Supporting information

Fluoroquinolones and sulfonamides: features of their determination in waters

Patricia S. Peixoto, Ildikó V. Tóth*, Marcela A. Segundo, José Luís F. C. Lima

* Corresponding author. UCIBIO/REQUIMTE, Department of Chemistry, Faculty of Pharmacy, University of Porto, R Jorge Viterbo Ferreira, 228, 4050-313 Porto, Portugal. Tel: +351 220428676; Fax: +351 226093483

Email address: ivtoth@ff.up.pt; tothildiporto@gmail.com (I. Tóth).

Table 1 Data on physico-chemical properties of the fluoroquinolone compounds.

Antimicrobial agent	Molecular Formula	Molecular weight (g/mol)	Log Kow	pKa	Solubilities	BCF
Ciprofloxacin (CAS No. 63-74-1)	C ₁₇ H ₁₈ FN ₃ O ₃	331.34	-1.08	6.09	Soluble in dilute (0.1N) hydrochloric acid; practically insoluble in ethanol; In water, 30 000 mg/L at 20°C	1.00 (pH 5.5; pH 7.4)
Danofloxacin (CAS No. 63-74-1)	C ₁₉ H ₂₀ FN ₃ O ₃	357.38	1.20±1.43	na	na	1.00 (pH 7.4 and pH 5.5)
Difloxacin (CAS No. 63-74-1)	C ₂₁ H ₁₉ F ₂ N ₃ O ₃	399.39	0.89 (Aqueous phase: pH 7; Analytical method: LC)	na	na	1.76 (pH 5.5); 3.83 (pH 7.4)
Enrofloxacin (CAS No. 63-74-1)	C ₁₉ H ₂₂ FN ₃ O ₃	359.39	0.91 (Aqueous phase at pH 7.4; Analytical method: AS)	6.12	Slightly soluble in water at pH 7	1.00 (pH 5.5; pH 7.4)
Flumequine (CAS No. 63-74-1)	C ₁₄ H ₁₂ FNO ₃	261.25	1.60 (Aqueous phase at pH to assure non-ionized molecule; Analytical method: AS)	6.32	Soluble in alkaline solutions and alcohol. Insoluble in water	11.75 (pH 5.5); 1.00 (pH 7.4)
Lomefloxacin (CAS No. 63-74-1)	C ₁₇ H ₁₉ F ₂ N ₃ O ₃	351.35	-0.80 (Aqueous phase at pH to assure non-ionized molecule)	5.82; 9.3	Solubility at 25°C (mg/ml): 1.03 at ionic strength 0.15 M NaCl	1.00 (pH 5.5; pH 7.4)
Marbofloxacin (CAS No. 63-74-1)	C ₁₇ H ₁₉ FN ₄ O ₄	362.35	-2.92	na	Water solubility at 25°C (mg/L): 10 ⁶	1.00 (pH 5.5; pH 7.4)

BCF, bioconcentration factor; Log Kow, octanol/water partition coefficient; AS, Absorption Spectrophotometry. Data from: (a) ChemSpider (2014) ChemSpider - Search and share chemistry. Royal Society of Chemistry. <http://www.chemspider.com/>. Accessed December 20 2013; (b) LOGKOW© A databank of evaluated octanol-water partition coefficients (Log P). Sangster Research Laboratories. <http://logkow.cisti.nrc.ca/>. Accessed January 17 2014; (c) Montesdeoca-Esponda S, Torres Padron ME, Sosa Ferrera Z, Santana Rodriguez JJ (2009) Solid-phase microextraction with micellar desorption and HPLC-fluorescence detection for the analysis of fluoroquinolones residues in water samples Analytical and bioanalytical chemistry 394:927-935 doi:10.1007/s00216-009-2629-8; (d) Neugebauer U, Szeghalmi A, Schmitt M, Kiefer W, Popp J, Holzgrabe U (2005) Vibrational spectroscopic characterization of fluoroquinolones Spectrochimica acta Part A, Molecular and biomolecular spectroscopy 61:1505-1517 doi:10.1016/j.saa.2004.11.014; (e) O'Neil MJ (2001) The Merck index: an encyclopedia of chemicals, drugs, and biologicals. 13th ed. / editorial staff, Maryadele J. O'Neil ... [et al.] edn. Merck Research Laboratories, Whitehouse Station, N.J. ; [Great Britain]; (f) PubChem PubChem Search. National Center for Biotechnology Information, U.S. National Library of Medicine. <http://pubchem.ncbi.nlm.nih.gov/>. Accessed Accessed in January 13 2014; (g) TOXNET TOXNET - Databases on toxicology, hazardous chemicals, environmental health, and toxic releases. U.S. National Library of Medicine. <http://toxnet.nlm.nih.gov/>. Accessed December 11 2013; (h) Ware GW et al. (2006) Reviews of Environmental Contamination and Toxicology vol 187. Springer, New York, NY.

Table 2 Data on physico-chemical properties of the fluoroquinolone compounds (*continued*).

Antimicrobial agent	Molecular Formula	Molecular weight (g/mol)	Log Kow	pKa	Solubilities	BCF
Norfloxacin (CAS No. 63-74-1)	C ₁₆ H ₁₈ FN ₃ O ₃	319.33	0.43 (Aqueous phase at pH 7.4; AM: AS)	6.34; 8.75	Solubility at 25°C (mg/ml): water 0.28; methanol 0.98; ethanol 1.9; acetone 5.1; chloroform 5.5; diethyl ether 0.01; benzene 0.15; ethyl acetate 0.94; octyl alcohol 5.1; glacial acetic acid 340. Solubility in water is pH dependent, increasing sharply at pH <5 or at pH>10. Hygroscopic in air, forms a hemihydrate	1.00 (pH 5.5; 7.4)
Ofloxacin (CAS No. 63-74-1)	C ₁₈ H ₂₀ FN ₃ O ₄	361.37	-0.39 (Aqueous phase at pH 7.4; Analytical method: AS)	6.05	Soluble in aqueous solutions with pH between 2 and 5. Sparingly to slightly soluble in aqueous solutions with pH 7 (solubility falls to 4 mg/mL) and freely soluble in aqueous solutions with pH above 9	1.00 (pH 5.5; pH 7.4)
Pefloxacin (CAS No. 63-74-1)	C ₁₇ H ₂₀ FN ₃ O ₃	333.36	0.27 (Aqueous phase at pH 7; Analytical method: LC)	6.1	Slightly soluble in water; soluble in alkaline and acidic solutions	1.00 (pH 5.5; pH 7.4)
Sarafloxacin (CAS No. 63-74-1)	C ₂₀ H ₁₇ F ₂ N ₃ O ₃	385.36	-0.65 (Aqueous phase at pH 5; Analytical method: AS); -0.89 (Aqueous phase at pH 7; Analytical method: AS)	5.62	Water solubility at 25°C: 1139 mg/L	1.00 (pH 5.5; pH 7.4)

Table 3 Data on physico-chemical properties of the sulfonamide compounds.

Antimicrobial agent	Molecular Formula	Molecular weight (g/mol)	Log Kow	pKa	Solubilities	BCF
Sulfabenzamide (CAS No. 127-71-9)	$C_{13}H_{12}N_2O_3S$	276.32	1.61 (Aqueous phase: pH 7.5)	4.18±0.70 (most acidic); 1.11±0.10 (most basic)	One gram dissolves in 3225ml of water at 30°, in 33ml of 95% ethanol, in 9ml of acetone. Solubility in 1N NaOH or KOH: ~16g/100ml; pH just above 7	2.04 at pH 1; 2.80 at pH 4; 1.00 at pH 7, 8 and 10
Sulfacetamide (CAS No. 144-80-9)	$C_8H_{10}N_2O_3S$	214.24	-0.96 (Analytical method: AS; Aqueous phase: pH 3.3)	5.78±0.70 (most acidic); 0.93±0.10 (most basic)	Soluble in 150 parts water at 20° C, in 15 parts alcohol, in 7 parts acetone. Soluble in mineral acids and solution of alkali hydroxides and carbonates. Slightly soluble in ether; very slightly soluble in chloroform.	1.00 at pH 1,4,7,8,10
Sulfachloropyridazine (CAS No. 80-32-0)	$C_{10}H_9ClN_4O_2S$	284.73	0.86 (Aqueous phase: pH 4); -1,09 (Aqueous phase: pH 7.5)	na	Water solubility: 7 000 mg/L (37°C)	1.66 (pH 5.5); 1.00 (pH 7.4)
Sulfadiazine (CAS No. 68-35-9)	$C_{10}H_{10}N_4O_2S$	250.28	-0.09 (Aqueous phase: pH 3.3)	6.50 ± 0.30 (most acidic); 1.57 ± 0.10 (most basic)	Sparingly soluble in water at 37°C: 13mg/100ml at pH 5,5; 200mg/100ml at pH 7,5. Sparingly soluble in alcohol, acetone	1.00 at pH 1,4,7,8,10
Sulfadimethoxine (CAS No. 122-11-2)	$C_{12}H_{14}N_4O_4S$	310.33	1.63 (Aqueous phase: pH<6; Analytical method: chemical reaction)	6.21±0.50 (most acidic); 2.44±0.48 (most basic)	Soluble in HCl dilute and in aqueous solutions of sodium carbonate. Solubility in water at 37°C (mg/100ml): 4,6 at pH 4,10; 29,5 at pH 6,7; 58 at pH 7,06; 5170 at pH 8,71	1.00 at pH 1, 8, 10; 7.21 at pH 4; 1.06 at pH 7
Sulfadoxine (CAS No. 2447-57-6)	$C_{12}H_{14}N_4O_4$	310.33	-0,73 (Aqueous phase: pH 7,4; Analytical method: LC)	6.16±0.50 (most acidic); 3.15±0.49 (most basic)	Practically insoluble in ether. Very slightly soluble in water, slightly soluble in alcohol, methanol. Soluble in mineral acids, solutions of alkali hydroxides and carbonates	1.0 at pH 1,4,7,8,10

BCF, bioconcentration factor; Log Kow, octanol/water partition coefficient; AS, Absorption Spectrophotometry. Data from: (a) ChemSpider (2014) ChemSpider - Search and share chemistry. Royal Society of Chemistry. <http://www.chemspider.com/>. Accessed December 20 2013; (b) LOGKOW© A databank of evaluated octanol-water partition coefficients (Log P). Sangster Research Laboratories. <http://logkow.cisti.nrc.ca/>. Accessed January 17 2014; (c) Montesdeoca-Esponda S, Torres Padron ME, Sosa Ferrera Z, Santana Rodriguez JJ (2009) Solid-phase microextraction with micellar desorption and HPLC-fluorescence detection for the analysis of fluoroquinolones residues in water samples Analytical and bioanalytical chemistry 394:927-935 doi:10.1007/s00216-009-2629-8; (d) Neugebauer U, Szeghalmi A, Schmitt M, Kiefer W, Popp J, Holzgrabe U (2005) Vibrational spectroscopic characterization of fluoroquinolones Spectrochimica acta Part A, Molecular and biomolecular spectroscopy 61:1505-1517 doi:10.1016/j.saa.2004.11.014; (e) O'Neil MJ (2001) The Merck index: an encyclopedia of chemicals, drugs, and biologicals. 13th ed. / editorial staff, Maryadele J. O'Neil ... [et al.] edn. Merck Research Laboratories, Whitehouse Station, N.J. ; [Great Britain]; (f) PubChem PubChem Search. National Center for Biotechnology Information, U.S. National Library of Medicine. <http://pubchem.ncbi.nlm.nih.gov/>. Accessed Accessed in January 13 2014; (g) TOXNET TOXNET - Databases on toxicology, hazardous chemicals, environmental health, and toxic releases. U.S. National Library of Medicine. <http://toxnet.nlm.nih.gov/>. Accessed December 11 2013; (h) Ware GW et al. (2006) Reviews of Environmental Contamination and Toxicology vol 187. Springer, New York, NY.

Table 4 Data on physico-chemical properties of the sulfonamide compounds (*continued*).

Antimicrobial agent	Molecular Formula	Molecular weight (g/mol)	Log Kow	pKa	Solubilities	BCF
Sulfaguanidine (CAS No. 57-67-0)	C ₇ H ₁₀ N ₄ O ₂ S	214.25	-1.22	na	One gram dissolves in about 1000 ml water at 25°C and in about 10 ml at 100°C. Sparingly soluble in alcohol or acetone. Freely soluble in diluted mineral acids. Insoluble in NaOH solutions at room temperature.	1.00 (pH 5.5; pH 7.4)
Sulfamerazine (CAS No. 127-79-7)	C ₁₁ H ₁₂ N ₄ O ₂ S	264.31	0.14 (Aqueous phase: pH 7.4)	6.98±0.30 (most acidic); 1.58±0.10 (most basic)	Solubility in water at 37°C: 35mg/100ml at pH 5.5; 170mg/100ml at pH 7.5. Readily soluble in dilute mineral acids and in solutions of potassium, ammonium and sodium hydroxides. Sparingly soluble in acetone, slightly soluble in alcohol, very slightly soluble in ether, chloroform.	1.00 at pH 1, 7, 8, 10; 1.05 at pH 4
Sulfameter (CAS No. 651-06-9)	C ₁₁ H ₁₂ N ₄ O ₃ S	280.31	0.41 (Analytical method: Chemical reaction; Aqueous phase: pH 4-8)	6.69±0.30 (most acidic); 1.48±0.10 (most basic)	Very sparingly soluble in water, alcohol, ether. Soluble in dilute acids, alkalies	1.00 at pH 1,7,8,10; 1.22 at pH 4
Sulfamethazine (CAS No. 57-68-1)	C ₁₂ -H ₁₄ -N ₄ -O ₂ -S	278.34	0.28 (Aqueous phase: pH<6)	7.4±0.0,2 (most acidic); 2.65±0.2 (most basic)	Solubility In water, at 29°C: 150mg/100ml; at 37°C: 192mg/100ml at pH Solubility increases rapidly with increasing pH.	2.26 at pH 4; 1.78 at pH 7; 1.00 at pH 10
Sulfamethoxazole (CAS No. 723-46-6)	C ₁₀ -H ₁₁ -N ₃ -O ₃ -S	253.28	0.89	8.81±0.50 (most acidic); 1.39±0.10 (most basic)	Practically insoluble in water, ether and chloroform; 1g in 50 ml alcohol and about 4 ml acetone; dissolves in HCl hydrogen chloride or sodium hydroxide solution through salt formation; in water, 610mg/l at 37°C.	1.00 at pH 1,7,8,10; 2.73 at pH 4
Sulfamethoxypyridazine (CAS No. 80-35-3)	C ₁₁ H ₁₂ N ₄ O ₃ S	280.31	0.32 (Aqueous phase: pH 3.3)	7.19±0.30 (most acidic); 2.18±0.50 (most basic)	Solubility in water at 37°C (mg/100ml): 110 at pH 5; 120 at pH 6; 147 at pH 6.5. Slightly soluble in methanol (about 1:200); more soluble in acetone (1:50), in dimethylformamide (1g/ml). Freely soluble in aqueous solutions of alkali hydroxides.	1.00 at pH 1,7,8,10; 1.52 at pH 4

BCF, bioconcentration factor; Log Kow, octanol/water partition coefficient; AS, Absorption Spectrophotometry. Data from: (a) ChemSpider (2014) ChemSpider - Search and share chemistry. Royal Society of Chemistry. <http://www.chemspider.com/>. Accessed December 20 2013; (b) LOGKOW© A databank of evaluated octanol-water partition coefficients (Log P). Sangster Research Laboratories. <http://logkow.cisti.nrc.ca/>. Accessed January 17 2014; (c) Montesdeoca-Esponda S, Torres Padron ME, Sosa Ferrera Z, Santana Rodriguez JJ (2009) Solid-phase microextraction with micellar desorption and HPLC-fluorescence detection for the analysis of fluoroquinolones residues in water samples Analytical and bioanalytical chemistry 394:927-935 doi:10.1007/s00216-009-2629-8; (d) Neugebauer U, Szeghalmi A, Schmitt M, Kiefer W, Popp J, Holzgrabe U (2005) Vibrational spectroscopic characterization of fluoroquinolones Spectrochimica acta Part A, Molecular and biomolecular spectroscopy 61:1505-1517 doi:10.1016/j.saa.2004.11.014; (e) O'Neil MJ (2001) The Merck index: an encyclopedia of chemicals, drugs, and biologicals. 13th ed. / editorial staff, Maryadele J. O'Neil ... [et al.] edn. Merck Research Laboratories, Whitehouse Station, N.J. ; [Great Britain]; (f) PubChem PubChem Search. National Center for Biotechnology Information, U.S. National Library of Medicine. <http://pubchem.ncbi.nlm.nih.gov/>. Accessed Accessed in January 13 2014; (g) TOXNET TOXNET - Databases on toxicology, hazardous chemicals, environmental health, and toxic releases. U.S. National Library of Medicine. <http://toxnet.nlm.nih.gov/>. Accessed December 11 2013; (h) Ware GW et al. (2006) Reviews of Environmental Contamination and Toxicology vol 187. Springer, New York, NY.

Table 5 Data on physico-chemical properties of the sulfonamide compounds (*continued*).

Antimicrobial agent	Molecular Formula	Molecular weight (g/mol)	Log Kow	pKa	Solubilities	BCF
Sulfanilamide (CAS No. 63-74-1)	C ₆ H ₈ N ₂ O ₂ S	172.21	-0.72 (Aqueous phase: water or pH 3.3)	10.10±0.10 (most acidic); 1.85±0.10 (most basic)	One gram dissolves in about 37 ml alcohol; in about 5ml acetone; in about 2ml boiling water. Soluble in glycerol, HCl, solution of K and Na hydroxides. Practically insoluble in chloroform, ether, benzene.	1.00 at pH 1,4,7,8,10
Sulfapyridine (CAS No. 144-83-2)	C ₁₁ H ₁₁ N ₃ O ₂ S	249.29	0.35 (Aqueous phase: pH 4)	8.54±0.30 (most acidic); 2.90±0.19 (most basic)	One gram dissolves in ~ 3500ml water, 440ml alcohol, 65ml acetone. Freely soluble in aqueous solutions of KOH and NaOH.	1.00 at pH 1,4,7,8,10
Sulfaquinoxaline (CAS No.59-40-5)	C ₁₄ H ₁₂ N ₄ O ₂ S	300.34	1.68	na	Solubility in water at pH 7: 0.75 mg/100 ml; in 95% alcohol: 73 mg/100 ml; in acetone: 430 mg/100 ml. Soluble in aqueous Na ₂ CO ₃ and NaOH solutions.	4.98 (pH 5.5); 1.00 (pH 7.4)
Sulfathiazole (CAS No. 72-14-0)	C ₉ H ₉ N ₃ O ₂ S ₂	255.3167	0.05 (Aqueous phase: pH 7.4)	7.2	Solubility at 26° C(mg/100 ml): water 60 (pH 6.03); alcohol 525. Soluble in acetone, dilute mineral acids, KOH and NaOH solutions, ammonia water. Very slightly sol in water; sparingly sol in ethanol. Practically insoluble in chloroform, ether.	24.79 (pH 5.5); 10.42 (pH 7.4)

Table 6 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013.

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Ciprofloxacin (CIP)	SPE/LC/FD-DAD	na	0.035 µg L ⁻¹	0.1-5 µg mL ⁻¹	SW	<LOQ-0.459 µg L ⁻¹	[1]
			0.035 µg L ⁻¹ 0.100 µg L ⁻¹		WW	<LOQ	
	SPE/LC-MS/MS	0.6 µg L ⁻¹	2.0 µg L ⁻¹	10-500 µg L ⁻¹	SW	0.072 ± 8.4 µg L ⁻¹	[2]
	SPE/LC-FD	8.50 ng L ⁻¹	25 ng L ⁻¹	na	WW	127.0-10962.5 ng L ⁻¹	[3]
	SPE/LC-MS/MS	13.2 ng L ⁻¹	na	1-500 µg L ⁻¹	SW	<LOD	[4]
					WW	46-1304 ng L ⁻¹	
	SPE (HLB sorbent)-LC-MS/MS	na	E(85): 29.4 ng L ⁻¹ E(170):14.7 ng L ⁻¹	na	WW	na	[5]
	SPE (WCX sorbent)-LC-MS/MS	na	E(90): 27.8 ng L ⁻¹ E(480): 5.2 ng L ⁻¹	na	WW	na	[5]
	SPME (MeOH desorption)-LC-FD	0.05 ng mL ⁻¹	0.12 ng mL ⁻¹	0.01-50 ng mL ⁻¹	GW	na	[6]
					SW		
					WW		
	SPME (POLE desorption)-LC-FD	0.03 ng mL ⁻¹	0.09 ng mL ⁻¹	0.01-50 ng mL ⁻¹	GW	na	[6]
					SW		
					WW		
	SPE/LC-FD	0.11 µg L ⁻¹	0.35 µg L ⁻¹	1.0-250 µg L ⁻¹	WW	0.014-0.444 µg L ⁻¹	[7]
	TFC/LC-MS/MS	15 ng L ⁻¹	45 ng L ⁻¹	100-600 ng L ⁻¹	WW	< 60 ng L ⁻¹	[8]
	SPE/LC-MS/MS	na	1.50 ng L ⁻¹ 0.40 ng L ⁻¹	na	WW	3-408 ng L ⁻¹	[9]
		na	1.50 ng L ⁻¹	na	SW	9-145 ng L ⁻¹	
	SPE/LC-MS/MS	5.7 ng L ⁻¹	19 ng L ⁻¹	5 ng L ⁻¹ -2.5 µg L ⁻¹	SW	<LOQ	[10]
	MIP/LC-MS/MS	5.50 ng L ⁻¹	na	20-2000 ng L ⁻¹	SW	nd	[11]
					WW	33-87 ng L ⁻¹	

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 7 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range	Sample matrix	Concentration found	
Ciprofloxacin (CIP)	DLLME/CE-UV	15.2 µg L ⁻¹	50.6 µg L ⁻¹	166-2000 µg L ⁻¹	DW	na	[12]
		155 µg L ⁻¹	461 µg L ⁻¹	500-2500 µg L ⁻¹	SW		
	SLME/LC-DAD	10 ng L ⁻¹	na	0.01-4 µg L ⁻¹	SW	na	[13]
	SPE/LC-FD	na	0.48 ng L ⁻¹	1-200 ng L ⁻¹	DW	2.0-679.7 ng L ⁻¹	[14]
	SPE/LC-MS/MS	na	0.005 µg L ⁻¹	na	WW	nd-0.458 ± 0.078 µg L ⁻¹	[15]
					SW	nd	
	SPE/LC-MS/MS	na	10 ng L ⁻¹	na	WW	<LOQ-13625 ng L ⁻¹	[16]
	SPE/LC-MS/MS	na	na	1-500 ng mL ⁻¹	SW	nd	[17]
		0.5 ng mL ⁻¹	1.0 ng mL ⁻¹		WW	38.06-2478.7 ng L ⁻¹	
	SPE/LC-MS/MS	1.0 ng L ⁻¹	3.3 ng L ⁻¹	5-5000 ng L ⁻¹	SW	<LOQ-135 ± 2 ng L ⁻¹	[18]
	SPE/LC-MS/MS	na	0.34 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd-26.12 ng L ⁻¹	[19]
	DSPE/CE-DAD	0.041 µg L ⁻¹	na	38-450 µg L ⁻¹	DW	na	[20]
		0.043 µg L ⁻¹			WW	na	
	SPE/LC-MS/MS	0.13 ng L ⁻¹	0.41 ng L ⁻¹	0.13-1000 ng L ⁻¹	SW	nd-119 ng L ⁻¹	[21]
					DW		
	SLME/LC-DAD	10 ng L ⁻¹	na	30-10 ⁶ ng L ⁻¹	SW	na	[22]
					WW		
					DW		
	SLME/LC-FD	3 ng L ⁻¹	na	8-10 ⁵ ng L ⁻¹	SW	na	[22]
					WW		
	MIP-MEPS/LC-MS/MS	0.8 ng L ⁻¹	na	25-1000 ng L ⁻¹	WW	na	[23]
	SLME/LC-MS/MS	0.06 µg L ⁻¹	0.20 µg L ⁻¹	0.5-50 µg L ⁻¹	SW	na	[24]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 8 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Ciprofloxacin (CIP)	MIP/LC-FD-DAD	5 ng L ⁻¹	na	95-3000 µg L ⁻¹	DW	na	[25]
		5 ng L ⁻¹			WW		
	IP-SAME/LC-UV	0.01 ng mL ⁻¹	na	0.03-100 ng mL ⁻¹	DW	nd	[26]
		na			SW		
					WW		
	SPE/LC-FD	0.010 µg L ⁻¹	0.020 µg L ⁻¹	0.02-0.30 µg L ⁻¹	SW	na	[27]
	SPE-MD/LC-FD	MeOH: 0.072 ng mL ⁻¹ POLE: 0.013 ng mL ⁻¹	MeOH: 0.240 ng mL ⁻¹ POLE: 0.044 ng mL ⁻¹	na	GW	na	[28]
					SW	na	
					WW	MeOH: 8.131 ± 3.17-46.01 ± 5.91 ng mL ⁻¹ ; POLE: 10.07 ± 3.34-46.94 ± 4.62 ng mL ⁻¹	
	SPE-MD/LC-MS/MS	MeOH: 0.013 ng mL ⁻¹ POLE: 0.008 ng mL ⁻¹	MeOH: 0.043 ng mL ⁻¹ POLE: 0.027 ng mL ⁻¹	na	GW	na	[28]
					SW	na	
					WW	MeOH:10.97 ± 3.31-49.33 ± 5.66 ng mL ⁻¹ POLE: 13.62 ± 2.95-49.07 ± 3.72 ng mL ⁻¹	
	SPE/LC-MS/MS	1.09 ng L ⁻¹	3.63 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW	nd	
		0.71 ng L ⁻¹	2.37 ng L ⁻¹		WW		
1.23 ng L ⁻¹		4.10 ng L ⁻¹	WW				
SPE/UV	1.55 ng L ⁻¹	5.17 ng L ⁻¹	0-6 mg L ⁻¹	WW	na	[30]	
	10 µg L ⁻¹	na		WW			
SPE/LC-MS	100 ng L ⁻¹	na	10-100 ng L ⁻¹	GW	nd	[31]	
				SW			
SPE/LC-MS/MS	0.03 ng mL ⁻¹	0.09 ng mL ⁻¹	LDR: LOQ-4.00 ng mL ⁻¹	WW	0.2-2.0 ng mL ⁻¹	[32]	

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 9 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Ciprofloxacin (CIP)	DLLME/LC-DAD	5.61 µg L ⁻¹	18.7 µg L ⁻¹	20-1000 µg L ⁻¹	DW	na	[33]
		10.5 µg L ⁻¹	35.0 µg L ⁻¹	35-1000 µg L ⁻¹	SW		
	SPE/LC-MS/MS	5.91 ng L ⁻¹	na	2-750 ng L ⁻¹	SW	<LOD-68.0 ng L ⁻¹	[34]
		11.9 ng L ⁻¹			WW		
	SPE/LC-MS/MS	1.09 ng L ⁻¹	3.63 ng L ⁻¹	10 to 100 ng L ⁻¹	SW	na	[35]
		1.23 ng L ⁻¹	4.10 ng L ⁻¹	200-2000 ng L ⁻¹	WW	nd-81.3 ± 15.1 ng L ⁻¹	
	SPE/LC-DAD	3.9 µg L ⁻¹	7.8 µg L ⁻¹	7.8-200 µg L ⁻¹	WW	nd	[36]
	SPE/LC-MS/MS	1.71 ng L ⁻¹	5.70 ng L ⁻¹	na	SW	na	[37]
		5.55 ng L ⁻¹	18.49 ng L ⁻¹		WW	nd-7494 ng L ⁻¹	
		8.95 ng L ⁻¹	29.84 ng L ⁻¹				
13.58 ng L ⁻¹		34.51 ng L ⁻¹					
Danofloxacin (DNF)	SPE/LC-FD	0.16 µg L ⁻¹	0.54 µg L ⁻¹	0.25-100 µg L ⁻¹	WW	0.002-0-095 µg L ⁻¹	[7]
	SPE/LC-MS/MS	6.0 ng L ⁻¹	20 ng L ⁻¹	5 ng L ⁻¹ -2.5 µg L ⁻¹	SW	<LOQ	[10]
	SPE/LC-MS/MS	na	1 ng L ⁻¹ 3 ng L ⁻¹	na	WW	nd	[9]
	SPE/LC-MS/MS	na	1 ng L ⁻¹	na	SW	nd	[9]
	DLLME/CE-UV	1.55 µg L ⁻¹	5.17 µg L ⁻¹	33-300 µg L ⁻¹	DW	na	[12]
		9.90 µg L ⁻¹	33.0 µg L ⁻¹	100-500 µg L ⁻¹	SW		
	SLME/LC-DAD	5 ng L ⁻¹	13 ng L ⁻¹	0.01-4 µg L ⁻¹	SW	na	[13]
	SPE/LC-MS/MS	na	0.14 ng L ⁻¹	0.50-250 ng L ⁻¹	SW	nd-29.51 ng L ⁻¹	[19]
	DSPE/CE-DAD	0.034 µg L ⁻¹ 0.036 µg L ⁻¹	na	38-450 µg L ⁻¹	DW	na	[20]
0.034 µg L ⁻¹		WW					

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 10 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Danofloxacin (DNF)	SLME/LC-DAD	7 ng L ⁻¹	na	20-10 ⁶ ng L ⁻¹	DW	na	[22]
					SW		
					WW		
	SLME/LC-FD	0.70 ng L ⁻¹	na	2-1000 ng L ⁻¹	DW	na	[22]
					SW		
					WW		
	SLME/LC-MS/MS	0.06 µg L ⁻¹	0.18 µg L ⁻¹	0.5-50 µg L ⁻¹	SW	na	[24]
	MIP/LC-FD-DAD	1 ng L ⁻¹	na	16-250 µg L ⁻¹	DW	na	[25]
		1 ng L ⁻¹			WW		
	SPE/LC-FD	0.001 µg L ⁻¹	0.002 µg L ⁻¹	0.002-0.075 µg L ⁻¹	SW	na	[27]
	SPE/LC-MS/MS	0.34 ng L ⁻¹	1.13 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW	nd	
		0.80 ng L ⁻¹	2.67 ng L ⁻¹		WW		
		2.23 ng L ⁻¹	7.43 ng L ⁻¹				
		2.32 ng L ⁻¹	7.74 ng L ⁻¹				
	MEPS-LC-UV	0.094 ng mL ⁻¹	0.315 ng mL ⁻¹	1-500 ng mL ⁻¹	GW	nd	[39]
	DLLME/LC-DAD	1.70 µg L ⁻¹	5.66 µg L ⁻¹	7-1000 µg L ⁻¹	DW	na	[33]
		1.16 µg L ⁻¹	3.88 µg L ⁻¹		SW		
	SPE/LC-MS/MS	20.50 ng L ⁻¹	na.	20-1500 ng L ⁻¹	SW	nd	[34]
		28 ng L ⁻¹			WW		
	SPE/LC-MS/MS	1.8 µg L ⁻¹	4.0 µg L ⁻¹	5-200 µg L ⁻¹	DW	na	[40]
	SPE/LC-MS/MS	13.55 ng L ⁻¹	45.17 ng L ⁻¹	na	SW	na	[37]
		11.93 ng L ⁻¹	39.78 ng L ⁻¹		WW		
		34.35 ng L ⁻¹	114.51 ng L ⁻¹				
		47.43 ng L ⁻¹	158.11 ng L ⁻¹				

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 11 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Difloxacin (DIX)	SPE/LC-FD	0.29 µg L ⁻¹	0.96 µg L ⁻¹	2.5-250 µg L ⁻¹	WW	nd-0.082 µg L ⁻¹	[7]
	SPE/LC-MS/MS	1.6 ng L ⁻¹	5.4 ng L ⁻¹	5 ng L ⁻¹ -2.5 µg L ⁻¹	SW	<LOQ	[10]
	SPE/LC-MS/MS	na	15 ng L ⁻¹ ; 8 ng L ⁻¹	na	WW	nd	[9]
		na	8 ng L ⁻¹	na	SW	nd	
	DLLME/CE-UV	1.63 µg L ⁻¹	5.43 µg L ⁻¹	20-200 µg L ⁻¹	DW	na	[12]
		6.58 µg L ⁻¹	22.00 µg L ⁻¹	50-250 µg L ⁻¹	SW		
	SPE/LC-MS/MS	na	0.14 ng L ⁻¹	0.50-250 ng L ⁻¹	SW	nd-20.65 ng L ⁻¹	[19]
	DSPE/CE-DAD	0.068 µg L ⁻¹ 0.069 µg L ⁻¹ 0.077 µg L ⁻¹	na	38-450 µg L ⁻¹	DW	na	[20]
					WW		
	SPE/LC-MS/MS	1.09 ng L ⁻¹	3.64 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW	nd	
	SPE/LC-MS/MS	0.56 ng L ⁻¹ 1.71 ng L ⁻¹ 1.78 ng L ⁻¹	1.85 ng L ⁻¹ 5.70 ng L ⁻¹ 5.92 ng L ⁻¹	5-200 µg L ⁻¹	WW	nd	[29]
	DLLME/LC-DAD	1.24 µg L ⁻¹	4.14 µg L ⁻¹	6-900 µg L ⁻¹	DW	na	[33]
		0.50 µg L ⁻¹	1.68 µg L ⁻¹	6-1000 µg L ⁻¹	SW		
Enrofloxacin (ENX)	SPE/LC-FD	17 ng L ⁻¹	50 ng L ⁻¹	na	WW	<LOQ-447.1 ng L ⁻¹	[3]
	SPE/LC-MS/MS	6.5 ng L ⁻¹	na	1-500 µg L ⁻¹	SW	<LOD	[4]
					WW		
	SPE/LC-FD	0.7 ng L ⁻¹	2 ng L ⁻¹	0.1-1000 µg L ⁻¹	SW	<0.7-37 ± 5 ng L ⁻¹	[41]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 12 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Enrofloxacin (ENX)	SPME (MeOH desorption)-LC-FD	0.18 ng mL ⁻¹	0.57 ng mL ⁻¹	0.01-50 ng mL ⁻¹	GW	na	[6]
					SW		
					WW		
	SPME (POLE desorption)-LC-FD	0.01 ng mL ⁻¹	0.04 ng mL ⁻¹	0.01-50 ng mL ⁻¹	GW	na	[6]
					SW		
					WW		
	SPE/LC-FD	0.19 µg L ⁻¹	0.62 µg L ⁻¹	1.0-250 µg L ⁻¹	WW	nd-0.069 µg L ⁻¹	[7]
	SPE/LC-MS/MS	na	1 ng L ⁻¹ 0.5 ng L ⁻¹	na	WW	1-407 ng L ⁻¹	[9]
		na	0.50 ng L ⁻¹	na	SW	3-16 ng L ⁻¹	
	MIP/LC-MS/MS	4.10 ng L ⁻¹	na	20-2000 ng L ⁻¹	SW	nd	[11]
					WW		
	DLLME/CE-UV	1.42 µg L ⁻¹	4.73 µg L ⁻¹	25-200 µg L ⁻¹	DW	na	[12]
		7.8 µg L ⁻¹	26.0 µg L ⁻¹	50-250 µg L ⁻¹	SW		
	SLME/LC-DAD	25 ng L ⁻¹	na	0.01-4 µg L ⁻¹	SW	na	[13]
	SPE/LC-FD	na	0.28 ng L ⁻¹	1-200 ng L ⁻¹	DW	nd-8.30 ng L ⁻¹	[14]
	SPE/LC-MS/MS	na	na	0.5-500 ng mL ⁻¹	SW	nd	[17]
		0.10 ng mL ⁻¹	0.50 ng mL ⁻¹		WW		
	SPE/LC-MS/MS	3.3 ng L ⁻¹	11.0 ng L ⁻¹	5-5000 ng L ⁻¹	SW	<LOQ	[18]
	SPE/LC-MS/MS	na	0.17 ng L ⁻¹	1-250 ng L ⁻¹	SW	0.78-5.14 ng L ⁻¹	[19]
	DSPE/CE-DAD	0.060 µg L ⁻¹ 0.065 µg L ⁻¹	na	38-450 µg L ⁻¹	DW	na	[20]
		0.081 µg L ⁻¹			WW		

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 13 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Enrofloxacin (ENX)	Immunoassay-Electrochemical	10 pg mL ⁻¹	na	0.01-10 ng mL ⁻¹	SW	na	[42]
	SLME/LC-DAD	7 ng L ⁻¹	na	20-10 ⁶ ng L ⁻¹	DW	na	[22]
					SW		
					WW		
	SLME/LC-FD	1.3 ng L ⁻¹	na	4-1000 ng L ⁻¹	DW	na	[22]
					SW		
					WW		
	SLME/LC-MS/MS	0.04 µg L ⁻¹	0.14 µg L ⁻¹	0.5-50 µg L ⁻¹	SW	na	[24]
	MIP/LC-FD-DAD	3 ng L ⁻¹	na	95-3000 µg L ⁻¹	DW	na	[25]
		4 ng L ⁻¹		95-3000 µg L ⁻¹	WW		[25]
	SPE/LC-FD	0.012 µg L ⁻¹	0.020 µg L ⁻¹	0.02-0.10 µg L ⁻¹	SW	na	[27]
	SPE-MD/LC-FD	MeOH: 0.088 ng mL ⁻¹	MeOH: 0.292 ng mL ⁻¹	na	GW	na	[28]
		POLE: 0.010 ng mL ⁻¹	POLE: 0.032 ng mL ⁻¹		SW	nd	
					WW		
	SPE-MD/LC-MS/MS	MeOH: 0.007 ng mL ⁻¹	MeOH: 0.023 ng mL ⁻¹	na	GW	na	[28]
POLE: 0.005 ng mL ⁻¹		POLE: 0.017 ng mL ⁻¹	SW		nd		
			WW				
SPE/LC-MS/MS	0.39 ng L ⁻¹	1.29 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]	
	na	na		GW	nd		
	2.32 ng L ⁻¹	7.72 ng L ⁻¹		WW	9.45-56.50 ng L ⁻¹		
	0.98 ng L ⁻¹	3.27 ng L ⁻¹					
	2.37 ng L ⁻¹	7.89 ng L ⁻¹					
SPE/LC-DAD	0.8 µg L ⁻¹	2 µg L ⁻¹	na	WW	<LOD-<LOQ	[43]	

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 14 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Enrofloxacin (ENX)	MEPS-LC-UV	0.051 ng mL ⁻¹	0.173 ng mL ⁻¹	1-500 ng mL ⁻¹	GW	nd	[39]
	SPE/LC-MS/MS	0.03 ng mL ⁻¹	0.11 ng mL ⁻¹	LDR: LOQ-4.00 ng mL ⁻¹	WW	nd	[32]
	DLLME/LC-DAD	1.07 µg L ⁻¹	3.55 µg L ⁻¹	5-900 µg L ⁻¹	DW	na	[33]
		0.35 µg L ⁻¹	1.17 µg L ⁻¹	5-1000 µg L ⁻¹	SW		
	MSPE/LC-DAD	0.49 µg L ⁻¹	1.60 µg L ⁻¹	2.0-200 µg L ⁻¹	SW	na	[44]
	MIP/FI-CL	0.27 µg L ⁻¹	na	0.2-150 µg L ⁻¹	SW	23.3 ± 0.2	[Luaces, 2013 #189]
	SPE/LC-MS/MS	0.39 ng L ⁻¹	1.29 ng L ⁻¹	10-100 ng L ⁻¹	SW	na	[35]
		2.37 ng L ⁻¹	7.89 ng L ⁻¹	200-2000 ng L ⁻¹	WW	nd	
Flumequin (FLU)	SPE/LC-MS/MS	4 ng L ⁻¹	11 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd	[45]
	SPE/LC-MS/MS	1.2 ng L ⁻¹	4 ng L ⁻¹	5 ng L ⁻¹ -2.5 µg L ⁻¹	SW	<LOQ	[10]
	SPE/LC-MS/MS	na	1.5 ng L ⁻¹	na	WW	nd	[9]
		na	0.6 ng L ⁻¹		SW	nd	
	SPE/LC-MS/MS	1.1 ng L ⁻¹	3.5 ng L ⁻¹	5-5000 ng L ⁻¹	SW	<LOQ and 4.6 ± 0.5 ng L ⁻¹	[18]
	SPE/LC-MS/MS	na	0.35 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd-7.03 ng L ⁻¹	[19]
	DSPE/CE-DAD	0.030 µg L ⁻¹	na	38-450 µg L ⁻¹	DW	na	[20]
		0.031 µg L ⁻¹			WW		
		0.031 µg L ⁻¹			DW		
	SLME/LC-DAD	7 ng L ⁻¹	na	20-10 ⁶ ng L ⁻¹	SW	na	[22]
					WW		
					DW		
	SLME/LC-FD	0.3 ng L ⁻¹	na	1-10 ³ ng L ⁻¹	SW	na	[22]
					WW		
					WW		
	SPE/LC-MS/MS	0.04 ng mL ⁻¹	0.15 ng mL ⁻¹	LDR: LOQ-4.00 ng mL ⁻¹	WW	nd	[32]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 15 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Flumequin (FLU)	DLLME/LC-DAD	1.73 µg L ⁻¹	5.77 µg L ⁻¹	8-750 µg L ⁻¹	DW	na	[33]
		3.08 µg L ⁻¹	10.3 µg L ⁻¹	11-750 µg L ⁻¹	SW		
	SPE/LC-MS/MS	0.73 ng L ⁻¹	2.44 ng L ⁻¹	na	SW	na	[37]
	SPE/LC-MS/MS	2.68 ng L ⁻¹	8.94 ng L ⁻¹	na	WW	nd-< 8.94 ng L ⁻¹	[37]
		3.17 ng L ⁻¹	10.58 ng L ⁻¹				
Lomefloxacin (LMX)	SPE/LC-MS/MS	4.25 ng L ⁻¹	14.15 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd	[45]
	SPE/LC-MS/MS	2 ng L ⁻¹	6 ng L ⁻¹				
	LC-UV	1.47 ng mL ⁻¹	7.50 ng mL ⁻¹	5-1000 ng mL ⁻¹	GW	nd	[46]
					WW		
	SPE/LC-MS/MS	1.8 µg L ⁻¹	6.0 µg L ⁻¹	10-500 µg L ⁻¹	SW	nd	[2]
	SPE/LC-FD	0.15 µg L ⁻¹	0.49 µg L ⁻¹	2.5-250 µg L ⁻¹	WW	0.024-0.735 µg L ⁻¹	[7]
	SPE/LC-MS/MS	na	3 ng L ⁻¹	na	WW	<1.0-18 ng L ⁻¹	[9]
		na	1 ng L ⁻¹		SW	1-11 ng L ⁻¹	
	SPE/LC-MS/MS	1.5 ng L ⁻¹	5 ng L ⁻¹	5 ng L ⁻¹ -2.5 µg L ⁻¹	SW	<LOQ	[10]
	MIP/LC-MS/MS	3.5 ng L ⁻¹	na	20-2000 ng L ⁻¹	SW	nd	[11]
					WW		
	DLLME/CE-UV	9.20 µg L ⁻¹	30.7 µg L ⁻¹	250-1500 µg L ⁻¹	DW	na	[12]
		71.5 µg L ⁻¹	238 µg L ⁻¹	500-2500 µg L ⁻¹	SW		
	SPE/LC-FD	na	0.83 ng L ⁻¹	1-200 ng L ⁻¹	DW	nd-179.0 ng L ⁻¹	[14]
	SPE/LC-MS/MS	na	0.005 µg L ⁻¹	na	WW	nd-0.313 ± 0.052 µg L ⁻¹	[15]
					SW	nd	
	SPE/LC-MS/MS	3.3 ng L ⁻¹	11.0 ng L ⁻¹	5-5000 ng L ⁻¹	SW	<LOQ	[18]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 16 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Lomefloxacin (LMX)	SPE/LC-MS/MS	na	0.13 ng L ⁻¹	0.5-250 ng L ⁻¹	SW	nd-1.16 ng L ⁻¹	[19]
	DSPE/CE-DAD	0.073 µg L ⁻¹	na	38-450 µg L ⁻¹	DW	na	[20]
		0.078 µg L ⁻¹			WW		
		0.093 µg L ⁻¹					
	SPE/LC-FD	0.020 µg L ⁻¹	0.040 µg L ⁻¹	0.04-0.30 µg L ⁻¹	SW	na	[27]
	SPE/LC-MS/MS	0.65 ng L ⁻¹	2.18 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW	nd	
	SPE/LC-MS/MS	0.77 ng L ⁻¹	2.57 ng L ⁻¹	5-200 µg L ⁻¹	WW	nd-<4.70 ng L ⁻¹	[29]
		1.41 ng L ⁻¹	4.70 ng L ⁻¹				
		1.59 ng L ⁻¹	5.31 ng L ⁻¹				
Marbofloxacin (MBX)	SPE/LC-MS/MS	0.04 ng mL ⁻¹	0.14 ng mL ⁻¹	LDR: LOQ-4 ng mL ⁻¹	WW	nd	[32]
	DLLME/LC-DAD	3.29 µg L ⁻¹	11.0 µg L ⁻¹	12-1000 µg L ⁻¹	DW	na	[33]
		3.62 µg L ⁻¹	12.0 µg L ⁻¹		SW		
	MSPE/LC-DAD	0.27 µg L ⁻¹	0.91 µg L ⁻¹	1.0-200.0 µg L ⁻¹	SW	na	[44]
	SPE/LC-FD	2 ng L ⁻¹	6 ng L ⁻¹	0.5-1000 µg L ⁻¹	SW	<2-9±3 ng L ⁻¹	[41]
	SPE/LC-MS/MS	na	1.5 ng L ⁻¹	na	WW	nd	[9]
		na	1.5 ng L ⁻¹	na	SW	nd	
	DLLME/CE-UV	9.03 µg L ⁻¹	30.1 µg L ⁻¹	133-1600 µg L ⁻¹	DW	na	[12]
		58.5 µg L ⁻¹	195 µg L ⁻¹	400-2000 µg L ⁻¹	SW		
Marbofloxacin (MBX)	SPE/LC-MS/MS	na	0.23 ng L ⁻¹	0.5-250 ng L ⁻¹	SW	nd-22.29 ng L ⁻¹	[19]
	DSPE/CE-DAD	0.045 µg L ⁻¹	na	38-450 µg L ⁻¹	DW	na	[20]
		0.052 µg L ⁻¹			WW		

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 17 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Conc. Found	
Marbofloxacin (MBX)	SLME/LC-DAD	16 ng L ⁻¹	na	50-10 ⁶ ng L ⁻¹	DW	na	[22]
					SW		
					WW		
	SLME/LC-FD	16 ng L ⁻¹	na	50-10 ⁵ ng L ⁻¹	DW	na	[22]
					SW		
					WW		
	SPE/LC-FD	0.020 µg L ⁻¹	0.050 µg L ⁻¹	0.05-0.75 µg L ⁻¹	SW	na	[27]
	SPE/LC-MS/MS	0.29 ng L ⁻¹	0.95 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW	nd-4.36 ng L ⁻¹	
		0.46 ng L ⁻¹	1.53 ng L ⁻¹		WW		
		1 ng L ⁻¹	3.34 ng L ⁻¹				
		2.08 ng L ⁻¹	6.92 ng L ⁻¹				
DLLME/LC-DAD	1.21 µg L ⁻¹	4.05 µg L ⁻¹	6-1000 µg L ⁻¹	DW	na	[33]	
	1.25 µg L ⁻¹	4.16 µg L ⁻¹		SW			
MSPE LC-DAD	0.50 µg L ⁻¹	1.64 µg L ⁻¹	2.0-200 µg L ⁻¹	SW	na	[44]	
SPE/LC-MS/MS	2.50 ng/	8.34 ng L ⁻¹	na	SW	na	[37]	
	2.23 ng L ⁻¹	7.45 ng L ⁻¹		WW	nd-96 ng L ⁻¹		
	4.02 ng L ⁻¹	13.41 ng L ⁻¹					
	4.31 ng L ⁻¹	14.37 ng L ⁻¹					
Norfloxacin (NFX)	SPE/LC/FD-DAD	na	0.035 µg L ⁻¹	SW	<LOQ-0.439 µg L ⁻¹	[1]	
			0.035 µg L ⁻¹ 0.120 µg L ⁻¹	WW	<LOQ		
	SPE/LC-MS/MS	0.8 µg L ⁻¹	2.7 µg L ⁻¹	10-500 µg L ⁻¹	SW	0.024 ± 9.7-0.048 ± 4.8 µg L ⁻¹	[2]
	SPE/LC-FD	8.50 ng L ⁻¹	25 ng L ⁻¹	na	WW	29.6-228.9 ng L ⁻¹	[3]
	SPME (MeOHdesorption)-LC-FD	0.02 ng mL ⁻¹	0.08 ng mL ⁻¹	0.01-50 ng mL ⁻¹	GW	na	[6]
SW							
WW							

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 18 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Norfloxacin (NFX)	SPME (POLE desorption)-LC-FD	0.01 ng mL ⁻¹	0.03 ng mL ⁻¹	0.01-50 ng mL ⁻¹	GW SW WW	na	[6]
	SPE/LC-FD	0.35 µg L ⁻¹	1.15 µg L ⁻¹	0.5-250 µg L ⁻¹	WW	0.056-1163 µg L ⁻¹	[7]
	SPE/LC-MS/MS	na	1.5 ng L ⁻¹ 0.5 ng L ⁻¹	na	WW	1-120 ng L ⁻¹	[9]
		na	0.5 ng L ⁻¹	na	SW	30-173 ng L ⁻¹	
	SPE/LC-MS/MS	1.2 ng L ⁻¹	4.1 ng L ⁻¹	5 ng L ⁻¹ -2.5 µg L ⁻¹	SW	<LOQ-18.6 ng L ⁻¹	[10]
	SLME/LC-DAD	18 ng L ⁻¹	na	0.01-4 µg L ⁻¹	SW	na	[13]
	SPE/LC-FD	na	0.31 ng L ⁻¹	1-200 ng L ⁻¹	DW	nd-82.70 ng L ⁻¹	[14]
	SPE/LC-MS/MS	na	0.005 µg L ⁻¹	na	WW	nd-0.859 ± 0.186 µg L ⁻¹	[15]
					SW	nd	
	SPE/LC-MS/MS	na	56 ng L ⁻¹	na	WW	nd	[16]
					SW	nd	
	SPE/LC-MS/MS	0.50 ng mL ⁻¹	1.00 ng mL ⁻¹	1-500 ng mL ⁻¹	WW	25.69-38.11 ng L ⁻¹	[17]
					GW	<LOD	
	icELISA	0.016 µg L ⁻¹	na	0.1-10 µg L ⁻¹	SW	<LOD-0.08 ± 0.03 µg L ⁻¹	[47]
					WW	0.13 ± 0.03-0.22 ± 0.06 µg L ⁻¹	
	SPE/LC-MS/MS	2.10 ng L ⁻¹	7 ng L ⁻¹	5-5000 ng L ⁻¹	SW	<LOQ-75 ± 6 ng L ⁻¹	[18]
	SPE/LC-MS/MS	na	0.60 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd-108.80 ng L ⁻¹	[19]
	SPE/LC-MS	0.13 ng L ⁻¹	0.41 ng L ⁻¹	0.13-1000 ng L ⁻¹	SW	nd-51 ng L ⁻¹	[21]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 19 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Norfloxacin (NFX)	SLME/LC-DAD	20 ng L ⁻¹	na	60-10 ⁶ ng L ⁻¹	DW	na	[22]
					SW		
					WW		
	SLME/LC-FD	5 ng L ⁻¹	na	15-10 ⁵ ng L ⁻¹	DW	na	[22]
					SW		
					WW		
	MIP-MEPS/LC-MS/MS	3.8 ng L ⁻¹	na	25-1000 ng L ⁻¹	WW	na	[23]
	MIP/LC-FD-DAD	8 ng L ⁻¹	na	95-3000 µg L ⁻¹	DW	na	[25]
		12 ng L ⁻¹			WW		
	SPE/LC-FD	0.006 µg L ⁻¹	0.010 µg L ⁻¹	0.01-0.30 µg L ⁻¹	SW	na	[27]
	SPE-MD/LC-FD	MeOH: 0.112 ng mL ⁻¹	MeOH: 0.372 ng mL ⁻¹	na	GW	MeOH: <LOQ-568.8 ± 11.8 ng mL ⁻¹ POLE: 0.062 ± 0.02-601.2 ± 10.3 ng mL ⁻¹	[28]
		POLE: 0.013 ng mL ⁻¹	POLE: 0.044 ng mL ⁻¹		SW		
					WW		
	SPE-MD/LC-MS/MS	MeOH: 0.011 ng mL ⁻¹	MeOH: 0.037 ng mL ⁻¹	na	GW	na	[28]
		POLE: 0.008 ng mL ⁻¹	POLE: 0.027 ng mL ⁻¹		SW		
					WW	MeOH: 0.104 ± 0.04-651.2 ± 18.5 ng mL ⁻¹ POLE: 0.110 ± 0.03-698.8 ± 13.4 ng mL ⁻¹	
SPE/LC-MS/MS	0.88 ng L ⁻¹	2.93 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]	
	na	na		GW	nd		
	1.45 ng L ⁻¹	4.83 ng L ⁻¹		WW	nd-< 10.5 ng L ⁻¹		
	1.88 ng L ⁻¹	6.27 ng L ⁻¹					
	3.14 ng L ⁻¹	10.5 ng L ⁻¹					
SPE/LC-MS/MS	0.02 ng mL ⁻¹	0.07 ng mL ⁻¹	LDR: LOQ-4 ng mL ⁻¹	WW	nd-1.6 ng mL ⁻¹	[32]	
SPE/LC-MS/MS	6.82 ng L ⁻¹	na	2-750 ng L ⁻¹	SW	nd	[34]	
	21.1 ng L ⁻¹			WW	71.3 ng L ⁻¹		

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 20 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref	
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found		
Norfloxacin (NFX)	SPE/LC-MS/MS	0.88 ng L ⁻¹	2.93 ng L ⁻¹	10-100 ng L ⁻¹	SW	nd-243 ± 21.90 ng L ⁻¹	[35]	
		3.14 ng L ⁻¹	10.50 ng L ⁻¹	200-2000 ng L ⁻¹	WW			
	SPE/LC-MS/MS	2.53 ng L ⁻¹	8.44 ng L ⁻¹	na	SW	na	[37]	
		28.75 ng L ⁻¹	95.84 ng L ⁻¹		WW	nd-385 ng L ⁻¹		
		55.11 ng L ⁻¹	183.69 ng L ⁻¹					
	77.71 ng L ⁻¹	272.50 ng L ⁻¹						
	SPE/LC-MS/MS	7 ng L ⁻¹	21 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd	[45]	
Ofloxacin (OFX)	SPE/LC/FD-DAD	na	0.035 µg L ⁻¹	0.1-5 µg mL ⁻¹	SW	<LOQ-0.439 µg L ⁻¹	[1]	
			0.035 µg L ⁻¹		WW	<LOQ		
	LC-UV	1.88 ng mL ⁻¹	5.69 ng mL ⁻¹	5-1000 ng mL ⁻¹	GW	nd	[46]	
					WW			
	SPE/LC-FD	85 ng L ⁻¹	250 ng L ⁻¹	na	WW	353.3-1675.5 ng L ⁻¹	[3]	
	SPE (HLB sorbent)-LC-MS/MS	na	E(85): 20 ng L ⁻¹ E(170): 10 ng L ⁻¹	na	WW	na	[5]	
	SPE (WCX sorbent)-LC-MS/MS	na	E(90): 18.9 ng L ⁻¹ E(480): 3.5 ng L ⁻¹	na	WW	na	[5]	
	SPE/LC-MS/MS	na	3 ng L ⁻¹ 0.9 ng L ⁻¹	na	WW	18-716 ng L ⁻¹	[9]	
		na	0.90 ng L ⁻¹		SW	80-231 ng L ⁻¹		
		SPE/LC-MS/MS	3.8 ng L ⁻¹	12.7 ng L ⁻¹	5 ng L ⁻¹ -2.5 µg L ⁻¹	SW	<LOQ-10.5 ng L ⁻¹	[10]
		SPE/LC-MS/MS	na	0.005 µg L ⁻¹	na	WW	0.008 ± 0.002-4.24 ± 0.221 µg L ⁻¹	[15]
	SW					nd-0.074 ± 0.009 µg L ⁻¹		
	SPE/LC-MS/MS	na	33 ng L ⁻¹	na	WW	<LOQ-5286 ng L ⁻¹	[16]	

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 21 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Ofloxacin (OFX)	SPE/LC-MS/MS	0.10 ng mL ⁻¹	0.50 ng mL ⁻¹	0.5-500 ng mL ⁻¹	SW	nd	[17]
					WW	nd-20.27 ng L ⁻¹	
	SPE/LC-MS/MS	0.5 ng L ⁻¹	1.7 ng L ⁻¹	5-5000 ng L ⁻¹	SW	2.3±0.1-231±4 ng L ⁻¹	[18]
	SPE/LC-MS/MS	na	0.66 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd	[19]
	DSPE/CE-DAD	0.044 µg L ⁻¹	na	38-450 µg L ⁻¹	DW	na	[20]
		0.045 µg L ⁻¹					
		0.050 µg L ⁻¹			WW		
	MIP-MEPS/LC-MS/MS	0.50 ng L ⁻¹	na	25-1000 ng L ⁻¹	WW	na	[23]
	Voltammetry	1.6 × 10 ⁻⁷ mol L ⁻¹	na	1.0 × 10 ⁻⁵ - 1.0 × 10 ⁻⁴ mol L ⁻¹	WW	nd	[48]
	IP-SAME/LC-UV	0.04 ng mL ⁻¹	na	0.10-100 ng mL ⁻¹	DW	nd	[26]
		na			SW		
					WW		
	SPE/LC-MS/MS	0.29 ng L ⁻¹	0.96 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW		
		0.72 ng L ⁻¹ , 1.07 ng L ⁻¹ , 3.17 ng L ⁻¹	2.40 ng L ⁻¹ , 3.21 ng L ⁻¹ , 10.6 ng L ⁻¹		WW		
	SPE/LC-MS/MS	0.02 ng mL ⁻¹	0.07 ng mL ⁻¹	LDR: LOQ-4 ng mL ⁻¹	WW	nd-2.0 ng mL ⁻¹	[32]
	SPE/LC-MS/MS	9.24 ng L ⁻¹ 28.40 ng L ⁻¹	na	2-750 ng L ⁻¹	SW WW	<LOD-127.0 ng L ⁻¹	[34]
	SPE/LC-MS/MS	0.29 ng L ⁻¹	0.96 ng L ⁻¹	10-100 ng L ⁻¹	SW	na	[35]
		3.17 ng L ⁻¹	10.60 ng L ⁻¹	200-2000 ng L ⁻¹	WW	nd-840 ± 120 ng L ⁻¹	
	SPE/LC-MS/MS	0.9 µg L ⁻¹	2.0 µg L ⁻¹	5-200 µg L ⁻¹	DW	na	[40]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 22 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Ofloxacin (OFX)	SPE/LC-MS/MS	2.54 ng L ⁻¹	8.47 ng L ⁻¹	na	SW	na	[37]
		6.44 ng L ⁻¹	21.48 ng L ⁻¹		WW	63-10368 ng L ⁻¹	
		13.81 ng L ⁻¹	42.05 ng L ⁻¹				
		15.70 ng L ⁻¹	52.32 ng L ⁻¹				
	SPE/LC-MS/MS	2 ng L ⁻¹	6 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd-7 ng L ⁻¹	[45]
Pefloxacin (PFX)	SPE/LC-MS/MS	na	1.5 ng L ⁻¹	na	WW	nd-160 ng L ⁻¹	[9]
		na	1.5 ng L ⁻¹	na	SW	nd-5 ng L ⁻¹	
	SPE/LC-MS/MS	1.0 ng mL ⁻¹	5.0 ng mL ⁻¹	5-500 ng mL ⁻¹	SW	nd	[17]
					WW		
	DSPE/CE-DAD	0.066 µg L ⁻¹	na	38-450 µg L ⁻¹	DW	na	[20]
		0.076 µg L ⁻¹			WW		
		0.078 µg L ⁻¹					
	SPE/LC-MS/MS	0.26 ng L ⁻¹	0.88 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW		
		0.77 ng L ⁻¹	2.56 ng L ⁻¹		WW	nd	
		1.60 ng L ⁻¹	5.32 ng L ⁻¹				
		3.77 ng L ⁻¹	12.6 ng L ⁻¹				
	DLLME/LC-DAD	2.57 µg L ⁻¹	8.56 µg L ⁻¹	10-1000 µg L ⁻¹	DW	na	[33]
1.41 µg L ⁻¹		4.71 µg L ⁻¹	SW				
SPE/LC-MS/MS	0.26 ng L ⁻¹	0.88 ng L ⁻¹	10-100 ng L ⁻¹	SW	nd	[35]	
	3.77 ng L ⁻¹	12.60 ng L ⁻¹	200-2000 ng L ⁻¹	WW			
Sarafloxacin (SFX)	SPE/LC-MS/MS	na	10 ng L ⁻¹	na	WW	nd	[9]
			4 ng L ⁻¹		SW		
	SPE/LC-FD	0.88 µg L ⁻¹	2.92 µg L ⁻¹	1.0-250 µg L ⁻¹	WW	nd	[7]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 23 Literature survey on analytical methods for determination of fluoroquinolone antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Sarafloxacin (SFX)	SPME (MeOH desorption)-LC-FD	0.05 ng mL ⁻¹	0.18 ng mL ⁻¹	0.01-50 ng mL ⁻¹	GW	na	[Montesdeoca-Esponda, 2009 #65]
					SW		
					WW		
	SPME (POLE desorption)-LC-FD	0.02 ng mL ⁻¹	0.05 ng mL ⁻¹	0.01-50 ng mL ⁻¹	GW	na	[6]
					SW		[6]
					WW		
	SPE/LC-MS/MS	3.2 ng L ⁻¹	10.8 ng L ⁻¹	5 ng L ⁻¹ -2.5 µg L ⁻¹	SW	<LOQ	[10]
	DLLME/CE-UV	8.66 µg L ⁻¹	28.9 µg L ⁻¹	200-1600 µg L ⁻¹	DW	na	[12]
		63.3 µg L ⁻¹	211 µg L ⁻¹	400-2000 µg L ⁻¹	SW		
	SPE/LC-MS/MS	1.1 ng L ⁻¹	3.6 ng L ⁻¹	5-5000 ng L ⁻¹	SW	<LOQ	[18]
	SPE/LC-MS/MS	na	0.16 ng L ⁻¹	0.5-250 ng L ⁻¹	SW	nd-14.61 ng L ⁻¹	[19]
	MIP/LC-FD-DAD	11 ng L ⁻¹	na	95-3000 µg L ⁻¹	DW	na	[25]
		8 ng L ⁻¹			WW		
	SPME/LC-FD	MeOH: 0.140 ng mL ⁻¹	MeOH: 0.468 ng mL ⁻¹	na	GW	na	[28]
		POLE : 0.014 ng mL ⁻¹	POLE: 0.048 ng mL ⁻¹		SW		
					WW		
	SPME/LC-MS/MS	MeOH: 0.010 ng mL ⁻¹	MeOH: 0.050 ng mL ⁻¹	na	GW	na	[28]
		POLE: 0.011 ng mL ⁻¹	POLE: 0.037 ng mL ⁻¹		SW		
					WW		
	SPE/LC-MS/MS	0.30 ng L ⁻¹	0.98 ng L ⁻¹	5-20 µg L ⁻¹	SW	na	[29]
		na	na		GW		
		0.58 ng L ⁻¹	1.94 ng L ⁻¹		WW		
	DLLME/LC-DAD	2.01 ng L ⁻¹	6.71 ng L ⁻¹	15-1000 µg L ⁻¹	DW	na	[33]
		5.81 ng L ⁻¹	19.40 ng L ⁻¹		SW		
		4.04 µg L ⁻¹	13.5 µg L ⁻¹		SW		
	SPE/LC-MS/MS	3.31 µg L ⁻¹	11.0 µg L ⁻¹	2-750 ng L ⁻¹	SW	nd	[34]
		4.12 ng L ⁻¹	na		WW		
		5.50 ng L ⁻¹					

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 24 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013.

Analyte	Analytical method	Analytical data			Sample matrix	Application	Ref
		LOD ^a	LOQ ^a	Linear range ^a		Concentration found	
Sulfabenzamide (SBZ)	SPE/LC-MS/MS	0.22 ng L ⁻¹	0.74 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd-3.41 ng L ⁻¹	[49]
		0.41 ng L ⁻¹	1.38 ng L ⁻¹		SW	nd-3.41 ng L ⁻¹	
		0.05 ng L ⁻¹ 0.11 ng L ⁻¹	0.17 ng L ⁻¹ 0.38 ng L ⁻¹		WW	nd-< 0.38 ng L ⁻¹	
	SPE/LC-MS/MS	1.04 ng L ⁻¹	0.13 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-0.2 ng L ⁻¹	[50]
	SPE/LC-MS/MS	0.75 ng L ⁻¹	2.50 ng L ⁻¹	na	SW	na	[37]
		1.92 ng L ⁻¹ 2.94 ng L ⁻¹ 3.06 ng L ⁻¹	6.40 ng L ⁻¹ 9.81 ng L ⁻¹ 10.21 ng L ⁻¹		WW	nd	
Sulfacetamide (SCT)	SPE/LC-MS/MS	5.13 ng L ⁻¹	17.1 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd-<LOD	[49]
		4.06 ng L ⁻¹	13.5 ng L ⁻¹		SW	nd	
		6.90 ng L ⁻¹	23.0 ng L ⁻¹		WW	nd	
	SPE/LC-MS/MS	na	0.96 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd-4.31 ng L ⁻¹	[19]
	SPE/LC-MS/MS	1.57 ng L ⁻¹	5.23 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW		
		1.33 ng L ⁻¹ 1.95 ng L ⁻¹ 4.52 ng L ⁻¹	4.43 ng L ⁻¹ 6.50 ng L ⁻¹ 15.1 ng L ⁻¹		WW	nd	
	SPE/LC-UV	6 µg L ⁻¹	20 µg L ⁻¹	5-1000 µg L ⁻¹	SW WW	nd	[51]
	DLLME/LC-DAD	9.87 µg L ⁻¹	32.9 µg L ⁻¹	34-1000 µg L ⁻¹	DW	na	[33]
		7.04 µg L ⁻¹	23.5 µg L ⁻¹		SW		
	Sulfachloropyridazine (SCP)	MSPE-CE-UV	0.35 µg L ⁻¹ 0.38 µg L ⁻¹	1.17 µg L ⁻¹ , 1.27 µg L ⁻¹	1.17-100 µg L ⁻¹ 1.27-100 µg L ⁻¹	DW	na
0.49 µg L ⁻¹			1.62 µg L ⁻¹	1.62-100 µg L ⁻¹	SW		

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 25 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range	Sample matrix	Concentration found	
Sulfachloropyridazine (SCP)	SPE/LC-MS/MS	na	1 ng L ⁻¹ 3 ng L ⁻¹	na	WW	<1-57 ng L ⁻¹	[9]
		na	1.0 ng L ⁻¹	na	SW	nd	
	SPE/LC-MS/MS	na	1.02 ng L ⁻¹	2-250 ng L ⁻¹	SW	nd-5.86 ng L ⁻¹	[19]
	MSPE/LC-UV	0.13 ng mL ⁻¹ 0.70 ng L ⁻¹	0.44 ng mL ⁻¹ 2.33 ng L ⁻¹	0.5-100 ng mL ⁻¹	SW	na	[53]
					WW	na	
	SPE/LC-MS/MS	na	na	5-200 µg L ⁻¹	SW	na	[29]
		2.12 ng L ⁻¹ 4.50 ng L ⁻¹ 8.32 ng L ⁻¹	7.06 ng L ⁻¹ 15.00 ng L ⁻¹ 27.70 ng L ⁻¹		GW	na	
					WW	nd	
Sulfadiazine (SDZ)	SPE/LC-MS/MS	9.70 ng L ⁻¹ 10.10 ng L ⁻¹	na	2-750 ng L ⁻¹	SW	8.87-12.8 ng L ⁻¹	[34]
					WW	<LOD-66.9 ng L ⁻¹	
	SPE/LC-MS/MS	0.70 ng L ⁻¹ 8.32 ng L ⁻¹	2.33 ng L ⁻¹ 27.70 ng L ⁻¹	10-100 ng L ⁻¹ 200-2000 ng L ⁻¹	SW	na	[35]
					WW	nd-321 ± 38.5 ng L ⁻¹	
	SPE/LC-DAD	na	0.070 µg L ⁻¹	0.1-5 µg mL ⁻¹	SW	<LOQ	[1]
			0.070 µg L ⁻¹ 0.200 µg L ⁻¹		WW	<LOQ	
					DW	<LOQ	
	SPE/LC-MS/MS	0.22 ng L ⁻¹ 0.48 ng L ⁻¹ 0.09 ng L ⁻¹ 1.02 ng L ⁻¹ 0.65 ng L ⁻¹	0.74 ng L ⁻¹ 1.60 ng L ⁻¹ 0.31 ng L ⁻¹ 3.41 ng L ⁻¹ 2.15 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	<LOQ	[54]
					SW	1.90-2312 ng L ⁻¹	
					WW	34.30 ng L ⁻¹	
	SPE/LC-MS	5 ng L ⁻¹ 20 ng L ⁻¹	10 ng L ⁻¹ 40 ng L ⁻¹	10-200 ng L ⁻¹ 40-1000 ng L ⁻¹	SW	nd	[55]
					WW	nd	
	SPE/LC-MS/MS	1.4 ng L ⁻¹	na	1-500 µg L ⁻¹	SW	<LOD-3 ng L ⁻¹	[4]
					WW	<LOD-27 ng L ⁻¹	

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 26 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref	
		LOD ^a	LOQ ^a	Linear range	Sample matrix	Concentration found		
Sulfadiazine (SDZ)	SLME/LC-UV	0.4 µg L ⁻¹	na	1-2000 µg L ⁻¹	SW	na	[56]	
					WW	nd		
	SPE/LC-MS/MS	na	0.005 µg L ⁻¹	na	WW	nd-1.380 ± 0.289 µg L ⁻¹	[15]	
					SW	nd		
	SPE/LC-MS/MS	0.05 ng L ⁻¹	0.17 ng L ⁻¹	0.01-5000 ng L ⁻¹	SW	nd->CR	[57]	
	SPE/LC-MS/MS	0.18 ng L ⁻¹	0.59 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd-0.81 ng L ⁻¹	[49]	
		0.34 ng L ⁻¹	1.12 ng L ⁻¹		SW	nd-0.81 ng L ⁻¹		
		0.90 ng L ⁻¹	2.99 ng L ⁻¹		WW	nd-< 0.9 ng L ⁻¹		
		1.12 ng L ⁻¹	3.72 ng L ⁻¹					
	TRFIA	5.4 ng L ⁻¹	14.7 ng L ⁻¹	na	DW	na	[58]	
					SW			
					WW	<LOD-0.589 µg L ⁻¹		
	SPE/LC-MS/MS	0.45 ng L ⁻¹	1.50 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-2.2 ng L ⁻¹	[50]	
	SPE/LC-MS/MS	na	1.53 ng L ⁻¹	5-250 ng L ⁻¹	SW	nd-3.04 ng L ⁻¹	[19]	
	SLME/LC-DAD	15 ng L ⁻¹	na	50-10 ⁶ ng L ⁻¹	DW	na	[59]	
					SW			
WW								
SLME/LC-FD	15 ng L ⁻¹	na	50-10 ⁵ ng L ⁻¹	DW	na	[59]		
				SW				
				WW				
SPE/LC-MS-MS	0.7 ng L ⁻¹	na	0.5-200 ng mL ⁻¹	DW	na	[60]		
	1.6 ng L ⁻¹			WW	<LOD			
	4.4 ng L ⁻¹							

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 27 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Sulfadiazine (SDZ)	SPE/LC-MS/MS	0.39 ng L ⁻¹	1.29 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW	1.47	
		1.13 ng L ⁻¹	11.30 ng L ⁻¹		WW	19.5-187	
		1.14 ng L ⁻¹					
		3.39 ng L ⁻¹					
	SPE/LC-UV	7.5 µg L ⁻¹	25 µg L ⁻¹	5-1000 µg L ⁻¹	SW	nd	[51]
					WW	nd	
	DLLME/LC-DAD	2.58 µg L ⁻¹	8.61 µg L ⁻¹	10-1000 µg L ⁻¹	DW	na	[33]
		1.53 µg L ⁻¹	5.10 µg L ⁻¹		SW		
	SPE/LC-MS/MS	8.52 ng L ⁻¹	na	2-750 ng L ⁻¹	SW	29.1-139 ng L ⁻¹	[34]
		20.20 ng L ⁻¹			WW	<LOD-276 ng L ⁻¹	
	SPE/LC-MS/MS	0.39 ng L ⁻¹	1.29 ng L ⁻¹	10-100 ng L ⁻¹	SW	na	[35]
		3.39 ng L ⁻¹	11.30 ng L ⁻¹	200-2000 ng L ⁻¹	WW	<LOQ-758 ± 234 ng L ⁻¹	
SPE/LC-MS/MS	3.35 ng L ⁻¹	11.16 ng L ⁻¹	na	SW	na	[37]	
	5.92 ng L ⁻¹	19.73 ng L ⁻¹		WW	nd		
	11.14 ng L ⁻¹	37.13 ng L ⁻¹					
	11.25 ng L ⁻¹	37.49 ng L ⁻¹					
SPE/LC-MS/MS	4 ng L ⁻¹	12 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd	[45]	
Sulfadimethoxine (SDM)	SPE/LC-MS/MS	0.02 ng L ⁻¹	0.05 ng L ⁻¹	0.05-1000 ng L ⁻¹	DW	0.16 ng L ⁻¹	[54]
		0.01 ng L ⁻¹	0.05 ng L ⁻¹		GW	0.2 ng L ⁻¹	
		0.04 ng L ⁻¹	0.12 ng L ⁻¹			3.40-62.7 ng L ⁻¹	
		0.31 ng L ⁻¹	1.02 ng L ⁻¹				
			0.19 ng L ⁻¹		0.63 ng L ⁻¹	WW	
	SPE/LC-MS	10 ng L ⁻¹	na	0.5-25 µg L ⁻¹	WW	nd-14.05 ± 0.08 µg L ⁻¹	[61]
	SPE/LC-MS/MS	na	0.6 ng L ⁻¹	na	WW	nd	[9]
1.5 ng L ⁻¹			SW				
		0.6 ng L ⁻¹					

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 28 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Sulfadimethoxine (SDM)	MSPE -CE-UV	0.30 µg L ⁻¹	0.99 µg L ⁻¹	0.99-100 µg L ⁻¹	DW	na	[52]
		0.42 µg L ⁻¹	1.40 µg L ⁻¹	1.4-100 µg L ⁻¹			
		0.47 µg L ⁻¹	1.58 µg L ⁻¹	0.75-100 µg L ⁻¹	SW		
	SLME/LC-UV	0.1 µg L ⁻¹	na	1-2000 µg L ⁻¹	WW	nd-0.22 µg L ⁻¹	[56]
					SW	na	
	SPE/LC-MS/MS	0.11 ng L ⁻¹	0.37 ng L ⁻¹	0.01-5000 ng L ⁻¹	SW	nd-136 ng L ⁻¹	[57]
	SPE/LC-MS/MS	na	0.005 µg L ⁻¹	na	WW	nd	[15]
					SW		
	SPE/LC-MS/MS	0.02 ng L ⁻¹	0.07 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd-20.10 ng L ⁻¹	[49]
		0.02 ng L ⁻¹	0.08 ng L ⁻¹		SW		
		0.01 ng L ⁻¹	0.02 ng L ⁻¹		WW		
		0.16 ng L ⁻¹	0.54 ng L ⁻¹				
	SPE/LC-MS/MS	0.21 ng L ⁻¹	0.70 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-0.6 ng L ⁻¹	[50]
	SPE/LC-MS/MS	na	1.02 ng L ⁻¹	2-250 ng L ⁻¹	SW	nd-1.36 ng L ⁻¹	[19]
	SPE/LC-MS/MS	0.56 ng L ⁻¹	1.87 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW		
		0.57 ng L ⁻¹	1.90 ng L ⁻¹		WW	nd	
0.93 ng L ⁻¹		3.10 ng L ⁻¹					
1.23 ng L ⁻¹		4.10 ng L ⁻¹					
SPE/LC-UV	6 µg L ⁻¹	20 µg L ⁻¹	5-1000 µg L ⁻¹	SW	nd	[51]	
				WW			
SPE/LC-MS/MS	0.01 µg L ⁻¹	0.04 µg L ⁻¹	1-200 µg L ⁻¹	SW	na	[62]	
DLLME/LC-DAD	1.54 µg L ⁻¹	5.15 µg L ⁻¹	5-1000 µg L ⁻¹	DW	na	[33]	
	1.00 µg L ⁻¹	3.33 µg L ⁻¹		SW			

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 29 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Sulfadimethoxine (SDM)	SPE/LC-MS/MS	10.40 ng L ⁻¹	na	2-750 ng L ⁻¹	SW	nd	[34]
		13.60 ng L ⁻¹			WW		
	SPE/LC-MS/MS	na	0.8 ng L ⁻¹	0.01-250 ng L ⁻¹	DW	nd	[63]
					SW	<LOQ-43 ng L ⁻¹	
	SPE/LC-MS/MS	0.41 ng L ⁻¹	1.38 ng L ⁻¹	na	SW	nd	[37]
9.67 ng L ⁻¹		32.24 ng L ⁻¹	WW				
11.53 ng L ⁻¹		38.42 ng L ⁻¹					
		16.17 ng L ⁻¹	53.90 ng L ⁻¹				
Sulfadoxine (SFD)	MSPE-CE-UV	0.42 µg L ⁻¹	1.40 µg L ⁻¹	1.4-100 µg L ⁻¹	DW	na	[52]
		0.30 µg L ⁻¹	0.99 µg L ⁻¹	0.99-100 µg L ⁻¹			
		0.47 µg L ⁻¹	1.58 µg L ⁻¹	1.58-100 µg L ⁻¹	SW		
	SPE/LC-MS/MS	0.02 ng L ⁻¹	0.08 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd-4.48 ng L ⁻¹	[49]
		0.19 ng L ⁻¹	0.63 ng L ⁻¹		SW	nd-20.00 ng L ⁻¹	
		0.04 ng L ⁻¹	0.14 ng L ⁻¹		WW	nd< 0.39 ng L ⁻¹	
		0.12 ng L ⁻¹	0.39 ng L ⁻¹				
	MSPE/LC-UV	0.16 ng mL ⁻¹	0.53 ng mL ⁻¹	1-100 ng mL ⁻¹	SW	na	[53]
					WW		
	SPE/LC-MS/MS	0.03 ng L ⁻¹	0.10 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-0.60 ng L ⁻¹	[50]
	SPE/LC-MS/MS	na	1.03 ng L ⁻¹	2-250 ng L ⁻¹	SW	nd-1.93 ng L ⁻¹	[19]
	SPE/LC-MS/MS	0.45 ng L ⁻¹	1.50 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW		
		0.74 ng L ⁻¹	2.47 ng L ⁻¹		WW	nd	
		1.21 ng L ⁻¹	4.03 ng L ⁻¹				
1.70 ng L ⁻¹		5.67 ng L ⁻¹					
DLLME/LC-DAD	0.41 µg L ⁻¹	1.36 µg L ⁻¹	3-900 µg L ⁻¹	DW	na	[33]	
	0.87 µg L ⁻¹	2.89 µg L ⁻¹	3-1000 µg L ⁻¹	SW			

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 30 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref	
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found		
Sulfaguanidine (SFG)	SPE/LC-MS/MS	12 ng L ⁻¹	40 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd	[49]	
		1.01 ng L ⁻¹	3.37 ng L ⁻¹		SW	na		
		1.01 ng L ⁻¹	3.37 ng L ⁻¹		WW	nd-1.88 ng L ⁻¹		
		7.84 ng L ⁻¹	26.1 ng L ⁻¹					
Sulfamerazine (SMR)	SPE/LC-MS/MS	na	0.5 ng L ⁻¹ 1.5 ng L ⁻¹	na	WW	nd	[9]	
		na	0.5 ng L ⁻¹	na	SW	nd		
	MSPE-CE-UV	0.44 µg L ⁻¹ 0.39 µg L ⁻¹	1.46 µg L ⁻¹ 1.30 µg L ⁻¹	1.46-100 µg L ⁻¹ 1.30-100 µg L ⁻¹	DW	na	[52]	
		MSPE-CE-UV	0.44 µg L ⁻¹	1.46 µg L ⁻¹	1.46-100 µg L ⁻¹	SW	na	[52]
	SLME/LC-UV	0.1 µg L ⁻¹	na	1-2000 µg L ⁻¹	WW	nd-0.26 µg L ⁻¹	[56]	
					SW	na		
	SPE/LC-MS/MS	0.12 ng L ⁻¹	0.40 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd-3.22 ng L ⁻¹	[49]	
		0.21 ng L ⁻¹	0.70 ng L ⁻¹		SW	nd-15.50 ng L ⁻¹		
		0.19 ng L ⁻¹	0.62 ng L ⁻¹		WW	nd-34.60 ng L ⁻¹		
		0.25 ng L ⁻¹	0.83 ng L ⁻¹					
	SPE/LC-MS/MS	0.05 ng L ⁻¹	0.17 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-103 ng L ⁻¹	[50]	
	SPE/LC-MS/MS	na	0.98 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd	[19]	
					DW			
	SLME/LC/DAD	5 ng L ⁻¹	na	15-10 ⁶ ng L ⁻¹	SW	na	[59]	
					WW			
					DW			
	SLME/LC/FD	15 ng L ⁻¹	na	50-10 ⁵ ng L ⁻¹	SW	na	[59]	
					WW			

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 31 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Sample matrix	Application	Ref	
		LOD ^a	LOQ ^a	Linear range ^a		Concentration found		
Sulfamerazine (SMR)	SLME/LC-MS/MS	0.06 µg L ⁻¹	0.21 µg L ⁻¹	0.5-50 µg L ⁻¹	SW	na	[24]	
	MSPE/LC-UV	0.10 ng mL ⁻¹	0.32 ng mL ⁻¹	0.5-100 ng mL ⁻¹	SW	na	[53]	
					WW			
	SPE/LC-MS-MS	0.3 ng L ⁻¹	na	0.5-200 ng mL ⁻¹	DW	na	[60]	
		1.1 ng L ⁻¹			WW	<LOD		
	SPE/LC-UV	3 µg L ⁻¹	10 µg L ⁻¹	5-1000 µg L ⁻¹	SW	na	[51]	
					WW			
	SPE/LC-MS/MS	15.20 ng L ⁻¹	na	na	SW	nd	[34]	
7.23 ng L ⁻¹		WW			<LOD-100 ng L ⁻¹			
Sulfameter (SME)	SPE/LC-MS/MS	2.37 ng L ⁻¹	7.90 ng L ⁻¹	na	SW	na	[37]	
		8.74 ng L ⁻¹	29.12 ng L ⁻¹		WW	nd		
	16.66 ng L ⁻¹	55.53 ng L ⁻¹						
	19.24 ng L ⁻¹	64.14 ng L ⁻¹						
Sulfameter (SME)	SPE/LC-MS/MS	na	0.9 ng L ⁻¹	na	WW	<0.90-215 ng L ⁻¹	[9]	
		na	3 ng L ⁻¹					
	SPE/LC-MS/MS	na	0.9 ng L ⁻¹	na	SW	nd-13 ng L ⁻¹	[19]	
		na	0.86 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd-1.21 ng L ⁻¹		
	MSPE/LC-UV	0.13 ng mL ⁻¹	0.43 ng mL ⁻¹	0.5-100 ng mL ⁻¹	SW	na	[53]	
					WW			
	SPE/LC-MS/MS	na	na	5-200 µg L ⁻¹	SW	na	[29]	
					GW			
0.87 ng L ⁻¹					2.90 ng L ⁻¹	WW		nd
1.34 ng L ⁻¹					4.47 ng L ⁻¹			
1.88 ng L ⁻¹	6.27 ng L ⁻¹							
Sulfamethazine (SMT)	SPE/LC-DAD	na	0.070 µg L ⁻¹	0.1-5 µg mL ⁻¹	SW	<LOQ	[1]	
			0.070 µg L ⁻¹		WW	<LOQ		
			0.200 µg L ⁻¹					

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 32 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Sulfamethazine (SMT)	SPE/LC-MS/MS	0.04 ng L ⁻¹	0.14 ng L ⁻¹	0.05-1000 ng L ⁻¹	DW	<LOQ	[54]
		0.07 ng L ⁻¹	0.25 ng L ⁻¹		GW	<LOQ	
		0.03 ng L ⁻¹	0.11 ng L ⁻¹		SW	1.7-6192 ng L ⁻¹	
		0.14 ng L ⁻¹	0.46 ng L ⁻¹		WW	10.7 ng L ⁻¹	
		43.09 ng L ⁻¹	143.65 ng L ⁻¹		SW	na	
	SPE/LC-MS	10 ng L ⁻¹	10 ng L ⁻¹	10-200 ng L ⁻¹	WW	nd-1.82 ng L ⁻¹	[55]
	SPE/LC-MS	20 ng L ⁻¹	40 ng L ⁻¹	40-1000 ng L ⁻¹	WW	nd-10.07± 0.67 µg L ⁻¹	[61]
	SPE/LC-MS/MS	18 ng L ⁻¹	na	0.5-25 µg L ⁻¹	SW	<LOD-19 ng L ⁻¹	[4]
	SLME/LC-UV	0.3 µg L ⁻¹	na	1-2000 µg L ⁻¹	WW	na	[56]
					SW	nd	
	SPE/LC-MS/MS	0.9 ng L ⁻¹	3 ng L ⁻¹	5 ng L ⁻¹ - 2.5 µg L ⁻¹	SW	<LOQ	[10]
	SPE/LC-MS/MS	0.22 ng L ⁻¹	0.73 ng L ⁻¹	0.01-5000 ng L ⁻¹	SW	nd- >CR	[57]
	TRFIA	7.4 ng L ⁻¹	18.0 ng L ⁻¹	na	DW	na	[58]
					SW	<LOD-0.043 µg L ⁻¹	
					WW	nd-0.825 ± 0.177 µg L ⁻¹	
	SPE/LC-MS/MS	na	0.005 µg L ⁻¹	na	SW	nd-0.010±0.002 µg L ⁻¹	[15]
					GW	nd-3.71 ng L ⁻¹	
	SPE/LC-MS/MS	0.04 ng L ⁻¹	0.13 ng L ⁻¹	0.05-1000 ng L ⁻¹	SW	nd-20.10 ng L ⁻¹	[49]
		0.05 ng L ⁻¹	0.15 ng L ⁻¹		WW	nd-18 ng L ⁻¹	
		0.06 ng L ⁻¹	0.19 ng L ⁻¹		SW	<LOQ	
	SPE/LC-MS/MS	0.40 ng L ⁻¹	1.33 ng L ⁻¹	5-5000 ng L ⁻¹	GW	<LOD-13.40 ng L ⁻¹	[18]
	SPE/LC-MS/MS	1.4 ng L ⁻¹	4.7 ng L ⁻¹	0.01-500 ng L ⁻¹	SW	<LOQ	[50]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 33 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Sulfamethazine (SMT)	SPE/LC-MS/MS	na	1.10 ng L ⁻¹	2-250 ng L ⁻¹	SW	nd-37.38 ng L ⁻¹	[19]
	SLME/LC-DAD	15 ng L ⁻¹	na	50-10 ⁶ ng L ⁻¹	DW	na	[59]
					SW		
					WW		
	SLME/LC-FD	15 ng L ⁻¹	na	50-10 ⁵ ng L ⁻¹	DW	na	[59]
					SW		
					WW		
	SLME/LC-MS/MS	0.01 µg L ⁻¹	0.04 µg L ⁻¹	0.5-50 µg L ⁻¹	SW	na	[24]
	SPE/LC-MS-MS	0.4 ng L ⁻¹	na	0.5-200 ng mL ⁻¹	DW	<LOD	[60]
		0.9 ng L ⁻¹			WW		
		3.3 ng L ⁻¹			SW		
	SPE/LC-MS/MS	0.31 ng L ⁻¹	1.03 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW	128 ng L ⁻¹	
		0.43 ng L ⁻¹	1.42 ng L ⁻¹		WW	280-600 ng L ⁻¹	
		0.75 ng L ⁻¹	2.50 ng L ⁻¹				
		1.64 ng L ⁻¹	5.47 ng L ⁻¹				
	SPE/LC-UV	1.5 µg L ⁻¹	5 µg L ⁻¹	5-1000 µg L ⁻¹	SW WW	nd	[51]
	SPE/LC-MS/MS	0.01 µg L ⁻¹	0.04 µg L ⁻¹	1-200 µg L ⁻¹	SW	na	[62]
	SPE/LC-MS/MS	na	0.2 ng L ⁻¹	0.1-1000 ng L ⁻¹	GW	5.2-6.1 ng L ⁻¹	[64]
			0.1 ng L ⁻¹		SW	na	
			9.8 ng L ⁻¹		WW		
	SPE/LC-MS/MS	5.81 ng L ⁻¹	na	2-750 ng L ⁻¹	SW	nd	[34]
		9.75 ng L ⁻¹			WW		
	SPE/LC-MS/MS	0.31 ng L ⁻¹	1.03 ng L ⁻¹	10-100 ng L ⁻¹	SW	na	[35]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 34 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Sample matrix	Application	Ref
		LOD ^a	LOQ ^a	Linear range ^a		Concentration found	
Sulfamethazine (SMT)	SPE/LC-MS/MS	1.64 ng L ⁻¹	5.47 ng L ⁻¹	200-2000 ng L ⁻¹	WW	nd-1010 ± 7.24 ng L ⁻¹	[35]
	SPE/LC-MS/MS	na	0.7 ng L ⁻¹	0.01-250 ng L ⁻¹	DW SW	<LOQ-113 ng L ⁻¹ nd	[63]
	SPE/LC-MS/MS	4 ng L ⁻¹	11 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd	[45]
Sulfamethoxazole (SMZ)	SPE/LC-DAD	na	0.080 µg L ⁻¹	0.1-5 µg mL ⁻¹	SW	<LOQ-0.510 µg L ⁻¹	[1]
			0.080 µg L ⁻¹ 0.250 µg L ⁻¹		WW	<0.080-5.597 µg L ⁻¹	
	SPE/LC-MS/MS	0.09 ng L ⁻¹	0.30 ng L ⁻¹	0.05-1000 ng L ⁻¹	DW	<LOQ	[54]
		1.13 ng L ⁻¹	3.77 ng L ⁻¹		GW	9.90 ng L ⁻¹	
		0.05 ng L ⁻¹	0.15 ng L ⁻¹ 0.17 ng L ⁻¹		SW	6.4-218.4 ng L ⁻¹	
		0.25 ng L ⁻¹	0.83 ng L ⁻¹		WW	241.6 ng L ⁻¹	
	SPE/LC-MS/MS	0.5 ng L ⁻¹	2.0 ng L ⁻¹	0-1200 µg L ⁻¹	SW	<LOQ	[65]
	SPE/LC-MS/MS	4.2 µg L ⁻¹	14 µg L ⁻¹	10-500 µg L ⁻¹	SW	0.047-0.096 µg L ⁻¹	[2]
	SPE/LC-MS	5 ng L ⁻¹	10 ng L ⁻¹	10-200 ng L ⁻¹	SW	ND	[55]
		20 ng L ⁻¹	40 ng L ⁻¹	40-1000 ng L ⁻¹	WW	nd-1.07 ng L ⁻¹	
	SPE/LC-MS	21 ng L ⁻¹	na	0.5-25 µg L ⁻¹	WW	nd-1.01 ± 0.03 µg L ⁻¹	[61]
	SPE/LC-MS/MS	0.1 ng L ⁻¹	0.5 ng L ⁻¹	na	SW	<LOQ-1 ng L ⁻¹	[66]
		na	3 ng L ⁻¹		WW	<LOQ-12 ng L ⁻¹	
	SPE/LC-MS/MS	3.3 ng L ⁻¹	na	1-500 µg L ⁻¹	SW	5-9 ng L ⁻¹	[4]
					WW	194-4664 ng L ⁻¹	
	SPE/LC-MS/MS	1 ng L ⁻¹	na	5-250 ng L ⁻¹	DW	<LOD	[67]
		2 ng L ⁻¹	na	10-100 ng L ⁻¹	SW	<LOD-<14 ng L ⁻¹	
	MSPE-CE-UV	0.49 µg L ⁻¹ 0.46 µg L ⁻¹	1.63 µg L ⁻¹ 1.53 µg L ⁻¹	1.63-100 µg L ⁻¹ 1.53-100 µg L ⁻¹	DW	na	[52]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 35 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Sulfamethoxazole (SMZ)	MSPE-CE-UV	0.56 µg L ⁻¹	1.88 µg L ⁻¹	1.88-100 µg L ⁻¹	SW	na	[52]
	Immuno-assay (ELISA plate)	0.001 ng mL ⁻¹	na	0.02-17.80 ng mL ⁻¹	WW	0.02 ± 0.01-0.11 ± 0.01 ng mL ⁻¹	[68]
	Immuno-assay (L-CD)	0.09 ng mL ⁻¹	na	DR: 0.24-36.84 ng mL ⁻¹	WW	nd	[68]
	SPE/LC-MS/MS	0.5 ng L ⁻¹	1.7 ng L ⁻¹	5 ng L ⁻¹ -2.5 µg L ⁻¹	SW	12.90-26 ng L ⁻¹	[10]
	TFC/LC-MS/MS	34 ng L ⁻¹	104 ng L ⁻¹	100-600 ng L ⁻¹	WW	<LOQ	[8]
	SLME/LC-UV	0.1 µg L ⁻¹	na	1-2000 µg L ⁻¹	SW	na	[56]
					WW	nd	
	SPE/LC-MS/MS	1.24 ng L ⁻¹	4.13 ng L ⁻¹	10-250 ng mL ⁻¹	GW	nd	[69]
					SW		
					WW		
	SPE/LC-MS/MS	0.17 ng L ⁻¹	0.57 ng L ⁻¹	0.01-5000 ng L ⁻¹	SW	nd-652.7 ng L ⁻¹	[57]
	Immuno-assay SPE/SPR	0.01 µg L ⁻¹	na	0.04-10 µg L ⁻¹	SW	na	[70]
	SPE/LC-MS/MS	na	6 ng L ⁻¹	1-2000 ng L ⁻¹	SW	na	[71]
			30 ng L ⁻¹		WW	<LOQ-140 ± 10 ng L ⁻¹	
	TRFIA	9.1 ng L ⁻¹	61.5 ng L ⁻¹	na	DW	na	[58]
					SW		
					WW		
SPE/LC-MS/MS	na	0.005 µg L ⁻¹	na	WW	nd-2.020 ± 0.368 µg L ⁻¹	[15]	
				SW	nd-0.023±0.003 µg L ⁻¹		
				GW	nd-53.9 ng L ⁻¹		
SPE/LC-MS/MS	0.81 ng L ⁻¹	2.69 ng L ⁻¹	0.05-1000 ng L ⁻¹	SW	nd-32.2 ng L ⁻¹	[49]	
	0.86 ng L ⁻¹	2.87 ng L ⁻¹		WW	nd-302 ng L ⁻¹		
	0.77 ng L ⁻¹	2.55 ng L ⁻¹					
	1.14 ng L ⁻¹	3.79 ng L ⁻¹					

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 36 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Sample matrix	Application Concentration found	Ref
		LOD ^a	LOQ ^a	Linear range ^a			
Sulfamethoxazole (SMZ)	SPE/LC-MS/MS	na	15 ng L ⁻¹	na	WW	104-530 ng L ⁻¹	[16]
	LC-MS	0.25 µg L ⁻¹	0.80 µg L ⁻¹	0.8-100.0 µg L ⁻¹	WW	12.5-37.3 µg L ⁻¹	[72]
	SPE/LC-MS/MS	na	5-17 ng L ⁻¹	10-25000 ng mL ⁻¹	WW	<5-680 ng L ⁻¹	[73]
	SPE/LC-MS/MS	0.6 ng L ⁻¹	2 ng L ⁻¹	5-5000 ng L ⁻¹	SW	<LOQ-1435 ± 41 ng L ⁻¹	[18]
	SPE/LC-MS/MS	0.06 ng L ⁻¹	0.20 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-8.80 ng L ⁻¹	[50]
	SPE/LC-MS/MS	na	0.94 ng L ⁻¹	1-250 ng L ⁻¹	SW	nd-212.15 ng L ⁻¹	[19]
	SPE/LC-MS/MS	0.24 ng L ⁻¹	0.78 ng L ⁻¹	0.13-1000 ng L ⁻¹	SW	nd-106 ng L ⁻¹	[21]
	SLME/LC-DAD	1 ng L ⁻¹	na	3-10 ⁶ ng L ⁻¹	DW	na	[59]
					SW		
					WW		
	SLME/LC-FD	0.3 ng L ⁻¹	na	0.9-10 ⁵ ng L ⁻¹	DW	na	[59]
					SW		
					WW		
	Potentiometry	3.0 µg mL ⁻¹	na	10.0-2500 µg mL ⁻¹	WW	na	[74]
	SPE/LC-MS/MS	0.7 ng L ⁻¹	na	0.5-200 ng mL ⁻¹	DW	na	[60]
		1.7 ng L ⁻¹			WW	206 (±2%)-1740 (±3%) ng L ⁻¹	
		3.5 ng L ⁻¹			WW	206 (±2%)-1740 (±3%) ng L ⁻¹	
	SPE/LC-MS/MS	0.29 ng L ⁻¹	0.96 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
		na	na		GW	nd	
		0.45 ng L ⁻¹	1.50 ng L ⁻¹		WW	<5.17 ng L ⁻¹	
		0.79 ng L ⁻¹	2.63 ng L ⁻¹		WW	<5.17 ng L ⁻¹	
		1.55 ng L ⁻¹	5.17 ng L ⁻¹		WW	<5.17 ng L ⁻¹	
	SPE/LC-UV	7.5 µg L ⁻¹	25 µg L ⁻¹	5-1000 µg L ⁻¹	SW WW	na	[51]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 37 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Sulfamethoxazole (SMZ)	SPE/LC-MS	10 ng L ⁻¹	na	10-100 ng L ⁻¹	GW	50-75 ng L ⁻¹	[31]
					SW	75-100 ng L ⁻¹	
	SPE/LC-MS/MS	na	7 ng L ⁻¹	0.1-1000 ng L ⁻¹	GW	8.8-15 ng L ⁻¹	[64]
			2.9 ng L ⁻¹		SW	na	
			11.6 ng L ⁻¹		WW	na	
	DLLME/LC-DAD	0.88 µg L ⁻¹	2.93 µg L ⁻¹	5-1000 µg L ⁻¹	DW	na	[33]
		1.70 µg L ⁻¹	5.68 µg L ⁻¹		SW	na	
	SPE/LC-MS/MS	6.40 ng L ⁻¹	na	2-750 ng L ⁻¹	SW	nd	[34]
		16.60 ng L ⁻¹			WW	<LOD-341 ng L ⁻¹	
	SPE/LC-DAD	0.90 µg L ⁻¹	2.9 µg L ⁻¹	2.9-150 µg L ⁻¹	WW	nd	[36]
	SPE/LC-MS/MS	0.29 ng L ⁻¹	0.96 ng L ⁻¹	10-100 ng L ⁻¹	SW	na	[35]
		1.55 ng L ⁻¹	5.17 ng L ⁻¹	200-2000 ng L ⁻¹	WW	nd-114 ± 0.26 ng L ⁻¹	
	SPE/LC-MS/MS	na	1.0 ng L ⁻¹	0.01-250 ng L ⁻¹	DW	nd	[63]
			1.1 ng L ⁻¹		SW	13-149 ng L ⁻¹	
			4.64 ng L ⁻¹		SW	na	
Sulfamethoxypyridazine (SMP)	SPE/LC-MS/MS	1.39 ng L ⁻¹	4.64 ng L ⁻¹	na	WW	19-200 ng L ⁻¹	[37]
		3.78 ng L ⁻¹	12.60 ng L ⁻¹			19-200 ng L ⁻¹	
		4.78 ng L ⁻¹	15.94 ng L ⁻¹			19-200 ng L ⁻¹	
	SPE/LC-MS/MS	8.07 ng L ⁻¹	26.88 ng L ⁻¹			19-200 ng L ⁻¹	
		4 ng L ⁻¹	11 ng L ⁻¹			19-200 ng L ⁻¹	
		4 ng L ⁻¹	11 ng L ⁻¹			19-200 ng L ⁻¹	
	SPE/LC-MS/MS	0.03 ng L ⁻¹	0.09 ng L ⁻¹	0.05-1000 ng L ⁻¹	DW	<LOQ	[54]
		0.05 ng L ⁻¹	0.17 ng L ⁻¹		GW	<LOD	
		0.02 ng L ⁻¹	0.07 ng L ⁻¹		SW	nd-3704 ng L ⁻¹	
	SPE/LC-MS/MS	0.77 ng L ⁻¹	2.57 ng L ⁻¹		SW	nd-3704 ng L ⁻¹	
		0.26 ng L ⁻¹	0.88 ng L ⁻¹	0.05-1000 ng L ⁻¹	WW	nd	[54]
Sulfamethoxypyridazine (SMP)	SPE/LC-MS/MS	na	0.5 ng L ⁻¹	na	WW	nd	[9]
		na	1.5 ng L ⁻¹		WW	nd	
	SPE/LC-MS/MS	na	0.5 ng L ⁻¹	na	SW	nd	

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 38 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Sample matrix	Application Concentration found	Ref
		LOD ^a	LOQ ^a	Linear range ^a			
Sulfamethoxypyridazine (SMP)	SPE/LC-MS/MS	0.05 ng L ⁻¹	0.17 ng L ⁻¹	0.01-5000 ng L ⁻¹	SW	nd->CR	[57]
	SPE/LC-MS/MS	0.03 ng L ⁻¹	0.09 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd-0.77 ng L ⁻¹	[49]
		0.09 ng L ⁻¹	0.31 ng L ⁻¹		SW	nd-15.50 ng L ⁻¹	
		0.05 ng L ⁻¹	0.17 ng L ⁻¹		WW	nd	
	SPE/LC-MS/MS	0.14 ng L ⁻¹	0.47 ng L ⁻¹				
	SPE/LC-MS/MS	0.03 ng L ⁻¹	0.10 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-0.20 ng L ⁻¹	[50]
	SPE/LC-MS/MS	na	1 ng L ⁻¹	1-250 ng L ⁻¹	SW	0.35-15.15 ng L ⁻¹	[19]
	SPE/LC-UV	7 µg L ⁻¹	23 µg L ⁻¹	5-1000 µg L ⁻¹	SW WW	na	[51]
	DLLME/LC-DAD	0.71 µg L ⁻¹	2.38 µg L ⁻¹	4-900 µg L ⁻¹	DW	na	[33]
		0.44 µg L ⁻¹	1.47 µg L ⁻¹	4-1000 µg L ⁻¹	SW	na	
Sulfanilamide (SFN)	SPE/LC-MS/MS	0.81 ng L ⁻¹	2.69 ng L ⁻¹	na	SW	na	[37]
		5.00 ng L ⁻¹	17.24 ng L ⁻¹		WW	nd	
		5.17 ng L ⁻¹	16.66 ng L ⁻¹				
	SPE/LC-MS/MS	7.97 ng L ⁻¹	26.56 ng L ⁻¹	na	WW	na	[37]
		20 ng L ⁻¹	30 ng L ⁻¹		SW	11-83 ng L ⁻¹	
	SPE/LC-MS/MS	na	20 ng L ⁻¹	na	WW	<20.0-1200 ng L ⁻¹	[9]
		na	20 ng L ⁻¹	na	SW	11-83 ng L ⁻¹	
	SPE/LC-UV	10 µg L ⁻¹	33 µg L ⁻¹	5-1000 µg L ⁻¹	SW WW	na	[51]
	DLLME/LC-DAD	1.17 µg L ⁻¹	3.89 µg L ⁻¹	5-1000 µg L ⁻¹	DW	na	[33]
		0.94 µg L ⁻¹	3.12 µg L ⁻¹		SW	na	
Sulfapyridine (SFP)	SPE/LC-MS/MS	0.04 ng L ⁻¹	0.14 ng L ⁻¹	0.05-1000 ng L ⁻¹	DW	<LOQ	[54]
		0.05 ng L ⁻¹	0.18 ng L ⁻¹		GW	<LOD	
		0.07 ng L ⁻¹	0.22 ng L ⁻¹		SW	1.2-12000 ng L ⁻¹	
		0.18 ng L ⁻¹	0.62 ng L ⁻¹		WW	28.8 ng L ⁻¹	
		0.18 ng L ⁻¹	0.59 ng L ⁻¹				

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 39 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref			
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found				
Sulfapyridine (SFP)	SPE/LC-MS	10 ng L ⁻¹	10 ng L ⁻¹	10-200 ng L ⁻¹	SW	nd	[55]			
		20 ng L ⁻¹	40 ng L ⁻¹	40-1000 ng L ⁻¹	WW	nd-0.80 ng L ⁻¹				
	SPE/LC-MS/MS	0.5 ng L ⁻¹	2 ng L ⁻¹	na	SW	<LOQ-34 ng L ⁻¹	[66]			
		na	8 ng L ⁻¹		WW	<LOQ-329 ng L ⁻¹				
	SPE/LC-MS/MS	8.5 ng L ⁻¹	na	1-500 µg L ⁻¹	SW	<LOD-<LOQ	[4]			
					WW	124-1885 ng L ⁻¹				
	SPE/LC-MS/MS	0.16 ng L ⁻¹	0.53 ng L ⁻¹	0.01-5000 ng L ⁻¹	SW	nd-> CR	[57]			
	SPE/LC-MS/MS	0.02 ng L ⁻¹	0.05 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd-1.11 ng L ⁻¹	[49]			
		0.06 ng L ⁻¹	0.20 ng L ⁻¹		SW	nd-11.20 ng L ⁻¹				
		0.13 ng L ⁻¹	0.42 ng L ⁻¹		WW	<0.42- 855 ng L ⁻¹				
		0.32 ng L ⁻¹	1.08 ng L ⁻¹							
	SPE/LC-MS/MS	na	24 ng L ⁻¹	na	WW	nd	[16]			
	SPE/LC-MS/MS	0.07 ng L ⁻¹	0.23 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-2 ng L ⁻¹	[50]			
	MSPE/LC-UV	0.09 ng mL ⁻¹	0.32 ng mL ⁻¹	0.5-100 ng mL ⁻¹	SW	na	[53]			
					WW					
	SPE/LC-MS/MS	0.6 ng L ⁻¹	na	0.5-200 ng mL ⁻¹	DW	na	[60]			
		1 ng L ⁻¹			WW	35 (±2%)-4260 (±17%) ng L ⁻¹				
		3.5 ng L ⁻¹								
	SPE/LC-MS/MS	0.29 ng L ⁻¹	0.98 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]			
		na	na		GW	nd				
		0.61 ng L ⁻¹	2.03 ng L ⁻¹		WW					
		0.98 ng L ⁻¹	3.27 ng L ⁻¹							
		1.92 ng L ⁻¹	6.41 ng L ⁻¹							
	SPE/LC-UV	3 µg L ⁻¹	10 µg L ⁻¹	5-1000 µg L ⁻¹	SW	nd	[51]			
					WW	na				

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 40 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Sulfapyridine (SFP)	SPE/LC-MS/MS	1.82 ng L ⁻¹	6 ng L ⁻¹	na	SW	na	[37]
		2.79 ng L ⁻¹	9.30 ng L ⁻¹		WW	nd-159 ng L ⁻¹	
		3.05 ng L ⁻¹	10.15 ng L ⁻¹				
		4.33 ng L ⁻¹	14.43 ng L ⁻¹				
Sulfaquinoxaline (SFQ)	SPE/LC-MS/MS	na	1 ng L ⁻¹ 3 ng L ⁻¹	na	WW	nd-103 ng L ⁻¹	[9]
		na	1 ng L ⁻¹	na	SW	nd	
	SPE/LC-MS/MS	0.02 ng L ⁻¹	0.08 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd-1.17 ng L ⁻¹	[49]
		0.19 ng L ⁻¹	0.63 ng L ⁻¹		SW	nd-20.80 ng L ⁻¹	
		0.04 ng L ⁻¹	0.15 ng L ⁻¹		WW	nd-< 0.15 ng L ⁻¹	
		0.55 ng L ⁻¹	1.83 ng L ⁻¹				
	SPE/LC-MS/MS	0.08 ng L ⁻¹	0.27 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-274 ng L ⁻¹	[50]
		0.19 ng L ⁻¹	0.63 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]
	SPE/LC-MS/MS	na	na		GW	nd	
		0.61 ng L ⁻¹	2.03 ng L ⁻¹		WW		
		0.98 ng L ⁻¹	3.27 ng L ⁻¹				
	DLLME/LC-DAD	2.57 µg L ⁻¹	8.57 µg L ⁻¹	34-1000 µg L ⁻¹	DW	na	[33]
		0.89 µg L ⁻¹	2.95 µg L ⁻¹		SW		
	Sulfathiazole (SFT)	SPE/LC-MS/MS	na	na	0.05-1000 ng L ⁻¹	DW	<LOQ
0.20 ng L ⁻¹			0.67 ng L ⁻¹	GW		<LOD	
SPE/LC-MS/MS		0.14 ng L ⁻¹	0.47 ng L ⁻¹	0.05-1000 ng L ⁻¹	SW	6.8-332 ng L ⁻¹	[54]
		0.19 ng L ⁻¹	0.64 ng L ⁻¹		WW	53.7 ng L ⁻¹	
		0.08 ng L ⁻¹	0.26 ng L ⁻¹				
SPE/LC-MS		10 ng L ⁻¹	10 ng L ⁻¹	10-200 ng L ⁻¹	SW	nd	[55]
		20 ng L ⁻¹	200 ng L ⁻¹	40-1000 ng L ⁻¹	WW	nd	
SPE/LC-MS	15 ng L ⁻¹	na	0.5-25 µg L ⁻¹	WW	nd-9.83 ± 0.02 µg L ⁻¹	[61]	

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 41 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Sample matrix	Application	Ref	
		LOD ^a	LOQ ^a	Linear range ^a		Concentration found		
Sulfathiazole (SFT)	SPE/LC-MS/MS	3.8 ng L ⁻¹	na	1-500 µg L ⁻¹	SW WW	<LOD <LOD-95 ng L ⁻¹	[4]	
	SPE/LC-MS/MS	0.13 ng L ⁻¹	0.43 ng L ⁻¹	0.01-5000 ng L ⁻¹	SW	nd-960.6 ng L ⁻¹	[57]	
	SPE/LC-MS/MS	0.21 ng L ⁻¹	0.70 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd	[49]	
		0.22 ng L ⁻¹	0.74 ng L ⁻¹		SW	nd-13.90 ng L ⁻¹		
		0.28 ng L ⁻¹	0.94 ng L ⁻¹		WW	nd-37.50 ng L ⁻¹		
		0.45 ng L ⁻¹	1.48 ng L ⁻¹					
	SPE/LC-MS/MS	0.06 ng L ⁻¹	0.20 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-0.30 ng L ⁻¹	[50]	
	SPE/LC-MS/MS	na	2.40 ng L ⁻¹	5-250 ng L ⁻¹	SW	nd	[19]	
	SLME/LC-MS/MS	0.07 µg L ⁻¹	0.22 µg L ⁻¹	0.5-50 µg L ⁻¹	SW	na	[24]	
	SPE/LC-MS-MS	0.3 ng L ⁻¹	na	0.5-200 ng mL ⁻¹	DW	na	[60]	
		1 ng L ⁻¹			WW	<LOD		
		3.6 ng L ⁻¹						
	SPE/LC-MS/MS	0.26 ng L ⁻¹	0.88 ng L ⁻¹	5-200 µg L ⁻¹	SW	na	[29]	
		na	na		GW	nd		
		0.43 ng L ⁻¹	1.42 ng L ⁻¹		WW			
		0.70 ng L ⁻¹	2.35 ng L ⁻¹					
		2.55 ng L ⁻¹	8.50 ng L ⁻¹					
SPE/LC-UV	9 µg L ⁻¹	30 µg L ⁻¹	5-1000 µg L ⁻¹	SW WW	nd	[51]		
SPE/LC-MS/MS	0.06 µg L ⁻¹	0.2 µg L ⁻¹	5-250 µg L ⁻¹	SW	na	[62]		
DLLME/LC-DAD	4.02 µg L ⁻¹	13.40 µg L ⁻¹	15-1000 µg L ⁻¹	DW	na	[33]		
	1.77 µg L ⁻¹	5.90 µg L ⁻¹		SW				
SPE/LC-MS/MS	7.18 ng L ⁻¹ 20.50 ng L ⁻¹	na	2-750 ng L ⁻¹	SW WW	nd	[34]		

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 42 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
Sulfathiazole (SFT)	SPE/LC-MS/MS	2.03 ng L ⁻¹	6.70 ng L ⁻¹	na	SW	na	[37]
		6.80 ng L ⁻¹	22.68 ng L ⁻¹		WW	nd	
		8.55 ng L ⁻¹	28.48 ng L ⁻¹				
		14.40 ng L ⁻¹	48.0 ng L ⁻¹				
N4-acetyl sulfadiazine (NSDZ)	SPE/LC-MS/MS	0.14 ng L ⁻¹	0.47 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-1 ng L ⁻¹	[50]
N4-acetyl sulfamerazine (NSMR)	SPE/LC-MS/MS	0.18 ng L ⁻¹	0.60 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-18 ng L-1	[50]
	SLME/LC-DAD	15 ng L ⁻¹	na	50-10 ⁶ ng L ⁻¹	DW	na	[59]
					SW		
					WW		
	SLME/LC-FD	8 ng L ⁻¹	na	25-10 ⁵ ng L ⁻¹	DW	na	[59]
					SW		
WW							
N4-acetyl sulfamethazine (NSMT)	SPE/LC-MS/MS	0.08 ng L ⁻¹	0.27 ng L ⁻¹	0.05-1000 ng L ⁻¹	DW	1.1 ng L ⁻¹	[54]
		0.11 ng L ⁻¹	0.35 ng L ⁻¹		GW	2.7 ng L ⁻¹	
		0.01 ng L ⁻¹	0.73 ng L ⁻¹		SW	0.7-316.8 ng L ⁻¹	
		0.04 ng L ⁻¹	0.80 ng L ⁻¹				
		460.90 ng L ⁻¹	1536.34 ng L ⁻¹				
	SPE/LC-MS/MS	0.12 ng L ⁻¹	0.40 ng L ⁻¹	0.01-5000 ng L ⁻¹	SW	nd-695.1 ng L ⁻¹	[57]
	SPE/LC-MS/MS	0.02 ng L ⁻¹	0.08 ng L ⁻¹	0.05-1000 ng L ⁻¹	GW	nd-2.18 ng L ⁻¹	[49]
		0.02 ng L ⁻¹	0.06 ng L ⁻¹		SW	nd- 5.32 ng L ⁻¹	
		0.14 ng L ⁻¹	0.48 ng L ⁻¹		WW	nd- 5.29 ng L ⁻¹	
		2.17 ng L ⁻¹	7.25 ng L ⁻¹				
	SPE/LC-MS/MS	0.05 ng L ⁻¹	0.17 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-4.40 ng L ⁻¹	[50]
	SLME/LC-DAD	15 ng L ⁻¹	na	50-10 ⁶ ng L ⁻¹	DW	na	[59]
					SW		
					WW		

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

Table 43 Literature survey on analytical methods for determination of sulfonamide antibiotics in table format from 2008 to 2013 (*continued*).

Analyte	Analytical method	Analytical data			Application		Ref
		LOD ^a	LOQ ^a	Linear range ^a	Sample matrix	Concentration found	
N4-acetyl sulfamethazine (NSMT)	SLME/LC-FD	33 ng L ⁻¹	na	100-10 ⁵ ng L ⁻¹	DW	na	[59]
					SW		
					WW		
	SPE/LC-MS-MS	0.3 ng L ⁻¹ 0.7 ng L ⁻¹ 1.4 ng L ⁻¹	na	0.5-200 ng mL ⁻¹	DW	na	[60]
					WW	<LOD	
N4-acetyl sulfamethoxazole (NSMZ)	SPE/LC-MS/MS	na	8 ng L ⁻¹	1-2000 ng L ⁻¹	SW	na	[71]
			30 ng L ⁻¹		WW	<LOQ-800 ± 240 ng L ⁻¹	
	SPE/LC-MS/MS	0.11 ng L ⁻¹	0.37 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-5.50 ng L ⁻¹	[50]
	SLME/LC-DAD	3.5 ng L ⁻¹	na	10-10 ⁶ ng L ⁻¹	DW	na	[59]
					SW		
					WW		
	SLME/LC-FD	8 ng L ⁻¹	na	25-10 ⁵ ng L ⁻¹	DW	na	[59]
					SW		
					WW		
N4-acetyl sulfapyridine (NSFP)	SPE/LC-MS-MS	0.4 ng L ⁻¹ 1.4 ng L ⁻¹ 5.9 ng L ⁻¹	na	0.5-200 ng mL ⁻¹	DW	na	[60]
					WW	5 (±14%)-445 (±2%) ng L ⁻¹	
	SPE/LC-MS/MS	0.09 ng L ⁻¹	0.30 ng L ⁻¹	0.01-500 ng L ⁻¹	GW	<LOD-6 ng L ⁻¹	[50]

a: Except otherwise specified; DW: Drinking water; GW: Groudwater; SW: Surface water; WW: Wastewater; CR: Reporting level (5xLOD); E: ion signal enrichment; LDR: Linear Dynamic Range; POLE: polyoxyethylene 10 lauryl ether; L-CD: low reflectivity compact discs.

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