BACKGROUND DOCUMENT

Plastics in the Spotlight Project

Plastic food packaging chemicals & human health

Food packaging, most commonly single-use, is not only wasteful and contributes to environmental pollution, but can also harm consumers' health as chemicals contained in the packaging migrate into the food and eventually our bodies. Among the scientific community there is growing evidence of, and concern over, the impact of food contact chemicals on the nervous, endocrine and immune systems.

Rezero (Spain), Zero Waste Europe (Brussels EU), Ekologi Brez Meja (Slovenia), Zero Waste Latvia (Latvia), Za Zemiata (Bulgaria), and ZERO (Portugal) decided to test the presence of hazardous chemicals commonly used in plastic food packaging in urine samples of participants across Europe. The results will be published on the 3rd of December 2020.

Project and Methodology

The Plastics in the Spotlight project collected urine samples from 52 participants in 6 countries, to test the presence of hazardous chemicals used in plastic food packaging and assess exposure of consumers to hazardous chemicals through plastic food packaging.

Samples were sent in dry ice to Norway, where laboratory analyses of urine samples were carried out inOctober 2020 by Dr. Cathrine Thomsen's team in the Norwegian Institute of Public Health (Oslo, Norway). The results were then analysed by Professor Miquel Porta and his team at the Institut Hospital del Mar d'Investigacions Mèdiques in Barcelona (IMIM).

Urine concentrations of 28 compounds were measured.[1] Of these, 17 were phthalates metabolites[2] (and 11 phenols compounds).[3] The number of compounds detected per individual ranged between a minimum of 18 to a maximum of 23 compounds. **The mean number of compounds detected per individual was 20.5**. This figure did not vary significantly among countries.

The full aggregated results are in the tables in the Annex below.

[1] Concentrations of phthalates were analysed by high performance liquid chromatography coupled to tandem mass spectrometry (HPLC-MS-MS), and concentrations of phenols were analysed by ultra-high performance liquid chromatography coupled to tandem mass spectrometry (UPLC-MS-MS)

[2] MEP, MiBP, MnBP, MBzP, MnPeP, MCHP, MnOP, MEHP, MEHHP, MEOHP, MECPP, ohMiNP, oxoMINP, cxMiNP, ohMPHP, oh MINCH and oxoMINCH

[3] MEPA, ETPA, PRPA, BUPA, BPA, BPS, BPB, BPAF, OXBE and TRCS

Exposure to hazardous chemicals through plastic food packaging

A wide array of chemicals are used as additives in plastic food packaging to provide a number of characteristics, including flexibility (softeners and plasticizers), durability against heat or sunlight (stabilizers and antioxidants), coloring, or as fillers. Plasticizers can constitute as much as 80% of the final product for some plastic products.[4]

Most plastic additives are not bound to the polymer matrix and therefore easily leach into the surrounding environment, including the food inside the packaging.[5] Also, as the plastic particles degrade (e.g. through scratches on the surface), new layers are exposed and more additives are likely to leach from the core of the packaging to the surface, and then to the food.

These additives include phthalates and bisphenols tested in this project.

Bisphenols

The most known and commonly used bisphenol is Bisphenol A (BPA). BPA is used for the production of polycarbonate plastics (used in electronic kitchen appliances and water bottles) and for the lining of aluminium cans. Food consumption is the largest source of exposure to BPA.[6]

There is broad evidence that BPA may have adverse effects on reproduction, the nervous system, the immune system, and has been associated with cancer risks (e.g. breast cancer), as well as having implications for the metabolic and cardiovascular systems.[7] The European Chemical Agency in 2017 listed BPA as a substance of very high concern (SVHC) because of its endocrine disrupting properties for humans. The EU has restricted the use of BPA for certain products (e.g. plastic baby bottles), but those restrictions are limited in scope.

BPA has often been replaced by another substance of the bisphenols family, such as BPS, BPF and BPAF, for which there is also growing evidence of adverse effects on health.[8] “BPA free” labeled plastic packaging is likely to contain other bisphenols instead.

Phtalates

The risks posed by (many) phthalates, notably due to their endocrine disrupting properties, have been repeatedly recognised, reviewed, and assessed by various authorities all over the world. Impacts on health include child development impairment, adult reproductive toxicity, insulin resistance, overweight, asthma and cancer.[9] This group of over 30 chemicals are largely used as plasticizers and are often present in food packaging as in PVC cling wrap.

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[4] See Christoph Buchta et al., Transfusion-related Exposure to the Plasticizer di(2-ehthylhexyl) phthalate in Patients Receiving Platletpherisis Concentrate, 45(5) Transfusion 798, 798-802 (2005), www.ncbi.nlm.nih.gov/ pubmed/15847671.

[5] The potential of plastic additives to leach depends on the properties of each chemical, the environmental conditions (changes in temperature, exposure to heat or to sunshine), the properties of the substances that plastic is in contact with (for example, the pH or fat content of food contained in plastic packaging, etc

[6] CEF. 2013, Draft scientific opinion on the risks to public health related to the presence of bisphenol A (BPA) in foodstuffs – Part: exposure assessment, EFSA Journal.

[7] www.foodpackagingforum.org/fpf-2016/wp-content/uploads/2015/11/FPF_Dossier01_BPA_ohne-Blase.pdf

[8] Ben-Jonathan N, Hugo ER. Bisphenols Come in Different Flavors: Is "S" Better Than "A"?. *Endocrinology*. 2016;157(4):1321-1323. doi:10.1210/en.2016-1120: www.ncbi.nlm.nih.gov/pmc/articles/PMC4816743/

[9] Benjamin, S., et al. (2017). “Phthalates impact human health: Epidemiological evidences and plausible mechanism of action.” *Journal of Hazardous Materials* (2017).

EU legislative framework on Food Contact Materials (FCMs)

The *EU framework regulation on FCMs (EC) 1935/2004*, together with the *EU Regulation on Good Manufacturing Practices for materials and articles intended to come into contact with food (EC) 2023/2006,* set the overall EU rules on food contact materials.

The regulation aims to "ensure the effective functioning of the internal market in relation to the placing on the market in the Community of materials and articles intended to come into contact directly or indirectly with food, whilst providing the basis for securing a high level of protection of human health and the interests of consumers,"[10] and clearly states that the constituents of the FCMs (i.e. migrating chemicals) must not be transferred into the food in quantities which could endanger human health.

The specific legislation for plastic FCMs[11] sets a number of specific rules, including a Union list of substances authorised and specific migration limits. It applies to single-layer plastic materials, multilayer plastic materials and plastic layers in multi-material multi-layers, plastic coatings on lids of cans, as well as printed or coated plastic materials. Yet it does not currently apply to adhesives or printing inks, nor to colorants and solvents used in plastics. It is accompanied by a specific legislation on recycled plastics.

The EU legislation does not adequately protect human health. Insufficiencies include:

- the lack of harmonisation of all food contact materials,
- the lack of transparency and traceability on chemicals in food contact materials (notably to consumers and waste managers)
- the inadequacy of the risk assessment and
- the lack of consistency with EU chemicals legislation.

The European Parliament has called on the European Commission to reform the current FCM framework in 2019 and 2020,[12] after having already highlighted in 2016 that the lack of uniform (EU) measures on FCMs is detrimental to public health and the protection of the environment.[13]

The European Commission committed in its Farm to Form Strategy to revise the FCM legislation and come with a proposal at the end of 2022. The stakeholder consultation process is expected to start in the coming weeks.

More information on our recommendations for the revision of the legislation are available in the Zero Waste Europe position paper "**Towards safe food contact materials in toxic-free circular economy**."

[10] Regulation (EC) No 1935/2004 of the European Parliament and of the Council of 27 October 2004 on materials and articles intended to come into contact with food and repealing Directives 80/590/EEC and 89/109/EEC
[11] Commission Regulation (EU) No 10/2011 of 14 January 2011 on plastic materials and articles intended to come into contact with food.
[12] European Parliament resolution of 18 April 2019 on a comprehensive European Union framework on endocrine disruptors (2019/2683(RSP)): www.europarl.europa.eu/doceo/document/TA-8-2019-0441_EN.pdf
European Parliament resolution of 15 January 2020 on the European Green Deal (2019/2956(RSP)): www.europarl.europa.eu/doceo/document/TA-9-2020-0005_EN.pdf
[13] European Parliament resolution of 6 October 2016 on the implementation of the Food Contact Materials Regulation (EC) No 1935/2004 (2015/2259(INI)): www.europarl.europa.eu/doceo/document/TA-8-2016-0384_EN.html

Annex: full aggregated results

Concentrations of 17 phthalate metabolites (ng/mL, adjusted for specific gravity) in the 52 participants

	MEP	MiBP	MnBP	MBzP	MnPeP	MCHP	MnOP	MEHP	MEHHP
Detection and quantification (N)	50	52	52	52	52	52	52	50	52
Detected (%)	100	100	100	100	3.8	0	21.2	94.0	100
Detected and quantified (%)	100	100	100	98.1	3.8	0	1.9	86.0	100
Detected and not quantified (%)	0	0	0	0.0	0.0	0	19.2	8.0	0
Not detected (%)	0	0	0	1.9	96.2	100	78.8	6.0	0
Median	40.30	16.64	19.11	2.06	<LD	n.a	<LD	1.84	8.75
Mean	61.50	21.01	23.91	3.44	-	n.a	-	3.42	12.43
Standard deviation	75.20	18.45	24.93	4.29	-	n.a	-	3.99	17.34
Geometric mean	35.38	16.16	18.19	2.12	<LD	n.a	<LD	1.94	8.97
25th percentile	16.45	9.48	10.17	1.09	<LD	n.a	<LD	0.86	5.26
75th percentile	70.88	28.78	25.72	3.31	<LD	n.a	<LD	4.19	13.81
95th percentile	214.33	44.34	61.55	13.19	<LD	n.a	<LQ	12.50	27.20
Minimum	4.00	3.30	4.15	<LD	<LD	n.a	<LD	<LD	2.53
Maximum	420.50	122.01	168.80	24.19	4.56	n.a	3.06	18.57	126.61

	MEOHP	MECPP	ohMiNP	oxoMiNP	cxMiNP	ohMPHP	ohMINCH	oxoMINCH
Detection and quantification (%)	52	52	52	52	52	52	52	52
Detected (%)	100	100	100	100	100	100	100	100
Detected and quantified (%)	100	98.1	100	96.2	100	96.2	98.1	94.2
Detected and not quantified (%)	0	1.9	0	3.8	0	3.8	1.9	5.8
Not detected (%)	0	0	0	0	0	0	0	0
Median	6.23	12.22	10.43	3.31	8.16	2.17	3.20	2.23
Mean	8.63	16.25	17.99	6.35	16.12	3.59	8.79	5.06
Standard deviation	11.24	23.40	26.76	11.25	31.04	4.76	19.38	8.92
Geometric mean	6.28	11.96	11.29	3.53	9.68	2.31	3.97	2.56
25th percentile	3.63	7.47	6.08	1.92	5.30	1.16	1.79	1.08
75th percentile	9.82	16.15	17.97	5.03	13.08	3.34	6.15	5.97
95th percentile	19.88	38.09	67.66	31.86	55.04	15.56	42.25	23.71
Minimum	1.39	<LQ	2.60	<LQ	3.25	<LQ	<LQ	<LQ
Maximum	81.16	171.66	168.27	71.04	217.94	27.85	129.97	56.91

LD: limit of detection. LQ: limit of quantification.
n.a.: not applicable.

Concentrations of 11 phenolic compounds (ng/mL, adjusted for specific gravity) in the 52 participants

	MEPA	ETPA	PRPA	BUPA	BPA	BPS
Detection and quantification						
Detected (%)	100	100	65.4	23.1	100	50.0
Detected and quantified (%)	100	98.1	61.5	7.7	100	42.3
Detected and not quantified (%)	0	1.9	3.8	15.4	0	7.7
Not detected (%)	0	0	34.6	76.9	0	50.0
Median	7.02	1.17	0.24	<LD	2.11	<LD
Mean	42.80	8.42	2.23	1.03	3.43	1.52
Standard deviation	156.71	26.79	7.76	6.35	4.66	3.72
Geometric mean	9.08	1.78	0.23	<LD	2.20	<LD
25th percentile	4.66	0.66	<LQ	<LD	1.03	<LD
75th percentile	11.99	3.90	1.17	<LD	3.71	1.21
95th percentile	347.88	73.18	13.61	1.84	12.81	8.41
Minimum	1.44	<LQ	<LD	<LD	0.58	<LD
Maximum	852.54	166.06	52.50	45.83	27.94	23.11

	BPF	BPB	BPAF	OXBE	TRCS
Detection and quantification					
Detected (%)	5.8	0	1.9	100	96.2
Detected and quantified (%)	5.8	0	0.0	100	96.2
Detected and not quantified (%)	0.0	0	1.9	0	0.0
Not detected (%)	94.2	100	98.1	0	3.8
Median	<LD	n.a.	<LD	4.00	0.54
Mean	-	n.a.	-	48.79	29.23
Standard deviation	-	n.a.	-	264.63	119.03
Geometric mean	<LD	n.a.	<LD	5.47	0.84
25th percentile	<LD	n.a.	<LD	1.66	0.30
75th percentile	<LD	n.a.	<LD	12.98	0.96
95th percentile	4.28	n.a.	<LD	73.38	374.90
Minimum	<LD	n.a.	<LD	0.70	<LD
Maximum	5.29	n.a.	<LQ	1915.1	672.24

LD: limit of detection. LQ: limit of quantification.
n.a.: not applicable.