An integrated human health risk assessment framework for alkylphenols due to drinking water and crops' food consumption

Luca Penserini[1], Beatrice Cantoni[1], Marco Gabrielli[1], Elena Sezenna[1], Sabrina Saponaro[1], Manuela Antonelli[1,*]

[1] *Politecnico Milano, Department of Civil and Environmental Engineering (DICA) - Environmental Section, Piazza Leonardo da Vinci 32, 20133 Milano, Italy*

* Corresponding Author: **Manuela Antonelli**

E-mail: manuela.antonelli@polimi.it

Supplementary Materials

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Section S1: Stochastic simulations

In this section the methodologies adopted for the fitting statistical distributions of NP and BPA data and the application of uncertainty analysis are explained. These methodologies were applied throughout the different steps of the developed probabilistic QCRA procedure.

Section S1.1: Definition of input and output distributions

For each collected input and estimated output, the dataset available was used to fit their statistical distributions. Fits to different statistical distributions were tested, in particular lognormal, normal, logistic, Weibull, gamma, beta, Rayleigh, uniform and triangular were the chosen distributions. The fit function in the R *fitdistrplus* package, which applies a Maximum Likelihood Estimation (MLE) method, was selected to fit data to specific distributions. Then, the statistical distribution having the minimum Akaike Information Criterion (AIC) was selected. Since, for C_{EXP} data, a high percentage of censored data were present, the method explained in [1] was used for the inclusion of left-censored in the fitted statistical distributions, namely the Maximum Likelihood Estimation method for left-censored data (MLE_{LC}).

Section S1.2: Uncertainty analysis

Uncertainty analyses were performed in different steps of the developed QCRA procedure, for the estimation of $Dose_{EXP}$ values first, and of BQ, then. A Monte Carlo simulation method was applied, which allowed for the simultaneous forward propagation of all the inputs uncertainties into the output distribution [2]. For the $Dose_{EXP,i,j}$ estimation (*i* referred to the contaminant, *j* to the exposure source), all the obtained $C_{EXP,i,j}$ and IR_j were simultaneously sampled from their estimated statistical distributions and randomly combined together, resulting in 1,000 values of $Dose_{EXP,i,j}$. Then the same procedure was applied to obtain 1,000 values of BQ, starting from $Dose_{EXP,i,j}$ and $HBGV_i$ estimated statistical distributions. As confirmed by the two previous work [2, 3], 1,000 simulations were enough to get stable outputs.

Section S2: Exposure assessment

Table S1: Summary of the C_{EXP} collected from literature for BPA and NP for each compartment, reporting: number of available data and studies, concentration data range and study's reference.

Compartment	Contaminant	# available data	# available studies	Range	Unit	Reference
Groundwater	BPA	10	9	0.01 – 2.30	µg L^{-1}	[4]–[12]
	NP	8	8	0.02 – 3.85	µg L^{-1}	[4]–[11]
Surface water	BPA	95	55	0.0055 – 46.70	µg L^{-1}	[4], [5], [7]–[60]
	NP	37	13	0.0012 – 2.55	µg L^{-1}	[4], [5], [7], [16], [21], [22], [26], [27], [39], [41], [46], [59], [61]
Treated drinking water	BPA	37	12	0.0005 – 3.57	µg L^{-1}	[38], [62]–[74]
	NP	34	11	<0.0001 – 1.10	µg L^{-1}	[62], [65]–[69], [71], [73]–[76]
Consumed tap water	BPA	88	27	<0.0001 – 3.61	µg L^{-1}	[8], [11], [16], [23], [26], [29], [39], [62], [71], [72], [77]–[93]
	NP	95	17	<0.0001 – 6.19	µg L^{-1}	[16], [23], [26], [39], [62], [71], [75], [77], [79], [80], [82]–[85], [90], [92], [94]
Consumed bottled water	BPA	54	13	<0.00001 – 1.18	µg L^{-1}	[77], [83], [84], [88], [95]–[103]
	NP	42	11	<0.006 – 0.54	µg L^{-1}	[77], [83], [84], [96], [99]–[101], [103]–[106]
Untreated wastewater	BPA	32	14	<0.005 – 29.74	µg L^{-1}	[7], [11], [15], [21], [39], [57], [73], [107]–[113]
	NP	7	5	0.0176 – 14.18	µg L^{-1}	[7], [21], [39], [73], [112]
Treated wastewater	BPA	31	14	0.0104 – 9.40	µg L^{-1}	[5]–[7], [11], [15], [21], [57], [73], [107], [109], [110], [112], [114], [115]
	NP	10	7	0.0006 – 4.20	µg L^{-1}	[4], [5], [7], [21], [73], [112], [116]
Biosolids	BPA	21	7	63.60 – 236,000	µg kg^{-1}	[15], [107], [110], [117]–[120]
	NP	6	3	2,000 – 1,359,000	µg kg^{-1}	[121]–[123]
Agricultural soil	BPA	55	16	<0.0042 – 167.90	µg kg^{-1}	[4], [5], [20], [35], [81], [119], [120], [124]–[133]
	NP	8	5	4.43 – 542.00	µg kg^{-1}	[4]–[6], [134], [135]
Food – Cereals	BPA	22	5	1.60 – 1,740	µg kg^{-1}	[4], [78], [81], [136], [137]
	NP	18	2	<0.06 – 440	µg kg^{-1}	[4], [136]
Food – Fruits and vegetables	BPA	62	11	<0.0009 – 1,188	µg kg^{-1}	[4], [35], [36], [81], [131], [137]–[142]
	NP	42	5	<0.0007 – 700.00	µg kg^{-1}	[4], [134], [140], [141], [143]

REFERENCES

[1] B. Cantoni, R. Delli Compagni, A. Turolla, I. Epifani, and M. Antonelli, “A statistical assessment of micropollutants occurrence, time trend, fate and human health risk using left-censored water quality data,” *Chemosphere*, vol. 257, p. 127095, 2020, doi: 10.1016/j.chemosphere.2020.127095.

[2] B. Cantoni *et al.*, “Development of a quantitative chemical risk assessment (QCRA) procedure for contaminants of emerging concern in drinking water supply,” *Water Res.*, vol. 194, p. 116911, 2021, doi: 10.1016/j.watres.2021.116911.

[3] L. Penserini *et al.*, “Quantitative chemical risk assessment for mixtures: Application to alkylphenol mixtures and phthalate mixtures in tap and bottled water,” *Environ. Int.*, vol. 165, no. April, p. 107294, 2022, doi: 10.1016/j.envint.2022.107294.

[4] Y. Li, H. Liu, L. Zhang, C. Lou, and Y. Wang, “Phenols in soils and agricultural products irrigated with reclaimed water,” *Environ. Pollut.*, vol. 276, p. 116690, 2021, doi: 10.1016/j.envpol.2021.116690.

[5] S. Saha, N. Narayanan, N. Singh, and S. Gupta, “Occurrence of endocrine disrupting chemicals (EDCs) in river water, ground water and agricultural soils of India,” *Int. J. Environ. Sci. Technol.*, no. 0123456789, 2022, doi: 10.1007/s13762-021-03858-2.

[6] S. Wang *et al.*, “Migration and health risks of nonylphenol and bisphenol a in soil-winter wheat systems with long-term reclaimed water irrigation,” *Ecotoxicol. Environ. Saf.*, vol. 158, no. March, pp. 28–36, 2018, doi: 10.1016/j.ecoenv.2018.03.082.

[7] A. I. Farounbi and N. P. Ngqwala, “Occurrence of selected endocrine disrupting compounds in the eastern cape province of South Africa,” *Environ. Sci. Pollut. Res.*, vol. 27, no. 14, pp. 17268–17279, 2020, doi: 10.1007/s11356-020-08082-y.

[8] A. Fazolo *et al.*, “Assessment of Conventional Full-Scale Treatment for the Removal of Endocrine Disruptors and Pharmaceuticals Present in the Tibagi River (Paraná

State, Brazil),” *Front. Environ. Sci.*, vol. 9, no. September, pp. 1–12, 2021, doi: 10.3389/fenvs.2021.715772.

[9] T. E. Félix-Cañedo, J. C. Durán-Álvarez, and B. Jiménez-Cisneros, “The occurrence and distribution of a group of organic micropollutants in Mexico City’s water sources,” *Sci. Total Environ.*, vol. 454–455, pp. 109–118, 2013, doi: 10.1016/j.scitotenv.2013.02.088.

[10] M. Fu, Z. Li, and H. Gao, “Distribution characteristics of nonylphenol in Jiaozhou Bay of Qingdao and its adjacent rivers,” *Chemosphere*, vol. 69, no. 7, pp. 1009–1016, 2007, doi: 10.1016/j.chemosphere.2007.04.061.

[11] K. Goeury, S. Vo Duy, G. Munoz, M. Prévost, and S. Sauvé, “Analysis of Environmental Protection Agency priority endocrine disruptor hormones and bisphenol A in tap, surface and wastewater by online concentration liquid chromatography tandem mass spectrometry,” *J. Chromatogr. A*, vol. 1591, pp. 87–98, 2019, doi: 10.1016/j.chroma.2019.01.016.

[12] M. Gorga, S. Insa, M. Petrovic, and D. Barceló, “Occurrence and spatial distribution of EDCs and related compounds in waters and sediments of Iberian rivers,” *Science of the Total Environment*, vol. 503–504. pp. 69–86, 2015, doi: 10.1016/j.scitotenv.2014.06.037.

[13] O. P. Heemken, H. Reincke, B. Stachel, and N. Theobald, “The occurrence of xenoestrogens in the Elbe river and the North Sea,” *Chemosphere*, vol. 45, no. 3, pp. 245–259, 2001, doi: 10.1016/S0045-6535(00)00570-1.

[14] C. Huang, L. H. Wu, G. Q. Liu, L. Shi, and Y. Guo, “Occurrence and Ecological Risk Assessment of Eight Endocrine-Disrupting Chemicals in Urban River Water and Sediments of South China,” *Arch. Environ. Contam. Toxicol.*, vol. 75, no. 2, pp. 224–235, 2018, doi: 10.1007/s00244-018-0527-9.

[15] Z. Huang *et al.*, “Occurrence, mass loads and risks of bisphenol analogues in the Pearl River Delta region, South China: Urban rainfall runoff as a potential source for receiving rivers,” *Environ. Pollut.*, vol. 263, p. 114361, 2020, doi: 10.1016/j.envpol.2020.114361.

[16] W. F. Jardim *et al.*, “An integrated approach to evaluate emerging contaminants in drinking water,” *Sep. Purif. Technol.*, vol. 84, pp. 3–8, 2012, doi: 10.1016/j.seppur.2011.06.020.

[17] D. D. A. Azevedo, S. Lacorte, P. Viana, and D. Barceló, “Occurrence of Nonylphenol and Bisphenol-A in Surface Waters from Portugal,” *J. Braz. Chem. Soc.*, vol. 12, no. 4, pp. 532–537, 2001, doi: 10.1590/S0103-50532001000400015.

[18] H. Jin and L. Zhu, “Occurrence and partitioning of bisphenol analogues in water and sediment from Liaohe River Basin and Taihu Lake, China,” *Water Res.*, vol. 103, pp. 343–351, 2016, doi: 10.1016/j.watres.2016.07.059.

[19] H. Kawahata, H. Ohta, M. Inoue, and A. Suzuki, “Endocrine disrupter nonylphenol and bisphenol A contamination in Okinawa and Ishigaki Islands, Japan - Within coral reefs and adjacent river mouths,” *Chemosphere*, vol. 55, no. 11, pp. 1519–1527, 2004, doi: 10.1016/j.chemosphere.2004.01.032.

[20] J. Lan, Z. Shen, W. Gao, and A. Liu, “Occurrence of bisphenol-A and its brominated derivatives in tributary and estuary of Xiaoqing River adjacent to Bohai Sea, China,” *Mar. Pollut. Bull.*, vol. 149, no. August, p. 110551, 2019, doi: 10.1016/j.marpolbul.2019.110551.

[21] K. Lei, H. Y. Pan, Y. Zhu, W. Chen, and C. Y. Lin, “Pollution characteristics and mixture risk prediction of phenolic environmental estrogens in rivers of the Beijing–Tianjin–Hebei urban agglomeration, China,” *Sci. Total Environ.*, vol. 787, p. 147646, 2021, doi: 10.1016/j.scitotenv.2021.147646.

[22] D. Liu *et al.*, “Occurrence, distribution, and risk assessment of alkylphenols, bisphenol A, and tetrabromobisphenol A in surface water, suspended particulate matter, and sediment in Taihu Lake and its tributaries,” *Mar. Pollut. Bull.*, vol. 112, no. 1–2, pp. 142–150, 2016, doi: 10.1016/j.marpolbul.2016.08.026.

[23] R. Loos, J. Wollgast, T. Huber, and G. Hanke, “Polar herbicides, pharmaceutical products, perfluorooctanesulfonate (PFOS), perfluorooctanoate (PFOA), and nonylphenol and its carboxylates and ethoxylates in surface and tap waters around Lake Maggiore in Northern Italy,” *Anal. Bioanal. Chem.*, vol. 387, no. 4, pp. 1469–1478, 2007, doi: 10.1007/s00216-006-1036-7.

[24] J. C. López-Doval, C. C. Montagner, A. F. de Alburquerque, V. Moschini-Carlos, G. Umbuzeiro, and M. Pompêo, “Nutrients, emerging pollutants and pesticides in a tropical urban reservoir: Spatial distributions and risk assessment,” *Sci. Total Environ.*, vol. 575, pp. 1307–1324, 2017, doi: 10.1016/j.scitotenv.2016.09.210.

[25] Y. Luo *et al.*, “A review on the occurrence of micropollutants in the aquatic environment and their fate and removal during wastewater treatment,” *Sci. Total Environ.*, vol. 473–474, pp. 619–641, Mar. 2014, doi: 10.1016/j.scitotenv.2013.12.065.

[26] K. C. Machado *et al.*, “A preliminary nationwide survey of the presence of emerging contaminants in drinking and source waters in Brazil,” *Sci. Total Environ.*, vol. 572, pp. 138–146, 2016, doi: 10.1016/j.scitotenv.2016.07.210.

[27] N. Y. Mar da Costa *et al.*, “Biogeochemical mechanisms controlling trophic state and micropollutant concentrations in a tropical artificial lake,” *Environ. Earth Sci.*, vol. 75, no. 10, 2016, doi: 10.1007/s12665-016-5629-y.

[28] C. Basheer, H. K. Lee, and K. S. Tan, “Endocrine disrupting alkylphenols and bisphenol-A in coastal waters and supermarket seafood from Singapore,” *Mar. Pollut. Bull.*, vol. 48, no. 11–12, pp. 1161–1167, 2004, doi: 10.1016/j.marpolbul.2004.04.009.

[29] S. M. Melo and N. M. Brito, “Analysis and occurrence of endocrine disruptors in Brazilian water by HPLC-fluorescence detection,” *Water. Air. Soil Pollut.*, vol. 225, no. 1, 2014, doi: 10.1007/s11270-013-1783-y.

[30] J. Michałowicz, “Bisphenol A - Sources, toxicity and biotransformation,” *Environmental Toxicology and Pharmacology*, vol. 37, no. 2. Elsevier, pp. 738–758, Mar. 2014, doi: 10.1016/j.etap.2014.02.003.

[31] M. Milanović *et al.*, “Seasonal variations of bisphenol A in the Danube River by the municipality of Novi Sad, Serbia,” *J. Serbian Chem. Soc.*, vol. 81, no. 3, pp. 333–345, 2016, doi: 10.2298/JSC150721095M.

[32] O. S. Olatunji, O. S. Fatoki, B. O. Opeolu, B. J. Ximba, and R. Chitongo, “Determination of selected steroid hormones in some surface water around animal farms in Cape Town using HPLC-DAD,” *Environ. Monit. Assess.*, vol. 189, no. 7, 2017, doi: 10.1007/s10661-017-6070-8.

[33] K. Ozhan and E. Kocaman, “Temporal and Spatial Distributions of Bisphenol A in Marine and Freshwaters in Turkey,” *Arch. Environ. Contam. Toxicol.*, vol. 76, no. 2, pp. 246–254, 2019, doi: 10.1007/s00244-018-00594-6.

[34] L. Patrolecco, S. Capri, S. De Angelis, R. Pagnotta, S. Polesello, and S. Valsecchi, “Partition of nonylphenol and related compounds among different aquatic compartments in Tiber river (central Italy),” *Water. Air. Soil Pollut.*, vol. 172, no. 1–4, pp. 151–166, 2006, doi: 10.1007/s11270-005-9067-9.

[35] Y. Picó, R. Alvarez-Ruiz, A. H. Alfarhan, M. A. El-Sheikh, H. O. Alshahrani, and D. Barceló, “Pharmaceuticals, pesticides, personal care products and microplastics contamination assessment of Al-Hassa irrigation network (Saudi Arabia) and its shallow lakes,” *Sci. Total Environ.*, vol. 701, 2020, doi: 10.1016/j.scitotenv.2019.135021.

[36] Y. Picó, J. Campo, A. H. Alfarhan, M. A. El-Sheikh, and D. Barceló, “A reconnaissance study of pharmaceuticals, pesticides, perfluoroalkyl substances and organophosphorus flame retardants in the aquatic environment, wild plants and vegetables of two Saudi Arabia urban areas: Environmental and human health risk assessment,” *Sci. Total Environ.*, vol. 776, 2021, doi: 10.1016/j.scitotenv.2021.145843.

[37] G. Pojana, A. Gomiero, N. Jonkers, and A. Marcomini, “Natural and synthetic endocrine disrupting compounds (EDCs) in water, sediment and biota of a coastal lagoon,” *Environ. Int.*, vol. 33, no. 7, pp. 929–936, 2007, doi: 10.1016/j.envint.2007.05.003.

[38] R. L. Ramos, V. R. Moreira, Y. A. R. Lebron, A. V. Santos, L. V. S. Santos, and M. C. S. Amaral, “Phenolic compounds seasonal occurrence and risk assessment in surface and treated waters in Minas Gerais—Brazil,” *Environ. Pollut.*, vol. 268, p. 115782, 2021, doi: 10.1016/j.envpol.2020.115782.

[39] M. Čelić, B. D. Škrbić, S. Insa, J. Živančev, M. Gros, and M. Petrović, “Occurrence and assessment of environmental risks of endocrine disrupting compounds in drinking, surface and wastewaters in Serbia,” *Environ. Pollut.*, vol. 262, 2020, doi: 10.1016/j.envpol.2020.114344.

[40] J. A. Sabino, A. L. de Sá Salomão, P. M. de Oliveira Muniz Cunha, R. Coutinho, and M. Marques, “Occurrence of organic micropollutants in an urbanized sub-basin and ecological risk assessment,” *Ecotoxicology*, vol. 30, no. 1, pp. 130–141, 2021, doi: 10.1007/s10646-020-02304-2.

[41] N. Salgueiro-González, I. Turnes-Carou, V. Besada, S. Muniategui-Lorenzo, P. López-Mahía, and D. Prada-Rodríguez, “Occurrence, distribution and bioaccumulation of endocrine disrupting compounds in water, sediment and biota samples from a

European river basin," *Sci. Total Environ.*, vol. 529, pp. 121–130, 2015, doi: 10.1016/j.scitotenv.2015.05.048.

[42] Z. N. Shehab, N. R. Jamil, and A. Z. Aris, "Occurrence, environmental implications and risk assessment of Bisphenol A in association with colloidal particles in an urban tropical river in Malaysia," *Sci. Rep.*, vol. 10, no. 1, pp. 1–16, 2020, doi: 10.1038/s41598-020-77454-8.

[43] W. Si *et al.*, "Investigating the role of colloids on the distribution of bisphenol analogues in surface water from an ecological demonstration area, China," *Sci. Total Environ.*, vol. 673, pp. 699–707, 2019, doi: 10.1016/j.scitotenv.2019.04.142.

[44] J. C. V. Sposito *et al.*, "Emerging contaminants in Brazilian rivers: Occurrence and effects on gene expression in zebrafish (Danio rerio) embryos," *Chemosphere*, vol. 209, pp. 696–704, 2018, doi: 10.1016/j.chemosphere.2018.06.046.

[45] K. M. Katrina and M. P. Espino, "Occurrence and distribution of hormones and bisphenol A in Laguna Lake, Philippines," *Chemosphere*, vol. 256, p. 127122, 2020, doi: 10.1016/j.chemosphere.2020.127122.

[46] B. Stachel *et al.*, "Xenoestrogens in the River Elbe and its tributaries," *Environ. Pollut.*, vol. 124, no. 3, pp. 497–507, 2003, doi: 10.1016/S0269-7491(02)00483-9.

[47] US EPA, "Bisphenol A Action Plan (CASRN 80-05-7) [CA Index Name: Phenol, 4,4'-(1-methylethylidene)bis-]," *Environ. Heal.*, p. 22, 2010, [Online]. Available: http://www.hhs.gov/safety/bpa/.%0Ahttps://www.epa.gov/sites/production/files/2015-09/documents/bpa_action_plan.pdf.

[48] A. D. Vethaak *et al.*, "An integrated assessment of estrogenic contamination and biological effects in the aquatic environment of The Netherlands," *Chemosphere*, vol. 59, no. 4, pp. 511–524, 2005, doi: 10.1016/j.chemosphere.2004.12.053.

[49] D. Voutsa, P. Hartmann, C. Schaffner, and W. Giger, "Benzotriazoles, alkylphenols

and bisphenol A in municipal wastewaters and in the Glatt River, Switzerland," *Environ. Sci. Pollut. Res.*, vol. 13, no. 5, pp. 333–341, 2006, doi: 10.1065/espr2006.01.295.

[50] R. Céspedes, S. Lacorte, D. Raldúa, A. Ginebreda, D. Barceló, and B. Piña, "Distribution of endocrine disruptors in the Llobregat River basin (Catalonia, NE Spain)," *Chemosphere*, vol. 61, no. 11, pp. 1710–1719, 2005, doi: 10.1016/j.chemosphere.2005.03.082.

[51] S. Y. Wee, A. Z. Aris, F. M. Yusoff, and S. M. Praveena, "Occurrence and risk assessment of multiclass endocrine disrupting compounds in an urban tropical river and a proposed risk management and monitoring framework," *Sci. Total Environ.*, vol. 671, pp. 431–442, 2019, doi: 10.1016/j.scitotenv.2019.03.243.

[52] M. Wu *et al.*, "Seasonal and spatial distribution of 4-tert-octylphenol, 4-nonylphenol and bisphenol A in the Huangpu River and its tributaries, Shanghai, China," *Environ. Monit. Assess.*, vol. 185, no. 4, pp. 3149–3161, 2013, doi: 10.1007/s10661-012-2779-6.

[53] E. G. B. Xu, S. Liu, G.-G. Ying, G. J. S. Zheng, J. H. W. Lee, and K. M. Y. Leung, "The occurrence and ecological risks of endocrine disrupting chemicals in sewage effluents from three different sewage treatment plants, and in natural seawater from a marine reserve of Hong Kong," *Mar. Pollut. Bull.*, vol. 85, no. 2, pp. 352–362, Aug. 2014, doi: 10.1016/j.marpolbul.2014.02.029.

[54] E. Yamazaki *et al.*, "Bisphenol A and other bisphenol analogues including BPS and BPF in surface water samples from Japan, China, Korea and India," *Ecotoxicol. Environ. Saf.*, vol. 122, pp. 565–572, 2015, doi: 10.1016/j.ecoenv.2015.09.029.

[55] Y. Yoon, J. Ryu, J. Oh, B. G. Choi, and S. A. Snyder, "Occurrence of endocrine disrupting compounds, pharmaceuticals, and personal care products in the Han River

(Seoul, South Korea)," *Sci. Total Environ.*, vol. 408, no. 3, pp. 636–643, 2010, doi: 10.1016/j.scitotenv.2009.10.049.

[56] Y. Zhang, W. Meng, and Y. Zhang, "Occurrence and Partitioning of Phenolic Endocrine-Disrupting Chemicals (EDCs) Between Surface Water and Suspended Particulate Matter in the North Tai Lake Basin, Eastern China," *Bull. Environ. Contam. Toxicol.*, vol. 92, no. 2, pp. 148–153, Feb. 2014, doi: 10.1007/s00128-013-1136-y.

[57] F. L. Chiriac, I. Paun, F. Pirvu, L. F. Pascu, and T. Galaon, "Occurrence and Fate of Bisphenol A and its Congeners in Two Wastewater Treatment Plants and Receiving Surface Waters in Romania," *Environ. Toxicol. Chem.*, vol. 40, no. 2, pp. 435–446, 2021, doi: 10.1002/etc.4929.

[58] F. L. Chiriac, I. Paun, V. Iancu, P. Florinela, M. Niculescu, and T. Galaon, "Occurrence of phenolic endocrine disruptors in Danube Delta, Romania," *Rev. Chim.*, vol. 71, no. 7, pp. 316–324, 2020, doi: 10.37358/RC.20.7.8250.

[59] J. M. M. Corrêa, A. L. Sanson, C. F. Machado, S. F. Aquino, and R. J. C. F. Afonso, "Occurrence of contaminants of emerging concern in surface waters from Paraopeba River Basin in Brazil: seasonal changes and risk assessment," *Environ. Sci. Pollut. Res.*, vol. 28, no. 23, pp. 30242–30254, 2021, doi: 10.1007/s11356-021-12787-z.

[60] S. Esteban, M. Gorga, M. Petrovic, S. González-Alonso, D. Barceló, and Y. Valcárcel, "Analysis and occurrence of endocrine-disrupting compounds and estrogenic activity in the surface waters of Central Spain," *Sci. Total Environ.*, vol. 466–467, pp. 939–951, 2014, doi: 10.1016/j.scitotenv.2013.07.101.

[61] Z. Mao, X. F. Zheng, Y. Q. Zhang, X. X. Tao, Y. Li, and W. Wang, "Occurrence and biodegradation of nonylphenol in the environment," *Int. J. Mol. Sci.*, vol. 13, no. 1, pp. 491–505, 2012, doi: 10.3390/ijms13010491.

[62] M. J. Benotti, R. A. Trenholm, B. J. Vanderford, J. C. Holady, B. D. Stanford, and S. A. Snyder, “Pharmaceuticals and endocrine disrupting compounds in U.S. drinking water,” *Environ. Sci. Technol.*, vol. 43, no. 3, pp. 597–603, 2009, doi: 10.1021/es801845a.

[63] S. Rodriguez-Mozaz, M. J. López De Alda, and D. Barceló, “Monitoring of estrogens, pesticides and bisphenol A in natural waters and drinking water treatment plants by solid-phase extraction-liquid chromatography-mass spectrometry,” *J. Chromatogr. A*, vol. 1045, no. 1–2, pp. 85–92, 2004, doi: 10.1016/j.chroma.2004.06.040.

[64] P. E. Stackelberg, E. T. Furlong, M. T. Meyer, S. D. Zaugg, A. K. Henderson, and D. B. Reissman, “Persistence of pharmaceutical compounds and other organic wastewater contaminants in a conventional drinking-water-treatment plant,” *Sci. Total Environ.*, vol. 329, no. 1–3, pp. 99–113, 2004, doi: 10.1016/j.scitotenv.2004.03.015.

[65] P. E. Stackelberg, J. Gibs, E. T. Furlong, M. T. Meyer, S. D. Zaugg, and R. L. Lippincott, “Efficiency of conventional drinking-water-treatment processes in removal of pharmaceuticals and other organic compounds,” *Sci. Total Environ.*, vol. 377, no. 2–3, pp. 255–272, 2007, doi: 10.1016/j.scitotenv.2007.01.095.

[66] C. Stavrakakis, R. Colin, V. Hequet, C. Faur, and P. Le Cloirec, “Analysis of endocrine disrupting compounds in wastewater and drinking water treatment plants at the nanogram per litre level,” *Environ. Technol.*, vol. 29, no. 3, pp. 279–286, 2008, doi: 10.1080/09593330802099452.

[67] H. W. Chen *et al.*, “Occurrence and assessment of treatment efficiency of nonylphenol, octylphenol and bisphenol-A in drinking water in Taiwan,” *Sci. Total Environ.*, vol. 449, pp. 20–28, 2013, doi: 10.1016/j.scitotenv.2013.01.038.

[68] M. Chen, K. Ohman, C. Metcalfe, M. G. Ikonomou, P. L. Amatya, and J. Wilson, “Pharmaceuticals and endocrine disruptors in wastewater treatment effluents and in the

water supply system of Calgary, Alberta, Canada," *Water Qual. Res. J. Canada*, vol. 41, no. 4, pp. 351–364, 2006, doi: 10.2166/wqrj.2006.039.

[69] Y. Y. Gou *et al.*, "Estrogenic effects in the influents and effluents of the drinking water treatment plants," *Environ. Sci. Pollut. Res.*, vol. 23, no. 9, pp. 8518–8528, 2016, doi: 10.1007/s11356-015-5946-9.

[70] S. Kleywegt *et al.*, "Pharmaceuticals, hormones and bisphenol A in untreated source and finished drinking water in Ontario, Canada - Occurrence and treatment efficiency," *Sci. Total Environ.*, vol. 409, no. 8, pp. 1481–1488, 2011, doi: 10.1016/j.scitotenv.2011.01.010.

[71] R. X. Li, C. M. Wang, J. kun Cao, W. X. Cao, Q. Xu, and J. Li, "Monitoring three typical phenol endocrine disrupting compounds in drinking water of Suzhou urban area–from raw water to tap water," *Int. J. Environ. Anal. Chem.*, vol. 98, no. 10, pp. 921–937, 2018, doi: 10.1080/03067319.2018.1516213.

[72] K. C. Makris and S. A. Snyder, "Screening of pharmaceuticals and endocrine disrupting compounds in water supplies of Cyprus," *Water Sci. Technol.*, vol. 62, no. 11, pp. 2720–2728, 2010, doi: 10.2166/wst.2010.549.

[73] B. Morasch *et al.*, "Occurrence and fate of micropollutants in the Vidy Bay of Lake Geneva, Switzerland. Part II: Micropollutant removal between wastewater and raw drinking water," *Environ. Toxicol. Chem.*, vol. 29, no. 8, pp. 1658–1668, 2010, doi: 10.1002/etc.222.

[74] L. P. Padhye, H. Yao, F. T. Kung'u, and C. H. Huang, "Year-long evaluation on the occurrence and fate ofpharmaceuticals, personal care products, andendocrine disrupting chemicals in an urban drinking water treatment plant," *Water Res.*, vol. 51, pp. 266–276, 2014, doi: 10.1016/j.watres.2013.10.070.

[75] J. Rajasärkkä, M. Pernica, J. Kuta, J. Lašňák, Z. Šimek, and L. Bláha, "Drinking water

contaminants from epoxy resin-coated pipes: A field study," *Water Res.*, vol. 103, pp. 133–140, 2016, doi: 10.1016/j.watres.2016.07.027.

[76] M. Petrović, S. Gonzalez, and D. Barceló, "Analysis and removal of emerging contaminants in wastewater and drinking water," *TrAC - Trends Anal. Chem.*, vol. 22, no. 10, pp. 685–696, 2003, doi: 10.1016/S0165-9936(03)01105-1.

[77] N. Casajuana and S. Lacorte, "Presence and release of phthalic esters and other endocrine disrupting compounds in drinking water," *Chromatographia*, vol. 57, no. 9–10, pp. 649–655, 2003, doi: 10.1007/BF02491744.

[78] P. Chakraborty *et al.*, "Endocrine-disrupting chemicals used as common plastic additives: Levels, profiles, and human dietary exposure from the Indian food basket," *Sci. Total Environ.*, vol. 810, p. 152200, 2022, doi: 10.1016/j.scitotenv.2021.152200.

[79] Y. C. Cheng, H. W. Chen, W. L. Chen, C. Y. Chen, and G. S. Wang, "Occurrence of nonylphenol and bisphenol A in household water pipes made of different materials," *Environ. Monit. Assess.*, vol. 188, no. 10, 2015, doi: 10.1007/s10661-016-5556-0.

[80] A. Colin, C. Bach, C. Rosin, J. F. Munoz, and X. Dauchy, "Is drinking water a major route of human exposure to alkylphenol and bisphenol contaminants in France?," *Arch. Environ. Contam. Toxicol.*, vol. 66, no. 1, pp. 86–99, 2014, doi: 10.1007/s00244-013-9942-0.

[81] D. Fan *et al.*, "Exposure of preschool-aged children to highly-concerned bisphenol analogues in Nanjing, East China," *Ecotoxicol. Environ. Saf.*, vol. 234, no. March, p. 113397, 2022, doi: 10.1016/j.ecoenv.2022.113397.

[82] H. M. Kuch and K. Ballschmiter, "Determination of endocrine-disrupting phenolic compounds and estrogens in surface and drinking water by HRGC-(NCI)-MS in the picogram per liter range," *Environ. Sci. Technol.*, vol. 35, no. 15, pp. 3201–3206, 2001, doi: 10.1021/es010034m.

[83] X. Li, G. G. Ying, H. C. Su, X. B. Yang, and L. Wang, "Simultaneous determination and assessment of 4-nonylphenol, bisphenol A and triclosan in tap water, bottled water and baby bottles," *Environ. Int.*, vol. 36, no. 6, pp. 557–562, 2010, doi: 10.1016/j.envint.2010.04.009.

[84] S. Maggioni, P. Balaguer, C. Chiozzotto, and E. Benfenati, "Screening of endocrine-disrupting phenols, herbicides, steroid estrogens, and estrogenicity in drinking water from the waterworks of 35 Italian cities and from PET-bottled mineral water," *Environ. Sci. Pollut. Res.*, vol. 20, no. 3, pp. 1649–1660, 2013, doi: 10.1007/s11356-012-1075-x.

[85] C. C. Montagner *et al.*, "Ten years-snapshot of the occurrence of emerging contaminants in drinking, surface and ground waters and wastewaters from São Paulo State, Brazil," *J. Braz. Chem. Soc.*, vol. 30, no. 3, pp. 614–632, 2019, doi: 10.21577/0103-5053.20180232.

[86] I. Notardonato, M. V. Russo, and P. Avino, "Phthalates and bisphenol-A residues in water samples: an innovative analytical approach," *Rend. Lincei*, vol. 29, no. 4, pp. 831–840, 2018, doi: 10.1007/s12210-018-0745-0.

[87] E. K. Radwan, M. B. M. Ibrahim, A. Adel, and M. Farouk, "The occurrence and risk assessment of phenolic endocrine-disrupting chemicals in Egypt's drinking and source water," *Environ. Sci. Pollut. Res.*, vol. 27, no. 2, pp. 1776–1788, 2020, doi: 10.1007/s11356-019-06887-0.

[88] V. A. Santhi, N. Sakai, E. D. Ahmad, and A. M. Mustafa, "Occurrence of bisphenol A in surface water, drinking water and plasma from Malaysia with exposure assessment from consumption of drinking water," *Sci. Total Environ.*, vol. 427–428, pp. 332–338, 2012, doi: 10.1016/j.scitotenv.2012.04.041.

[89] F. F. Sodré and T. R. Sampaio, "Development and application of a SPE-LC-QTOF

method for the quantification of micropollutants of emerging concern in drinking waters from the Brazilian capital," *Emerg. Contam.*, vol. 6, pp. 72–81, 2020, doi: 10.1016/j.emcon.2020.01.001.

[90] F. F. Sodré, M. A. F. Locatelli, and W. F. Jardim, "Occurrence of emerging contaminants in Brazilian drinking waters: A sewage-to-tap issue," *Water. Air. Soil Pollut.*, vol. 206, no. 1–4, pp. 57–67, 2010, doi: 10.1007/s11270-009-0086-9.

[91] C. Y. Tang *et al.*, "Influence of polluted SY river on child growth and sex hormones," *Biomed. Environ. Sci.*, vol. 25, no. 3, pp. 291–296, 2012, doi: 10.3967/0895-3988.2012.03.006.

[92] Y. Valcárcel *et al.*, "Determining the presence of chemicals with suspected endocrine activity in drinking water from the Madrid region (Spain) and assessment of their estrogenic, androgenic and thyroidal activities," *Chemosphere*, vol. 201, pp. 388–398, 2018, doi: 10.1016/j.chemosphere.2018.02.099.

[93] S. Y. Wee, A. Z. Aris, F. M. Yusoff, and S. M. Praveena, "Occurrence of multiclass endocrine disrupting compounds in a drinking water supply system and associated risks," *Sci. Rep.*, vol. 10, no. 1, pp. 1–12, 2020, doi: 10.1038/s41598-020-74061-5.

[94] Y. Jie *et al.*, "Pollution by Nonylphenol in river, tap water, and aquatic in an acid rain-plagued city in southwest China," *Int. J. Environ. Health Res.*, vol. 27, no. 3, pp. 179–190, 2017, doi: 10.1080/09603123.2017.1332345.

[95] T. Toyo'oka and Y. Oshige, "Determination of alkylphenols in mineral water contained in PET bottles by liquid chromatography with coulometric detection," *Anal. Sci.*, vol. 16, no. 10, pp. 1071–1076, 2000, doi: 10.2116/analsci.16.1071.

[96] R. B. P. Vidal, G. A. Ibañez, and G. M. Escandar, "A green method for the quantification of plastics-derived endocrine disruptors in beverages by chemometrics-assisted liquid chromatography with simultaneous diode array and fluorescent

detection," *Talanta*, vol. 159, pp. 336–343, 2016, doi: 10.1016/j.talanta.2016.06.049.

[97] H. Wang *et al.*, "Bisphenol analogues in Chinese bottled water: Quantification and potential risk analysis," *Sci. Total Environ.*, vol. 713, p. 136583, 2020, doi: 10.1016/j.scitotenv.2020.136583.

[98] X. L. Cao and J. Corriveau, "Survey of bisphenol A in bottled water products in Canada," *Food Addit. Contam. Part B Surveill.*, vol. 1, no. 2, pp. 161–164, 2008, doi: 10.1080/02652030802563290.

[99] M. H. Dévier, K. Le Menach, L. Viglino, L. Di Gioia, P. Lachassagne, and H. Budzinski, "Ultra-trace analysis of hormones, pharmaceutical substances, alkylphenols and phthalates in two French natural mineral waters," *Sci. Total Environ.*, vol. 443, pp. 621–632, 2013, doi: 10.1016/j.scitotenv.2012.10.015.

[100] A. Guart, F. Bono-Blay, A. Borrell, and S. Lacorte, "Effect of bottling and storage on the migration of plastic constituents in Spanish bottled waters," *Food Chem.*, vol. 156, pp. 73–80, 2014, doi: 10.1016/j.foodchem.2014.01.075.

[101] M. Pernica, P. Poloucká, M. Seifertová, and Z. Šimek, "Determination of alkylphenols in water samples using liquid chromatography-tandem mass spectrometry after pre-column derivatization with dansyl chloride," *J. Chromatogr. A*, vol. 1417, pp. 49–56, 2015, doi: 10.1016/j.chroma.2015.09.030.

[102] A. K. Sakhi *et al.*, "Concentrations of phthalates and bisphenol A in Norwegian foods and beverages and estimated dietary exposure in adults," *Environ. Int.*, vol. 73, pp. 259–269, 2014, doi: 10.1016/j.envint.2014.08.005.

[103] B. Shao *et al.*, "Determination of alkylphenol and bisphenol a in beverages using liquid chromatography/electrospray ionization tandem mass spectrometry," *Anal. Chim. Acta*, vol. 530, no. 2, pp. 245–252, 2005, doi: 10.1016/j.aca.2004.09.086.

[104] L. Le Coadou *et al.*, "Quality survey of natural mineral water and spring water sold in

France: Monitoring of hormones, pharmaceuticals, pesticides, perfluoroalkyl substances, phthalates, and alkylphenols at the ultra-trace level," *Sci. Total Environ.*, vol. 603–604, pp. 651–662, 2017, doi: 10.1016/j.scitotenv.2016.11.174.

[105] D. Amiridou and D. Voutsa, "Alkylphenols and phthalates in bottled waters," *J. Hazard. Mater.*, vol. 185, no. 1, pp. 281–286, 2011, doi: 10.1016/j.jhazmat.2010.09.031.

[106] A. Guart, I. Calabuig, S. Lacorte, and A. Borrell, "Continental bottled water assessment by stir bar sorptive extraction followed by gas chromatography-tandem mass spectrometry (SBSE-GC-MS/MS)," *Environ. Sci. Pollut. Res.*, vol. 21, no. 4, pp. 2846–2855, 2014, doi: 10.1007/s11356-013-2177-9.

[107] X. Sun *et al.*, "Determination of nine bisphenols in sewage and sludge using dummy molecularly imprinted solid-phase extraction coupled with liquid chromatography tandem mass spectrometry," *J. Chromatogr. A*, vol. 1552, pp. 10–16, 2018, doi: 10.1016/j.chroma.2018.04.004.

[108] L. C. G. M. Teixeira *et al.*, "Occurrence and removal of drugs and endocrine disruptors in the Bolonha Water Treatment Plant in Belém/PA (Brazil)," *Environ. Monit. Assess.*, vol. 193, no. 5, pp. 1–17, 2021, doi: 10.1007/s10661-021-09025-x.

[109] N. H. Tran and K. Y. H. Gin, "Occurrence and removal of pharmaceuticals, hormones, personal care products, and endocrine disrupters in a full-scale water reclamation plant," *Sci. Total Environ.*, vol. 599–600, pp. 1503–1516, 2017, doi: 10.1016/j.scitotenv.2017.05.097.

[110] J. Xue and K. Kannan, "Mass flows and removal of eight bisphenol analogs, bisphenol A diglycidyl ether and its derivatives in two wastewater treatment plants in New York State, USA," *Sci. Total Environ.*, vol. 648, pp. 442–449, 2019, doi: 10.1016/j.scitotenv.2018.08.047.

[111] E. M. F. Brandt, F. B. de Queiroz, R. J. C. F. Afonso, S. F. Aquino, and C. A. L. Chernicharo, "Behaviour of pharmaceuticals and endocrine disrupting chemicals in simplified sewage treatment systems," *J. Environ. Manage.*, vol. 128, pp. 718–726, 2013, doi: 10.1016/j.jenvman.2013.06.003.

[112] S. Mohapatra, C. H. Huang, S. Mukherji, and L. P. Padhye, "Occurrence and fate of pharmaceuticals in WWTPs in India and comparison with a similar study in the United States," *Chemosphere*, vol. 159, pp. 526–535, 2016, doi: 10.1016/j.chemosphere.2016.06.047.

[113] F. B. Queiroz, E. M. F. Brandt, S. F. Aquino, C. A. L. Chernicharo, and R. J. C. F. Afonso, "Occurrence of pharmaceuticals and endocrine disruptors in raw sewage and their behavior in UASB reactors operated at different hydraulic retention times," *Water Sci. Technol.*, vol. 66, no. 12, pp. 2562–2569, 2012, doi: 10.2166/wst.2012.482.

[114] I. Al-Saleh, R. Elkhatib, T. Al-Rajoudi, and G. Al-Qudaihi, "Assessing the concentration of phthalate esters (PAEs) and bisphenol A (BPA) and the genotoxic potential of treated wastewater (final effluent) in Saudi Arabia," *Sci. Total Environ.*, vol. 578, pp. 440–451, Feb. 2017, doi: 10.1016/j.scitotenv.2016.10.207.

[115] J. M. Santos, D. A. Putt, M. Jurban, A. Joiakim, K. Friedrich, and H. Kim, "Differential BPA levels in sewage wastewater effluents from metro Detroit communities," *Environ. Monit. Assess.*, vol. 188, no. 10, 2016, doi: 10.1007/s10661-016-5593-8.

[116] Y. Luo *et al.*, "A review on the occurrence of micropollutants in the aquatic environment and their fate and removal during wastewater treatment," *Sci. Total Environ.*, vol. 473–474, pp. 619–641, 2014, doi: 10.1016/j.scitotenv.2013.12.065.

[117] L. Pang *et al.*, "Occurrence and Estrogenic Potency of Bisphenol Analogs in Sewage Sludge from Wastewater Treatment Plants in Central China," *Arch. Environ. Contam.*

Toxicol., vol. 77, no. 3, pp. 461–470, 2019, doi: 10.1007/s00244-019-00663-4.

[118] S. Song *et al.*, "Occurrence and profiles of bisphenol analogues in municipal sewage sludge in China," *Environ. Pollut.*, vol. 186, pp. 14–19, 2014, doi: 10.1016/j.envpol.2013.11.023.

[119] C. Staples *et al.*, "Estimating potential risks to terrestrial invertebrates and plants exposed to bisphenol a in soil amended with activated sludge biosolids," *Environ. Toxicol. Chem.*, vol. 29, no. 2, pp. 467–475, 2010, doi: 10.1002/etc.49.

[120] Z. Zhang *et al.*, "A study on temporal trends and estimates of fate of Bisphenol A in agricultural soils after sewage sludge amendment," *Sci. Total Environ.*, vol. 515–516, pp. 1–11, 2015, doi: 10.1016/j.scitotenv.2015.01.053.

[121] V. S. Thomaidi, A. S. Stasinakis, V. L. Borova, and N. S. Thomaidis, "Assessing the risk associated with the presence of emerging organic contaminants in sludge-amended soil: A country-level analysis," *Sci. Total Environ.*, vol. 548–549, pp. 280–288, Apr. 2016, doi: 10.1016/j.scitotenv.2016.01.043.

[122] K. Xia, A. Bhandari, K. Das, and G. Pillar, "Occurrence and Fate of Pharmaceuticals and Personal Care Products (PPCPs) in Biosolids," *J. Environ. Qual.*, vol. 34, no. 1, pp. 91–104, Jan. 2005, doi: 10.2134/JEQ2005.0091.

[123] K. Xia, L. S. Hundal, K. Kumar, K. Armbrust, A. E. Cox, and T. C. Granato, "Triclocarban, triclosan, polybrominated diphenyl ethers and 4-nonylphenol in biosolids and in soil receiving 33-year biosolids application," *Environ. Toxicol. Chem.*, vol. 29, no. 3, pp. 597–605, Mar. 2010, doi: 10.1002/etc.66.

[124] C. A. Kinney *et al.*, "Response to 'Comment on "bioaccumulation of pharmaceuticals and other anthropogenic waste indicators in earthworms from agricultural soil amended with biosolid or swine manure,"'" *Environ. Sci. Technol.*, vol. 43, no. 2, pp. 545–547, 2009, doi: 10.1021/es802721d.

[125] A. Margenat, V. Matamoros, S. Díez, N. Cañameras, J. Comas, and J. M. Bayona, "Occurrence of chemical contaminants in peri-urban agricultural irrigation waters and assessment of their phytotoxicity and crop productivity," *Sci. Total Environ.*, vol. 599–600, pp. 1140–1148, 2017, doi: 10.1016/j.scitotenv.2017.05.025.

[126] B. C. Tran, M. J. Teil, M. Blanchard, F. Alliot, and M. Chevreuil, "Fate of phthalates and BPA in agricultural and non-agricultural soils of the Paris area (France)," *Environ. Sci. Pollut. Res.*, vol. 22, no. 14, pp. 11118–11126, 2015, doi: 10.1007/s11356-015-4178-3.

[127] US EPA, "2018 Edition of the Drinking Water Standards and Health Advisories Tables," no. March, 2018.

[128] J. Wang and M. Harrison, "Removal of organic micro-pollutants from water by β-cyclodextrin triazine polymers," *J. Incl. Phenom. Macrocycl. Chem.*, vol. 92, no. 3–4, pp. 347–356, 2018, doi: 10.1007/s10847-018-0851-8.

[129] J. Xu, L. Wu, W. Chen, and A. C. Chang, "Simultaneous determination of pharmaceuticals, endocrine disrupting compounds and hormone in soils by gas chromatography-mass spectrometry," *J. Chromatogr. A*, vol. 1202, no. 2, pp. 189–195, 2008, doi: 10.1016/j.chroma.2008.07.001.

[130] Y. Xu, A. Hu, Y. Li, Y. He, J. Xu, and Z. Lu, "Determination and occurrence of bisphenol A and thirteen structural analogs in soil," *Chemosphere*, vol. 277, p. 130232, 2021, doi: 10.1016/j.chemosphere.2021.130232.

[131] I. Antić, B. D. Škrbić, V. Matamoros, and J. M. Bayona, "Does the application of human waste as a fertilization material in agricultural production pose adverse effects on human health attributable to contaminants of emerging concern?," *Environ. Res.*, vol. 182, no. November 2019, 2020, doi: 10.1016/j.envres.2020.109132.

[132] S. B. Gewurtz *et al.*, "Bisphenol A in the Canadian environment: A multimedia

analysis," *Sci. Total Environ.*, vol. 755, p. 142472, 2021, doi: 10.1016/j.scitotenv.2020.142472.

[133] R. Gibson, J. C. Durán-Álvarez, K. L. Estrada, A. Chávez, and B. Jiménez Cisneros, "Accumulation and leaching potential of some pharmaceuticals and potential endocrine disruptors in soils irrigated with wastewater in the Tula Valley, Mexico," *Chemosphere*, vol. 81, no. 11, pp. 1437–1445, 2010, doi: 10.1016/j.chemosphere.2010.09.006.

[134] Q. Y. Cai *et al.*, "Occurrence of nonylphenol and nonylphenol monoethoxylate in soil and vegetables from vegetable farms in the pearl river delta, South China," *Arch. Environ. Contam. Toxicol.*, vol. 63, no. 1, pp. 22–28, 2012, doi: 10.1007/s00244-011-9741-4.

[135] R. Gibson, J. C. Durán-Álvarez, K. L. Estrada, A. Chávez, and B. Jiménez Cisneros, "Accumulation and leaching potential of some pharmaceuticals and potential endocrine disruptors in soils irrigated with wastewater in the Tula Valley, Mexico," *Chemosphere*, vol. 81, no. 11, pp. 1437–1445, 2010, doi: 10.1016/j.chemosphere.2010.09.006.

[136] B. Albero, J. L. Tadeo, and R. A. Pérez, "Determination of Emerging Contaminants in Cereals by Gas Chromatography-Tandem Mass Spectrometry," *Front. Chem.*, vol. 8, no. September, pp. 1–11, 2020, doi: 10.3389/fchem.2020.571668.

[137] K. Yao *et al.*, "Bisphenol A and Its Analogues in Chinese Total Diets: Contaminated Levels and Risk Assessment," *Oxid. Med. Cell. Longev.*, vol. 2020, 2020, doi: 10.1155/2020/8822321.

[138] H. Shaaban *et al.*, "Simultaneous determination of bisphenol A and its analogues in foodstuff using UPLC-MS/MS and assessment of their health risk in adult population," *J. Food Compos. Anal.*, vol. 110, no. April, p. 104549, 2022, doi:

10.1016/j.jfca.2022.104549.

[139] P. Chakraborty, S. Sampath, M. Mukhopadhyay, S. Selvaraj, G. K. Bharat, and L. Nizzetto, “Baseline investigation on plasticizers, bisphenol A, polycyclic aromatic hydrocarbons and heavy metals in the surface soil of the informal electronic waste recycling workshops and nearby open dumpsites in Indian metropolitan cities,” *Environ. Pollut.*, vol. 248, pp. 1036–1045, 2019, doi: 10.1016/j.envpol.2018.11.010.

[140] L. Hejji, A. Azzouz, L. P. Colón, B. Souhail, and E. Ballesteros, “A multi-residue method for determining twenty-four endocrine disrupting chemicals in vegetables and fruits using ultrasound-assisted solid–liquid extraction and continuous solid-phase extraction,” *Chemosphere*, vol. 263, 2021, doi: 10.1016/j.chemosphere.2020.128158.

[141] J. Lu, J. Wu, P. J. Stoffella, and P. C. Wilson, “Analysis of bisphenol A, nonylphenol, and natural estrogens in vegetables and fruits using gas chromatography-tandem mass spectrometry,” *J. Agric. Food Chem.*, vol. 61, no. 1, pp. 84–89, 2013, doi: 10.1021/jf304971k.

[142] J. Martín, J. L. Santos, J. L. Malvar, I. Aparicio, and E. Alonso, “Determination of bisphenol A, its chlorinated derivatives and structural analogues in vegetables by focussed ultrasound solid-liquid extraction and GC-MS/MS,” *Environ. Chem.*, vol. 17, no. 3, pp. 266–277, 2020, doi: 10.1071/EN19172.

[143] L. K. Dodgen, J. Li, D. Parker, and J. J. Gan, “Uptake and accumulation of four PPCP/EDCs in two leafy vegetables,” *Environ. Pollut.*, vol. 182, pp. 150–156, 2013, doi: 10.1016/j.envpol.2013.06.038.