Supporting information for "Equilibrium Sorption of Structurally Diverse Organic Ions to Bovine Serum Albumin"

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25 Pages

21 Figures

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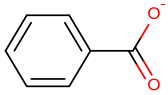
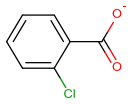
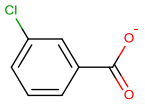
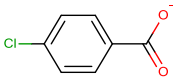
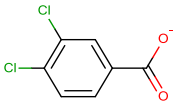
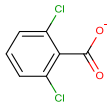
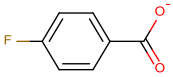
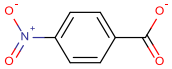
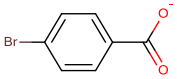
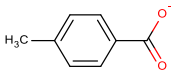
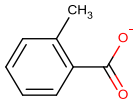
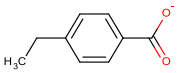
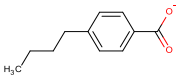
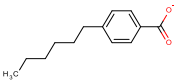
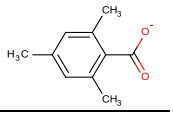
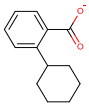
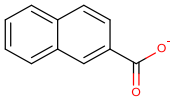
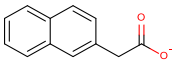
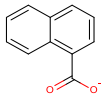
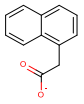
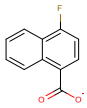
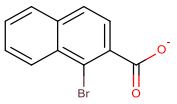
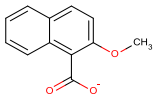
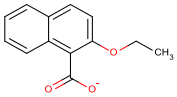
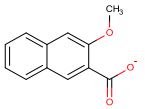
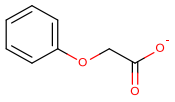
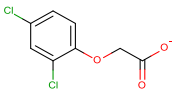
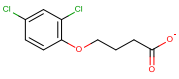
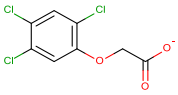
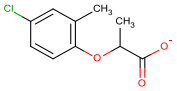
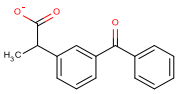
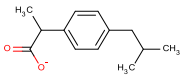
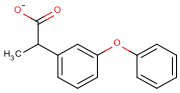
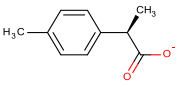
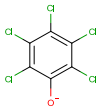
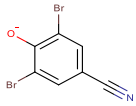
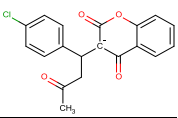
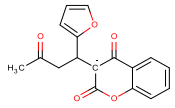
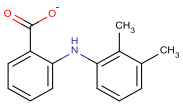
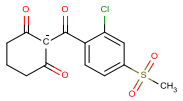
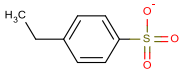
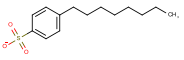
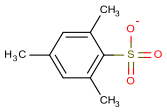
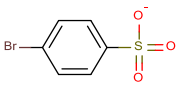
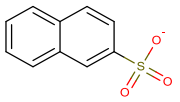
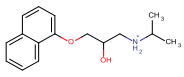
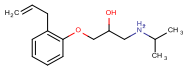
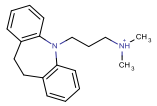
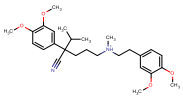
S1 Test chemicals

Table S1. Selected properties and experimental conditions of test chemicals. pK_a values were calculated using the Calculator Plugins from Marvin 15.8.17.0, 2015, ChemAxon (http://www.chemaxon.com). Test chemicals were bought as free acid/base or as salt (e.g., with Na^+, Ca^{2+}, Cl^-). The CAS numbers given in this table denote either the free acid/base or a salt.

Name	CAS-No.	Provider	Method	Mean recovery [%]	pK_a	Structure
Benzoic acids						
benzoic acid	65-85-0	Sigma Aldrich	HPLC-UV	107	4.1	
2-chlorobenzoic acid	118-91-2	Fluka	HPLC-UV	100	3.1	
3-chlorobenzoic acid	535-80-8	Fluka	HPLC-UV	104	3.9	
4-chlorobenzoic acid	74-11-3	Fluka	HPLC-UV	101	4.1	
3,4-dichlorobenzoic acid	51-44-5	Sigma Aldrich	LC-MS/MS	117	3.9	
2,6-dichlorobenzoic acid	50-30-6	Fluka	HPLC-UV	100	2.1	
4-fluorobenzoic acid	456-22-4	Sigma Aldrich	HPLC-UV	96	4.2	
4-nitrobenzoic acid	62-23-7	Fluka	HPLC-UV	93	3.2	
4-bromobenzoic acid	586-76-5	Sigma Aldrich	LC-MS/MS	117	4.0	
4-methylbenzoic acid	99-94-5	Sigma Aldrich	HPLC-UV	100	4.3	
2-methylbenzoic acid	118-90-1	Sigma Aldrich	HPLC-UV	100	4.0	

4-ethylbenzoic acid	619-64-7	Sigma Aldrich	HPLC-UV	104	4.2	
4-butylbenzoic acid	20651-71-2	Sigma Aldrich	HPLC-UV	98	4.2	
4-hexylbenzoic acid	21643-38-9	Sigma Aldrich	LC-MS/MS	91	4.2	
2,4,6-trimethylbenzoic acid	480-63-7	Sigma Aldrich	HPLC-UV	98	4.0	
2-cyclohexylbenzoic acid	97023-48-8	Alfa Aesar	HPLC-UV	91	4.1	
Naphthoic acids						
2-naphthoic acid	93-09-4	Sigma Aldrich	HPLC-FLD	102	4.0	
2-naphthaleneacetic acid	581-96-4	Sigma Aldrich	HPLC-FLD	101	4.7	
1-naphthoic acid	86-55-5	abcr	HPLC-FLD	95	3.6	
1-naphthaleneacetic acid	86-87-3	Fluka	HPLC-FLD	97	4.7	
4-fluoro-1-naphthoic acid	573-03-5	abcr	HPLC-UV	99	3.8	
1-bromo-2-naphthoic acid	20717-79-7	abcr	HPLC-UV	99	3.2	
2-methoxy-1-naphthoic acid	947-62-6	Sigma Aldrich	HPLC-UV	109	3.3	
2-ethoxy-1-naphthoic acid	2224-00-2	Alfa Aesar	HPLC-UV	94	3.3	
3-methoxy-2-naphthoic acid	883-62-5	Sigma Aldrich	HPLC-UV	98	3.6	

Phenoxy acids						
2-phenoxyacetic acid	122-59-8	Fluka	HPLC-UV	94	3.7	
2,4-dichlorophenoxyacetic acid	94-75-7	Fluka	LC-MS	106	2.8	
4-(2,4-dichlorophenoxy)butyric acid	94-82-6	Fluka	LC-MS/MS	108	3.6	
2,4,5-trichlorophenoxyacetic acid	93-76-5	Fluka	LC-MS/MS	117	2.6	
mecoprop	7085-19-0	Fluka	LC-MS/MS	115	3.5	
Arylpropionic acids						
ketoprofen	22071-15-4	Sigma Aldrich	HPLC-UV	93	3.9	
ibuprofen	15687-27-1	Sigma Aldrich	LC-MS/MS	92	4.9	
fenoprofen	53746-45-5	Fluka	LC-MS/MS	96	4.0	
α,4-dimethylphenylacetic acid	938-94-3	Sigma Aldrich	HPLC-UV	106	4.7	
Phenols						
pentachlorophenol	87-86-5	Dr. Ehrenstorfer	LC-MS/MS	114	5.0	
bromoxynil	1689-84-5	Dr. Ehrenstorfer	LC-MS/MS	110	5.1	
Coumarines						
coumachlor	81-82-3	Fluka	HPLC-UV	107	4.7	
coumafuryl	117-52-2	Fluka	HPLC-UV	108	3.2	

Others						
mefenamic acid	61-68-7	Sigma Aldrich	LC-MS/MS	93	3.9	
sulcotrione	99105-77-8	Fluka	HPLC-UV	99	2.3	
Sulfonates						
4-ethylbenzenesulfonate	14995-38-1	TCI	SPE, HPLC-UV	92	-2.0	
4-n-octylbenzenesulfonate	6149-03-7	TCI	LC-MS/MS	91	-1.8	
2,4,6-trimethylbenzenesulfonate	6148-75-0	TCI	LC-MS/MS	106	-1.8	
4-bromobenzenesulfonate	79326-93-5	Sigma Aldrich	LC-MS/MS	105	-2.9	
naphthalene-2-sulfonate	532-02-5	Fluka	HPLC-FLD	94	-1.8	
Cations						
(S)-(-)-propranolol	4199-10-4	Sigma Aldrich	HPLC-DAD	95	9.7	
alprenolol	13707-88-5	Sigma Aldrich	HPLC-UV	95	9.7	
imipramine	113-52-0	Sigma Aldrich	HPLC-UV	98	9.2	
verapamil	152-11-4	Sigma Aldrich	HPLC-UV	92	9.7	

S2 Dialysis experiments

Table S2. Concentration of stock solutions in methanol (C_{MeOH}), initial water phase (C_{in}) and measured equilibrium water phase concentrations (C_{eq}) of all test chemicals, concentration of BSA solution used for the dialysis experiments (C_{BSA}) and amount of test chemical/amount of BSA at equilibrium (ν).

Chemical	C_{MeOH} [g/L]	C_{in} [mg/L]	C_{eq} ± SD [mg/L]	C_{BSA} [g/L]	ν [mol/mol]
benzoic acid	10.04	1.51	0.88 ± 0.03	10	0.08
2-chlorobenzoic acid	10.30	5.15	2.79 ± 0.06	25	0.08
3-chlorobenzoic acid	10.05	1.21	0.13 ± 0.01	10	0.09
4-chlorobenzoic acid	10.14	2.54	0.12 ± 0.01	25	0.08
3,4-dichlorobenzoic acid	10.24	1.02	0.020 ± 0.001	10	0.08
2,6-dichlorobenzoic acid	10.05	1.21	0.78 ± 0.01	25	0.01
4-fluorobenzoic acid	10.10	1.21	0.28 ± 0.02	10	0.09
4-nitrobenzoic acid	10.26	1.23	0.36 ± 0.01	10	0.06
4-bromobenzoic acid	20.09	1.00	0.073 ± 0.004	10	0.07
4-methylbenzoic acid	10.55	1.27	0.38 ± 0.01	10	0.09
2-methylbenzoic acid	10.45	1.25	0.57 ± 0.02	25	0.03
4-ethylbenzoic acid	10.48	2.62	0.18 ± 0.01	25	0.09
4-butylbenzoic acid	10.20	1.22	0.045 ± 0.002	10	0.09
4-hexylbenzoic acid	10.24	1.02	0.011 ± 0.001	10	0.06
2,4,6-trimethylbenzoic acid	10.08	1.21	0.64 ± 0.02	10	0.05
2-cyclohexylbenzoic acid	10.29	1.54	0.08 ± 0.01	10	0.09
2-naphthoic acid	10.45	1.25	0.011 ± 0.002	10	0.10
2-naphthaleneacetic acid	9.31	1.12	0.0039 ± 0.0004	10	0.08
1-naphthoic acid	10.78	1.29	0.31 ± 0.01	10	0.08
1-naphthaleneacetic acid	10.28	1.23	0.09 ± 0.01	10	0.08
4-fluoro-1-naphthoic acid	9.92	1.19	0.078 ± 0.002	10	0.08
1-bromo-2-naphthoic acid	10.12	1.21	0.029 ± 0.002	10	0.08
2-methoxy-1-naphthoic acid	9.68	1.16	0.74 ± 0.01	10	0.04
2-ethoxy-1-naphthoic acid	10.00	1.20	0.35 ± 0.01	10	0.05
3-methoxy-2-naphthoic acid	10.00	1.20	0.26 ± 0.01	10	0.06
2-phenoxyacetic acid	10.15	1.22	0.43 ± 0.04	10	0.06
2,4-dichlorophenoxyacetic acid	7.30	0.18	0.10 ± 0.01	1	0.06
4-(2,4-dichlorophenoxy)butyric acid	10.60	1.59	0.026 ± 0.002	10	0.09
2,4,5-trichlorophenoxyacetic acid	10.23	1.02	0.035 ± 0.002	10	0.06
mecoprop	10.84	1.08	0.045 ± 0.006	10	0.08
ketoprofen	20.18	1.51	0.127 ± 0.003	10	0.07
ibuprofen	9.61	0.96	0.021 ± 0.001	10	0.06
fenoprofen	9.99	1.00	0.024 ± 0.001	10	0.05
α,4-dimethylphenylacetic acid	10.86	1.30	0.24 ± 0.01	10	0.10
pentachlorophenol	10.37	1.56	0.0018 ± 0.0004	10	0.08
bromoxynil	9.95	1.49	0.0020 ± 0.0003	10	0.07
coumachlor	9.95	2.04	0.16 ± 0.01	10	0.08
coumafuryl	7.00	2.45	0.61 ± 0.02	10	0.09
mefenamic acid	10.22	1.02	0.0084 ± 0.0005	10	0.05
sulcotrione	10.00	2.00	0.87 ± 0.07	50	0.01

4-ethylbenzenesulfonate	10.00	0.13	0.072	±	0.002	1	0.04
4-n-octylbenzenesulfonate	12.71	1.27	0.0037	±	0.0002	10	0.06
2,4,6-trimethylbenzenesulfonate	10.11	1.01	0.012	±	0.001	10	0.07
4-bromobenzenesulfonate	12.22	1.22	0.11	±	0.01	10	0.06
naphthalene-2-sulfonate	10.09	1.21	0.0045	±	0.0004	10	0.07
(S)-(-)-propranolol	10.02	2.57	1.59	±	0.06	50	0.01
alprenolol	10.29	5.15	4.09	±	0.12	50	0.01
imipramine	10.11	10.11	5.20	±	0.51	50	0.05
verapamil	7.74	3.87	3.19	±	0.16	50	0.004

S3 *Salt composition of HBBS*

Table S3. Salt composition of HBSS buffer and blood plasma.

	Human Plasma [mM]*	**HBSS + 10 mM Tris****
Na^+	142	142
K^+	4.3	5.8
Ca^{2+}	1.3	1.3
Mg^{2+}	0.5	0.8
Cl^-	104	155
HCO_3^-	24	4.2
Phosphate	2	0.8
SO_4^{2-}	ns	0.8
D-Glucose	4.2-6.4	5.6
pH	7.4	7.4

ns - not specified

* from reference 1

** calculated from the individual components of HBSS

S4 *pH dependence of log* $K_{BSA/w}$

In this study sorption of 2,6-dichlorobenzoic acid to BSA was measured at pH 6, 7 and 8 at a constant concentration of Cl^- (150 mM). To control the pH value in the experiments, 10 mM Bis-Tris (pK_a = 6.5) were added for solutions at pH 6 and 10 mM Tris (pK_a = 8.06) for pH 7 and 8. To each solution, 10 mM HCl and 140 mM NaCl were added. The pH value was adjusted by dropping only 0.1 or 1 N NaOH solution, but no additional HCl, to keep a constant Cl^- concentration. The buffers mentioned above were chosen because they are neither anionic nor zwitterionic and should not compete with 2,6-dichlorobenzoic acid at a possible binding site for organic anions.

S5 Instrumental analysis

For the majority of the test chemicals an HPLC system from JASCO was used, equipped with an Eclipse Plus C18 column (4.6 mm × 100 mm, 5 µm particle size) or a ZORBAX Extend C18 column (4.6 mm × 150 mm, 5 µm particle size), both from Agilent. Chemicals were detected using either a UV detector (UV-970 M, JASCO) or a fluorescence detector (RF-10AXL, Shimadzu). Gradient or isocratic elution of acetonitrile and water (both containing 0.1 % orthophosphoric acid) at a flow rate of 1 mL/min was applied. The instrumental analysis of 4-ethylbenzenesulfonate, 2,4-dichlorophenoxyacetic acid and verapamil has been described elsewhere in detail.[2] Propranolol was measured with a Shimadzu HPLC system equipped with a diode array detector (SPD-M10AVP) and a Phenomenex Luna HILIC column (4.6 mm × 100 mm, 5 µm particle size). The mobile phase was a mixture of acetonitrile and water (90:10 or 10:90) both with 5 mM ammonium acetate. A flow rate of 1 mL/min was applied.

For chemicals that needed a sensitive quantification method, LC-MS/MS measurements were performed with two different instruments. First, an Acquity UPLC system from Waters with a Xevo TQ mass spectrometer operating in negative ion mode. The test chemicals were separated on an Acquity BEH C18 column (100 × 2.1 mm, 1.7 µm particle size, Waters). Gradient elution of acetonitrile and water (with 10 mM ammonium acetate) was applied at a flow rate of 0.2 mL/min. Second, an UPLC system from Agilent Technologies (1290 Infinity Series) equipped with a 6400 Triple Quad mass spectrometer operating in negative ion mode and a Poroshell 120 EC C18 column (50 × 4.6 mm, 2.7 µm particle size, Agilent Technologies). The mobile phase was a mixture of acetonitrile and water (both with 0.1 % formic acid) and a flow rate of 1 mL/min was applied. Chemicals that were measured with LC-MS/MS and the MS parameters are listed in Table S2 and S3.

Table S4. MS parameters for chemicals measured with LC-MS/MS from Waters.

CAS-No.	Name	Ion transition	Collision energy [eV]	Capillary voltage [V]	Cone voltage [V]
7085-19-0	mecoprop	213 → 141	15	2.5	20
94-82-6	4-(2,4-dichlorophenoxy)butyric acid	247 → 161	10	2.5	20
93-76-5	2,4,5-trichlorophenoxyacetic acid	255 → 197	10	2.5	20
15687-27-1	ibuprofen	205 → 161	10	2.5	25
53746-45-5	fenoprofen	241 → 197	10	2.5	20
61-68-7	mefenamic acid	240 → 196	15	2.5	30
51-44-5	3,4-dichlorobenzoic acid	189 → 145	10	2.5	20
21643-38-9	4-hexylbenzoic acid	205 → 161	15	2.5	30
586-76-5	4-bromobenzoic acid	199 → 155 201 → 157	15	2.5	25
6148-75-0	2,4,6-trimethylbenzenesulfonate	199 → 135 199 → 80	20	2.5	40
79326-93-5	4-bromobenzenesulfonate	235 → 171 237 → 173	20	2.5	40

Table S5. MS parameters for chemicals measured with LC-MS/MS from Agilent Technologies.

CAS-No.	Name	Ion transition	Collision energy [eV]	Fragmentor voltage [V]	Cell Accelerator voltage [V]
87-86-5	pentachlorophenol	262.9 → 262.9	2	36	4
		266.9 → 266.9	10	27	4
1689-84-5	bromoxynil	276 → 81	30	27	4
		274 → 79	26	39	4
6149-03-7	4-n-octylbenzenesulfonate	269 → 183	34	24	4
		269 → 170	26	24	4

S6 Reversibility tests

Table S6. Results from the reversibility tests.

Test chemical	log $K_{BSA/w}$ [L/kg]*	
	3 days	6 days
coumachlor	3.38	3.40
sulcotrione	1.66	1.67
benzoic acid	2.22	2.19
2-chlorobenzoic acid	1.84	1.84
4-nitrobenzoic acid	2.69	2.69
1-naphthoic acid	2.78	2.78
2-methoxy-1-naphthoic acid	2.23	2.23
α,4-dimethylphenylacetic acid	3.09	3.08

* mean of 2 replicates, deviation from mean was always < 0.1 log units.

S7 Increase of log $K_{BSA/w}$ with the number of CH_2 units

Table S7. Increase of log $K_{BSA/w}$ with the number CH_2 units.

CAS-No.	Name	log $K_{BSA/w}$	Increase per CH_2
	Ionic chemicals from this work		
65-85-0	benzoic acid	2.23	
99-94-5	4-methylbenzoic acid	2.67	0.44
619-64-7	4-ethylbenzoic acid	3.03	0.36
20651-71-2	4-butylbenzoic acid	3.73	0.35
21643-38-9	4-hexylbenzoic acid	4.23	0.25
93-09-4	2-naphthoic acid	4.36	0.41
581-96-4	2-naphthaleneacetic acid	4.77	
86-55-5	1-naphthoic acid	2.81	0.62
86-87-3	1-naphthaleneacetic acid	3.43	
947-62-6	2-methoxy-1-naphthoic acid	2.16	0.50
2224-00-2	2-ethoxy-1-naphthoic acid	2.66	

94-75-7	2,4-dichlorophenoxyacetic acid	3.28	0.42
94-82-6	4-(2,4-dichlorophenoxy)butyric acid	4.12	
14995-38-1	4-ethylbenzene-1-sulfonate	3.17	0.28
6149-03-7	4-n-octylbenzenesulfonate	4.84	
	Neutral chemicals from the literature		
110-54-3	hexane	3.09*	0.45
142-82-5	heptane	3.59*	
111-65-9	octane	4.01*	
111-84-2	nonane	4.45*	
110-82-7	cyclohexane	2.01*	0.49
291-64-5	cycloheptane	2.52*	
292-64-8	cyclooctane	2.98*	
142-96-1	dibutyl ether	2.01*	0.50
693-65-2	dipentyl ether	3.00*	
111-13-7	2-octanone	2.09*	0.40
821-55-6	2-nonanone	2.48*	
693-54-9	2-decanone	2.88*	
71-43-2	benzene	1.58*	0.35
108-88-3	toluene	2.26*	
100-41-4	ethylbenzene	2.70*	
103-65-1	propylbenzene	2.95*	
111-27-3	1-hexanol	1.64*	0.49
111-70-6	1-heptanol	2.18*	
111-87-5	1-octanol	2.74*	
143-08-8	1-nonanol	3.10*	

* log $K_{BSA/w}$ are taken from Endo et al. [3]

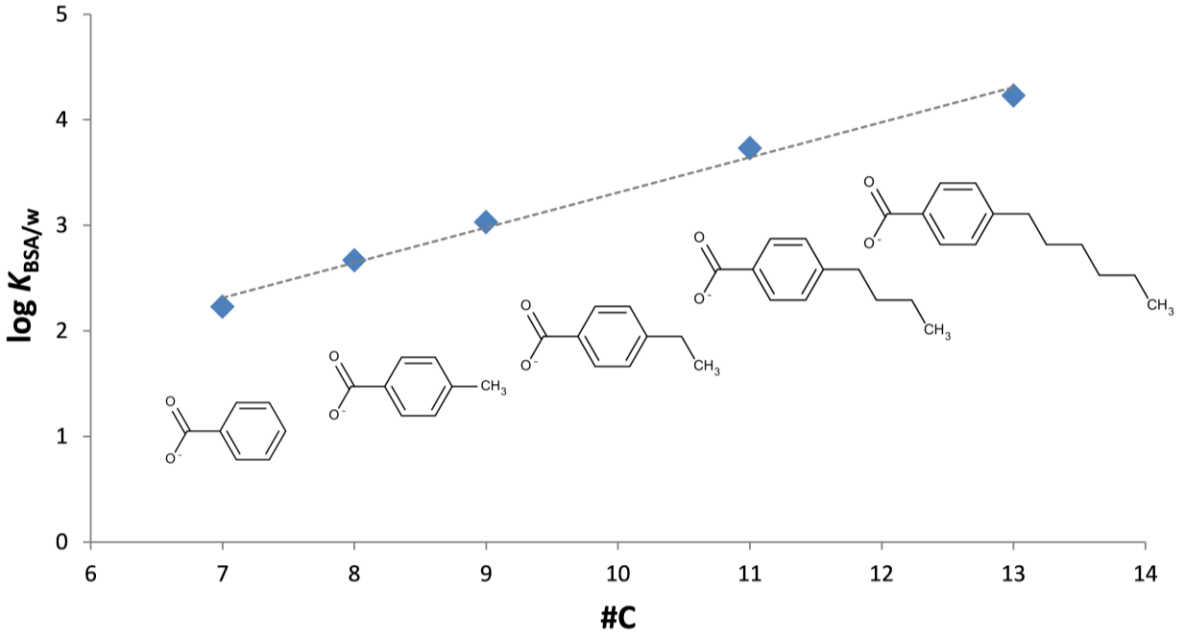


Figure S1. Logarithmic BSA-water partition coefficient (log $K_{BSA/w}$) of benzoic acid and linear increase of log $K_{BSA/w}$ within a homologous series of 4-alkylbenzoic acids.

S8 Salt concentration dependence of log $K_{BSA/w}$

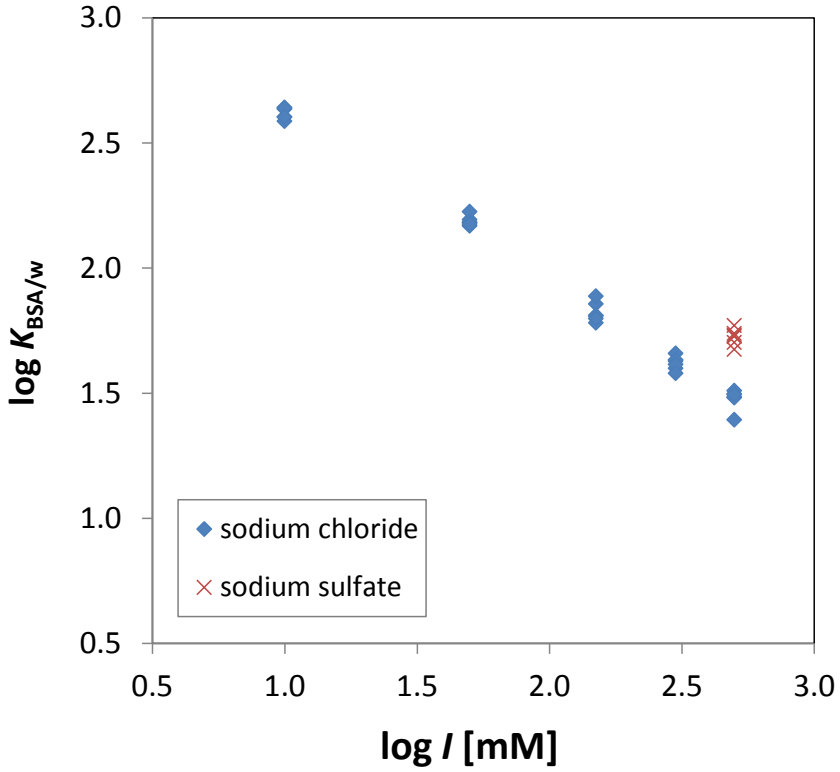


Figure S2. Salt concentration dependence of log $K_{BSA/w}$ for 2,6-dichlorobenzoic acid.

S9 Experimental and calculated partition coefficients of test chemicals

Table S8. Experimental and calculated partition coefficients of test chemicals; experimental and calculated octanol-water partition coefficients of neutral species (log K_{ow} (neutral)) are taken from EPI Suite (version 4.1) provided by the U.S. Environmental Protection Agency (http://www.epa.gov/oppt/exposure/pubs/episuite.htm); theoretical octanol-water partition coefficients of ionic species (COSMO-calculated log K_{ow} ion) were calculated using a quantum chemically based software (COSMOtherm); retention factors (log k') were measured at 30°C on a weak anion exchange column (Luna NH2, 30 × 4.6 mm, 5µm particle size from Phenomenex), the eluent was 10 mM Tris-HCl with 40 mM NaCl in MilliQ-water (pH 7.5) at a flow rate of 1.5 mL/min, and thiourea was used as tracer for estimating the dead time.

CAS-No.	Name	log K_{ow} (neutral)	COSMO-calculated log K_{ow} ion	log *k'*
65-85-0	benzoic acid	1.87	-5.31	0.62
118-91-2	2-chlorobenzoic acid	2.05	-4.90	0.49
535-80-8	3-chlorobenzoic acid	2.68	-4.54	0.89
74-11-3	4-chlorobenzoic acid	2.65	-4.61	0.84
51-44-5	3,4-dichlorobenzoic acid	3.25	-3.90	1.13
50-30-6	2,6-dichlorobenzoic acid	2.23	-4.21	0.48
456-22-4	4-fluorobenzoic acid	2.07	-5.04	0.57

62-23-7	4-nitrobenzoic acid	1.89	-4.86	0.53
586-76-5	4-bromobenzoic acid	2.86	-4.44	0.96
99-94-5	4-methylbenzoic acid	2.27	-5.12	0.77
118-90-1	2-methylbenzoic acid	2.46	-4.84	0.36
619-64-7	4-ethylbenzoic acid	2.89	-4.42	0.85
20651-71-2	4-butylbenzoic acid	3.97	-3.50	1.05
21643-38-9	4-hexylbenzoic acid	4.88*	-2.40	1.26
480-63-7	2,4,6-trimethylbenzoic acid	2.42*	-4.32	0.3
97023-48-8	2-cyclohexylbenzoic acid	4.35*	-3.06	0.55
93-09-4	2-naphthoic acid	3.28	-4.34	1.37
581-96-4	2-naphthaleneacetic acid	2.81	-4.10	1.2
86-55-5	1-naphthoic acid	3.10	-4.23	1.05
86-87-3	1-naphthaleneacetic acid	2.24	-4.14	1.08
573-03-5	4-fluoro-1-naphthoic acid	3.25*	-3.90	1.06
20717-79-7	1-bromo-2-naphthoic acid	3.60*	-3.55	1.26
947-62-6	2-methoxy-1-naphthoic acid	2.79*	-4.58	0.87
2224-00-2	2-ethoxy-1-naphthoic acid	3.28*	-3.94	0.95
883-62-5	3-methoxy-2-naphthoic acid	2.79*	-4.38	1.2
122-59-8	2-phenoxyacetic acid	1.34	-5.48	0.45
94-75-7	2,4-dichlorophenoxyacetic acid	2.81	-4.04	0.76
94-82-6	4-(2,4-dichlorophenoxy)butyric acid	3.53	-3.35	1.01
93-76-5	2,4,5-trichlorophenoxyacetic acid	3.31	-3.25	0.93
7085-19-0	mecoprop	3.13	-3.53	0.77
22071-15-4	ketoprofen	3.12	-3.63	0.97
15687-27-1	ibuprofen	3.97	-2.92	0.63
53746-45-5	fenoprofen	3.90*	-3.45	0.96
938-94-3	α,4-dimethylphenylacetic acid	2.39*	-4.18	0.49
87-86-5	pentachlorophenol	5.12	-1.07	2.47
1689-84-5	bromoxynil	3.39*	-2.57	1.35
81-82-3	coumachlor	3.11*	-0.89	1.87
117-52-2	coumafuryl	2.26*	-2.28	1.27
61-68-7	mefenamic acid	5.12	-1.74	1.92
99105-77-8	sulcotrione	2.31*	-4.32	0.45
14995-38-1	4-ethylbenzenesulfonate	-0.13*	-4.10	0.7
6149-03-7	4-n-octylbenzenesulfonate	2.82*	-0.78	1.44
6148-75-0	2,4,6-trimethylbenzenesulfonate	0.48*	-4.13	0.84
79326-93-5	4-bromobenzenesulfonate	-0.28*	-4.17	0.84
532-02-5	naphthalene-2-sulfonate	0.63	-4.26	1.51
4199-10-4	(S)-(-)-propranolol	3.48		
13707-88-5	alprenolol	3.10		
113-52-0	imipramine	4.80		
152-11-4	verapamil	3.79		

* calculated log K_{ow} from EPISuite.

S10 *3D-structures of selected test chemicals*

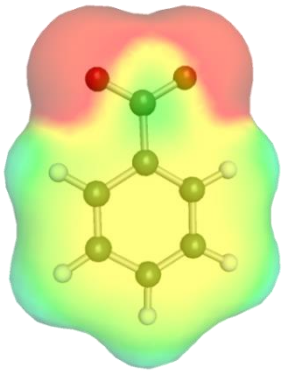


Figure S3. benzoic acid.

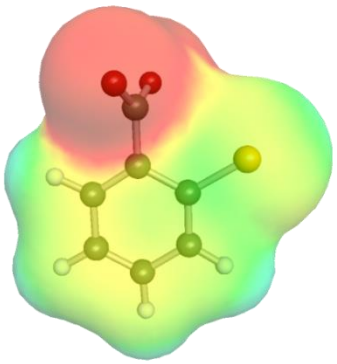


Figure S4. 2-chlorobenzoic acid.

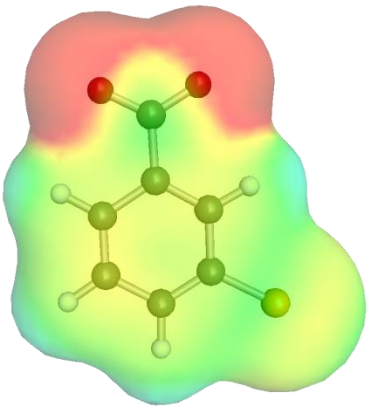


Figure S5. 3-chlorobenzoic acid.

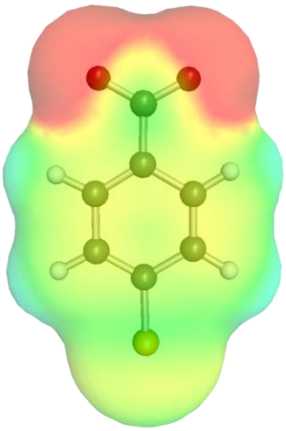


Figure S6. 4-chlorobenzoic acid.

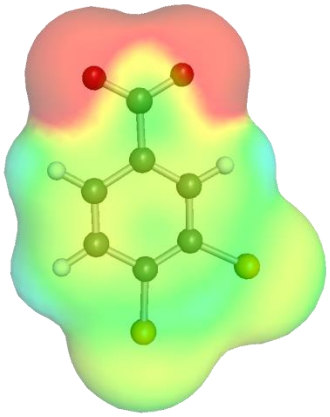


Figure S7. 3,4-dichlorobenzoic acid.

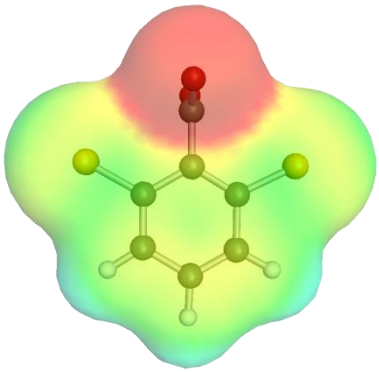


Figure S8. 2,6-dichlorobenzoic acid.

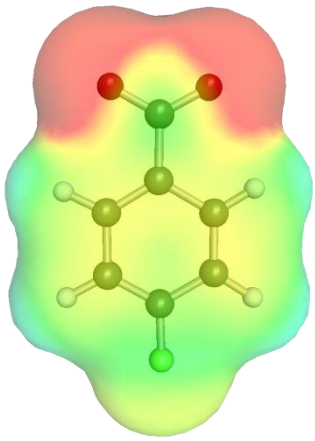


Figure S9. 4-fluorobenzoic acid.

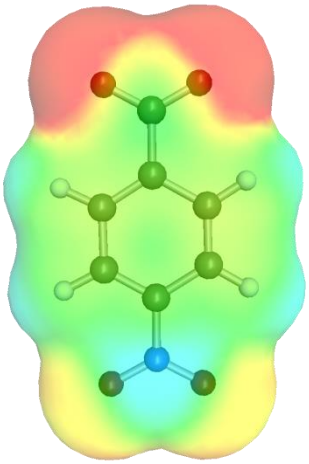


Figure S10. 4-nitrobenzoic acid.

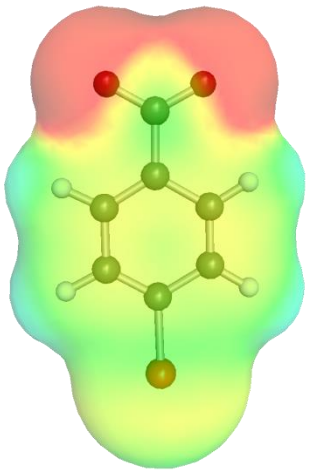


Figure S11. 4-bromobenzoic acid.

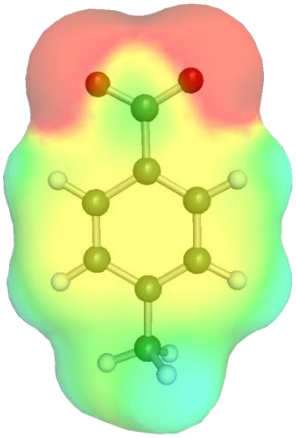


Figure S12. 4-methylbenzoic acid.

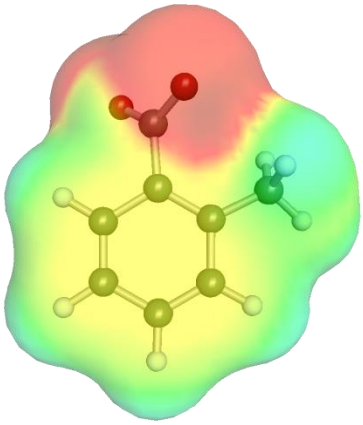


Figure S13. 2-methylbenzoic acid.

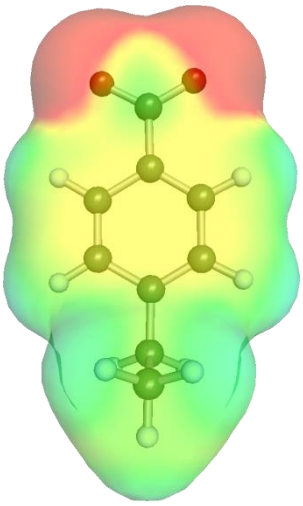


Figure S14. 4-ethylbenzoic acid.

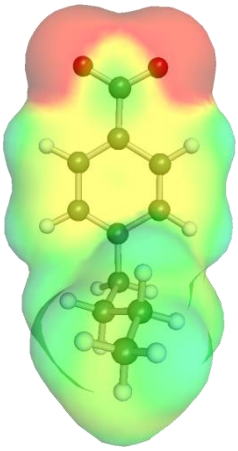


Figure S15. 4-butylbenzoic acid.

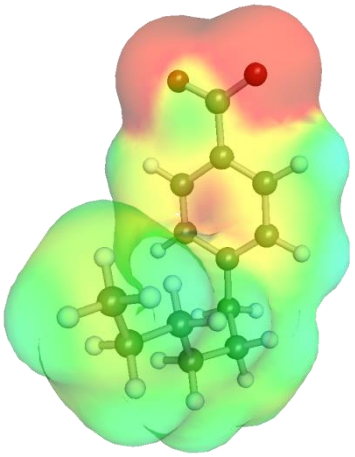


Figure S16. 4-hexylbenzoic acid.

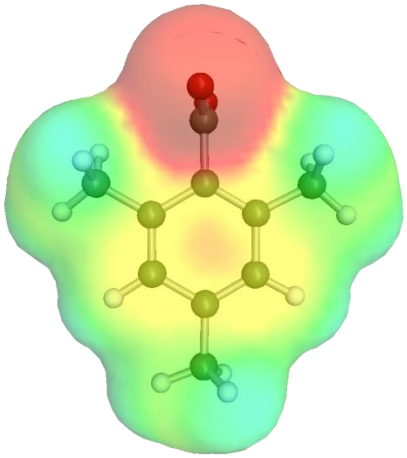


Figure S17. 2,4,6-trimethylbenzoic acid.

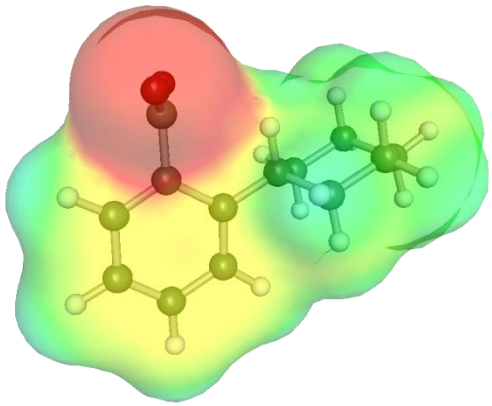


Figure S18. 2-cyclohexylbenzoic acid.

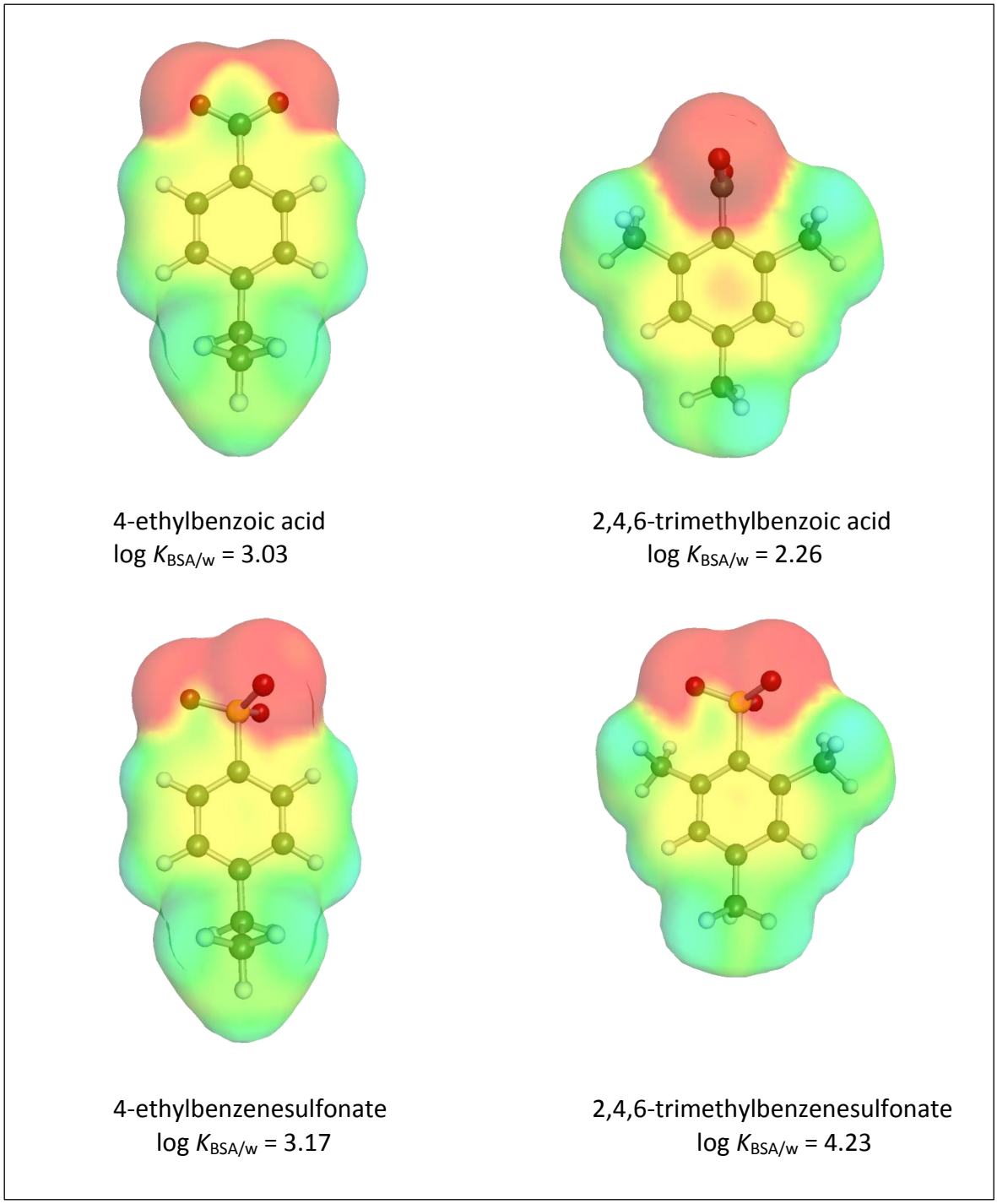


Figure S19. 3D structures of selected benzoic acids and benzenesulfonates.

S11 *Comparison of log $K_{BSA/w}$ with other partition coefficients*

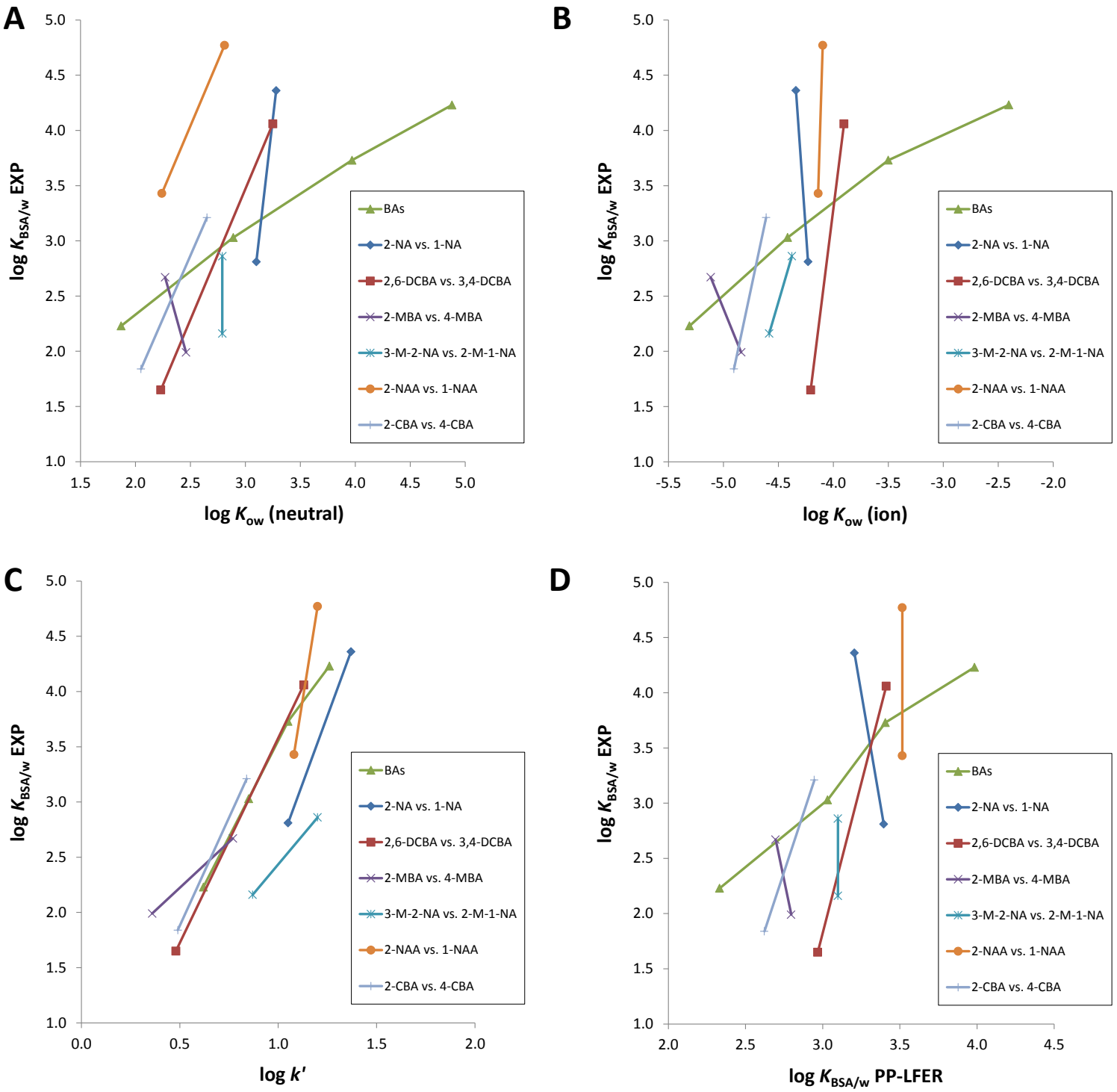


Figure S20. Comparison of experimentally determined BSA-water partition coefficients (log $K_{BSA/w}$ EXP) with (A) octanol-water partition coefficients of neutral species (log K_{ow} (neutral)), (B) calculated octanol-water partition coefficients of ionic species (log K_{ow} (ion)), (C) retention factors measured on a weak anion exchange column (log k') and (D) PP-LFER predicted BSA-water partition coefficients (log $K_{BSA/w}$ PP-LFER). BAs - 4-alkylbenzoic acids, NA - naphthoic acid, DCBA - dichlorobenzoic acid, MBA - methylbenzoic

acid, M - methoxy, NAA - naphthaleneacetic acid, CBD - chlorobenzoic acid. Chemicals with similar structure (e.g., constitutional isomers), but widely different log $K_{BSA/w}$ were selected. If the partition coefficients chosen for comparison correctly predict the differences between isomers the figures would show a set of parallel lines with a slope of 1.

S12 *Fitting of a PP-LFER model*

A PP-LFER model for the prediction of BSA-water partition coefficients (log $K_{BSA/w}$) of neutral chemicals was already fitted to data before,[3] using the following equation:

$$\log K_{BSA/w} = c + eE + sS + aA + bB + vV \quad (1)$$

In this equation the capital letters represent the substance properties and the small letters the corresponding system properties. *E* is the excess molar refraction, *S* is the polarizability/dipolarity parameter, *A* represents the H-bond donor properties and *B* the H-bond acceptor properties, and *V* is the molar volume.

According to Abraham et al.,[4, 5] the PP-LFER approach can also be applied to ionic chemicals by adding two ionic descriptors (J^+ and J^-) and by using the substance descriptors of the ionic species (E_i, S_i, A_i, B_i, V_i, J_i^+, J_i^-):

$$\log K_{BSA/w} = c + eE_i + sS_i + aA_i + bB_i + vV_i + j^+J_i^+ + j^-J_i^- \quad (2)$$

The flow chart in Figure S21 shows how the PP-LFER model for the organic ions in this study was derived. To derive the descriptors for the ionic species, descriptors for the neutral species of all test chemicals (*E*, *S*, *A*, *B*, *V*) are required. Experimentally determined descriptors from the literature were collected by using the UFZ-LSER database,[6] if values were available. Often, no experimental substance descriptors exist and the descriptors were predicted using the ABSOLV module from the ACD/Percepta software (2015 release). The descriptors of the neutral species were then used to calculate descriptors for the ionic species (E_i, S_i, A_i, B_i, V_i, J_i^+, J_i^-) using the empirical equations from Abraham et al.[4, 7] Equations are only available for phenols, carboxylic acids, pyridine, and amines. Hence, some chemicals had to be excluded (e.g., sulfonates, coumarines, and quaternary ammonium). Additionally, the data for 82 neutral chemicals from Endo et al.[3] were added to the dataset. All substance descriptors used are shown in Table S7. All chemicals (82 neutral, 37 anionic, 4 cationic, 123 in total) were then used to derive all system descriptors (*e*, *s*, *a*, *b*, *v*, j^+, j^-), leading to the following equation:

$$\log K_{BSA/w}\,[L_{water}/kg_{BSA}] = 0.85(0.19) + 0.63(0.08)E_i - 0.63(0.07)S_i - 0.05(0.22)A_i - 2.08(0.19)B_i + 2.06(0.20)V_i - 1.16(0.27)J_i^+ + 3.13(0.28)J_i^- \quad (3)$$

The values in parentheses are the standard errors of the coefficients. Equation 3 gives a good fit for all chemicals (R^2 = 0.72, RMSE = 0.50, Figure S22). Figure S20D shows a trend plot for selected data pairs. If the PP-LFER model correctly predicts the trends in the data set, the Figure S20D would show a set of parallel lines with a slope of 1. However, the PP-LFER model predicts similar values for the structural isomers included in this study, which resulted in vertical lines in the figure.

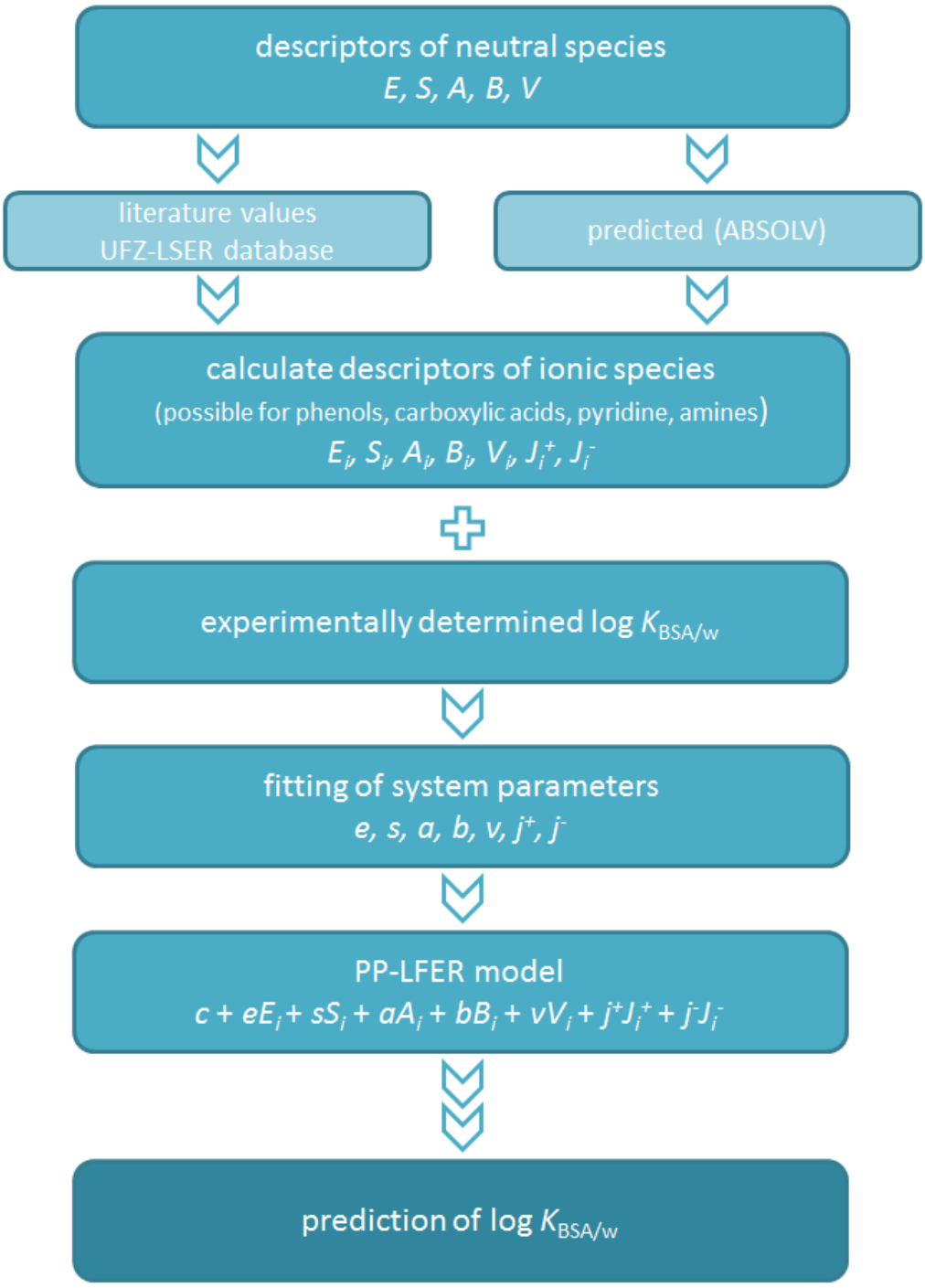


Figure S21. Schematic illustration of PP-LFER modeling approach used in this study.

Table S9. Experimental and calculated substance descriptors of test chemicals.

Name	log $K_{BSA/w}$ EXP	log $K_{BSA/w}$ PP-LFER	source of descriptors	E	S	A	B	V	E_i	S_i	A_i	B_i	V_i	J^+	J^-
pentachlorophenol	5.27	6.38	database	1.22	0.86	0.61	0.09	1.39	1.37	7.93	0.00	2.79	1.37	0.00	4.04
bromoxynil	5.18	5.09	ABSOLV	1.47	1.48	0.42	0.34	1.28	1.62	7.97	0.00	2.63	1.26	0.00	3.55
2-phenoxyacetic acid	2.53	2.02	ABSOLV	0.79	1.23	0.57	0.66	1.13	0.94	11.27	0.00	2.46	1.11	0.00	3.36
2,4-dichlorophenoxyacetic acid	3.28	3.50	ABSOLV	1.04	1.41	0.57	0.58	1.38	1.19	11.49	0.00	2.56	1.36	0.00	3.73
4-(2,4-dichlorophenoxy)butyric acid	4.12	4.07	ABSOLV	1.04	1.42	0.57	0.58	1.66	1.19	11.46	0.00	2.55	1.64	0.00	3.71
2,4,5-trichlorophenoxyacetic acid	3.83	3.29	ABSOLV	1.16	1.51	0.57	0.50	1.50	1.31	4.21	0.02	2.92	1.48	0.00	2.33
mecoprop	3.74	2.92	ABSOLV	0.97	1.28	0.57	0.68	1.54	1.12	3.86	0.04	3.20	1.52	0.00	2.34
ibuprofen	3.91	3.35	database	0.73	0.70	0.56	0.79	1.78	0.88	3.27	0.08	3.53	1.76	0.00	2.47
fenoprofen	3.92	3.54	ABSOLV	1.39	1.63	0.57	0.78	1.88	1.54	4.69	0.04	3.36	1.86	0.00	2.50
ketoprofen	3.31	3.27	database	1.65	2.26	0.55	0.89	1.98	1.80	5.49	0.01	3.39	1.96	0.00	2.49
mefenamic acid	4.36	4.18	ABSOLV	1.65	1.47	0.65	0.70	1.92	1.80	4.81	0.08	3.30	1.90	0.00	2.62
benzoic acid	2.23	2.33	database	0.73	0.90	0.59	0.40	0.93	0.88	3.05	0.02	2.75	0.91	0.00	2.14
2-chlorobenzoic acid	1.84	2.62	database	0.84	1.01	0.68	0.40	1.05	0.99	3.30	0.05	2.76	1.03	0.00	2.19
3-chlorobenzoic acid	3.22	2.92	database	0.84	0.95	0.65	0.30	1.05	0.99	3.25	0.05	2.65	1.03	0.00	2.20
4-chlorobenzoic acid	3.21	2.95	database	0.84	1.02	0.63	0.27	1.05	0.99	3.31	0.04	2.60	1.03	0.00	2.19
3,4-dichlorobenzoic acid	4.06	3.41	database	0.95	0.92	0.67	0.26	1.18	1.10	3.38	0.07	2.65	1.16	0.00	2.28
2,6-dichlorobenzoic acid	1.65	2.97	ABSOLV	1.02	1.22	0.57	0.38	1.18	1.17	3.69	0.01	2.73	1.16	0.00	2.24
4-fluorobenzoic acid	2.84	2.53	database	0.60	0.91	0.61	0.29	0.95	0.75	2.95	0.03	2.62	0.93	0.00	2.11
4-nitrobenzoic acid	2.66	2.30	database	0.99	1.43	0.68	0.51	1.11	1.14	3.81	0.03	2.83	1.08	0.00	2.17
4-bromobenzoic acid	3.48	3.20	database	1.00	1.07	0.63	0.26	1.11	1.15	3.52	0.04	2.60	1.09	0.00	2.24
4-methylbenzoic acid	2.67	2.69	database	0.73	0.90	0.60	0.38	1.07	0.88	3.12	0.03	2.77	1.05	0.00	2.19
2-methylbenzoic acid	1.99	2.80	database	0.73	0.90	0.60	0.34	1.07	0.88	3.12	0.03	2.72	1.05	0.00	2.19

4-ethylbenzoic acid	3.03	3.03	database	0.73	0.90	0.59	0.37	1.21	0.88	3.18	0.04	2.80	1.19	0.00	2.24
4-butylbenzoic acid	3.73	3.41	ABSOLV	0.77	1.03	0.57	0.45	1.50	0.92	3.45	0.05	2.96	1.48	0.00	2.32
4-hexylbenzoic acid	4.23	3.98	ABSOLV	0.76	1.04	0.57	0.46	1.78	0.91	3.58	0.07	3.06	1.76	0.00	2.42
2,4,6-trimethylbenzoic acid	2.26	3.21	ABSOLV	0.82	0.90	0.57	0.45	1.35	0.97	3.32	0.04	2.94	1.33	0.00	2.31
2-cyclohexylbenzoic acid	3.55	3.90	ABSOLV	0.99	1.11	0.57	0.46	1.67	1.14	3.80	0.06	3.01	1.65	0.00	2.43
2-naphthoic acid	4.36	3.21	ABSOLV	1.47	1.40	0.57	0.50	1.30	1.62	4.31	0.01	2.88	1.28	0.00	2.37
2-naphthaleneacetic acid	4.77	3.52	ABSOLV	1.47	1.40	0.57	0.50	1.44	1.62	4.37	0.02	2.93	1.42	0.00	2.42
1-naphthoic acid	2.81	3.40	database	1.46	1.30	0.60	0.45	1.30	1.61	4.21	0.03	2.84	1.28	0.00	2.38
1-naphthaleneacetic acid	3.43	3.52	ABSOLV	1.47	1.40	0.57	0.50	1.44	1.62	4.37	0.02	2.93	1.42	0.00	2.42
1-bromo-2-naphthoic acid	4.02	3.79	ABSOLV	1.80	1.56	0.57	0.50	1.48	1.95	4.82	0.02	2.90	1.46	0.00	2.49
3-methoxy-2-naphthoic acid	2.86	3.10	ABSOLV	1.53	1.50	0.57	0.71	1.50	1.68	4.53	0.02	3.18	1.48	0.00	2.43
2-methoxy-1-naphthoic acid	2.16	3.10	ABSOLV	1.53	1.50	0.57	0.71	1.50	1.68	4.53	0.02	3.18	1.48	0.00	2.43
2-ethoxy-1-naphthoic acid	2.66	3.38	ABSOLV	1.53	1.50	0.57	0.72	1.64	1.68	4.60	0.03	3.24	1.62	0.00	2.48
4-fluoro-1-naphthoic acid	3.46	3.20	ABSOLV	1.39	1.37	0.66	0.50	1.32	1.54	4.22	0.05	2.89	1.30	0.00	2.36
α,4-dimethylphenylacetic acid	3	3.02	ABSOLV	0.78	1.01	0.57	0.48	1.35	0.93	3.38	0.04	2.95	1.33	0.00	2.28
(S)-(-)-propranolol	1.43	0.75	database	1.84	1.43	0.44	1.31	2.15	1.69	4.31	2.07	0.00	2.17	2.43	0.00
alprenolol	1.02	1.02	database	1.25	1.03	0.10	1.25	2.16	1.10	3.97	1.69	0.00	2.18	2.09	0.00
imipramine	1.58	1.96	database	1.15	1.60	0.00	1.15	2.40	1.00	4.00	2.24	0.00	2.42	1.62	0.00
verapamil	0.97	1.34	database	1.81	2.91	0.00	2.51	3.79	1.66	7.91	3.95	0.00	3.81	2.77	0.00
1,2,3,4-tetrachlorobenzene	4.21	3.51	reference 3	1.18	0.92	0.00	0.00	1.21	1.18	0.92	0.00	0.00	1.21	0.00	0.00
1,2,4-trichlorobenzene	3.6	3.18	reference 3	0.98	0.81	0.00	0.00	1.08	0.98	0.81	0.00	0.00	1.08	0.00	0.00
1,2,4-trimethylbenzene	3.35	2.88	reference 3	0.68	0.56	0.00	0.19	1.14	0.68	0.56	0.00	0.19	1.14	0.00	0.00
1,2-dichlorobenzene	3.03	2.80	reference 3	0.87	0.78	0.00	0.04	0.96	0.87	0.78	0.00	0.04	0.96	0.00	0.00
1,4-dibromobenzene	3.97	3.16	reference 3	1.15	0.86	0.00	0.04	1.07	1.15	0.86	0.00	0.04	1.07	0.00	0.00
1-chlorooctane	3.85	3.33	reference 3	0.19	0.40	0.00	0.09	1.36	0.19	0.40	0.00	0.09	1.36	0.00	0.00
1-heptanol	2.18	2.07	reference 3	0.21	0.42	0.37	0.48	1.15	0.21	0.42	0.37	0.48	1.15	0.00	0.00
1-heptyne	2.49	2.67	reference 3	0.16	0.23	0.13	0.10	1.01	0.16	0.23	0.13	0.10	1.01	0.00	0.00

1-hexanol	1.64	1.78	reference 3	0.21	0.42	0.37	0.48	1.01	0.21	0.42	0.37	0.48	1.01	0.00	0.00
1-nitronaphthalene	3.17	2.85	reference 3	1.60	1.59	0.00	0.29	1.26	1.60	1.59	0.00	0.29	1.26	0.00	0.00
1-nitrooctane	3.38	2.67	reference 3	0.19	0.95	0.00	0.29	1.41	0.19	0.95	0.00	0.29	1.41	0.00	0.00
1-nonanol	3.1	2.65	reference 3	0.19	0.42	0.37	0.48	1.44	0.19	0.42	0.37	0.48	1.44	0.00	0.00
1-nonene	4.22	3.45	reference 3	0.09	0.08	0.00	0.07	1.33	0.09	0.08	0.00	0.07	1.33	0.00	0.00
1-octanol	2.74	2.37	reference 3	0.20	0.42	0.37	0.48	1.30	0.20	0.42	0.37	0.48	1.30	0.00	0.00
2,4-dinitrotoluene	1.73	2.22	reference 3	1.17	1.27	0.07	0.51	1.21	1.17	1.27	0.07	0.51	1.21	0.00	0.00
2-chloroaniline	1.95	2.20	reference 3	1.03	0.92	0.25	0.31	0.94	1.03	0.92	0.25	0.31	0.94	0.00	0.00
2-decanone	2.88	2.58	reference 3	0.11	0.68	0.00	0.51	1.53	0.11	0.68	0.00	0.51	1.53	0.00	0.00
2-nitrotoluene	2.12	2.24	reference 3	0.87	1.11	0.00	0.28	1.03	0.87	1.11	0.00	0.28	1.03	0.00	0.00
2-nonanone	2.48	2.30	reference 3	0.12	0.68	0.00	0.51	1.39	0.12	0.68	0.00	0.51	1.39	0.00	0.00
2-octanone	2.09	2.00	reference 3	0.11	0.68	0.00	0.51	1.25	0.11	0.68	0.00	0.51	1.25	0.00	0.00
2-phenylphenol	2.62	2.74	reference 3	1.55	1.40	0.56	0.49	1.38	1.55	1.40	0.56	0.49	1.38	0.00	0.00
3-chlorophenol	2.35	2.26	reference 3	0.91	1.06	0.69	0.15	0.90	0.91	1.06	0.69	0.15	0.90	0.00	0.00
4-aminobiphenyl	2.55	2.82	reference 3	1.57	1.48	0.26	0.48	1.42	1.57	1.48	0.26	0.48	1.42	0.00	0.00
4-bromophenol	2.81	2.30	reference 3	1.08	1.17	0.67	0.20	0.95	1.08	1.17	0.67	0.20	0.95	0.00	0.00
4-chlorobenzyl alcohol	2.1	1.90	reference 3	0.91	0.96	0.40	0.50	1.04	0.91	0.96	0.40	0.50	1.04	0.00	0.00
4-chlorophenol	2.43	2.15	reference 3	0.92	1.08	0.67	0.20	0.90	0.92	1.08	0.67	0.20	0.90	0.00	0.00
4-ethyl-3-hexanol	1.48	2.20	reference 3	0.17	0.36	0.33	0.57	1.30	0.17	0.36	0.33	0.57	1.30	0.00	0.00
4-fluorophenol	1.57	1.82	reference 3	0.67	0.97	0.63	0.23	0.81	0.67	0.97	0.63	0.23	0.81	0.00	0.00
4-iodoaniline	2.95	2.37	reference 3	1.53	1.28	0.31	0.40	1.07	1.53	1.28	0.31	0.40	1.07	0.00	0.00
4-iodophenol	3.41	2.62	reference 3	1.38	1.22	0.68	0.20	1.03	1.38	1.22	0.68	0.20	1.03	0.00	0.00
4-nitroaniline	1.69	1.70	reference 3	1.22	1.92	0.46	0.35	0.99	1.22	1.92	0.46	0.35	0.99	0.00	0.00
4-nitroanisole	2.48	2.06	reference 3	0.97	1.29	0.00	0.40	1.09	0.97	1.29	0.00	0.40	1.09	0.00	0.00
4-n-propylphenol	2.59	2.47	reference 3	0.79	0.88	0.55	0.37	1.20	0.79	0.88	0.55	0.37	1.20	0.00	0.00
anisole	2.16	2.12	reference 3	0.71	0.75	0.00	0.29	0.92	0.71	0.75	0.00	0.29	0.92	0.00	0.00
atrazine	1.77	2.03	reference 3	1.22	1.29	0.17	1.01	1.62	1.22	1.29	0.17	1.01	1.62	0.00	0.00

benzene	1.58	2.10	reference 3	0.61	0.52	0.00	0.14	0.72	0.61	0.52	0.00	0.14	0.72	0.00	0.00
benzo[b]fluoranthene	4.42	4.91	reference 3	3.19	1.82	0.00	0.40	1.95	3.19	1.82	0.00	0.40	1.95	0.00	0.00
benzo[ghi]perylene	4.76	5.58	reference 3	4.07	1.90	0.00	0.45	2.08	4.07	1.90	0.00	0.45	2.08	0.00	0.00
benzophenone	2.62	2.83	reference 3	1.45	1.50	0.00	0.50	1.48	1.45	1.50	0.00	0.50	1.48	0.00	0.00
bisphenol A	2.88	2.77	reference 3	1.61	1.56	0.99	0.91	1.86	1.61	1.56	0.99	0.91	1.86	0.00	0.00
carbazole	3.52	3.24	reference 3	1.79	1.42	0.47	0.26	1.32	1.79	1.42	0.47	0.26	1.32	0.00	0.00
chlorobenzene	2.32	2.48	reference 3	0.72	0.65	0.00	0.07	0.84	0.72	0.65	0.00	0.07	0.84	0.00	0.00
chrysene	4.46	4.74	reference 3	3.03	1.73	0.00	0.33	1.82	3.03	1.73	0.00	0.33	1.82	0.00	0.00
cycloheptane	2.52	3.05	reference 3	0.35	0.10	0.00	0.00	0.99	0.35	0.10	0.00	0.00	0.99	0.00	0.00
cyclohexane	2.01	2.73	reference 3	0.31	0.10	0.00	0.00	0.85	0.31	0.10	0.00	0.00	0.85	0.00	0.00
cyclooctane	2.98	3.37	reference 3	0.41	0.10	0.00	0.00	1.13	0.41	0.10	0.00	0.00	1.13	0.00	0.00
diazepam	2.68	2.79	reference 3	2.08	1.55	0.00	1.28	2.07	2.08	1.55	0.00	1.28	2.07	0.00	0.00
dibenzofuran	3.79	3.36	reference 3	1.41	1.02	0.00	0.17	1.27	1.41	1.02	0.00	0.17	1.27	0.00	0.00
dibenzothiophene	4.16	3.69	reference 3	1.96	1.31	0.00	0.20	1.38	1.96	1.31	0.00	0.20	1.38	0.00	0.00
di-n-butyl ether	2.01	2.43	reference 3	0.00	0.25	0.00	0.45	1.30	0.00	0.25	0.00	0.45	1.30	0.00	0.00
di-n-pentyl ether	3	3.01	reference 3	0.00	0.25	0.00	0.45	1.58	0.00	0.25	0.00	0.45	1.58	0.00	0.00
di-n-propyl phthalate	2.84	2.68	reference 3	0.71	1.40	0.00	0.88	1.99	0.71	1.40	0.00	0.88	1.99	0.00	0.00
enflurane	1.59	2.33	reference 3	-0.24	0.40	0.07	0.13	0.90	0.24	0.40	0.07	0.13	0.90	0.00	0.00
estrone	2.69	2.82	reference 3	1.73	2.05	0.50	1.08	2.16	1.73	2.05	0.50	1.08	2.16	0.00	0.00
ethylbenzene	2.7	2.66	reference 3	0.61	0.51	0.00	0.15	1.00	0.61	0.51	0.00	0.15	1.00	0.00	0.00
fluoranthene	4.28	4.16	reference 3	2.38	1.55	0.00	0.24	1.59	2.38	1.55	0.00	0.24	1.59	0.00	0.00
halothane	1.62	2.20	reference 3	0.10	0.39	0.13	0.05	0.80	0.10	0.39	0.13	0.05	0.80	0.00	0.00
hexafluorobenzene	1.55	2.47	reference 3	0.09	0.56	0.00	0.01	0.94	0.09	0.56	0.00	0.01	0.94	0.00	0.00
indene	2.92	2.62	reference 3	1.00	0.77	0.00	0.20	0.99	1.00	0.77	0.00	0.20	0.99	0.00	0.00
indole	2.25	2.38	reference 3	1.20	1.12	0.44	0.22	0.95	1.20	1.12	0.44	0.22	0.95	0.00	0.00
isoflurane	1.58	2.34	reference 3	-0.24	0.56	0.00	0.08	0.90	0.24	0.56	0.00	0.08	0.90	0.00	0.00
methoxyflurane	1.77	2.08	reference 3	0.11	0.67	0.07	0.14	0.91	0.11	0.67	0.07	0.14	0.91	0.00	0.00

methylpentafluorobenzene	2.32	2.72	reference 3	0.16	0.59	0.00	0.01	1.05	0.16	0.59	0.00	0.01	1.05	0.00	0.00
metolachlor	1.74	2.76	reference 3	1.15	1.01	0.07	1.38	2.28	1.15	1.01	0.07	1.38	2.28	0.00	0.00
N,N-diethylaniline	2.27	2.75	reference 3	0.95	0.80	0.00	0.50	1.38	0.95	0.80	0.00	0.50	1.38	0.00	0.00
naphthalene	3.56	2.95	reference 3	1.34	0.92	0.00	0.20	1.09	1.34	0.92	0.00	0.20	1.09	0.00	0.00
n-heptane	3.59	3.11	reference 3	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.00	1.10	0.00	0.00
n-hexane	3.09	2.81	reference 3	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.00	0.95	0.00	0.00
n-nonane	4.45	3.69	reference 3	0.00	0.00	0.00	0.00	1.38	0.00	0.00	0.00	0.00	1.38	0.00	0.00
n-octane	4.01	3.40	reference 3	0.00	0.00	0.00	0.00	1.24	0.00	0.00	0.00	0.00	1.24	0.00	0.00
n-propylbenzene	2.95	2.95	reference 3	0.60	0.50	0.00	0.15	1.14	0.60	0.50	0.00	0.15	1.14	0.00	0.00
phenanthrene	4.15	3.72	reference 3	2.06	1.29	0.00	0.29	1.45	2.06	1.29	0.00	0.29	1.45	0.00	0.00
pyrene	4.76	4.24	reference 3	2.81	1.71	0.00	0.28	1.59	2.81	1.71	0.00	0.28	1.59	0.00	0.00
styrene	2.76	2.62	reference 3	0.85	0.65	0.00	0.16	0.96	0.85	0.65	0.00	0.16	0.96	0.00	0.00
tetrachloroethene	2.4	2.71	reference 3	0.64	0.44	0.00	0.00	0.84	0.64	0.44	0.00	0.00	0.84	0.00	0.00
tetrachloromethane	1.77	2.43	reference 3	0.46	0.38	0.00	0.00	0.74	0.46	0.38	0.00	0.00	0.74	0.00	0.00
toluene	2.26	2.38	reference 3	0.60	0.52	0.00	0.14	0.86	0.60	0.52	0.00	0.14	0.86	0.00	0.00
tribromomethane	1.95	2.51	reference 3	0.97	0.68	0.15	0.06	0.78	0.97	0.68	0.15	0.06	0.78	0.00	0.00
trichloroethene	1.88	2.36	reference 3	0.52	0.37	0.08	0.03	0.72	0.52	0.37	0.08	0.03	0.72	0.00	0.00
tri-n-butyl phosphate	2.47	2.44	reference 3	-0.10	0.90	0.00	1.21	2.24	0.10	0.90	0.00	1.21	2.24	0.00	0.00
valerophenone	2.7	2.68	reference 3	0.80	0.95	0.00	0.50	1.44	0.80	0.95	0.00	0.50	1.44	0.00	0.00
γ-hexachlorocyclohexane	2.46	3.17	reference 3	1.45	1.28	0.00	0.50	1.58	1.45	1.28	0.00	0.50	1.58	0.00	0.00

References

1. Silbernagl, S.; Despopoulos, A., *Color atlas of physiology*. Georg Thieme Verlag KG: Stuttgart, New York, 2009.
2. Oemisch, L.; Goss, K.-U.; Endo, S., Ion exchange membranes as novel passive sampling material for organic ions: Application for the determination of freely dissolved concentrations. *J. Chromatogr. A* **2014,** *1370*, 17-24.
3. Endo, S.; Goss, K. U., Serum Albumin Binding of Structurally Diverse Neutral Organic Compounds: Data and Models *Chem. Res. Toxicol.* **2011,** *24*, (12), 2293-2301.
4. Abraham, M. H.; Acree, W. E., Equations for the Transfer of Neutral Molecules and Ionic Species from Water to Organic phases. *J. Org. Chem.* **2010,** *75*, (4), 1006-1015.
5. Abraham, M. H.; Zhao, Y. H., Determination of Solvation Descriptors for Ionic Species: Hydrogen Bond Acidity and Basicity. *J. Org. Chem.* **2004,** *69*, (14), 4677-4685.
6. Endo, S.; Watanabe, N.; Ulrich, N.; Bronner, G.; Goss, K.-U., UFZ-LSER database v 2.1 [Internet]. In Helmholtz Centre for Environmental Research-UFZ: Leipzig, Germany, 2015; Vol. v 2.1.
7. Abraham, M. H., The permeation of neutral molecules, ions, and ionic species through membranes: Brain permeation as an example. *J. Pharm. Sci.* **2011,** *100*, (5), 1690-1701.