

Supplemental online material

Table S1. 175 chemicals present on the SIN list 2.1, the TEDX, Union, ESCO and/or Pew lists. The FDA approval for chemicals present on the Pew list were shown according to the agency's designation as listed in [1]. A truncated format was used for the CASRN ((X)_nXXX instead of (X)_n-XX-X).

CASRN	Chemical name	SIN 2.1	TEDX	Union	ESCO	Pew	FDA approval						Application of non-indirect food additives in FCM
							Direct	Indirect	Flavour	GRAS	Colour	Prior sanct.	
50000	Formaldehyde	+		+	+	+	D	I					
51036	Piperonylbutoxide		+			+		I					
56235	Carbon tetrachloride		+		+	+		I					
56359	Tributyltin oxide (TBTO)	+	+		+	+		I					
56360	Tributyltin acetate		+			+		I					
57578	Propiolactone	+				+		I					
58082	Caffeine		+			+	D		F	G			Not known.
59507	4-Chloro-3-methylphenol		+		+	+		I					
60822	Phloretin		+			+	D		F	G			Not known.
62533	Aniline	+				+		I					
64675	Diethyl sulphate	+				+		I					
65850	Benzoic acid		+	+	+	+		I	F	G			
68122	N,N-Dimethylformamide	+	+			+		I					
71432	Benzene	+	+		+	+	D	I					
71487	Cobalt acetate	+				+		I					
74317	Diphenyl- <i>p</i> -phenylenediamine		+			+		I					
75014	Chloroethylene	+		+	+	+		I					
75092	Dichloromethane		+			+	D	I			C		

Table S1 - continued

CASRN	Chemical name	SIN 2.1	TEDX	Union	ESCO	Pew	FDA approval						Application of non-indirect food additives in FCM
							Direct	Indirect	Flavour	GRAS	Colour	Prior sanct.	
75127	Formamide	+				+		I					
75150	Carbon disulfide		+			+		I					
75218	Ethylene oxide	+	+	+	+	+	D	I	F	G			
75569	Methyloxirane	+		+	+	+	D	I					
77407	Bisphenol B		+			+		I					
77587	Dibutyltin (dilaurate)	+			+	+		I					
77781	Dimethyl sulphate	+				+		I					
78795	Isoprene	+		+	+	+		I					
79016	Trichloroethylene	+				+	D	I	F				
79061	Acrylamide	+		+	+	+		I					
79469	2-Nitropropane	+				+		I					
80057	Bisphenol A	+	+	+	+	+		I					
80091	Bisphenol S		+	+		+		I					
80466	4-tert-Pentylphenol		+			+		I					
81141	Musk ketone		+			+	D		F				Not known.
84617	Dicyclohexyl phthalate (DCHP)	+	+		+	+		I					
84628	Diphenyl phthalate		+			+		I					
84662	Diethyl phthalate (DEP)	+	+		+	+		I				P	
84695	Diisobutyl phthalate	+	+		+	+		I					
84742	Dibutyl phthalate (DBP)	+	+	+	+	+		I					
84753	Dihexyl phthalate (DHP)	+	+			+		I					
85687	Benzyl butyl phthalate (BBP)	+	+	+	+	+		I					
87865	Pentachlorophenol (PCP)	+	+			+		I					
88040	4-Chloro-3,5-dimethylphenol		+			+		I					

Table S1 - continued

CASRN	Chemical name	SIN 2.1	TEDX	Union	ESCO	Pew	FDA approval						Application of non-indirect food additives in FCM
							Direct	Indirect	Flavour	GRAS	Colour	Prior sanct.	
90437	2-Phenylphenol		+		+	+	D	I		G			
91225	Quinoline	+				+	D		F	G			Not known.
91532	Ethoxyquin		+			+	D	I					
92524	Biphenyl		+		+	+			F				Fungistat in FCM [2]; in wrapping paper for citrus fruits [3].
92693	4-Phenylphenol		+			+		I					
92886	4,4'-Biphenol		+	+									
92933	4-Nitrobiphenyl	+				+		I					
94133	Propylparaben	+	+	+	+	+	D	I	F	G		P	
94188	Benzyl paraben		+		+								
94268	Butylparaben	+	+			+	D		F	G			Not known.
95807	4-Methyl- <i>m</i> -phenylenediamine	+			+	+		I					
96093	Styrene oxide	+	+			+		I					
96184	1,2,3-Trichloropropane	+				+		I					
96457	Ethylene thiourea	+	+		+								
97234	Dichlorophen		+	+	+	+		I					
98293	4-tert-Butylpyrocatechol		+			+		I					
98544	4-tert-Butylphenol	+	+	+	+	+	D	I	F	G			
99763	Methylparaben		+	+	+	+	D	I	F	G		P	
99934	4-Hydroxyacetophenone		+			+	D		F	G			Not known.
99967	4-Hydroxybenzoic acid		+	+	+	+	D		F	G			Printing inks [3].
100425	Styrene	+	+	+	+	+	D	I	F	G			
101144	4,4'-Methylenebis[2-chloroaniline]	+			+								
101779	4,4'-Methylenedianiline (MDA)	+			+	+		I					

Table S1 - continued

CASRN	Chemical name	SIN 2.1	TEDX	Union	ESCO	Pew	FDA approval						Application of non-indirect food additives in FCM
							Direct	Indirect	Flavour	GRAS	Colour	Prior sanct.	
103162	4-Benzyloxyphenol		+			+		I					
103231	Di(2-ethylhexyl)adipate		+	+	+	+		I					
104405	4-Nonylphenol	+	+			+		I					
106445	p-Cresol		+	+	+	+	D	I	F	G			
106898	1-Chloro-2,3-epoxypropane	+	+	+	+	+		I					
106990	Buta-1,3-diene	+		+	+	+		I					
107062	1,2-Dichloroethane	+				+	D	I					
107131	Acrylonitrile	+		+	+	+		I				P	
107211	Ethylene glycol		+	+	+	+		I					
107302	Chloromethyl methyl ether	+				+	D						Not known.
108054	Vinyl acetate		+	+	+	+	D	I					
108463	1,3-Dihydroxybenzene	+	+	+	+	+	D	I	F	G			
108781	Melamine		+	+	+	+		I					
108883	Toluene		+		+	+		I					
108952	Phenol		+	+	+	+	D	I	F	G			
109864	2-Methoxyethanol	+	+		+	+		I					
110543	n-Hexane	+	+			+	D	I					
110805	2-Ethoxyethanol	+			+	+		I			C		
111159	2-Ethoxyethyl acetate	+				+		I					
111411	2-(2-Aminoethyl-amino)ethanol	+		+	+	+		I					
115866	Triphenyl phosphate		+			+		I					
115968	Tris(2-chloroethyl)-phosphate (TCEP)	+		+	+								
117817	Bis(2-ethylhexyl) phthalate (DEHP)	+	+	+	+	+		I				P	
117840	Diethyl phthalate		+		+	+		I					

Table S1 - continued

CASRN	Chemical name	SIN 2.1	TEDX	Union	ESCO	Pew	FDA approval						Application of non-indirect food additives in FCM
							Direct	Indirect	Flavour	GRAS	Colour	Prior sanct.	
118558	Phenyl salicylate		+			+	D	I		G			
118752	Chloranil		+			+		I					
119619	Benzophenone	+	+	+	+	+	D	I	F	G			
120478	Ethyl paraben		+	+	+	+		I					
120809	Catechol		+	+	+								
122601	2,3-Epoxypropyl phenyl ether	+				+		I					
123079	4-Ethylphenol		+			+	D		F	G			Not known.
123319	Hydroquinone		+	+	+	+		I					
123773	Diazene-1,2-dicarboxamide	+			+	+	D	I					
126001	Diphenolic acid		+			+		I					
126998	2-Chlorobuta-1,3-diene	+	+		+	+		I					
127184	Perchloroethylene	+	+			+		I					
131566	2,4-Dihydroxybenzophenon	+	+	+	+								
131577	Benzophenone-3; Oxybenzone	+	+	+	+	+		I					
135193	2-Naphthol		+			+		I					
136367	Resorcinol monobenzoate		+			+		I					
137268	Thiram	+	+		+	+		I					
137304	Ziram		+		+	+		I					
137428	Sodium methyl-dithiocarbamate	+	+		+								
140669	4-(1,1,3,3-Tetra-methylbutyl)phenol	+	+		+	+	D						Printing inks [3].
142596	Nabam		+			+	D						Slimicide in FCM [2].
149575	2-Ethylhexanoic acid		+		+								
151564	Ethyleneimine	+		+	+	+		I					

Table S1 - continued

CASRN	Chemical name	SIN 2.1	TEDX	Union	ESCO	Pew	FDA approval						Application of non-indirect food additives in FCM
							Direct	Indirect	Flavour	GRAS	Colour	Prior sanct.	
302012	Hydrazine	+				+	D						Polymerization catalyst, foaming agent [4].
520332	Hesperetin		+			+	D		F	G			Not known.
611994	4,4'-Dihydroxy-benzophenone	+	+	+	+								
620177	3-Ethylphenol		+			+		I					
620928	Bisphenol F		+	+	+								
630080	Carbon monoxide	+		+		+		I					
645567	4- <i>n</i> -Propylphenol		+			+	D		F	G			Not known.
683181	Dibutyltin dichloride	+	+			+		I					
872504	N-Methyl-2-pyrrolidone	+		+	+	+		I					
1131608	4-Cyclohexylphenol		+			+		I					
1303964	Disodium tetraborate decahydrate	+				+		I					
1309644	Antimony trioxide	+		+	+								
1330207	Xylene		+		+	+		I					
1330434	Disodium tetraborate, anhydrous	+		+	+	+							Preservative in paper and board; printing inks [3].
1332214	Asbestos	+				+		I					
1344087	Sodium polysulfide (Na ₂ (S _x))		+		+	+		I					
1461229	Tributyltin chloride	+	+			+		I					
1675543	Bisphenol A diglycidyl ether		+	+	+								
1806264	4-Octylphenol		+			+		I					
2451629	Tris(2,3-epoxypropyl) isocyanurate	+				+		I					
3033770	2,3-Epoxypropyl-trimethylammonium chloride	+				+		I					
3380345	Triclosan	+	+	+	+								

Table S1 - continued

CASRN	Chemical name	SIN 2.1	TEDX	Union	ESCO	Pew	FDA approval						Application of non-indirect food additives in FCM
							Direct	Indirect	Flavour	GRAS	Colour	Prior sanct.	
3825261	Perfluorooctanoic acid, ammonium salt		+	+	+								
7235407	β-Carotene		+			+			G	C			Not known.
7429905	Aluminum		+		+	+		I					
7439965	Manganese		+			+		I					
7440224	Silver (nanoparticles)		+		+								
7601890	Sodium perchlorate		+	+									
7632044	Sodium peroxometaborate	+			+	+		I					
7664417	Ammonia		+	+	+	+		I					
7681494	Sodium fluoride		+			+		I					
7758012	Potassium bromate	+				+	D						Not known.
7758987	Copper sulfate		+			+			G	C			Not known.
7775113	Sodium chromate	+				+		I					
7778509	Potassium dichromate	+				+		I					
7778747	Potassium perchlorate		+			+		I					
7783064	Hydrogen sulfide		+			+	D		F	G			Not known.
8009038	Petrolatum	+			+	+	D	I					
8016259	Hops extract		+			+	D		F				Not known.
8030306	Naphtha	+				+	D						Adhesive and defoamer in FCM [2].
8032324	Ligroine	+				+		I					
9002931	4-(1,1,3,3-Tetramethylbutyl)- phenyl-polyethylene glycol	+				+	D						Adhesive in FCM [2].
9016459	Nonylphenol, ethoxylated	+			+	+		I					
10043013	Aluminum sulfate		+			+	D			G			Not known.
10043353	Boric acid	+	+	+	+	+		I					
10049044	Chlorine dioxide		+		+	+	D	I					

Table S1 - continued

CASRN	Chemical name	SIN 2.1	TEDX	Union	ESCO	Pew	FDA approval						Application of non-indirect food additives in FCM
							Direct	Indirect	Flavour	GRAS	Colour	Prior sanct.	
10380286	Oxine-copper		+			+		I					
10605217	Carbendazim		+		+								
12001284	Crocidolite	+				+		I					
12001295	Chrysotile	+				+		I					
12122677	Zineb	+	+			+		I					
13171001	ADBI; Celestoide		+			+	D		F	G			Not known.
21245023	2-Octyl-(4-dimethyl-amino)benzoic acid		+		+								
25013165	tert-Butylhydroxyanisole (BHA)	+	+	+	+	+	D	I	F	G		P	
25154523	Nonylphenol	+				+		I					
25167833	2,3,4,5-Tetrachlorophenol		+			+		I					
26027383	4-Nonylphenol, ethoxylated	+			+	+		I					
26761400	Diisodecyl phthalate		+	+	+	+		I					
27193288	(1,1,3,3-tetramethyl-butyl)phenol	+				+		I					
28553120	Diisononyl phthalate (DINP)	+		+	+	+		I					
52918635	Deltamethrin		+		+								
63449398	Chlorinated paraffins (CPs)	+				+		I					
68515480	Diisononyl phthalate (DINP)	+	+	+	+								
Σ	175	96	119	54	88	154	45	129	26	27	4	6	

1. Neltner TG, Alger HM, Leonard JE, et al. 2013. Data gaps in toxicity testing of chemicals allowed in food in the United States. *Reprod Toxicol.* 42:85-94.
2. Ash M, and Ash I. 2008. Handbook of food packaging chemicals and materials. Synapse Information Resources, Inc., Endicott, NY.
3. EFSA. 2012. Report of ESCO WG on non-plastic Food Contact Materials - Annex I, Supporting Publications.
4. Sheftel VO. 2000. Indirect food additives and polymers - Migration and toxicology. Lewis publishers, Boca Raton.

Table S2. 54 Chemicals from the SIN list 2.1 that were present on the Union and/or ESCO lists. Chemicals on the SIN list 2.1 were classified as carcinogenic, mutagenic or toxic for reproduction (CMR), as endocrine disrupters (ED) or according to further criteria referring to article 57 of REACH. The presence on the SVHC list and Annex XIV is shown. Any restrictions, specifications, specific migration limits (SMLs) of all food contact substances and applications of non-plastic food contact substances were shown. A truncated format was used for the CASRN ((X)_nXXX instead of (X)_n-XX-X).

CASRN	Chemical name	SIN list 2.1			REACH		Union list			ESCO list			
		CMR	ED	Art. 57 REACH	SVHC list	Annex XIV		Restrictions and specifications	SML [mg/kg] Group SML (T) [mg/kg]		Application	Restrictions and specifications	SML [mg/kg] Group SML (T) [mg/kg]
50000	Formaldehyde			+ ⁴			+		(T) 15	+	Cork and wood, paper and board, printing inks, rubber		(T) 15
56359	Tributyltin oxide (TBTO)			+ ⁴	+					+	Cork and wood		0.01
71432	Benzene	+ ¹								+	Coatings		0.05
75014	Chloroethylene	+ ¹					+	1 mg/kg in final product	ND	+	Printing inks, rubber	1 mg/kg in final product	ND (DL = 0.01)
75218	Ethylene oxide	+ ¹					+	1 mg/kg in final product	ND	+	Printing inks, rubber	1 mg/kg in final product	
75569	Methyloxirane	+ ¹			+		+	1 mg/kg in final product	ND	+	Printing inks, rubber	1 mg/kg in final product	
77587	Dibutyltin (dilaurate)	+ ²								+	Coatings, silicones		0.1 for Sn; (T) 0.05
78795	Isoprene	+ ¹					+	1 mg/kg in final product	ND	+	Printing inks, rubber	1 mg/kg in final product	ND (DL = 0.02)
79061	Acrylamide	+ ¹			+		+		ND	+	Paper and board, printing inks, rubber		ND (DL = 0.01); 12
80057	Bisphenol A			+ ⁴			+	Not to be used for infant feeding bottles.	0.6	+	Printing inks		0.6
84617	Dicyclohexyl phthalate (DCHP)		+ ³							+	Coatings, paper and board, printing inks, rubber		6; 30
84662	Diethyl phthalate (DEP)		+ ³							+	Rubber		
84695	Diisobutyl phthalate	+ ²			+	+				+	Coatings, paper and board		(T) 1
84742	Dibutyl phthalate (DBP)	+ ¹			+	+	+	Restricted use ⁵	0.3; (T) 60	+	Paper and board, printing inks, rubber		1; 3; 15
85687	Benzyl butyl phthalate (BBP)	+ ¹			+	+	+	Restricted use ⁶	30; (T) 60	+	Paper and board, printing inks, rubber		6

Table S2 - continued

CASRN	Chemical name	SIN list 2.1			REACH		Union list			ESCO list			
		CMR	ED	Art. 57 REACH	SVHC list	Annex XIV		Restrictions and specifications	SML [mg/kg]	Group SML (T) [mg/kg]		Application	Restrictions and specifications
94133	Propylparaben		+ ³				+			+	Printing inks		
95807	4-Methyl- <i>m</i> -phenylenediamine	+ ¹			+					+	Rubber		
96457	Ethylene thiourea	+ ¹			+					+	Rubber		0.05
98544	4- <i>tert</i> -Butylphenol			+ ⁴			+		0.05	+	Printing inks		0.05
100425	Styrene			+ ⁴			+			+	Printing inks, rubber		
101144	4,4'-Methylene-bis[2-chloroaniline]	+ ¹			+					+	Rubber		
101779	4,4'-Methylene-dianiline (MDA)	+ ¹			+	+				+	Printing inks		ND (DL = 0.01)
106898	1-Chloro-2,3-epoxypropane	+ ¹					+	1 mg/kg in final product	ND	+	Paper and board, printing inks, rubber	1 mg/kg in final product	ND (DL = 0.01)
106990	Buta-1,3-diene	+ ¹					+	1 mg/kg in final product	ND	+	Printing inks, rubber	1 mg/kg in final product	ND (DL = 0.02)
107131	Acrylonitrile	+ ¹					+			+	Printing inks, rubber	1 mg/kg in final product	ND (DL = 0.01); 0.01
108463	1,3-Dihydroxybenzene		+ ³				+		2.4	+	Printing inks, rubber		
109864	2-Methoxyethanol	+ ¹			+					+	Printing inks		
110805	2-Ethoxyethanol	+ ¹			+					+	Printing inks		(T) 3
111411	2-(2-Aminoethyl-amino)ethanol	+ ²					+	For indirect food contact only.	0.05	+	Printing inks		
115968	Tris(2-chloroethyl)phosphate (TCEP)	+ ²			+	+	+		ND	+	Printing inks		ND (DL = 0.02)
117817	Bis(2-ethylhexyl) phthalate (DEHP)	+ ¹			+	+	+	Restricted use ⁵	1.5; (T) 60	+	Paper and board, printing inks, rubber		1.5; 40
119619	Benzophenone			+ ⁴			+		0.6	+	Printing inks		(T) 0.6
123773	Diazene-1,2-dicarboxamide			+ ⁴	+					+	Rubber		
126998	2-Chlorobuta-1,3-diene	+ ¹								+	Rubber	1 mg/kg in final product	ND (DL = 0.02)
131566	2,4-Dihydroxybenzophenon		+ ³				+		(T) 6	+	Printing inks		(T) 6
131577	Benzophenone-3; Oxybenzone		+ ³				+		(T) 6	+	Printing inks		(T) 6

Table S2 - continued

CASRN	Chemical name	SIN list 2.1			REACH		Union list			ESCO list			
		CMR	ED	Art. 57 REACH	SVHC list	Annex XIV	Restrictions and specifications	SML [mg/kg]	Group SML (T) [mg/kg]	Application	Restrictions and specifications	SML [mg/kg]	Group SML (T) [mg/kg]
137268	Thiram		+ ³							+	Coatings, paper and board, rubber		ND; (T) 1
137428	Sodium methyl-dithiocarbamate		+ ³							+	Paper and board		ND
140669	4-(1,1,3,3-Tetra-methylbutyl)-phenol			+ ⁴	+					+	Printing inks		ND
151564	Ethyleneimine	+ ¹					+			+	Printing inks		ND (DL = 0.01)
611994	4,4'-Dihydroxy-benzophenone		+ ³				+		(T) 6	+	Printing inks		(T) 6
630080	Carbon monoxide	+ ¹					+						
872504	N-Methyl-2-pyrrolidone	+ ²			+		+		60	+	Printing inks		
1309644	Antimony trioxide			+ ⁴			+		0.04	+	Printing inks		0.04 for Sb
1330434	Disodium tetra-borate, anhydrous	+ ²			+		+		(T) 6	+	Paper and board, printing inks		(T) 6
3380345	Triclosan			+ ⁴			+	Provisional list ⁷		+	Printing inks		
7632044	Sodium peroxometaborate	+ ²								+	Paper and board		1
8009038	Petrolatum	+ ²								+	Coatings, rubber		
9016459	Nonylphenol, ethoxylated			+ ⁴	+					+	Paper and board		
10043353	Boric acid	+ ²			+		+		(T) 6	+	Cork and wood, printing inks		1; (T) 6
25013165	tert-Butylhydroxy-anisole (BHA)		+ ³				+		30	+	Coatings, printing inks		30; (T) 0.6
26027383	4-Nonylphenol, ethoxylated			+ ⁴	+					+	Paper and board		
28553120	Diisononyl phthalate (DINP)			+ ⁴			+	Restricted use ⁶	(T) 9; (T) 60	+	Rubber		1.8
68515480	Diisononyl phthalate (DINP)			+ ⁴			+	Restricted use ⁶	(T) 9; (T) 60	+	Printing inks		T 9
Σ	54	30	10	14	21	6	33			53			

¹ Classified CMR (Class I & II) according to Annex 1 of Directive 67/548/EEC

² Classified CMR according to Annex VI of Regulation 1272/2008

³ Endocrine disrupter in the European Commission EDC database (http://ec.europa.eu/environment/archives/docum/pdf/bkh_main.pdf)

Table S2 - *continued*

⁴ According to criteria defined by article 57, REACH

⁵ Only to be used: as plasticizer in • repeated use materials and articles; • technical support agent up to defined concentrations.

⁶ Only to be used as plasticizer in • repeated use materials and articles; • technical support agent up to defined concentrations; • plasticizer in single-use materials and articles for non-fatty foods (exception: formula, cereal-based and baby food for infants and young children).

⁷ Triclosan is on the Provisional list (http://ec.europa.eu/food/food/chemicalsafety/foodcontact/docs/080410_provisional_list_7_211009.pdf) according to articles 6 and 7 of the Commission Regulation (EU) No. 10/2011.