Environmental Hazard Assessment for Polymeric and Inorganic Nanobiomaterials used in Drug Delivery

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Additional file 1

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Table S1: Data for freshwater toxicity of chitosan

Reference	Taxonomy	Test organisms	Ecotoxical endpoint	Concentration (µg/L) (nano-sized)	Exposure time (h)	AF-time	AF-NOEC	species sensitivity (µg/L) = concentration/AF
Costa et al (2012)	bacterium	P. gingivalis	MIC	1,000,000	72	1	2	500,000
Costa et al (2012)	bacterium	P. gingivalis	MIC	1,000,000	72	1	2	500,000
Costa et al (2012)	bacterium	T. forsythensis	MIC	1,000,000	72	1	2	500,000
Costa et al (2012)	bacterium	T. forsythensis	MIC	3,000,000	72	1	2	1,500,000
Costa et al (2012)	bacterium	P.buccae	MIC	3,000,000	72	1	2	1,500,000
Costa et al (2012)	bacterium	P.buccae	MIC	1,000,000	72	1	2	500,000
Costa et al (2012)	bacterium	A. actinomycetemcomitans	MIC	5,000,000	72	1	2	2,500,000
Costa et al (2012)	bacterium	A. actinomycetemcomitans	MIC	3,000,000	72	1	2	1,500,000
Costa et al (2012)	bacterium	P. intermedia	MIC	1,000,000	72	1	2	500,000
Costa et al (2012)	bacterium	P. intermedia	MIC	3,000,000	72	1	2	1,500,000
Tsai et al (2002)	bacterium	E. coli	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	E. coli	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	E. coli	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	E. coli	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	E. coli	MIC	500,000	48	1	2	250,000
Tsai et al (2002)	bacterium	E. coli	MIC	200,000	48	1	2	100,000
Du et al (2008)	bacterium	E. coli	MIC	468,000	24	1	2	234,000
No et al (2002)	bacterium	E. coli	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	E. coli	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	E. coli	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	E. coli	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	E. coli	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	E. coli	HONEC	1,000,000	72	1	1	1,000,000
Du et al (2008)	bacterium	E. coli	MIC	**117,000**	24	1	2	58,500
Fernandes et al (2008)	bacterium	E. coli	MIC	1,900,000	24	1	2	950,000
Fernandes et al (2008)	bacterium	E. coli	MIC	2,400,000	24	1	2	1,200,000
Fernandes et al (2008)	bacterium	E. coli	MIC	2,500,000	24	1	2	1,250,000
Qi et al (2004)	bacterium	E. coli	MIC	**125**	24	1	2	62.50
Qi et al (2004)	bacterium	E. coli	MIC	8,000	24	1	2	4,000
Qi et al (2004)	bacterium	E. coli	MIC	**62.50**	24	1	2	31.250
Qi et al (2004)	bacterium	E. coli	MIC	**62.50**	24	1	2	31.250
Qi et al (2004)	bacterium	E. coli	MIC	8,000	24	1	2	4,000
Qi et al (2004)	bacterium	E. coli	MIC	**31.25**	24	1	2	15.6250
Tsai et al (2002)	bacterium	P. aeruginosa	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	P. aeruginosa	MIC	150,000	48	1	2	75,000
Tsai et al (2002)	bacterium	P. aeruginosa	HONEC	200,000	48	1	1	200,000
Tsai et al (2002)	bacterium	P. aeruginosa	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	P. aeruginosa	HONEC	200,000	48	1	1	200,000
Tsai et al (2002)	bacterium	P. aeruginosa	HONEC	200,000	48	1	1	200,000
No et al (2002)	bacterium	P. fluorescens	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	P. fluorescens	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	P. fluorescens	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	P. fluorescens	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	P. fluorescens	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	P. fluorescens	MIC	1,000,000	72	1	2	500,000
Qi et al (2004)	bacterium	S. choleraesuis	MIC	**125**	24	1	2	62.50
Qi et al (2004)	bacterium	S. choleraesuis	MIC	16,000	24	1	2	8,000
Qi et al (2004)	bacterium	S. choleraesuis	MIC	**62.50**	24	1	2	31.250
No et al (2002)	bacterium	S. tiphymurium	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	S. tiphymurium	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	S. tiphymurium	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	S. tiphymurium	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	S. tiphymurium	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	S. tiphymurium	HONEC	1,000,000	72	1	1	1,000,000
Tsai et al (2002)	bacterium	S. tiphymurium	MIC	1,500,000	48	1	2	750,000
Tsai et al (2002)	bacterium	S. tiphymurium	MIC	1,500,000	48	1	2	750,000
Tsai et al (2002)	bacterium	S. tiphymurium	MIC	1,500,000	48	1	2	750,000
Tsai et al (2002)	bacterium	S. tiphymurium	MIC	1,500,000	48	1	2	750,000

Table S1: Data for freshwater toxicity of chitosan (cont.)

Reference	Taxonomy	Test organisms	Ecotoxical endpoint	Concentration (μg/L) (nano-sized)	Exposure time (h)	AF-time	AF-NOEC	species sensitivity (μg/L) = concentration/AF
Tsai et al (2002)	bacterium	S. tiphymurium	HONEC	2,000,000	48	1	1	2,000,000
Tsai et al (2002)	bacterium	S. tiphymurium	HONEC	2,000,000	48	1	1	2,000,000
Qi et al (2004)	bacterium	S. tiphymurium	MIC	**125**	24	1	2	63
Qi et al (2004)	bacterium	S. tiphymurium	MIC	16,000	24	1	2	8,000
Qi et al (2004)	bacterium	S. tiphymurium	MIC	**250**	24	1	2	125.00
Tsai et al (2002)	bacterium	S. dysenteriae	MIC	500,000	48	1	2	250,000
Tsai et al (2002)	bacterium	A. hydrophila	MIC	500,000	48	1	2	250,000
Tsai et al (2002)	bacterium	A. hydrophila	MIC	500,000	48	1	2	250,000
Tsai et al (2002)	bacterium	A. hydrophila	MIC	500,000	48	1	2	250,000
Tsai et al (2002)	bacterium	A. hydrophila	HONEC	500,000	48	1	1	500,000
Tsai et al (2002)	bacterium	A. hydrophila	HONEC	500,000	48	1	1	500,000
Tsai et al (2002)	bacterium	A. hydrophila	MIC	500,000	48	1	2	250,000
Tsai et al (2002)	bacterium	A. hydrophila	MIC	1,000,000	48	1	2	500,000
Tsai et al (2002)	bacterium	A. hydrophila	MIC	1,000,000	48	1	2	500,000
Tsai et al (2002)	bacterium	A. hydrophila	MIC	1,000,000	48	1	2	500,000
Tsai et al (2002)	bacterium	A. hydrophila	MIC	1,500,000	48	1	2	750,000
Tsai et al (2002)	bacterium	A. hydrophila	HONEC	2,000,000	48	1	1	2,000,000
Tsai et al (2002)	bacterium	S. dysenteriae	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	S. dysenteriae	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	S. dysenteriae	HONEC	200,000	48	1	1	200,000
Tsai et al (2002)	bacterium	S. dysenteriae	HONEC	200,000	48	1	1	200,000
Tsai et al (2002)	bacterium	S. dysenteriae	HONEC	200,000	48	1	1	200,000
Tsai et al (2002)	bacterium	S. dysenteriae	HONEC	200,000	48	1	1	200,000
Tsai et al (2002)	bacterium	V. cholerae	MIC	150,000	48	1	2	75,000
Tsai et al (2002)	bacterium	V. cholerae	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	V. cholerae	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	V. cholerae	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	V. cholerae	HONEC	200,000	48	1	1	200,000
Tsai et al (2002)	bacterium	V. cholerae	HONEC	200,000	48	1	1	200,000
Tsai et al (2002)	bacterium	V. parahaemolyticus	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	V. parahaemolyticus	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	V. parahaemolyticus	MIC	150,000	48	1	2	75,000
Tsai et al (2002)	bacterium	V. parahaemolyticus	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	V. parahaemolyticus	HONEC	150,000	48	1	1	150,000
Tsai et al (2002)	bacterium	V. parahaemolyticus	HONEC	150,000	48	1	1	150,000
No et al (2002)	bacterium	V. parahaemolyticus	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	V. parahaemolyticus	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	V. parahaemolyticus	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	V. parahaemolyticus	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	V. parahaemolyticus	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	V. parahaemolyticus	HONEC	1,000,000	72	1	1	1,000,000
Costa et al (2012)	bacterium	S. mutans	MIC	3,000,000	72	1	2	1,500,000
Costa et al (2012)	bacterium	S. mutans	MIC	5,000,000	72	1	2	2,500,000
Tsai et al (2002)	bacterium	S. aureus	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	S. aureus	MIC	50,000	48	1	2	25,000
Tsai et al (2002)	bacterium	S. aureus	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	S. aureus	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	S. aureus	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	S. aureus	MIC	150,000	48	1	2	75,000
No et al (2002)	bacterium	S. aureus	MIC	1,000,000	48	1	2	500,000
No et al (2002)	bacterium	S. aureus	HONEC	1,000,000	48	1	1	1,000,000
No et al (2002)	bacterium	S. aureus	MIC	800,000	48	1	2	400,000
No et al (2002)	bacterium	S. aureus	MIC	800,000	48	1	2	400,000
No et al (2002)	bacterium	S. aureus	MIC	800,000	48	1	2	400,000
No et al (2002)	bacterium	S. aureus	HONEC	1,000,000	48	1	1	1,000,000
Fernandes et al (2008)	bacterium	S. aureus	MIC	1,900,000	24	1	2	950,000
Fernandes et al (2008)	bacterium	S. aureus	MIC	1,000,000	24	1	2	500,000
Fernandes et al (2008)	bacterium	S. aureus	MIC	1,000,000	24	1	2	500,000
Qi et al (2004)	bacterium	S. aureus	MIC	**250**	24	1	2	125.0
Qi et al (2004)	bacterium	S. aureus	MIC	**125**	24	1	2	62.5
Qi et al (2004)	bacterium	S. aureus	MIC	8,000	24	1	2	4,000
Sadeghi et al (2008)	bacterium	S. aureus	MIC	1,000,000	24	1	2	500,000

Table S1: Data for freshwater toxicity of chitosan (cont.)

Reference	Taxonomy	Test organisms	Ecotoxical endpoint	Concentration (µg/L) (nano-sized)	Exposure time (h)	AF-time	AF-NOEC	species sensitivity (µg/L) = concentration/AF
Sadeghi et al (2008)	bacterium	S. aureus	MIC	**2,000,000**	24	1	2	1,000,000
No et al (2002)	bacterium	L. plantarum	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	L. plantarum	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	L. plantarum	MIC	500,000	72	1	2	250,000
No et al (2002)	bacterium	L. plantarum	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	L. plantarum	MIC	500,000	72	1	2	250,000
No et al (2002)	bacterium	L. plantarum	MIC	500,000	72	1	2	250,000
No et al (2002)	bacterium	L. bulgaricus	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	L. bulgaricus	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	L. bulgaricus	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	L. bulgaricus	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	L. bulgaricus	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	L. bulgaricus	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	L. brevis	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	L. brevis	MIC	500,000	72	1	2	250,000
No et al (2002)	bacterium	L. brevis	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	L. brevis	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	L. brevis	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	L. brevis	MIC	800,000	72	1	2	400,000
Tsai et al (2002)	fungi	C. albicans	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	fungi	C. albicans	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	fungi	C. albicans	MIC	500,000	48	1	2	250,000
Tsai et al (2002)	fungi	C. albicans	MIC	800,000	48	1	2	400,000
Tsai et al (2002)	fungi	C. albicans	MIC	800,000	48	1	2	400,000
Tsai et al (2002)	fungi	C. albicans	MIC	800,000	48	1	2	400,000
Hu et al (2011)	fish	D. rerio	LOEC	**40,000**	96	10	2	2,000
Hu et al (2011)	fish	D. rerio	LOEC	**30,000**	96	10	2	1,500
Sigma-Aldrich (2016)	fish	O. mykiss	LC50	1,730	96	10	10	17.3
Wen et al (2010)	algae	C. vulgaris	EC27	1,000	168	1	10	100
Wen et al (2010)	algae	C. vulgaris	EC25	**1,000**	168	1	10	100
Wen et al (2010)	algae	S. obliquus	EC15	1,000	168	1	2	500
Wen et al (2010)	algae	S. obliquus	EC17	**1,000**	168	1	2	500
Rizzo et al (2008)	invertebrate	D. magna	EC40	500	24	10	10	5.00
Sigma-Aldrich (2016)	invertebrate	D. pulex	EC50	13,690	48	10	10	136.9

Table S2: Data for freshwater toxicity of HAP

Reference	Taxonomy	Test organisms	Ecotoxical endpoint	Concentration (µg/L)	Exposure time (h)	AF-time	AF-NOEC	species sensitivity (µg/L) = concentratioNAF
Zhao et al (2013)	fish	zebrafish embryos	HONEC	300,000	80	10	1	30,000
Zhao et al (2013)	fish	zebrafish embryos	HONEC	300,000	80	10	1	30,000
Pujari-P. et al (2017)	fish	zebrafish embryos	EC50	100,000	120	10	10	1,000
Pujari-P. et al (2017)	fish	zebrafish embryos	EC50	100,000	72	10	10	1,000
Pujari-P. et al (2017)	fish	zebrafish embryos	EC50	100,000	72	10	10	1,000
Pujari-P. et al (2017)	fish	zebrafish embryos	EC50	40,000	24	10	10	400
Li et al (2010)	bacterium	E.coli	LC50	10,000,000	24	1	10	1,000,000
Baskar et al (2016)	bacterium	E.coli	MIC	500,000	24	1	2	250,000
Baskar et al (2016)	bacterium	P. aeruginosa	MIC	131,700	24	1	2	65,850
Baskar et al (2016)	bacterium	K. pneumoniae	MIC	292,800	24	1	2	146,400
Baskar et al (2016)	bacterium	S. typhi	MIC	370,700	24	1	2	185,350
Pereira et al (2017)	algae	P. subcapitata	IC50	340,000	72	1	10	34,000
Pereira et al (2017)	algae	P. subcapitata	IC50	350,000	72	1	10	35,000

Table S3: Data for freshwater toxicity of PAN

Reference	Taxonomy	Test organisms	Ecotoxical endpoint	Concentration (μg/L)	Exposure time (h)	AF-time	AF-NOEC	species sensitivity (μg/L) = concentratioNAF
He et al 2016	bacterium	E.coli	EC50	3,000,000,000	24	1	10	300,000,000
Shi et al 2011	bacterium	E.coli	HONEC	32,500,000	18	10	1	3,250,000

Table S4: Data for soil toxicity of chitosan

Reference	Taxonomy	Test organisms	Ecotoxical endpoint	Concentration (μg/kg)	Exposure time (h)	AF-time	AF-NOEC	species sensitivity (μg/L) = concentratioNAF
Tsai et al (2002)	bacterium	P. aeruginosa	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	P. aeruginosa	MIC	150,000	48	1	2	75,000
Tsai et al (2002)	bacterium	P. aeruginosa	HONEC	200,000	48	1	1	200,000
Tsai et al (2002)	bacterium	P. aeruginosa	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	P. aeruginosa	HONEC	200,000	48	1	1	200,000
Tsai et al (2002)	bacterium	P. aeruginosa	HONEC	200,000	48	1	1	200,000
No et al (2002)	bacterium	P. aeruginosa	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	P. aeruginosa	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	P. aeruginosa	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	P. aeruginosa	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	P. aeruginosa	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	P. aeruginosa	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	B. cereus	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	B. cereus	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	B. cereus	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	B. cereus	MIC	500,000	72	1	2	250,000
No et al (2002)	bacterium	B. cereus	MIC	500,000	72	1	2	250,000
No et al (2002)	bacterium	B. cereus	HONEC	1,000,000	72	1	1	1,000,000
Tsai et al (2002)	bacterium	B. cereus	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	B. cereus	MIC	200,000	48	1	2	100,000
Tsai et al (2002)	bacterium	B. cereus	MIC	1,000,000	48	1	2	500,000
Tsai et al (2002)	bacterium	B. cereus	MIC	500,000	48	1	2	250,000
Tsai et al (2002)	bacterium	B. cereus	MIC	1,000,000	48	1	2	500,000
Tsai et al (2002)	bacterium	B. cereus	MIC	1,000,000	48	1	2	500,000
No et al (2002)	bacterium	B. megaterium	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	B. megaterium	MIC	500,000	72	1	2	250,000
No et al (2002)	bacterium	B. megaterium	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	B. megaterium	MIC	500,000	72	1	2	250,000
No et al (2002)	bacterium	B. megaterium	MIC	500,000	72	1	2	250,000
No et al (2002)	bacterium	B. megaterium	MIC	800,000	72	1	2	400,000
Tsai et al (2002)	bacterium	L. monocytogenes	MIC	100,000	48	1	2	50,000
Tsai et al (2002)	bacterium	L. monocytogenes	MIC	150,000	48	1	2	75,000
Tsai et al (2002)	bacterium	L. monocytogenes	MIC	150,000	48	1	2	75,000
Tsai et al (2002)	bacterium	L. monocytogenes	MIC	150,000	48	1	2	75,000
Tsai et al (2002)	bacterium	L. monocytogenes	MIC	150,000	48	1	2	75,000
Tsai et al (2002)	bacterium	L. monocytogenes	MIC	150,000	48	1	2	75,000
No et al (2002)	bacterium	L. monocytogenes	MIC	1,000,000	72	1	2	500,000
No et al (2002)	bacterium	L. monocytogenes	HONEC	1,000,000	72	1	1	1,000,000
No et al (2002)	bacterium	L. monocytogenes	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	L. monocytogenes	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	L. monocytogenes	MIC	800,000	72	1	2	400,000
No et al (2002)	bacterium	L. monocytogenes	MIC	1,000,000	72	1	2	500,000
Tsai et al (2002)	fungi	F. oxysporum	MIC	500,000	168	1	2	250,000
Tsai et al (2002)	fungi	F. oxysporum	MIC	500,000	168	1	2	250,000
Tsai et al (2002)	fungi	F. oxysporum	MIC	1,000,000	168	1	2	500,000
Tsai et al (2002)	fungi	F. oxysporum	MIC	500,000	168	1	2	250,000
Tsai et al (2002)	fungi	F. oxysporum	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	F. oxysporum	HONEC	2,000,000	168	1	1	2,000,000

Table S4: Data for soil toxicity of chitosan (cont.)

Reference	Taxonomy	Test organisms	Ecotoxical endpoint	Concentration (µg/kg)	Exposure time (h)	AF-time	AF-NOEC	species sensitivity (µg/L) = concentratioNAF
Tsai et al (2002)	fungi	A. fumigatus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. fumigatus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. fumigatus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. fumigatus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. fumigatus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. fumigatus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. parasiticus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. parasiticus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. parasiticus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. parasiticus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. parasiticus	HONEC	2,000,000	168	1	1	2,000,000
Tsai et al (2002)	fungi	A. parasiticus	HONEC	2,000,000	168	1	1	2,000,000

Table S5: Data for soil toxicity of HAP

Reference	Taxonomy	Test organisms	Ecotoxical endpoint	Concentration (µg/kg)	Exposure time (h)	AF-time	AF-NOEC	species sensitivity (µg/L) = concentratioNAF
Baskar et al (2016)	bacterium	K. pneumoniae	MIC	292,800	24	1	2	146,400

Table S6: Data for soil toxicity of PAN

Reference	Taxonomy	Test organisms	Ecotoxical endpoint	Concentration (µg/kg)	Exposure time (h)	AF-time	AF-NOEC	species sensitivity (µg/L) = concentratioNAF
Shi et al (2011)	bacterium	B. cereus	HONEC	32,500,000	18	10	1	7,552,000

Table S7: Summary of nanoparticle size and characterization in collected ecotoxicological data points

Nano Particle	*Particle Size (nm)*	*# data points*	*Morphology/Characterization[1]*	*Reference*
Chitosan	40	10	Agglomerated nanoparticles, shaped like snowflakes	(Qi et al., 2004)
Chitosan	54	1	Primary nanoparticles[2], perfect spherical shape	(Du et al., 2008)
Chitosan	200	1	Primary nanoparticles, round shape	(Hu et al., 2011)
Chitosan	340	1	Primary nanoparticles, round shape	(Hu et al., 2011)
HAP	11	1	Agglomerated nanoparticles, rod-shaped	(Pereira et al., 2017)
HAP	14	5	Primary nanoparticles, spherical	(Baskar et al., 2017)
HAP	15	1	Primary nanoparticles, dots	(Pujari-Palmer et al., 2017)
HAP	19	1	Agglomerated nanoparticles, rod-shaped	(Pereira et al., 2017)
HAP	60 x 1000 to 4000	1	Primary nanoparticles, fibers	(Pujari-Palmer et al., 2017)
HAP	70	1	Primary nanoparticles, elongated spheroid	(Li et al., 2010)
HAP	75 x 30	1	Primary nanoparticles, sheets	(Pujari-Palmer et al., 2017)
HAP	150	1	Primary nanoparticles, rod-shaped	(Zhao et al., 2013)
HAP	200 x 20	1	Primary nanoparticles, long rods	(Pujari-Palmer et al., 2017)
HAP	230	1	Primary nanoparticles, needle-shaped	(Zhao et al., 2013)
PAN	221	1	La_2O_3 nanoparticle-doped PAN nanofibers[3]	(He et al., 2016)
PAN	400	2	Ag/PAN hybrid nanofibers[3]	(Shi et al., 2011)

[1] Forms and morphologies shown in TEM/AFM images
[2] The status of nanoparticles in the solution is dispersive
[3] Size distribution/particle characterization only available for certain forms of nanoparticles/nanofibers

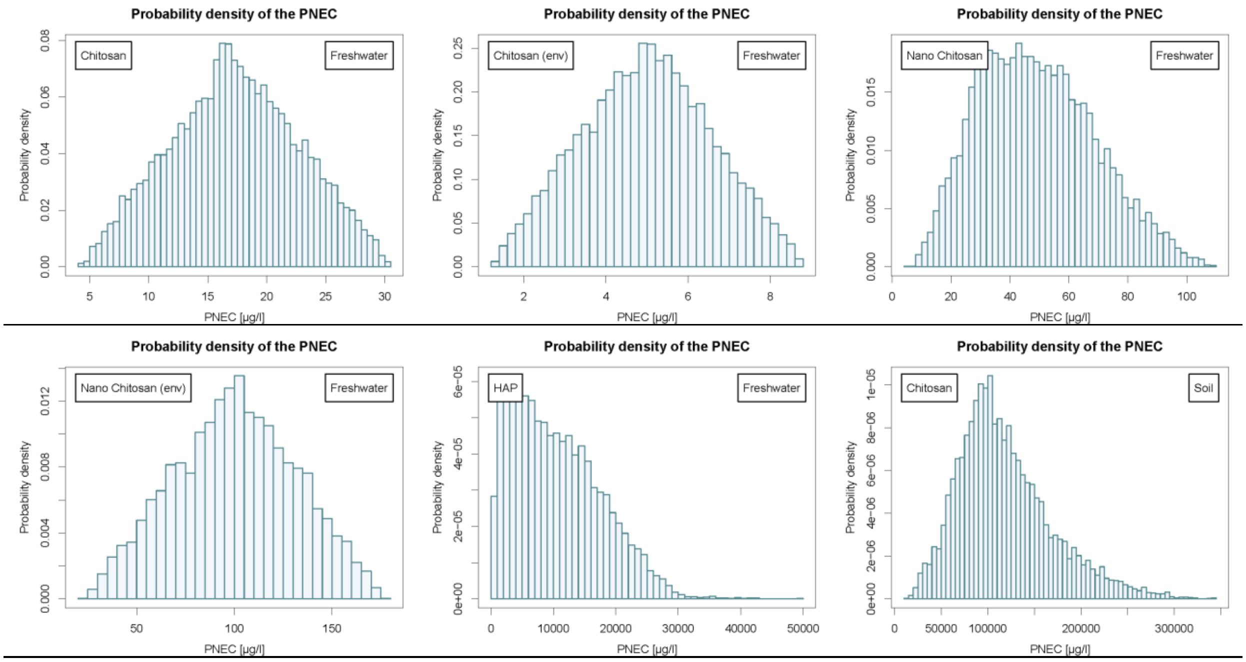

Figure S1: Predicted no-effect concentration (PNEC) distribution for chitosan, chitosan (env), nano chitosan, nano chitosan (env), HAP, and PAN

Table S8: Predicted no-effect concentrations (PNECs) of studied nanobiomaterials and other pollutants in freshwater

Material	*PNEC (ng/L)*	*Category*	*Reference*
Chitosan (env)	5,000	NanoBioMaterial	calculated
Nano Chitosan (env)	100,000	NanoBioMaterial	calculated
HAP	$1.1 * 10^{7}$	NanoBioMaterial	calculated
PAN	$3.0 * 10^{9}$	NanoBioMaterial	calculated
CNT	55,600	ENMs	(Coll et al., 2016)
Nano-TiO_2	15,700	ENMs	(Coll et al., 2016)
Fullerenes	3840	ENMs	(Coll et al., 2016)
Nano-ZnO	1000	ENMs	(Coll et al., 2016)
Nano-Ag	17	ENMs	(Coll et al., 2016)
Aspirin	61,000	Pharmaceuticals	(Jones et al., 2002)
Ibuprofen	9060	Pharmaceuticals	(Jones et al., 2002)
Estrogen	1060	Hormones	(Stuer-Lauridsen et al., 2000)
Doxycycline	300	Antibiotics	(Kümmerer & Henninger, 2003)
Amoxicillin	100	Antibiotics	(Kümmerer & Henninger, 2003)
Atrazine	100,000	Pesticides/POPs	(Sangchan et al., 2014)
Cu	50,000	Heavy metal	(Wang et al., 2010)
Triclosan	1550	Antimicrobial agent	(Capdevielle et al., 2008)
Pb & Cd	1000	Heavy metal	(Wang et al., 2010)
DBP	740	Plasticizer	(Slobodnik et al., 2012)
Hg	50	Heavy metal	(Wang et al., 2010)
Dichlorvos	1.9	Pesticides/POPs	(Sangchan et al., 2014)

Table S9: Median, mean, mode, minimum, maximum, 25th and 75th quantiles from predicted no-effect concentration (PNEC) distributions of chitosan in freshwater. All values in μg/l.

[μg/L]	*Chitosan*	*Nano-Chitosan*
Median	17	47
Mean	17	49
Mode	18	36
Min	4	8
25%	14	33
75%	21	62
Max	30	110

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