

## Supplementary Materials

*Review*

### **Pharmaceutical and microplastic pollution before and during the COVID-19 pandemic in surface water, wastewater, and groundwater**

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**Table S1.** PhAC residues before and during the COVID-19 pandemic in surface water.

Location	Sampling year	[N]	Type of pharmaceutical	Concentration (ng/L)	pH	Depth (m)	Temperature (°C)	Analytical method	Reference
South Africa	2013*	24	Ibuprofen	84600	8.92	0.02	20±1	HPLC-MS/MS	[26]
USA	2008*	27	Caffeine	4200	N/A	N/A	N/A	LC-MS/MS	[27]
USA	2008*	27	Carbamazepine	1200	N/A	N/A	N/A	LC-MS/MS	[27]
USA	2008*	27	Ibuprofen	2800	N/A	N/A	N/A	LC-MS/MS	[27]
Ghana	2021*	10	Acetaminophen	2988	N/A	N/A	N/A	HPLC-MS/MS	[52]
Ghana	2021*	10	Ibuprofen	105.39	N/A	N/A	N/A	HPLC-MS/MS	[52]
Ghana	2021*	10	Tramadol	105.11	N/A	N/A	N/A	HPLC-MS/MS	[52]
Ghana	2021*	10	Diclofenac	100.91	N/A	N/A	N/A	HPLC-MS/MS	[52]
Ghana	2021*	10	Furosemide	157.89	N/A	N/A	N/A	HPLC-MS/MS	[52]
Greece	2008*	6	Diclofenac	432	8.00	N/A	21±1	GC-MS	[45]
Sweden	2008*	7	Carbamazepine	90	N/A	0.5	N/A	LC-MS/MS	[46]
Japan	2008*	109	Caffeine	2400	N/A	N/A	N/A	LC MS/MS, TSQ	[47]
Japan	2008*	109	Crotamiton	1500	N/A	N/A	N/A	LC MS/MS, TSQ	[47]
Japan	2008*	109	Sulpiride	1400	N/A	N/A	N/A	LC MS/MS, TSQ	[47]
South Korea	2016*	72	Carbamazepine	206.7	N/A	N/A	N/A	LC-MS/MS	[48]
South Korea	2016*	72	Sulfamethoxazole	113.2	N/A	N/A	N/A	LC-MS/MS	[48]
South Korea	2016*	72	Naproxen	51.6	N/A	N/A	N/A	LC-MS/MS	[48]
South Korea	2016*	72	Clarithromycin	42.7	N/A	N/A	N/A	LC-MS/MS	[48]
China	2015*	72	Paracetamol	7024	8.00	N/A	N/A	HPLC-HESI-MS/MS	[49]
China	2015*	72	Caffeine	8571	8.00	N/A	N/A	HPLC-HESI-MS/MS	[49]
Portugal	2016*	31	Sertraline	304	N/A	1.00	N/A	UHPLC-TOF-MS	[42]
Portugal	2016*	31	Diclofenac	51.8	N/A	1.00	N/A	UHPLC-TOF-MS	[42]
Portugal	2016*	31	Gemfibrozil	77	N/A	1.00	N/A	UHPLC-TOF-MS	[42]
Portugal	2016*	31	Ibersartan	161.9	N/A	1.00	N/A	UHPLC-TOF-MS	[42]
Portugal	2016*	31	Doxycycline	128.0	N/A	1.00	N/A	UHPLC-TOF-MS	[42]

\* Surface water

[N] = Number of samples

Location	Sampling year	[N]	Type of pharmaceutical	Concentration (ng/L)	pH	Depth (m)	Temperature (°C)	Analytical method	Reference
Italy	2020*	328	Ketoprofen	5.84	N/A	N/A	N/A	LC-MS	[43]
UK	2017*	9	Ibuprofen	6297	8.00	N/A	18±1	UPTM-ESI-MS/MS	[41]
UK	2017*	9	Paracetamol	916.88	8.00	N/A	18±1	UPTM-ESI-MS/MS	[41]
UK	2017*	9	Diclofenac	250.8	8.00	N/A	18±1	UPTM-ESI-MS/MS	[41]
UK	2017*	9	Trimethoprim	247.02	8.00	N/A	18±1	UPTM-ESI-MS/MS	[41]
UK	2017*	9	Citalopram	42.93	8.00	N/A	18±1	UPTM-ESI-MS/MS	[41]
Chile	2013*	10	Acetaminophen	48740	N/A	N/A	N/A	LC-MS/MS	[38]
Chile	2013*	10	Diclofenac	15090	N/A	N/A	N/A	LC-MS/MS	[38]
Chile	2013*	10	Ibuprofen	10050	N/A	N/A	N/A	LC-MS/MS	[38]
Uganda	2018*	75	Sulfamethoxazole	5600	8.35	N/A	23±1	HPLC	[33]
Uganda	2018*	75	Trimethoprim	89	8.35	N/A	23±1	HPLC	[33]
Uganda	2018*	75	Tetracycline	70	8.35	N/A	23±1	HPLC	[33]
Uganda	2018*	75	Sulfacetamide	13	8.35	N/A	23±1	HPLC	[33]
Uganda	2018*	75	Ibuprofen	780	8.35	N/A	23±1	HPLC	[33]
Nigeria	2018*	22	Sulfamethoxazole	129000	N/A	N/A	N/A	HPLC-MS/MS	[35]
Nigeria	2018*	22	Paracetamol	111000	N/A	N/A	N/A	HPLC-MS/MS	[35]
Lebanon	2016*	100	Caffeine	2805	N/A	N/A	N/A	LC-ESI-MS/MS	[31]
Lebanon	2016*	100	Anhydroerythromycin	157	N/A	N/A	N/A	LC-ESI-MS/MS	[31]
Lebanon	2016*	100	Erythromycin	98	N/A	N/A	N/A	LC-ESI-MS/MS	[31]
Lebanon	2016*	100	Caffeine	57	N/A	N/A	N/A	LC-ESI-MS/MS	[31]
Egypt	2018*	10	Metformin	63	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018*	10	Acetaminophen	144	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018*	10	Amoxicillin	24	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018*	10	Trimethoprim	116	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018*	10	Tramadol	93	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018*	10	Caffeine	41	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018*	10	Metoprolol	8	N/A	N/A	N/A	UHPLC-MS/MS	[56]

\* Surface water

[N] = Number of samples

Location	Sampling year	[N]	Type of pharmaceutical	Concentration (ng/L)	pH	Depth (m)	Temperature (°C)	Analytical method	Reference
Egypt	2018*	10	Carbamazepine	6	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018*	10	Ibuprofen	26	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018*	10	Valsartan	55	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Bangladesh	2017*	20	Metronidazole	13.51	N/A	N/A	N/A	HPLC-MS/MS	[36]
Bangladesh	2017*	20	Trimethoprim	17.20	N/A	N/A	N/A	HPLC-MS/MS	[36]
Malaysia	2016*	18	Amoxicillin	4.44	6.15	0.50	25±1	ELISA	[30]
Malaysia	2016*	18	Caffeine	32.47	6.15	0.50	25±1	ELISA	[30]
Malaysia	2016*	18	Ciprofloxacin	87.48	6.15	0.50	25±1	ELISA	[30]
Malaysia	2016*	18	Diclofenac	4.49	6.15	0.50	25±1	ELISA	[30]
Malaysia	2016*	18	Sulfamethoxazole	71.81	6.15	0.50	25±1	ELISA	[30]
Malaysia	2016*	18	Triclosan	5.01	6.15	0.50	25±1	ELISA	[30]
Sri Lanka	2013*	19	Diclofenac	80	N/A	N/A	N/A	LC-MS/MS	[40]
Sri Lanka	2013*	19	Ibuprofen	84	N/A	N/A	N/A	LC-MS/MS	[40]
Sri Lanka	2013*	19	Triclosan	5.85	N/A	N/A	N/A	LC-MS/MS	[40]
Sri Lanka	2013*	19	Trimethoprim	42.4	N/A	N/A	N/A	LC-MS/MS	[40]
Cameroon	2018*	10	Diclofenac	65	N/A	N/A	N/A	LC-HRMS	[44]
Cameroon	2018*	10	Carbamazepine	46	N/A	N/A	N/A	LC-HRMS	[44]
Cameroon	2018*	10	Sulfamethoxazole	104	N/A	N/A	N/A	LC-HRMS	[44]
Cameroon	2018*	10	Acetaminophen	12	N/A	N/A	N/A	LC-HRMS	[44]
Ghana	2019*	18	Trimethoprim	420	N/A	N/A	N/A	HPLC	[55]
Ghana	2019*	18	Amoxicillin	402	N/A	N/A	N/A	HPLC	[55]
Ghana	2019*	18	Cefuroxime	34	N/A	N/A	N/A	HPLC	[55]
Ghana	2021*	10	Azithromycin	10.46	N/A	N/A	N/A	HPLC-MS/MS	[52]
Ghana	2021*	10	Clarithromycin	29.11	N/A	N/A	N/A	HPLC-MS/MS	[52]
Ghana	2021*	10	Carbamazepine	6.44	N/A	N/A	N/A	HPLC-MS/MS	[52]
Ghana	2021*	10	Chloramphenicol	41.36	N/A	N/A	N/A	HPLC-MS/MS	[52]
Ghana	2019*	28	Diclofenac	30	6.50	N/A	N/A	HPLC	[63]
Ghana	2019*	28	Chloramphenicol	180	6.50	N/A	N/A	HPLC	[63]

\* Surface water

[N] = Number of samples

Location	Sampling year	[N]	Type of pharmaceutical	Concentration (ng/L)	pH	Depth (m)	Temperature (°C)	Analytical method	Reference
Italy	2011*	56	Ketoprofen	90	N/A	N/A	N/A	LC-MS/MS	[66]
China	2020*	6	Citalopram	4.8	N/A	0.5	N/A	LC-MS/MS	[65]
China	2020*	6	Venlafaxin	54.2	N/A	0.5	N/A	LC-MS/MS	[65]
China	2020*	6	Sertraline	1.9	N/A	0.5	N/A	LC-MS/MS	[65]
China	2017*	16	Venlafaxin	22.9	N/A	0.5	N/A	LC-MS/MS	[64]
China	2019*	12	Tetracycline	5.27	N/A	3	N/A	LC-MS/MS	[67]
China	2020*	12	Tetracycline	1.52	N/A	3	N/A	LC-MS/MS	[67]
China	2019*	12	Sulfamerazine	0.79	N/A	3	N/A	LC-MS/MS	[67]
China	2020*	12	Sulfamerazine	0.06	N/A	3	N/A	LC-MS/MS	[67]
China	2019*	12	Doxycycline	9.44	N/A	3	N/A	LC-MS/MS	[67]
China	2020*	12	Doxycycline	0	N/A	3	N/A	LC-MS/MS	[67]
China	2019*	12	Ciprofloxacin	14.07	N/A	3	N/A	LC-MS/MS	[67]
China	2020*	12	Ciprofloxacin	0	N/A	3	N/A	LC-MS/MS	[67]
China	2019*	12	Ofloxacin	2.12	N/A	3	N/A	LC-MS/MS	[67]
China	2020*	12	Ofloxacin	0	N/A	3	N/A	LC-MS/MS	[67]
China	2019*	12	Azithromycin	0	N/A	3	N/A	LC-MS/MS	[67]
China	2020*	12	Azithromycin	0.16	N/A	3	N/A	LC-MS/MS	[67]

\* Surface water

[N] = Number of samples



**Table S2.** PhAC residues before and during the COVID-19 pandemic in wastewater influent and effluent.

Location	Sampling year	[N]	Type of pharmaceutical	Concentration (ng/L)	pH	Depth (m)	Temperature (°C)	Analytical method	Reference
South Africa	2013 <sup>1</sup>	9	Ibuprofen	62820	7.24	0.02	21±1	HPLC-MS/MS	[26]
South Africa	2013 <sup>1</sup>	9	Caffeine	4480	7.24	0.02	21±1	HPLC-MS/MS	[26]
South Africa	2013 <sup>1</sup>	9	Acetaminophen	5760	7.24	0.02	21±1	HPLC-MS/MS	[26]
South Africa	2013 <sup>1</sup>	9	Sulfamethoxazole	34500	7.24	0.02	21±1	HPLC-MS/MS	[26]
South Africa	2013 <sup>1</sup>	9	Erythromycin	610	7.24	0.02	21±1	HPLC-MS/MS	[26]
South Africa	2013 <sup>1</sup>	9	Carbamazepine	2210	7.24	0.02	21±1	HPLC-MS/MS	[26]
South Africa	2018 <sup>1</sup>	28	Caffeine	60136	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>1</sup>	28	Diclofenac	246.3	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>1</sup>	28	Efavirenz	2169	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>1</sup>	28	Naproxen	546.1	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>1</sup>	28	Paraxanthine	35286	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>1</sup>	28	Salicylamide	563.50	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>1</sup>	28	Sulfamethoxazole	2405	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>1</sup>	28	Triclocarban	276.1	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>1</sup>	28	Valsartan	1289	N/A	N/A	N/A	UHPLC-MS/MS	[57]
Australia	2013 <sup>1</sup>	11	Carbamazepine	685	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>1</sup>	11	Venlafaxine	100	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>1</sup>	11	Sertraline	241	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>1</sup>	11	Fluoxetine	51.1	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>1</sup>	11	Atenolol	300	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>1</sup>	11	Sotalol	322	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>1</sup>	11	Metoprolol	379	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>1</sup>	11	Propranolol	151	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>1</sup>	11	Chlorpheniramine	43.9	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>1</sup>	11	Diphenhydramine	18.9	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>1</sup>	11	Triclosan	3544	N/A	N/A	N/A	LC-MS/MS	[111]

<sup>1</sup> Influent<sup>2</sup> Effluent

[N] = Number of samples

Location	Sampling year	[N]	Type of pharmaceutical	Concentration (ng/L)	pH	Depth (m)	Temperature (°C)	Analytical method	Reference
USA	2017 <sup>1</sup>	77	Sulfamethoxazole	1372.43	N/A	N/A	N/A	HPLC-MS	[54]
USA	2017 <sup>1</sup>	77	Erythromycin	85.52	N/A	N/A	N/A	HPLC-MS	[54]
USA	2017 <sup>1</sup>	77	Triclosan	313.20	N/A	N/A	N/A	HPLC-MS	[54]
USA	2017 <sup>1</sup>	77	Trimethoprim	668.76	N/A	N/A	N/A	HPLC-MS	[54]
Jordan	2017 <sup>1</sup>	4	Carbamazepine	1104	N/A	N/A	N/A	LC-MS/MS	[50]
Jordan	2017 <sup>1</sup>	4	Sulfamethoxazole	96	N/A	N/A	N/A	LC-MS/MS	[50]
Jordan	2017 <sup>1</sup>	4	Caffeine	155600	N/A	N/A	N/A	LC-MS/MS	[50]
Jordan	2017 <sup>1</sup>	4	Cotinine	4980	N/A	N/A	N/A	LC-MS/MS	[50]
Jordan	2017 <sup>1</sup>	4	Acetaminophen	36700	N/A	N/A	N/A	LC-MS/MS	[50]
France	2015 <sup>1</sup>	13	Acetaminophen	96700	N/A	N/A	N/A	GC-MS	[51]
France	2015 <sup>1</sup>	13	Carbamazepine	937	N/A	N/A	N/A	GC-MS	[51]
France	2015 <sup>1</sup>	13	Ketoprofen	6560	N/A	N/A	N/A	GC-MS	[51]
Colombia	2016 <sup>1</sup>	14	Acetaminophen	39250	N/A	N/A	N/A	UHPLC-MS/MS	[37]
Colombia	2016 <sup>1</sup>	14	Azithromycin	6320	N/A	N/A	N/A	UHPLC-MS/MS	[37]
China	2020 <sup>1</sup>	6	Fluoxetine	4.25	N/A	0.5	N/A	LC-MS/MS	[65]
China	2020 <sup>1</sup>	6	Citalopram	3.2	N/A	0.5	N/A	LC-MS/MS	[65]
China	2020 <sup>1</sup>	6	Venlafaxine	80.4	N/A	0.5	N/A	LC-MS/MS	[65]
China	2014 <sup>1</sup>	5	Fluoxetine	2.6	N/A	0.5	N/A	LC-MS/MS	[99]
South Africa	2013 <sup>2</sup>	9	Ibuprofen	58710	7.24	0.02	21±1	HPLC-MS/MS	[26]
South Africa	2013 <sup>2</sup>	9	Caffeine	610	7.24	0.02	21±1	HPLC-MS/MS	[26]
South Africa	2013 <sup>2</sup>	9	Erythromycin	160	7.24	0.02	21±1	HPLC-MS/MS	[26]
South Africa	2013 <sup>2</sup>	9	Carbamazepine	910	7.24	0.02	21±1	HPLC-MS/MS	[26]
South Africa	2018 <sup>2</sup>	16	Caffeine	4878	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>2</sup>	16	Diclofenac	243.6	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>2</sup>	16	Efavirenz	2042	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>2</sup>	16	Naproxen	349.6	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>2</sup>	16	Paraxanthine	8452	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>2</sup>	16	Salicylamide	112.9	N/A	N/A	N/A	UHPLC-MS/MS	[57]

<sup>1</sup> Influent

<sup>2</sup> Effluent

[N] = Number of samples



Location	Sampling year	[N]	Type of pharmaceutical	Concentration (ng/L)	pH	Depth (m)	Temperature (°C)	Analytical method	Reference
South Africa	2018 <sup>2</sup>	16	Sulfamethoxazole	504.4	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>2</sup>	16	Triclocarban	44.89	N/A	N/A	N/A	UHPLC-MS/MS	[57]
South Africa	2018 <sup>2</sup>	16	Valsartan	762.4	N/A	N/A	N/A	UHPLC-MS/MS	[57]
India	2008 <sup>2</sup>	18	Cetirizine	2100000	N/A	N/A	N/A	LC-ESI-MS/MS	[29]
India	2008 <sup>2</sup>	18	Ciprofloxacin	14000000	N/A	N/A	N/A	LC-ESI-MS/MS	[29]
Egypt	2018 <sup>2</sup>	10	Metformin	5613	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Acetaminophen	15947	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Amoxicillin	2038	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Trimethoprim	2738	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Tramadol	1103	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Caffeine	855	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Metoprolol	1089	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Sulfamethoxazole	19	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Erythromycin	275	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Carbamazepine	342	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Ibuprofen	6702	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Egypt	2018 <sup>2</sup>	10	Valsartan	594	N/A	N/A	N/A	UHPLC-MS/MS	[56]
Australia	2013 <sup>2</sup>	11	Carbamazepine	702	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>2</sup>	11	Venlafaxine	511	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>2</sup>	11	Sertraline	36.7	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>2</sup>	11	Fluoxetine	16.2	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>2</sup>	11	Atenolol	75.5	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>2</sup>	11	Sotalol	209	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>2</sup>	11	Metoprolol	178	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>2</sup>	11	Propranolol	75.8	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>2</sup>	11	Chlorpheniramine	20.7	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>2</sup>	11	Diphenhydramine	29.8	N/A	N/A	N/A	LC-MS/MS	[111]
Australia	2013 <sup>2</sup>	11	Triclosan	5.4	N/A	N/A	N/A	LC-MS/MS	[111]

<sup>1</sup> Influent

<sup>2</sup> Effluent

[N] = Number of samples

Location	Sampling year	[N]	Type of pharmaceutical	Concentration (ng/L)	pH	Depth (m)	Temperature (°C)	Analytical method	Reference
Iran	2019 <sup>2</sup>	6	Valsartan	8400	N/A	0.10	N/A	LC-MS/MS	[32]
Iran	2019 <sup>2</sup>	6	Carbamazepine	19000	N/A	0.10	N/A	LC-MS/MS	[32]
Iran	2019 <sup>2</sup>	6	Caffeine	140000	N/A	0.10	N/A	LC-MS/MS	[32]
USA	2017 <sup>2</sup>	77	Sulfamethoxazole	1861.29	N/A	N/A	N/A	HPLC-MS	[54]
USA	2017 <sup>2</sup>	77	Erythromycin	46.43	N/A	N/A	N/A	HPLC-MS	[54]
USA	2017 <sup>2</sup>	77	Triclosan	121.86	N/A	N/A	N/A	HPLC-MS	[54]
USA	2017 <sup>2</sup>	77	Trimethoprim	248.29	N/A	N/A	N/A	HPLC-MS	[54]
Jordan	2017 <sup>2</sup>	4	Carbamazepine	856	N/A	N/A	N/A	LC-MS/MS	[50]
Jordan	2017 <sup>2</sup>	4	Sulfamethoxazole	96	N/A	N/A	N/A	LC-MS/MS	[50]
Jordan	2017 <sup>2</sup>	4	Caffeine	86	N/A	N/A	N/A	LC-MS/MS	[50]
Jordan	2017 <sup>2</sup>	4	Cotinine	78	N/A	N/A	N/A	LC-MS/MS	[50]
Jordan	2017 <sup>2</sup>	4	Acetaminophen	41	N/A	N/A	N/A	LC-MS/MS	[50]
France	2015 <sup>2</sup>	13	Acetaminophen	172	N/A	N/A	N/A	GC-MS	[51]
France	2015 <sup>2</sup>	13	Carbamazepine	357	N/A	N/A	N/A	GC-MS	[51]
France	2015 <sup>2</sup>	13	Ketoprofen	176	N/A	N/A	N/A	GC-MS	[51]
Colombia	2016 <sup>2</sup>	14	Acetaminophen	29660	N/A	N/A	N/A	UHPLC-MS/MS	[37]
Colombia	2016 <sup>2</sup>	14	Azithromycin	3990	N/A	N/A	N/A	UHPLC-MS/MS	[37]
China	2020 <sup>2</sup>	6	Fluoxetine	1.05	N/A	0.5	N/A	LC-MS/MS	[65]
China	2020 <sup>2</sup>	6	Citalopram	7.60	N/A	0.5	N/A	LC-MS/MS	[65]
China	2020 <sup>2</sup>	6	Venlafaxine	87	N/A	0.5	N/A	LC-MS/MS	[65]
China	2014 <sup>2</sup>	5	Fluoxetine	1.40	N/A	0.5	N/A	LC-MS/MS	[99]

<sup>1</sup> Influent

<sup>2</sup> Effluent

[N] = Number of samples



**Table S3.** PhAC residues before and during the COVID-19 pandemic in groundwater.

Location	Sampling year	[N]	Type of pharmaceutical	Concentration (ng/L)	pH	Depth (m)	Temperature (°C)	Analytical method	Reference
USA	2010 <sup>3</sup>	1231	Acetaminophen	1890	N/A	61.00	N/A	HPLC-MS	[25]
USA	2010 <sup>3</sup>	1231	Caffeine	290	N/A	61.00	N/A	HPLC-MS	[25]
USA	2010 <sup>3</sup>	1231	Carbamazepine	420	N/A	61.00	N/A	HPLC-MS	[25]
USA	2010 <sup>3</sup>	1231	Codeine	214	N/A	61.00	N/A	HPLC-MS	[25]
USA	2010 <sup>3</sup>	1231	Sulfamethoxazole	170	N/A	61.00	N/A	HPLC-MS	[25]
USA	2010 <sup>3</sup>	1231	Trimethoprim	18	N/A	61.00	N/A	HPLC-MS	[25]
Italy	2020 <sup>3</sup>	328	Ketoprofen	152.88	N/A	N/A	N/A	LC-MS	[43]
Italy	2020 <sup>3</sup>	328	Azithromycin	82.46	N/A	N/A	N/A	LC-MS	[43]
Italy	2020 <sup>3</sup>	328	Caffeine	65.92	N/A	N/A	N/A	LC-MS	[43]
Italy	2020 <sup>3</sup>	328	Ibuprofen	10.54	N/A	N/A	N/A	LC-MS	[43]
Italy	2020 <sup>3</sup>	328	Diclofenac	121.46	N/A	N/A	N/A	LC-MS	[43]
Cameroon	2018 <sup>3</sup>	10	Diclofenac	518	N/A	N/A	N/A	LC-HRMS	[44]
Cameroon	2018 <sup>3</sup>	10	Carbamazepine	335	N/A	N/A	N/A	LC-HRMS	[44]
Cameroon	2018 <sup>3</sup>	10	Sulfamethoxazole	1285	N/A	N/A	N/A	LC-HRMS	[44]
Cameroon	2018 <sup>3</sup>	10	Acetaminophen	111	N/A	N/A	N/A	LC-HRMS	[44]
Nigeria	2018 <sup>3</sup>	12	Acetaminophen	1	N/A	N/A	N/A	UPLC	[35]
Nigeria	2018 <sup>3</sup>	12	Sulfamethoxazole	1	N/A	N/A	N/A	UPLC	[35]
Nigeria	2018 <sup>3</sup>	12	Caffeine	4	N/A	N/A	N/A	UPLC	[35]
Nigeria	2018 <sup>3</sup>	12	Amoxicillin	44	N/A	N/A	N/A	UPLC	[35]
Nigeria	2018 <sup>3</sup>	12	Carbamazepine	1	N/A	N/A	N/A	UPLC	[35]
Nigeria	2018 <sup>3</sup>	12	Naproxen	1	N/A	N/A	N/A	UPLC	[35]
Nigeria	2018 <sup>3</sup>	12	Diclofenac	1	N/A	N/A	N/A	UPLC	[35]
Nigeria	2018 <sup>3</sup>	12	Ibuprofen	4	N/A	N/A	N/A	UPLC	[35]

<sup>3</sup>Groundwater

[N] = Number of samples

Location	Sampling year	[N]	Type of pharmaceutical	Concentration (ng/L)	pH	Depth (m)	Temperature (°C)	Analytical method	Reference
China	2019 <sup>3</sup>	12	Tetracycline	2.63	N/A	3	N/A	LC-MS/MS	[67]
China	2020 <sup>3</sup>	12	Tetracycline	2.11	N/A	3	N/A	LC-MS/MS	[67]
China	2019 <sup>3</sup>	12	Sulfamerazine	0	N/A	3	N/A	LC-MS/MS	[67]
China	2020 <sup>3</sup>	12	Sulfamerazine	0.02	N/A	3	N/A	LC-MS/MS	[67]
China	2019 <sup>3</sup>	12	Doxycycline	5.73	N/A	3	N/A	LC-MS/MS	[67]
China	2020 <sup>3</sup>	12	Doxycycline	4.35	N/A	3	N/A	LC-MS/MS	[67]
China	2019 <sup>3</sup>	12	Ciprofloxacin	14.83	N/A	3	N/A	LC-MS/MS	[67]
China	2020 <sup>3</sup>	12	Ciprofloxacin	1.84	N/A	3	N/A	LC-MS/MS	[67]
China	2019 <sup>3</sup>	12	Ofloxacin	7.56	N/A	3	N/A	LC-MS/MS	[67]
China	2020 <sup>3</sup>	12	Ofloxacin	3.06	N/A	3	N/A	LC-MS/MS	[67]
China	2019 <sup>3</sup>	12	Azithromycin	0	N/A	3	N/A	LC-MS/MS	[67]
China	2020 <sup>3</sup>	12	Azithromycin	0.10	N/A	3	N/A	LC-MS/MS	[67]

<sup>3</sup>Groundwater

[N] = Number of samples



**Table S4.** MP particles before and during the COVID-19 pandemic in surface water.

Location	Sampling year	[N]	Type of polymer	Concentration (Particles/m³)	Shape	Size	Color	Instrumental method	Reference
Tunisia	2019 <sup>1</sup>	28	PE	453	Fiber	N/A	Transparent	ATR-FTIR	[73]
			PP		Film		White		
			PETE		Fragment		Blue		
			COP		Green				
			NL		Yellow				
			PS		Red				
China	2013 <sup>1</sup>	15	PE	1245.8	Fiber	Class 2	Transparent	Raman spectroscopy	[74]
			PP	1170.8	Film	Class 3	White		
			PVC	955.6	Granules	Class 4	Black		
			PTFE	680.0		Class 5			
Indonesia	2019 <sup>1,2,3</sup>	8	PE	43.11	Fiber	N/A	Transparent	FTIR	[75]
			PP	12.56	Film		White		
			PETE	34.63	Fragment		Blue		
			PS	Pellet	Yellow				
				Foam	Red				
						Black			

\* Class 1: 0.05–0.5 mm; Class 2: 0.5–1 mm; Class 3: 1–2.5 mm; Class 4: 2.5–5 mm; Class 5: >5 mm

<sup>1</sup> Surface water

<sup>2</sup> Middle water

<sup>3</sup> Bottom water

Location	Sampling year	[N]	Type of polymer	Concentration (Particles/m <sup>3</sup> )	Shape	Size	Color	Instrumental method	Reference
South Korea	2017 <sup>1</sup>	9	PE	293	Fiber	Class 1	N/A	FTIR	[76]
			PP	5242	Film				
			PVC		Fragment				
			PES		Spherule				
			PUR						
			AC						
			PEVA						
			PAS						
			AL						
			PA						
			PS						
China	2019 <sup>1</sup>	10	PE	0.93	Fiber	Class 2	N/A	SEM	[77]
			PP	0.497	Fragment				
			PS						
China	2019 <sup>1</sup>	20	PE	0.00987	Fiber	Class 1	N/A	FTIR	[78]
			PP		Film	Class 2			
			PS		Fragment	Class 4			
					Pellet				

\* Class 1: 0.05–0.5 mm; Class 2: 0.5–1 mm; Class 3: 1–2.5 mm; Class 4: 2.5–5 mm; Class 5: >5 mm

<sup>1</sup> Surface water



Location	Sampling year	[N]	Type of polymer	Concentration (Particles/m <sup>3</sup> )	Shape	Size	Color	Instrumental method	Reference
Iran	2016 <sup>1</sup>	33	N/A	0.000042	Fiber	Class 2	Transparent	TGA	[79]
	2019 <sup>1</sup>					Spherule	Class 3 Class 5 Blue Red Gray Black		
India	2019 <sup>1</sup>	60	PETE	0.000004	N/A	Class 5	Brown	FTIR	[80]
			PVC NL PES AC RA				Blue Green Yellow Red Purple Clear Black		
South Korea	2018 <sup>1</sup>	21	PP PES PUR SI PS	42.9	Fiber Fragment	Class 1	N/A	FTIR	[81]

\* Class 1: 0.05–0.5 mm; Class 2: 0.5–1 mm; Class 3: 1–2.5 mm; Class 4: 2.5–5 mm; Class 5: >5 mm

<sup>1</sup> Surface water

Location	Sampling year	[N]	Type of polymer	Concentration (Particles/m <sup>3</sup> )	Shape	Size	Color	Instrumental method	Reference
Portugal	2016 <sup>1</sup>	43	PE	1265	Fiber	N/A	N/A	FTIR	[82]
			PP		Film				
			PETE		Fragment				
			SBR		Pellet				
			CA		Foam				
			PTFE						
			PVA						
			PMMA						
			PEA						
			EA						
			PS						
China	2018 <sup>1</sup>	6	PE	967	Fiber	Class 1	Transparent	Micro-Raman	[83]
			PP		Fragment	Class 2	White		
			PETE		Pellet	Class 3	Blue		
			PA			Class 4	Green		
			PS				Red		
							Black		

\* Class 1: 0.05–0.5 mm; Class 2: 0.5–1 mm; Class 3: 1–2.5 mm; Class 4: 2.5–5 mm; Class 5: >5 mm

<sup>1</sup> Surface water

Location	Sampling year	[N]	Type of polymer	Concentration (Particles/m <sup>3</sup> )	Shape	Size	Color	Instrumental method	Reference
Turkey	2009 <sup>1</sup>	24	PE	0.331	Fiber	Class 1	N/A	FTIR	[84]
	2010 <sup>1</sup>		PP	0.925	Film	Class 2			
	2012 <sup>1</sup>		PETE	0.413	Fragment	Class 3			
	2014 <sup>1</sup>		ABS	0.350	Pellet	Class 4			
	2017 <sup>1</sup>		PBPE	0.794	Foam	Class 5			
	2018 <sup>1</sup>		DP	0.725					
	2019 <sup>1</sup>		PVC	0.750					
	2020 <sup>1</sup>		HFFR	0.944					
			PA						
			PVA						
			ABR						
			PS						
			PAN						
Greece	2019 <sup>1</sup>	6	PE	27.73	Film	Class 1	N/A	FTIR	[85]
			PP		Fragment	Class 2			
					Filament	Class 3			
						Class 4			
						Class 5			

\* Class 1: 0.05–0.5 mm; Class 2: 0.5–1 mm; Class 3: 1–2.5 mm; Class 4: 2.5–5 mm; Class 5: >5 mm

<sup>1</sup> Surface water

Location	Sampling year	[N]	Type of polymer	Concentration (Particles/m <sup>3</sup> )	Shape	Size	Color	Instrumental method	Reference
Italy	2018 <sup>1</sup>	30	PE	13	Fiber	Class 1	Transparent	Py-GC-MS	[86]
			PP		Fragment	Class 2	Brown		
			PVC		Pellet	Class 3	White		
			PUR		Foam	Class 4	Blue		
			PS		Foils		Green		
					Line		Yellow		
							Red		
							Black		
USA	2015 <sup>1</sup>	30	PE	0.287	Fiber	N/A	N/A	FTIR	[87]
			PP		Film				
			PETE		Fragment				
			PA		Foam				
			NL		Spherule				
			PUR						
			AR						
			AN						
			PS						
			CP						

\* Class 1: 0.05–0.5 mm; Class 2: 0.5–1 mm; Class 3: 1–2.5 mm; Class 4: 2.5–5 mm; Class 5: >5 mm

<sup>1</sup> Surface water

Location	Sampling year	[N]	Type of polymer	Concentration (Particles/m <sup>3</sup> )	Shape	Size	Color	Instrumental method	Reference
Latvia	2018 <sup>1</sup>	44	PE	4.43	Fiber	Class 2	Transparent	FTIR	[88]
			PP		Film	Class 3	Brown		
			PETE		Fragment	Class 4	White		
			NL		Foam	Class 5	Blue		
			PES		Beads		Orange		
			PEVA				Green		
			PS				Yellow		
							Purple		
							Pink		
							Gray		
							Black		
Norway	2018 <sup>1</sup>	20	PE	0.00084	Fiber	Class 1	Transparent	FTIR, SEM	[89]
			PP		Film	Class 3	Blue		
			PES		Fragment	Class 4			
			PA		Granules				
			PVA		Line				
			PS						

\* Class 1: 0.05–0.5 mm; Class 2: 0.5–1 mm; Class 3: 1–2.5 mm; Class 4: 2.5–5 mm; Class 5: >5 mm

<sup>1</sup> Surface water

Location	Sampling year	[N]	Type of polymer	Concentration (Particles/m <sup>3</sup> )	Shape	Size	Color	Instrumental method	Reference
USA	2016 <sup>1</sup>	96	PP	1.93	Fiber	Class 3	N/A	FTIR	[90]
			LDPE	2.61	Film	Class 4			
			PS	1.58	Fragment				
				2.71	Pellet				
				2.57	Foam				
				5.67					
				1.00					
				1.27					
				0.55					
				0.42					
Pakistan	2021 <sup>1</sup>		PP	88	Fiber	N/A	Transparent	ATR-FTIR	[110]
			HDPE		Beads		Red		
			EVA		Fragment		White		
			LDPE				Blue		
			NI				Green		
			PMMA				Yellow		
			PETE				Pink		
							Black		

\* Class 1: 0.05–0.5 mm; Class 2: 0.5–1 mm; Class 3: 1–2.5 mm; Class 4: 2.5–5 mm; Class 5: >5 mm

<sup>1</sup> Surface water

Location	Sampling year	[N]	Type of polymer	Concentration (Particles/m <sup>3</sup> )	Shape	Size	Color	Instrumental method	Reference
Bangladesh	2020 <sup>1</sup>	34	PE	0.00057	Fiber	Class 3	Transparent	μ-FTIR	[36]
			PP		Fragment	Class 4	Red		
					Film	Class 5	White		
					Pellet		Blue		
							Green		
							Black		
Iran	2021 <sup>1</sup>	19	PE	43	Fiber		Black	FTIR	[92]
			PA		Fragment		White		
			PS		Film		Blue		
					Foam		Gray		
							Brown		
							Transparent		
							Red		
							Green		
							Yellow		

\* Class 1: 0.05–0.5 mm; Class 2: 0.5–1 mm; Class 3: 1–2.5 mm; Class 4: 2.5–5 mm; Class 5: >5 mm

<sup>1</sup> Surface water