Food Contact Chemicals Priority (FCCprio) List: Methodology

Version 0.1

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About this list

Foodware and food packaging materials are a source of human exposure to chemicals because chemicals transfer (or migrate) from the packaging into the food. Some of these food contact chemicals (FCCs) are regularly discussed due to their hazardous properties (e.g., bisphenols and phthalates). However, systematic approaches have not been applied to identify and prioritize the hazards of all known FCCs.

Therefore, the FCCprio List was compiled to systematically identify and prioritize FCCs based on their hazard properties and exposure potential. The list was created following the published, evidence-based methodology by the PlastChem report [1]. The methodology was slightly modified to include only harmonized hazard classifications for broader agreement and to focus on human health hazards, given their primary relevance for exposure through food contact materials (FCMs). In detail, publicly available and officially recognized hazard information was collected for all known FCCs. Using these data, FCCs were first prioritized if they have at least one of the following hazards: persistence, bioaccumulation, mobility, carcinogenicity, mutagenicity, reproductive toxicity, specific target organ toxicity upon repeated exposure, and/or endocrine disruption. The prioritized FCCs were subsequently ranked into four tiers based on their evidence for human exposure via food contact materials, as reported in the FCChumon [2, 3], FCCmigex [4, 5] and FCCdb [6, 7] databases.

Methodology

1 Identifying food contact chemicals

FCCs that may be intentionally used during the manufacture of FCMs (included in the Food Contact Chemicals database (FCCdb) [6, 7]) and FCCs that have been detected in extracts or migrates from FCMs (included in the FCCmigex database [4, 5]) were combined to create a list of all known FCCs. In this list, we only included chemicals for

which a Chemical Abstract Service Registry Number (CASRN) was available. The correctness of the included CASRNs was verified using the check digit method [8], and where needed, corrected. Additionally, 'replaced and deleted CASRNs' were retrieved from Common Chemistry [9], where available, to ensure maximum coverage of hazard data.

As of March 2025, 15'159 FCCs have verified CASRNs, with a total of 44'269 associated (standard, replaced, and deleted) CASRNs. 10'153 FCCs (67%) are only present in the FCCdb [6, 7], 3'609 FCCs (24%) are only present in the FCCmigex [4, 5], and 1'397 FCCs (9%) are part of both databases (Figure 1).

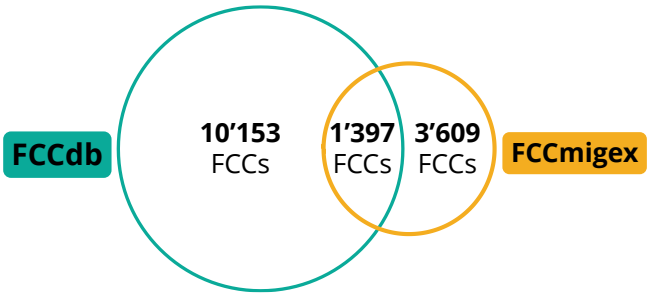

Figure 1: Overview of known food contact chemicals (FCCs). Relevancy for 'food contact' was based on potential use during manufacturing (from the FCCdb database [6, 7], green circle) or evidence for migration or extraction from food contact materials (from the FCCmigex database [4, 5], yellow circle).

2 Retrieval and mapping of hazard information

Hazard data was retrieved from various government sources to prioritize FCCs (Table 1).

Table 1: Hazard data sources and retrieved information. The numbering of lists follows the PlastChem methodology [1]. n CASRN = number of unique Chemical Abstracts Service Registry Numbers on the list; n FCCs = number of food contact chemicals with CASRNs on the list; CMR = carcinogenic, mutagenic, or toxic for reproduction; EDC = endocrine disrupting chemical; PBT = persistent, bioaccumulative, and toxic; PMT = persistent, mobile, and toxic; STOT-RE = specific target organ toxicity upon repeated exposure; IARC = International Agency for Research on Cancer; ECHA = European Chemicals Agency; C&L = Classification & Labelling (part of the CLP Regulation); HCIS = Hazardous Chemical Information System; GHS = Globally Harmonized System of Classification and Labelling of Chemicals; NITE = National Institute of Technology and Evaluation; SVHC = Substances of Very High Concern; vPvB = very persistent and very bioaccumulative; POP = Persistent Organic Pollutant.

List		Download date	n CASRN	n FCCs	Included hazard classification(s)				
					CMR	EDC	PBT	PMT	STOT-RE
L1	IARC	04.07.2024	883	384	X				
L2.1	ECHA harmonized C&L inventory	29.07.2024	4'114	1'141	X				X
L2.2	ECHA notified C&L inventory	23.07.2024	245'609	9'654	*				*
L3	ECHA Authorisation list	19.07.2024	114	45	X	X	X		
L4	Australian HCIS	08.10.2024	4'354	910	X				X
L5	Japanese GHS, NITE	27.06.2024	3'341	1'657	X				X
L6	ECHA SVHC list	27.06.2024	432	186	X	X	X		X
L7	Californian Proposition 65 List	27.06.2024	772	242	X				
L8	ECHA EDC list	22.07.2024	149	88		X			
L9	ECHA PBT list	04.07.2024	259	138			X		
L10	ECHA PBT/vPvB assessment list	04.07.2024	127	76			X		
L11	US EPA PBT list	22.07.2024	65	38			X		
L12	ECHA POPs proposal list	04.07.2024	220	26			X		
L13	ECHA POPs list	04.07.2024	294	66			X		
L14	UBA PMT list	04.07.2024	333	163				X	
L15	ECHA SVHC proposal list	04.07.2024	248	157	X	X	X		X

* L2.2 ECHA notified REACH and C&L classifications were not used for the final hazard prioritization

In short, hazard data relating to persistence (P), mobility (M), bioaccumulation (B), carcinogenicity (C), mutagenicity (M), toxicity for reproduction (R), specific target organ toxicity upon repeated exposure (STOT-RE) and endocrine disruption (ED) were downloaded from these sources. Based on these data, hazard scores were assigned by following the overall approach of the PlastChem report [1]. In deviation from the PlastChem approach, only harmonized C&L inventory hazard data (L2.1), but not the notified hazard data (L2.2) were used to ensure the proposed hazard prioritization is based on broadly accepted hazard classifications.

3 Prioritization based on hazard classifications

FCCs were assigned to the priority list by applying the hazard criteria from Table 2, which mostly follow those for the Red List of the PlastChem report [1]. Unlike PlastChem, the FCCprio List focuses on human health hazards due to their primary relevance for exposure through FCMs and thus excludes aquatic toxicity.

Table 2: Criteria applied for assigning food contact chemicals (FCCs) to the FCCprio List. The required hazard classifications generally follow the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), except for persistence, bioaccumulation, mobility, and endocrine disruption, which follow the EU Hazard classification system. Hazards are signified with their respective hazard class and category, and their hazard code. STOT-RE = specific target organ toxicity upon repeated exposure; PBT = persistent, bioaccumulative, and toxic; vPvB = very persistent and very bioaccumulative; PMT = persistent, mobile, and toxic; vPvM = very persistent and very mobile; Carc. = carcinogenicity; Muta. = mutagenicity; Repr. = reproductive toxicity; Repr. Lact. = reproductive toxicity – effects on or via lactation; ED = endocrine disruption.

Hazard Class	FCCprio list criteria
Persistence, Bioaccumulation, Mobility	PBT (EUH440), vPvB (EUH441), PMT (EUH450), vPvM (EUH451)
Carcinogenicity	Carc. 1 (H350)
Mutagenicity	Muta. 1 (H340)
Reproductive Toxicity	Repr. 1 (H360), Repr. 2 (H361), Repr. Lact. (H362)
STOT-RE	STOT-RE 1 (H372), STOT-RE 2 (H373)
Endocrine Disruption	ED (EUH380, EUH430)

The remaining FCCs may (i) have less severe hazards (i.e., a lower hazard category of the considered hazards), such as Carc. 2 (H351), (ii) have environmental hazards, such as aquatic toxicity, (iii) have hazards solely based on notified data (L2.2 in Table 1), (iv) do not possess any considered hazards, or (v) lack hazard data for any of these hazard classes.

4 Ranking priority FCCs by evidence for exposure from FCMs

Following the general suggestions in the PlastChem report (Chapter 5 in Part III in PlastChem [1]), an exposure-based approach was applied to further rank the priority FCCs into four tiers (Figure 2). Accordingly, exposure to FCCs was assessed using the Food Packaging Forum's databases on (i) presence in humans (FCChumon [2, 3]), (ii) migration and extraction (FCCmigex [4, 5]), and (iii) intentional use in manufacture (FCCdb [6, 7]).

Tier 1 are chemicals with evidence for human exposure due to their detection in national biomonitoring programs and migration from FCMs. Tier 2 are chemicals with evidence

for migration, but they have not been detected in humans in national biomonitoring programs. Tier 3 are chemicals known to be present in FCMs, but they have not been shown to migrate from FCMs. Tier 4 includes FCCs that have no evidence for presence or migration from FCMs but are potentially used in FCM manufacture.

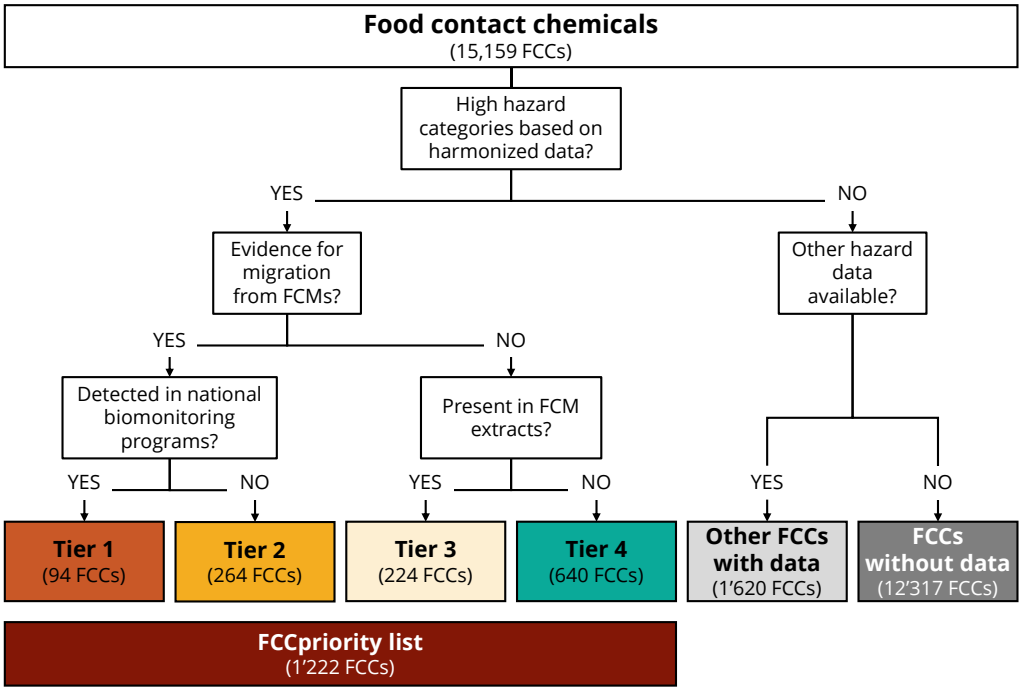

Figure 2: Applied methodology for hazard-based prioritizing and further exposure-based ranking of FCCs. FCCs = Food contact chemicals**;** FCM**s** = Food contact material**s**.

5. Summary Results

In total, 1'222 FCCs were identified as hazardous and placed on the FCCprio List and internally ranked based on their relevance for human exposure from FCMs, the full list is available in the following Zenodo repository: https://zenodo.org/records/14881618

Tiers 1 to 4 contain 94, 264, 224, and 640 FCCs, respectively (Figure 2). Tier 1 chemicals, which have the highest evidence for human exposure from FCMs, include, for example:

- Phthalates: e.g., di(2-ethylhexyl) phthalate (CAS 117-81-7), dibutyl phthalate (CAS 84-74-2), diisobutyl phthalate (CAS 84-69-5)
- Metals and metalloids: e.g., lead, cadmium, nickel, antimony
- Per- and polyfluoroalkyl substances (PFAS): e.g., perfluorooctanoic acid (CAS 335-67-1), perfluorohexanoic acid (CAS 307-24-4), perfluorododecanoic acid (CAS 307-55-1)

Furthermore, a total of 1'173 FCCs might be of concern, due to lower category hazards, their environmental hazards, or hazards solely based on notified data sources (L2.2).

Of the 15'159 known FCCs, 12'317 (81%) currently lack any relevant hazard data and could thus not be prioritized.

Disclaimer

This methodology, the accompanying FCCprio List, and any related files are provided 'as-is'. While best efforts were made, the authors do not warrant or guarantee that the provided information is error-free. Users of the data are responsible for any decisions or actions taken using these data. The authors cannot be held responsible for the use or misuse of the data, even in the case of errors in the datasets. This methodology remains under development by the Food Packaging Forum Foundation, and the criteria applied, as well as the identified priority chemicals, may become subject to change in future updates. Please see the root page of this publication on Zenodo for the latest version of this and other related supporting documents.

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