

Supplementary Table S1. Effects of pesticides to aquatic marine invertebrates.

Marine organism	Pesticide (class) ¹	Exposure		Toxic/Neurotoxic effects	Ref.
		Dose	Time (h) ²		
<u>Echinoderms</u>					
<i>H. pulcherrimus</i>	MCP (OP)	0.01, 0.1, 1 mg/L	24, 36, 48h	ACh, DA, 5-HT metabolism disruption	Zhang 2017
	MCP (OP)	0.01, 0.1, 1 mg/L	12-48h	HpNetrin/neogenin expression affected	Zhang 2017
	MCP (OP)	5, 10, 30 µg/mL	30, 36, 48, 53h	5-HT-hpr decreased expression, no serotonergic axons, swimming activity affected	Yao 2010
<i>S. purpuratus</i> , <i>S. drobachiensis</i> <i>L. variegatus</i> , <i>S. drobachiensis</i> , <i>S. granularis</i> , <i>D. excentricus</i> <i>P. lividus</i>	CPS (OP)	1-160 µM	20-30h	Generalized dismorphology	Buznikov 2001; Buznikov 2007
	CPS (OP)	10 ⁻⁴ to 10 ⁻⁸ M	24h	Signs of nerve damages	Amaroli 2013
	Basudin (OP) Diazinon (OP) Carbaryl (CA) Pirimicarb (CA)	10 ⁻³ to 10 ⁻⁷ M	Up to 30h	Strong AChE activity inhibition	Pesando 2003
<u>Molluscs</u>					
<i>R. philippinurum</i> <i>C. gigas</i>	DDVP (OP)	0.1, 1 mg/L	6h + 42h depuration	Adductor muscles paralysis	Le Bris 1995
<i>C. gigas</i>	DDVP (OP) Carbofuran (CA) Oxamyl (OP) Lindane (OC)	0.1-200 µM	96h	AChE activity inhibition Reduced AChE activity	Anguiano 2010
	Paraoxon (OP) DFP (OP) Eserine (CA) Carbaryl (CA) Carbofuran (CA)	1-2.5 µM	12 days	Slight decreased AChE activity	
	Paraoxon (OP) DFP (OP) Eserine (CA) Carbaryl (CA) Carbofuran (CA)	-	-	Soluble AChE insensitive to OC and CA pesticides	Bocquene 1997
<i>R. decussatus</i>	DDVP (OP)	0.05, 0.25 mg/L	2 days	Oxidative stress Reduced AChE activity	El Ayari 2020
<i>M. edulis</i>	DDVP (OP)	1-10000 µg/L gradient	24h	Increased mortality, reduced AChE activity	McHenry 1997
	AZ (OP)	0.1 mg/L	1h, 24h	Immune system affected, decreased AChE activity	Canty 2007
	Paraoxon (OP) DFP (OP) CPS (OP) Eserine (CA) CPS (OP) CPS (OP)	0.05-1 mM	24h	AChE activity inhibition	Galloway 2002
	CPS (OP) CPS (OP)	0.003-0.03 mg/L 0.4-30 mg/L	24, 48, 96h	Immunotoxic effects, decreased AChE activity	Rickwood and Galloway 2004
<i>Aplysia</i>	Paraoxon (OP)	5 mM	36h	Reduced neurite growth, neural death	Srivatsan 1999
<i>A. californica</i>	Paraoxon (OP)	5 mM	36h	Chlorid conductance inhibition	Filbert 1992
<i>A. juliana</i>	MP (OP)	1, 2 mg/L	7, 14 days	Reduced AChE activity, increased antioxidant enzymes activities	Chen 2014

<i>P. viridis</i>	ATZ (OC)	30-3000 ng/L	7 days	Immune functions alterations, hemolymph AChE activity inhibition	Juhel 2017
<u>Crustaceans</u>					
<i>H. gammarus</i>	DDVP (OP)	0.01-100 µg/L 0.1-50 µg/L	24h 6h	AChE activity inhibition	McHenery 1991 McHenery 1997
<i>H. nilssoni</i>	DDVP (OP)	5-320 µg/L	96h	Reduced AChE activity	Murison 1997
<i>L. vannamei</i>	Methamidophos (OP)	0.66-1.35 mg/L	24h	Eye ChE activity inhibition	Garcia-de la Parra 2005
	CPS (OP)	0.7, 1.3 µg/L	4 days	Antioxidant enzymes activities changes; AChE activity inhibition	Duarte-Restrepo 2008
<i>P. serratus</i>	CPS-oxon (OP) Malaoxon (OP) TRZ (OP) DDVP (OP) Paraoxone (OP) Serine sulphate (CA) Carbofuran (CA) Propoxur (CA) Carbaryl (CA) DDVP (OP)	various 0.057-0.452 µM	- 24h	Eye ChE enzyme responsiveness Mortality, ChE activity inhibition	Frasco 2006 Frasco 2008
	Fenitrothion (OP)	39-625 ng/L	96h	Swimming velocity alteration, AChE activity inhibition	Oliveira 2013
	Deltamethrin (PR)	0.6-313 ng/L	96h	Antioxidant enzymes activities changes, Eye AChE activity increase	Oliveira 2012
<i>H. americanus</i>	AZ (OP)	61 ng/L	10 days	Stress/hypoxia changes, oxidative damage, ChE activity inhibition	Couillard 2015
<i>L. salmonis</i>	AZ (OP)	various	-	AChE activity inhibition	Fallang 2004
<i>A. franciscana</i>	CPS (OP)	0.1, 1, 5 µg/L	various days	AChE activity inhibition	Varò 2015
<i>A. parthenogenetica</i>	CPS (OP)	10 ⁻¹¹ to 10 ⁻⁵ M	72, 96, 192h	Larval survival changes, decreased ChE activity	Gambarella 2018
<i>A. salina</i>	Diazinon (OP) Carbaryl (CA)				
<i>T. japonicas</i>	CPS (OP) Lindane (OC)	various	24h	AChE activity inhibition	Lee 2105
<i>P. monodon</i>	Deltamethrin (PR)	0.1 µg/L	4 days	Oxidative stress changes, AChE activity reduction	Thi Tu 2012

¹ Pesticides class: OC, organochlorine; OP, organophosphate; CA, carbamate; PR, pyrethroid.

² hours of exposure.

5-HT-hpr, serotonin receptor; ACh, acetylcholine; DA, dopamine; 5-HT, serotonin.

ATZ, atrazine; AZ, azamethiphos; CPS, chlorpyrifos; DDVP, dichlorvos; DFP, diisopropylfluorophosphate; MCP, monocrotophos; MP, methyl parathion; TRZ, triazophos-oxon.

Supplementary Table S2. Effects of microplastics (MPs) to aquatic marine invertebrates.

Marine organism	MP type and size	Exposure		Toxic effects	Neurotoxic effects	Ref.
		Dose	Method and Time (h) ¹			
<u>Molluscs</u>						
<i>Mytilus galloprovincialis</i>	PE and PS (100 µm)	1.5 g/L +/- 50 µg/L of PYR	Water 7 days	Primary MP accumulation in DG MP presence in G and H DNA damage No oxidative stress Alteration in gene expression (immunity, lysosomal metabolism)	Reduced AChE activity in G, no in H	Avio 2015
	PS (0,11 µm)	0.005, 0.05, 0.5, 5 and 50 mg/L 6.3 µg/L Cbz; PS + Cbz (0.05 mg/L + 6.3 g/L)	Water 96h	Alteration in gene expression in G (biotransformation and innate immunity) and in DG (cell stress) DNA damage	Reduced ChE activity in H	Brandts 2018
<i>Scrobicularia plana</i>	PS (20 µm)	1 mg/L	Water, 21 days (14 days exposure + 7 days of depuration)	Primary MP accumulation in G MP presence also in and DG Oxidative stress in DG Increase of antioxidant capacity in G	Reduced AChE activity in G	Ribeiro 2017
	LDPE (11–13 µm)	1 mg /L +/- 82 ng/g BP-3	Water-sediment, 14 days	Oxidative stress in DG (only LDPE+BP3) Oxidative stress and increase of antioxidant activities in G	No AChE activity inhibition in G	O'Donovan 2020
<i>Donax trunculus</i>	Mixture PP/PE, ratio 1:1 (100-400 nm)	0.06 g/Kg	Sand 15 days	Primary MP accumulation in G No MP presence in F Oxidative stress	Reduced AChE activity in G and DG, no in F	Tlili 2020
<i>C. Fluminea</i>	PS-NP fl (80 nm)	0.1, 1 and 5 mg/L	Water 96h	Primary MP accumulation in G and in VM Oxidative stress and increase of antioxidant activities Intestinal inflammation	Reduced AChE activity In VM, no in G	Li 2020
<i>Tegillarca granosa</i>	PS-MP (490 ± 11 nm)	1 mg /L +/- 10 and 100 ng/L BPA	Water 14 days	Changes in the hematic parameters Immunotoxicity	Increase of neurotransmitters (GABA, DA, ACh)	Yu Tang 2020

Crustaceans

<i>A. Amphitrite (shrimp)</i> <i>A. fransiscana (larvae)</i>	PS (0.1 µm)	0.001, 0.01, 0.1, 1, 10 mg/L	Water 24 and 48h	MP accumulation in intestine Swimming alteration Oxidative stress	Partial AChE and PChE activity inhibition	Gambardella 2017
<i>A. fransiscana (shrimp)</i>	PS-NH ₂ (50 nm)	0.1-10mg/L	Water 48h and 14 days	Alteration in growth and development (48h) Mortality (14 days) Oxidative stress Alteration in gene expression (cell <u>stress, development and molting</u>)	Reduced AChE activity	Varò 2019

¹ hours of exposure.

Invertebrate tissues: DG, digestive gland; F, flesh; G, gills; H, hemolymph; VM, visceral mass.

ACh, acetylcholine; Cbz, carbamazepine; BP-3, oxybenzone; BPA, bisphenol A; DA, dopamine; GABA, g-aminobutyric acid; LDPE, low-density polyethylene; NP fl, fluorescent nanoparticles; PE, Polyethylene; PP, polypropylene; PS, polystyrene; PS-NH₂, amino-modified polystyrene; PYR, pyrene.