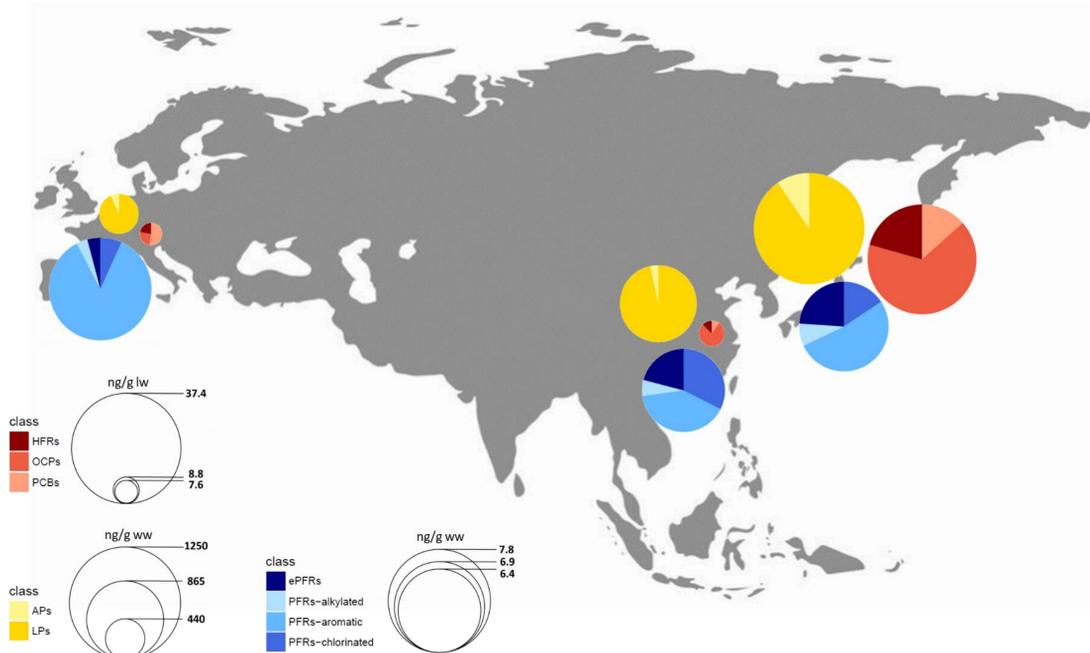


Fig. 1 Median contamination of edible insects purchased in three identified geographical regions (EU, PRC, JPN/SK). Size of the pie charts: median per class of compounds; colors: distribution of the main sub-groups of compounds for each class.

- TPHP and DEHP were the most abundant compounds, suggesting a post harvesting industrial origin of contamination.
- Total EDI values for all compounds (Tab. 1) were comparable with common food of animal origin.
- HQ was always within the acceptable level ($HQ < 1$).
- CR was always within the acceptable level ($CR < 10^{-6}$), except for DEHP in both Europe and Asia.

- Chemical contamination was low and comparable with other common animal products.
- Pollutant levels were influenced by seasoning, suggesting a relationship between sample contamination and industrial processing.
- Median concentrations of POPs, HFRs and contamination pattern of PFRs emphasized differences between EU, PRC and SK/JPN.
- The pattern of contamination with plasticizers was similar between the three regions (Fig. 1).

	EDI (mg/kg bw/d)		RfDs ⁴ (mg/kg bw/d)	HQ		SFO ⁴ (mg/kg bw/d) ⁻¹	CR	
	EU	Asia		EU	Asia		EU	Asia
HFRs	1.3E-07	2.3E-07	-	-	-	-	-	-
BDE-99	6.7E-09	1.2E-08	1.0E-04	6.7E-05	1.2E-04	-	-	-
BDE-153	4.5E-10	7.7E-10	2.0E-04	2.2E-06	3.9E-06	-	-	-
OCPs	4.4E-07	7.6E-07	-	-	-	-	-	-
DDT	7.1E-08	1.2E-07	5.0E-04	1.4E-04	2.4E-04	3.4E-01	2.4E-08	4.1E-08
HCB	5.5E-08	9.5E-08	8.0E-04	6.9E-05	1.2E-04	1.6E+00	8.8E-08	1.5E-07
a-HCH	3.4E-09	5.8E-09	8.0E-03	4.2E-07	7.2E-07	6.3E+00	2.1E-08	3.7E-08
b-HCH	6.7E-09	1.2E-08	-	-	-	1.8E+00	1.2E-08	2.1E-08
g-HCH	6.7E-09	1.2E-08	3.0E-04	2.2E-05	3.9E-05	1.1E+00	7.4E-09	1.3E-08
PCBs	1.6E-07	2.8E-07	2.0E-05	8.2E-03	1.4E-02	4.0E-01	6.5E-08	1.1E-07
PFRs	1.3E-05	2.2E-05	-	-	-	-	-	-
TCEP	1.9E-07	3.2E-07	7.0E-03	2.7E-05	4.6E-05	2.0E-02	3.7E-09	6.4E-09
TCIPP	6.4E-07	1.1E-06	1.0E-02	6.4E-05	1.1E-04	-	-	-
TPHP	2.6E-06	4.4E-06	2.0E-02	1.3E-04	2.2E-04	-	-	-
EHDPHP ⁵	1.9E-07	3.2E-07	1.5E-02	1.2E-05	2.1E-05	-	-	-
TEHP	5.6E-08	9.7E-08	1.0E-01	5.6E-07	9.7E-07	3.2E-03	1.8E-10	3.1E-10
Plasticizers	1.2E-03	2.1E-03	-	-	-	-	-	-
DEHP	9.8E-04	1.7E-03	2.0E-02	4.9E-02	8.4E-02	1.4E-02	1.4E-05	2.4E-05

Tab. 1 Dietary risk assessment for the median measured concentrations of individual/classes of compounds present in edible insects ($n=35$). In bold: HQ=hazard quotient; CR=potential carcinogenic risk.

CONCLUSIONS

- No adverse health effects are expected in the adult population following ingestion of chemical compounds through consumption of edible insects.
- Edible insects were proven a chemically safe protein source.
- Production and industrial manipulation after harvesting are additional factors concerning the chemical safety of insect-based food products.
- Investigations on the potential chemical contamination of edible insects, together with the more frequently performed microbiological safety assays, are crucial to guarantee consumer safety.

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