Supplementary data for the article:

Ilijević, K.; Vujanović, D.; Orčić, S.; Purać, J.; Kojić, D.; Zarić, N.; Gržetić, I.; Blagojević, D. P.; Čelić, T. V. Anthropogenic Influence on Seasonal and Spatial Variation in Bioelements and Non-Essential Elements in Honeybees and Their Hemolymph. *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology* **2021**, *239*, 108852. https://doi.org/10.1016/j.cbpc.2020.108852.

Table S1. Results of two way ANOVA used for evaluating the effect of different location (rural , urban and industrial region) and season (winter, spring and summer) on the concentration of the elements in bee homogenate.

	Effect	Df	MS	F	p
Ca	**L**	2	72232	14.061	**<0.001**
	S	2	433695	84.427	**<0.001**
	L x S	4	90181	17.555	**<0.001**
	Error	18	5137		
K	**L**	0			
	S	1	1311699	88.48307	**<0.001**
	L x S	2	396204	26.72664	**<0.001**
	Error	12	14824		
Mg	**L**	2	4537	1.023	**NS**
	S	2	105128	23.694	**<0.001**
	L x S	4	46895	10.569	**<0.001**
	Error	18	4437		
Na	**L**	2	7696	3.9693	**<0.05**
	S	2	156096	80.5038	**<0.001**
	L x S	4	7437	3.8353	**<0.05**
	Error	18	1939		
Cu	**L**	2	131.747	37.627	**<0.001**
	S	2	218.271	62.338	**<0.001**
	L x S	4	60.552	17.293	**<0.001**
	Error	18	3.501		
Fe	**L**	2	8087.4	87.426	**<0.001**
	S	2	6999.1	75.661	**<0.001**
	L x S	4	2265.0	24.484	**<0.001**
	Error	18	92.5		
Mn	**L**	2	4977.9	9.3504	**<0.01**
	S	2	1279.0	2.4025	**NS**
	L x S	4	8818.8	16.5651	**<0.001**
	Error	18	532.4		
Zn	**L**	2	367.4	1.1067	**NS**
	S	2	2099.8	6.3256	**<0.01**
	L x S	4	2874.8	8.6600	**<0.001**
	Error	18	332.0		

	Effect	Df	MS	F	p
Al	**L**	2	485.36	5.5928	**<0.05**
	S	2	2346.51	27.0387	**<0.001**
	L x S	4	1303.78	15.0234	**<0.001**
	Error	18	86.78		
Ba	**L**	2	6.3725	22.398	**<0.001**
	S	2	27.0862	95.204	**<0.001**
	L x S	4	4.0387	14.195	**<0.001**
	Error	18	0.2845		
Cd	**L**	2	4.63913	31.0113	**<0.001**
	S	2	2.27648	15.2177	**<0.001**
	L x S	4	4.51910	30.2090	**<0.001**
	Error	18	0.14959		
Co	**L**	1	0.084347	57.76673	**<0.001**
	S	1	0.019275	13.20101	**<0.01**
	L x S	3	0.046851	32.08691	**<0.001**
	Error	14	0.001460		
Ni	**L**	2	0.293716	29.1322	**<0.001**
	S	2	0.129176	12.8123	**<0.001**
	L x S	4	0.113495	11.2570	**<0.001**
	Error	18	0.010082		
Pb	**L**	1	1791.291	154.4121	**<0.001**
	S	0			
	L x S	2	60.705	5.2329	**<0.05**
	Error	14	11.601		
Sr	**L**	2	32.8669	847.235	**<0.001**
	S	2	11.9800	308.818	**<0.001**
	L x S	4	12.1686	313.678	**<0.001**
	Error	18	0.0388		

Significant difference was estimated with $p < 0.05$, $p < 0.01$ and $p < 0.001$ confidence intervals.
L location, S season, dF degree of freedom, MS mean square, F factor, NS not significant.

Table S2. Mean, minimum, maximum (mg kg^{-1} d.m.) and standard deviation for values of elements concentration in bee homogenate from three seasons (winter, spring and summer) in rural region (Golija).

		Golija											
		Winter				Spring				Summer			
		Mean	Min	Max	St.dev.	Mean	Min	Max	St.dev.	Mean	Min	Max	St.dev.
Macroel.	Ca	**409.743**	406.018	414.290	4.19692	**716.296**	641.866	816.524	90.1414	**906.5915**	880.3703	937.3155	28.73839
	K	**2536.920**	2481.082	2570.019	48.63342	**2296.653**	2049.539	2480.270	222.2747	**>OR**			
	Mg	**565.302**	552.418	576.976	12.32367	**635.524**	556.731	708.304	75.9652	**917.0028**	915.6168	918.3887	1.38592
	Na	**190.275**	182.682	202.543	10.72414	**75.372**	75.163	75.581	0.2088	**336.3299**	288.4175	367.8652	42.17989
Microel.	Cu	**19.927**	19.619	20.088	0.26635	**10.909**	9.363	11.891	1.3547	**19.6714**	18.5614	21.2327	1.39167
	Fe	**58.506**	55.506	62.302	3.46694	**72.553**	61.918	80.115	9.4795	**117.5616**	100.8221	141.0897	20.97458
	Mn	**56.055**	50.064	60.788	5.47161	**114.029**	83.861	139.014	27.9392	**91.6971**	67.5224	131.0218	34.35378
	Zn	**68.625**	66.355	72.180	3.11728	**92.666**	69.515	113.897	22.2529	**81.1246**	74.5900	87.2969	6.36121
Non-essential elements	Al	**4.174**	4.150	4.199	0.02437	**19.255**	19.204	19.307	0.0515	**46.5840**	21.2956	69.8429	24.33719
	Ba	**1.506**	1.419	1.578	0.08025	**4.432**	3.415	5.122	0.8996	**5.6472**	5.1760	6.3241	0.60106
	Cd	**0.080**	0.079	0.080	0.00053	**1.285**	0.968	1.472	0.2761	**0.4194**	0.4032	0.4355	0.01618
	Co	**0.109**	0.100	0.116	0.00841	**0.396**	0.345	0.433	0.0458	**0.3662**	0.3230	0.4363	0.06125
	Cr	**<DL**				**0.173**	0.155	0.192	0.0184	**0.2241**	0.2127	0.2330	0.01036
	Ni	**0.679**	0.644	0.706	0.03163	**0.290**	0.259	0.339	0.0426	**0.7563**	0.6752	0.8523	0.08949
	Pb	**<DL**				**<DL**				**0.4180**	0.2558	0.5718	0.15818
	Sr	**0.934**	0.934	0.934	0.00016	**7.703**	7.601	7.805	0.1019	**4.9003**	4.8731	4.9274	0.02717

OR operating range; DL detection limit.

Table S3. Mean, minimum, maximum (mg kg^{-1} d.m.) and standard deviation for values of elements concentration in bee homogenate from three seasons (winter, spring and summer) in urban region (Belgrade).

		Belgrade											
		Winter				**Spring**				**Summer**			
		Mean	**Min**	**Max**	**St.dev.**	**Mean**	**Min**	**Max**	**St.dev.**	**Mean**	**Min**	**Max**	**St.dev.**
Macroel.	**Ca**	**457.106**	456.757	457.454	0.3485	**744.803**	702.304	780.276	39.45811	**773.4636**	766.0114	780.916	7.4522
	K	**3037.368**	2925.180	3223.059	161.9723	**2791.280**	2773.473	2809.087	17.80705	**>OR**			
	Mg	**574.073**	573.122	575.025	0.9516	**716.140**	660.255	792.945	68.77461	**845.5851**	711.8265	1035.735	169.1572
	Na	**159.649**	154.690	165.432	5.4179	**136.281**	119.292	158.157	19.88784	**429.1168**	415.6345	447.417	16.4298
Microel.	**Cu**	**22.499**	21.976	22.814	0.4561	**16.958**	15.532	18.534	1.50670	**30.3131**	24.8657	34.570	4.9605
	Fe	**77.788**	75.328	80.197	2.4350	**140.797**	139.430	142.164	1.36696	**165.6037**	152.3051	184.254	16.6331
	Mn	**30.439**	30.368	30.510	0.0711	**50.132**	46.521	53.253	3.39250	**49.5810**	44.8736	54.466	4.7988
	Zn	**94.209**	85.215	103.592	9.1945	**87.614**	76.545	96.754	10.24180	**76.6605**	70.6630	80.600	5.2785
Non-essential elements	**Al**	**11.336**	11.317	11.356	0.0193	**64.622**	49.308	73.908	13.36197	**22.8865**	19.9408	25.832	2.9457
	Ba	**0.979**	0.940	1.009	0.0353	**2.170**	1.634	2.559	0.47980	**3.7610**	3.1814	4.532	0.6954
	Cd	**0.188**	0.175	0.198	0.0119	**0.166**	0.148	0.180	0.01616	**0.1644**	0.1533	0.174	0.0104
	Co	**0.091**	0.091	0.091		**0.120**	0.098	0.134	0.01906	**0.1865**	0.1712	0.199	0.0143
	Cr	**<DL**				**0.242**	0.242	0.242		**0.2381**	0.2009	0.280	0.0400
	Ni	**0.442**	0.425	0.463	0.0195	**0.786**	0.660	0.861	0.10926	**0.8459**	0.6524	1.079	0.2162
	Pb	**0.270**	0.202	0.314	0.0593	**0.552**	0.443	0.713	0.14242	**0.4550**	0.3875	0.540	0.0777
	Sr	**0.669**	0.666	0.671	0.0025	**0.920**	0.807	0.978	0.09828	**1.7589**	1.7475	1.770	0.0114

OR operating range; DL detection limit.

Table S4. Mean, minimum, maximum (mg kg^{-1} d.m.) and standard deviation for values of elements concentration in bee homogenate from three seasons (winter, spring and summer) in industrial region (Zajača).

		Zajača											
		Winter				**Spring**				**Summer**			
		Mean	**Min**	**Max**	**St.dev.**	**Mean**	**Min**	**Max**	**St.dev.**	**Mean**	**Min**	**Max**	**St.dev.**
Macroel.	**Ca**	**715.362**	710.865	719.860	4.49752	**555.345**	525.772	580.248	27.53662	**1196.150**	1070.071	1410.682	186.7403
	K	**3318.612**	3226.253	3410.971	92.35910	**2185.277**	2139.383	2230.863	45.74048	**4899.690**	4899.690	4899.690	0.0000
	Mg	**767.667**	755.030	780.305	12.63744	**543.503**	520.458	555.466	19.96200	**700.014**	689.795	710.233	10.2194
	Na	**281.778**	227.155	371.632	78.41735	**131.228**	124.602	140.714	8.42812	**358.809**	296.811	465.695	92.9600
Microel.	**Cu**	**23.792**	23.647	23.937	0.14506	**11.662**	10.818	12.231	0.74599	**13.870**	13.783	13.957	0.0865
	Fe	**81.753**	80.910	82.596	0.84269	**38.567**	36.760	40.989	2.18021	**93.721**	92.818	94.624	0.9029
	Mn	**164.202**	121.794	223.000	52.55634	**35.175**	33.845	37.445	1.97555	**40.625**	40.494	40.756	0.1307
	Zn	**149.856**	119.401	202.490	45.76971	**61.647**	61.535	61.759	0.11215	**69.087**	56.341	78.328	11.4050
Non-essential elements	**Al**	**4.261**	4.211	4.311	0.04983	**9.817**	9.383	10.428	0.54437	**41.495**	40.387	42.603	1.1083
	Ba	**3.002**	2.996	3.008	0.00598	**1.724**	1.530	1.902	0.18614	**6.171**	5.322	6.901	0.7961
	Cd	**3.692**	2.780	4.945	1.12212	**0.633**	0.604	0.649	0.02575	**0.392**	0.292	0.487	0.0977
	Co	**0.196**	0.136	0.256	0.06010	**<DL**				**0.070**	0.058	0.079	0.0110
	Cr	**<DL**				**<DL**				**0.227**	0.175	0.314	0.0755
	Ni	**0.232**	0.147	0.343	0.10069	**0.366**	0.352	0.376	0.01273	**0.412**	0.326	0.526	0.1028
	Pb	**17.497**	17.436	17.558	0.06103	**15.958**	11.634	18.831	3.81128	**27.677**	21.387	36.900	8.1621
	Sr	**1.371**	1.021	1.891	0.45872	**0.802**	0.734	0.866	0.06646	**1.716**	1.343	1.998	0.3367

DL detection limit.

Table S5. Range and average concentrations (mg kg^{-1}) of metals in bodies of adult honeybees reported in this study and in the literature.

Element	Current study (range and average concentrations)	Earlier studies (range and average concentrations)	
Ca	406.02 - 1410.68 (719.43)	630 – 1466 (1047)	Zarić et al., 2017
		660 – 1838 (1167)	Zarić et al., 2018b
K	2049.54 – 4899.69 (2796.63)	-	-
Mg	520.46 – 1035.74 (696.09)	664 – 1088 (932)	Zarić et al., 2017
		590 – 1312 (979)	Zarić et al., 2018b
Na	75.16 – 465.69 (233.20)	216 – 687 (426)	Zarić et al., 2016
		216 – 630 (415)	Zarić et al., 2018b
		383 – 795 (535)	Zarić et al., 2017
Cu	9.36 – 34.57 (18.85)	11.8 – 29.2 (21.0)	Zarić et al., 2016
		15.6 – 32.0 (21.6)	Zarić et al., 2017
		11.8 – 29.2 (19.1)	Zarić et al., 2018b
		11.65 – 19.77 (-)	van der Steen et al., 2012
		19.5 – 25.5 (-)	Roman, 2010
		13 – 27 (-)	Fakhimzadeh and Lodenius, 2000
		15.6 – 37.68 (-)	Veleminsky et al., 1990
		2.00 – 39.11	Davodpour et al., 2019
Fe	36.76 – 184.25 (94.09)	101 - 421 (188)	Zarić et al., 2016
		90 – 211 (130)	Zarić et al., 2017
		77 – 227 (145)	Zarić et al., 2018b
		73 – 336 (-)	Al Naggar et al., 2013
		163 – 1695 (-)	Davodpour et al., 2019
Mn	30.37 – 223.00 (70.21)	34 – 90 (54)	Zarić et al., 2016
		29.0 – 62 (41)	Zarić et al., 2017
		21 – 78 (48)	Zarić et al., 2018b
		20.69 – 68.78 (-)	van der Steen et al., 2012
		- (75.7)	Kump et al., 1996
Zn	56.34 – 202.49 (86.83)	65 – 156 (100)	Zarić et al., 2016
		74 – 151.1 (103)	Zarić et al., 2017
		59 – 179 (99)	Zarić et al., 2018b
		61.14 – 100.46 (-)	van der Steen et al., 2012
		13.80 – 77.95 (-)	Al Naggar et al., 2013
		55 – 100 (-)	Fakhimzadeh and Lodenius, 2000
		90.34 – 204.4 (-)	Veleminsky et al., 1990
		52.5 – 76.2 (-)	Leita et al., 1996
Al	4.15 – 73.91 (24.94)	6.8 – 327 (60)	Zarić et al., 2016
		8.4 – 104 (35)	Zarić et al., 2017
		7 – 146 (36)	Zarić et al., 2018b
		4.6 – 15.52 (-)	van der Steen et al., 2012
Ba	0.94 – 6.90 (3.26)	0.54 – 3.97 (2.00)	Zarić et al., 2016

		0.46 – 3.21 (1.29)	Zarić et al., 2017
		2.00 – 3.925 (-)	Sadeghi et al., 2012
Cd	0.08 – 4.95 (0.78)	0.0046 – 0.33 (0.16)	Zarić et al., 2016
		0.0057 – 0.312 (0.14)	Zarić et al., 2017
		0.03 – 0.260 (0.125)	Zarić et al., 2018b
		0.07 – 1.60 (-)	Al Naggar et al., 2013
		0.05 – 0.75 (-)	van der Steen et al., 2012
		0.03 – 1.2 (-)	Fakhimzadeh and Lodenius, 2000
		0.16 – 1.75 (-)	Veleminsky et al., 1990
		0.39 – 1.04 (-)	Roman, 2010
		0.089 – 0.195 (0.084)	Costa et al., 2019
		0.01 – 2.35 (-)	Davodpour et al., 2019
Co	0.06 – 0.44 (0.19)	0.076 – 0.26 (0.14)	Zarić et al., 2016
		0.062 – 0.240 (0.11)	Zarić et al., 2017
		0.022 – 0.221 (0.104)	Zarić et al., 2018b
		0.08 – 0.33 (-)	van der Steen et al., 2012
Cr	0.15 – 0.31 (0.22)	0.066 – 1.07 (0.22)	Zarić et al., 2016
		0.052 – 0.61 (0.18)	Zarić et al., 2017
		0.045 – 0.333 (0.144)	Zarić et al., 2018b
		0.15 – 0.28 (-)	van der Steen et al., 2012
		0.05 – 0.23 (-)	Roman, 2005
		0.06 – 0.8 (-)	Kalnins and Detroy, 1984
		0.02 – 18.10 (-)	Davodpour et al., 2019
Ni	0.15 – 1.08 (0.53)	0.25 -2.16 (1.02)	Zarić et al., 2016
		0.21 – 1.03 (0.48)	Zarić et al., 2017
		0.12 – 1.88 (0.74)	Zarić et al., 2018b
		0.19 – 0.47 (-)	van der Steen et al., 2012
		0.12 – 0.43 (-)	Porrini et al., 2002
		0.27 – 0.50 (-)	Roman, 2005
Pb	0.20 – 36.90 (7.08)	<DL – 0.97 (0.31)	Zarić et al., 2016
		0.53 – 4.0 (-)	Zarić et al., 2018a
		0.19 – 1.26 (-)	van der Steen et al., 2012
		2.32 – 11.23 (-)	Al Naggar et al., 2013
		1.08 – 3.11 (-)	Roman, 2010
		0.004 – 1.175 (-)	Lambert et al., 2012
		0.18 – 1.34 (-)	Perugini et al., 2011
Sr	0.67 – 7.80 (2.31)	1.17 – 3.55 (2.20)	Zarić et al., 2016
		0.674 – 4.77 (2.6)	Zarić et al., 2017
		0.79 – 3.71 (1.99)	Zarić et al., 2018b
		0.86 – 2.99	van der Steen et al., 2012