

**Assessment of oxidative stress, genotoxicity and
histopathological responses in the digestive gland of
Ruditapes decussatus collected from
northern Tunisian lagoons**

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Supplementary material

Table S1. – Mean (\pm SD) environment parameters recorded during four seasons in the three Tunisian lagoons: Ghar el Melh (LCA), the North Lake (MCA) and the South Lake (HCA). Values are presented as mean \pm SD (n=3 repetitions). Significant differences are determined at 0.05 using two-way ANOVA: *p<0.05, **p<0.01; ***p<0.001.

		Temperature (°C)	Salinity (psu)	pH	Suspended matter (mg/L)	Chlorophyll <i>a</i> (µg/L)
Spring	LCA	28.51 \pm 2.50	37.62 \pm 1.15	8.11 \pm 0.43	175.27 \pm 15.51	2.04 \pm 0.30
	MCA	27.92 \pm 1.63	37.60 \pm 0.68	8.13 \pm 0.11	182.18 \pm 12.31**	1.91 \pm 0.28***
	HCA	29.34 \pm 2.41***	37.61 \pm 1.55	8.10 \pm 0.58	211.35 \pm 10.96***	1.87 \pm 0.24***
Summer	LCA	29.47 \pm 1.86	38.50 \pm 2.38	8.12 \pm 0.69	132.25 \pm 14.63***	1.58 \pm 0.11***
	MCA	30.21 \pm 4.28***	39.26 \pm 2.12	8.09 \pm 0.21	148.00 \pm 12.47***	1.56 \pm 0.18***
	HCA	31.10 \pm 1.76***	39.74 \pm 1.72	8.11 \pm 0.46	150.30 \pm 10.96**	1.43 \pm 0.16***
Autumn	LCA	22.30 \pm 1.31***	36.87 \pm 0.52	8.15 \pm 0.20	123.59 \pm 20.56***	1.39 \pm 0.15***
	MCA	23.19 \pm 1.67***	37.41 \pm 1.77	8.12 \pm 0.30	137.45 \pm 10.34***	1.27 \pm 0.31***
	HCA	22.85 \pm 2.53***	37.16 \pm 1.85	8.20 \pm 0.15	132.26 \pm 9.42***	1.00 \pm 0.27***
Winter	LCA	20.42 \pm 2.71***	35.27 \pm 2.72	8.13 \pm 0.69	120.20 \pm 7.11***	1.12 \pm 0.36***
	MCA	19.20 \pm 1.44***	34.72 \pm 1.92	8.11 \pm 0.24	142.34 \pm 12.56***	1.00 \pm 0.19***
	HCA	19.33 \pm 2.92***	35.05 \pm 2.04	8.15 \pm 0.70	141.73 \pm 5.70***	1.26 \pm 0.33***

Table S2. – Mean (\pm SD) weight (W), length (L), condition (CI) and gonad (GI) indices of *R. decussatus* from Tunisian lagoons: Ghar el Melh (LCA), the North Lake (MCA) and the South Lake (HCA). Values are expressed as means \pm SD (n=40 replications). Significant differences are determined at 0.05 using two-way ANOVA: *p<0.05, **p<0.01; ***p<0.001.

		W (g)	L (cm)	CI	GI
Spring	LCA	41.96 \pm 3.02	12.80 \pm 2.23	23.22 \pm 1.06	8.70 \pm 0.22
	MCA	42.47 \pm 2.18	13.68 \pm 2.46	20.05 \pm 2.10**	7.85 \pm 0.61**
	HCA	40.42 \pm 4.34	11.22 \pm 4.16	17.00 \pm 1.04**	7.57 \pm 1.08**
Summer	LCA	44.05 \pm 3.18	13.44 \pm 2.34	18.34 \pm 1.08*	5.21 \pm 0.83
	MCA	44.59 \pm 2.29	14.37 \pm 2.59	15.38 \pm 2.30***	3.29 \pm 0.38***
	HCA	42.45 \pm 4.56	13.78 \pm 4.37	12.47 \pm 1.24***	3.00 \pm 0.44***
Autumn	LCA	42.70 \pm 3.96	13.98 \pm 2.85	20.55 \pm 2.26	6.33 \pm 0.82**
	MCA	40.49 \pm 2.76	14.61 \pm 2.48	16.93 \pm 2.45**	6.78 \pm 0.74***
	HCA	41.66 \pm 3.63	14.93 \pm 2.84	15.58 \pm 1.41***	5.90 \pm 0.96***
Winter	LCA	42.22 \pm 2.42	13.50 \pm 2.68	22.63 \pm 3.51*	7.54 \pm 0.34**
	MCA	40.67 \pm 2.47	13.66 \pm 3.32	20.93 \pm 2.73	6.97 \pm 0.66*
	HCA	40.78 \pm 3.08	13.26 \pm 2.21	15.90 \pm 2.33**	6.70 \pm 1.02*

Table S3. – Levels of trace elements in the water column and sediments of Tunisian lagoons: Ghar el Melh (LCA), the North Lake (MCA) and the South Lake (HCA).

		Pb	Cu	Cd	Zn	Fe	References
LCA	Water (nmol/l)	2-3500	4-1600	2-1000	3-9000	-	Oueslati et al. (2014)
	Sediments (mg/g)	8.82	3.32	50.31	6.01	2.14	Oueslati et al. (2017)
MCA	Water	-	-	-	-	-	-
	Sediments (mg/kg)	18.7-98.8	7.28-89.30	0.07-0.67	75-249	25.73-47.92	Ennouri et al. (2010)
HCA	Water	-	-	-	-	-	-
	Sediments (µg/g)	170-239	11-19	0.78-0.96	341-432	-	Chalghmi et al. (2016)

Table S4. – Correlation matrix of non-parametric Spearman's rank correlation coefficients between *R. decussatus* biomarkers, trace element digestive gland tissue levels (Cd, Pb, Cu, Zn, and Fe) and environmental parameters measured in this study. AChE, acetylcholinesterase; CAT, catalase; AOPP, advanced oxidation proteins products; GPx, glutathione peroxidase; GSH, glutathione; NPSH, non-protein SH; MDA, malondialdehyde; Vit C, vitamin C; MTs, metallothionins; T, temperature; S, salinity; pH, hydrogen potential; SPM, suspended matter; Ch *a*, Chlorophyll *a*. The positive and significant correlation is presented in red and the negative and significant correlation is presented in green.

	T°C	Spus	pH	MES	Ch <i>a</i>	Cd	Pb	Cu	Zn	Fe
CI	0.635	0.632	ns	0.854	-0.243	0.934	0.646	0.645	0.432	0.835
GI	0.579	0.631	ns	0.801	-0.429	0.756	0.801	0.596	0.863	0.905
AChE	ns	ns	-0.307	-0.241	0.220	-0.533	-0.499	-0.541	-0.780	-0.596
CAT	0.405	0.444	ns	0.601	-0.171	0.657	0.455	0.780	0.804	0.587
AOPP	0.340	0.444	ns	0.564	-0.302	0.752	0.564	0.767	0.801	0.700
GPx	Ns	0.225	ns	ns	-0.309	0.531	0.421	0.236	0.264	0.406
GSH	0.340	0.451	ns	0.549	-0.309	0.754	0.561	0.756	0.799	0.703
NPSH	0.319	0.401	ns	0.482	-0.333	0.754	0.606	0.620	0.639	0.660
MDA	0.310	0.406	ns	0.519	-0.342	0.771	0.598	0.733	0.763	0.726
Vit C	0.345	0.382	ns	0.427	-0.192	0.373	0.338	0.682	0.702	0.460
MTs	0.428	0.499	ns	0.413	-0.535	0.562	0.733	0.853	0.806	0.813
DNA	0.657	ns	ns	0.545	ns	0.405	0.375	0.603	0.345	0.426
T°C	ns	ns	ns	ns	ns	ns	ns	0.603	ns	ns
Spus	ns	ns	ns	ns	ns	ns	ns	0.630	0.239	ns
pH	ns	ns	ns	ns	ns	ns	0.241	ns	ns	0.374
MES	ns	ns	ns	ns	ns	0.404	ns	0.539	0.280	ns
Cha	ns	ns	ns	ns	ns	ns	-0.735	-0.370	-0.353	-0.716