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INTRODUCTION and OBJECTIVES

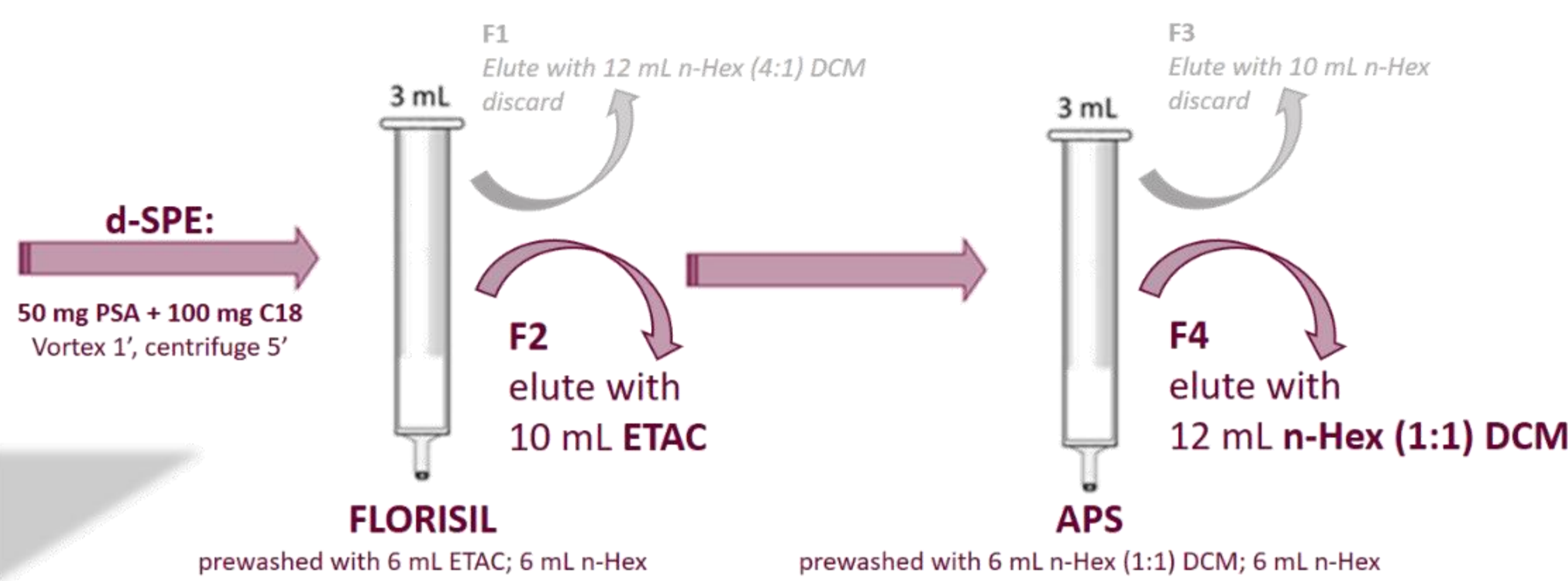
- ✓ The worldwide ban of the main brominated flame retardants (BFRs), such as PBDEs and HBCDs, led to the increased usage of organophosphorus flame retardants (PFRs) as alternatives¹.
- ✓ PFRs have been already measured in environmental abiotic matrices (air, dust, surface water, and sediments) all over the world¹ but data on the human exposure to PFRs from food are still scarce^{2,3}.
- ✓ In this study, we analyzed 14 PFRs in 165 composite food samples belonging to different categories (fish, meat, grains, eggs, milk, cheese, vegetables, food for infants, oils) and purchased from the Belgian food market.
- ✓ Based on the results obtained and using recent data concerning the Belgian food consumption in 2014⁴, the average PFR *per capita* intake of the Belgian adult population (15-64 years) was calculated.

Target analytes

Triphenyl phosphate	TPhP
Tri-ethyl phosphate	TEP
Tri-n-propyl phosphate	TnPP
Tri-n-butyl phosphate	TnBP
Tris (2-chloroethyl) phosphate	TCEP
Tris (1-chloro-2-propyl) phosphate	TCIPP
Tris (1,3-dichloro-2-propyl) phosphate	TDCIPP
2-Ethylhexyl diphenyl phosphate	EHDHP
Tris (2-ethylhexyl) phosphate	TEHP
Tri-o-tolyl phosphate	TOTP
Tri-m-tolyl phosphate	TMTP
Tri-p-tolyl phosphate	TPTP
Tris (2-isopropylphenyl) phosphate	T2IPPP
Tris (3,5-dimethylphenyl) phosphate	T35DMPP

MATERIALS and METHODS

0.2 g sample:
Solid-liquid
EXTRACTION
with 5 mL
ACN



- ✓ Quantification of target analytes was achieved by gas chromatography coupled to tandem mass spectrometry (GC-MS/MS) operating in electron ionization (EI) mode².
- ✓ The *per capita* intake was determined by multiplying the *per capita* consumption of a specific food group with the concentration of the compound found in the considered food sample.

RESULTS and DISCUSSION

- ✓ Out of 14 PFRs, TnBP, TCEP, TCIPP, TDCIPP, TPHP, EHDHP, TEHP were measured in most of the food categories (detection frequency 10 - 100 %), while the other target analytes were < LOQ. TPHP was the most abundant compound (27%), followed by TCIPP (25%) and EHDHP (20%).
- ✓ Fats > Grains > Cheese were the food categories with the highest levels of PFRs (Fig. 1). The whole data set was divided into "non-processed food" (foodstuffs slightly altered from their natural state, e.g. frozen, freshly cut, or directly packed) and "processed food" (manipulated and industrially altered/processed foodstuffs, e.g. canned, smoked, dried, fried, minced, etc.) (Fig. 2).

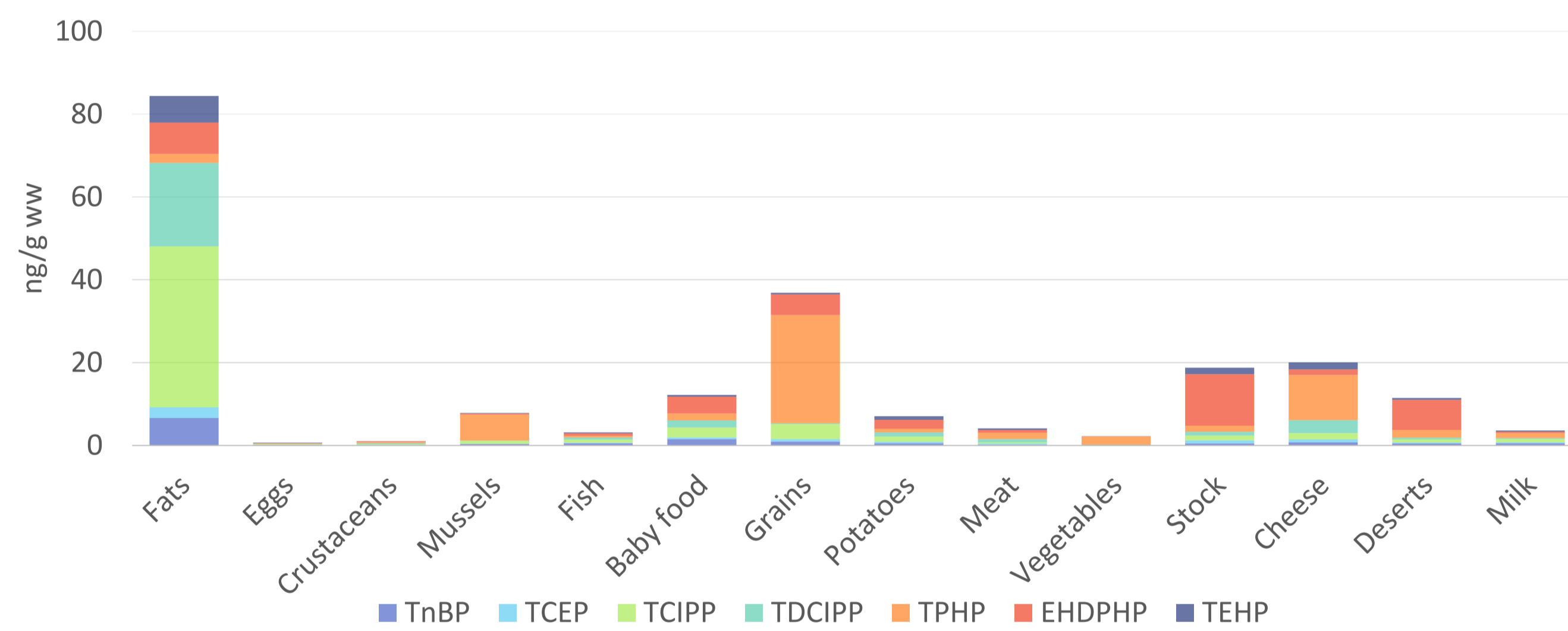


Fig. 1 Mean MB levels of PFRs in the different food groups

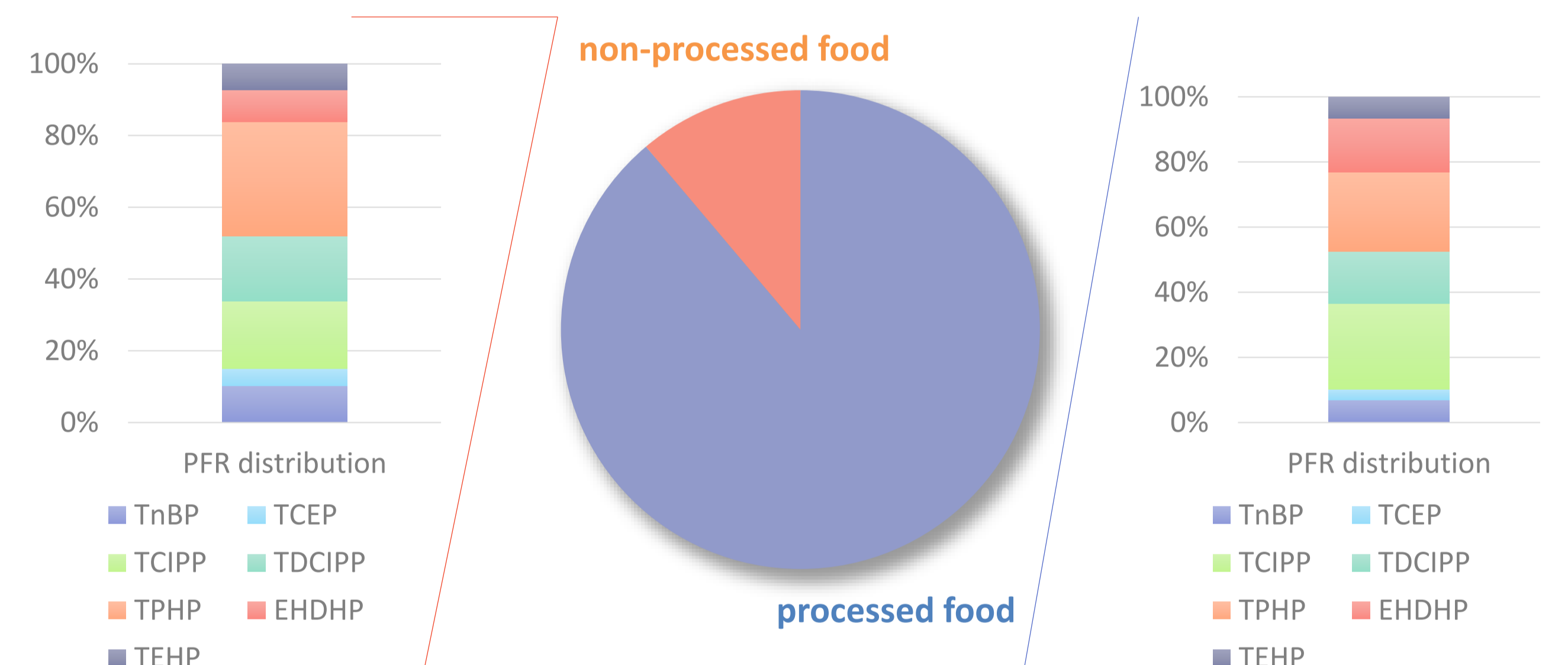


Fig. 2 Distribution of total PFRs in processed food and non-processed food

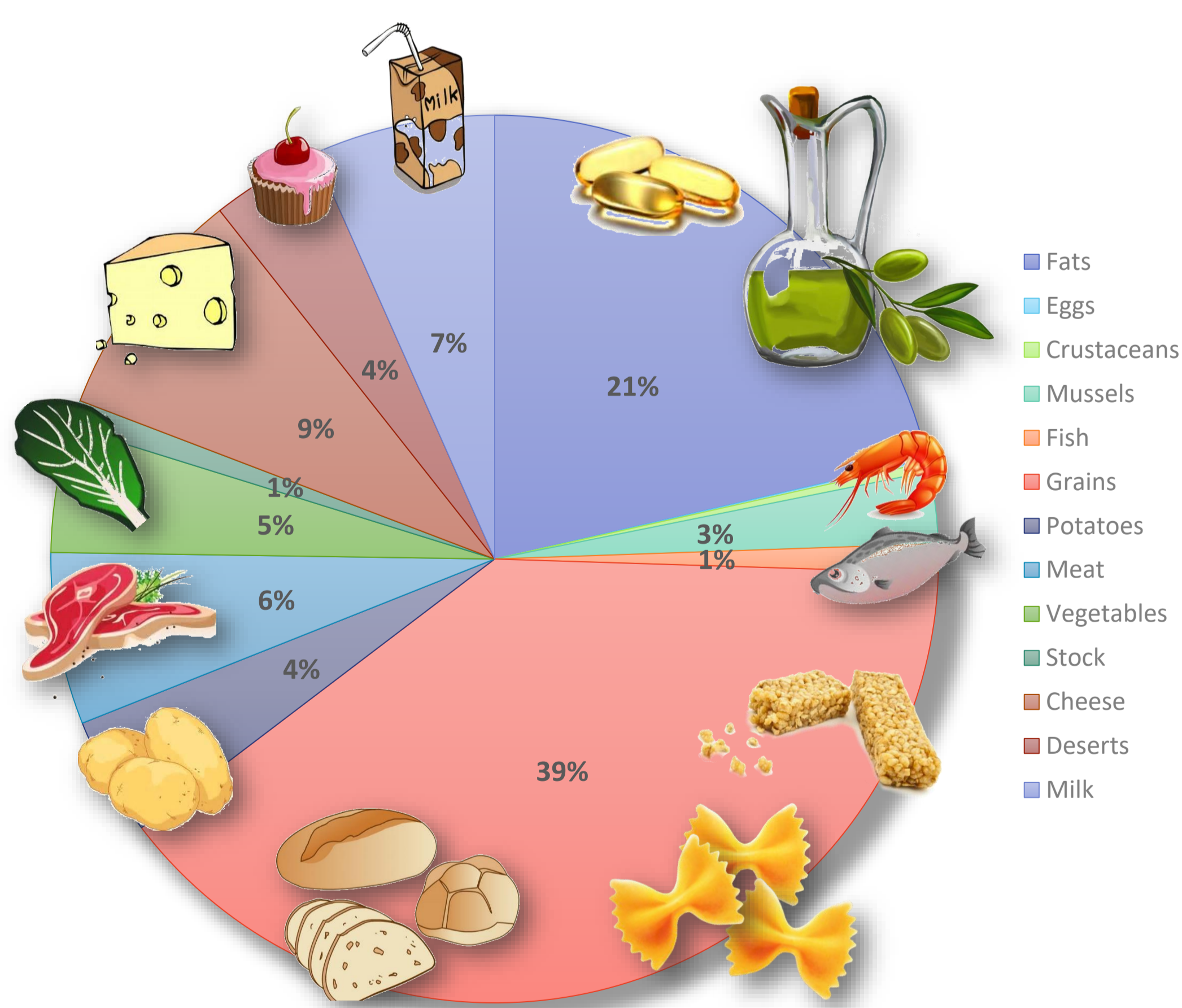


Fig. 3 Contribution of each food category to the daily PFR intake

Table 1 Mean daily dietary intake in ng/day and ng/kg bw/day for Belgian adult population (72,9 kg on average)

Food groups	TnBP	TCEP	TCIPP	TDCIPP	TPHP	EHDHP	TEHP
Fats	126	49	739	383	41	144	123
Eggs	1	0	2	1	1	1	2
Crustaceans	1	1	6	5	6	4	2
Mussels	9	1	19	1	157	6	3
Fish	13	3	19	12	10	15	6
Grains	74	49	291	12	2080	398	30
Potatoes	25	18	56	47	39	101	39
Meat	27	23	33	92	174	82	40
Vegetables	19	0	3	2	315	1	2
Stock	2	3	5	4	6	50	6
Cheese	24	23	49	99	350	42	55
Deserts	13	6	20	10	50	188	13
Milk	70	31	111	30	166	55	35
Total (ng/day)	404	207	1350	697	3396	1087	355
Total (ng/kg bw/day)	5.5	2.8	18.5	9.6	46.6	14.9	4.9
RfD values (ng/kg bw/day)	-	22,000	80,000	15,000	70,000	15,000	-

- ✓ For the average adult population (15-64 years), the total dietary intake of PFRs was estimated to be 7500 ± 1550 ng/day, and no significant differences between the PFR intakes of men and women were observed (Table 1).
- ✓ The mean dietary exposure mainly originated from grains (39%), followed by fats and oils (21%) and dairy products (20%) (Fig. 3).
- ✓ The major contributors to the total intake were TPHP (45 %) > TCIPP (18 %) > EHDHP (15%) > TDCIPP (9%) > TEHP and TnBP (5 %) > TCEP (3 %).

CONCLUSION

- ✓ Detectable levels of PFRs were found in the majority of the food categories.
- ✓ Fats were found to be the highest contaminated food group in this study, followed by grains. These categories were also the main contributors to the PFR *per capita* intake.
- ✓ The contamination of food with PFRs might likely originate from industrial processing and manipulation and/or alteration of food products.
- ✓ Human *per capita* exposure to PFRs from food was estimated and found much lower than the health-based reference points. Overall, Belgian foodstuff showed low contamination and low risk to humans.

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