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Article

Assessment and Mitigation of Heavy Metals Uptake by Edible Vegetables Grown in a Turin Contaminated Soil Used as Vegetable Garden

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Supplementary materials

Table S1. Summary of multiple comparisons for pairs of plants weights and morphometric parameters with Tukey test. NOB= plants grown in Nobile soil, CA= plants grown in Campana soil, AM = addition of amendment to the soil, *Ls=Lactuca sativa, Bo= Brassica oleracea*. Letter B identifies weights and parameters whose means are significantly lower than the ones obtained for weights and parameters identified by letter A; the same concept applies to letter C with respect to letter B, letter D with respect to letter C and letter E with respect to letter D.

Soil	Group	Parameter
NOB*Ls*AM	A	Aerial part fresh weight (g)
NOB*Bo*AM	B	
CA*Ls*AM	C	
CA*Bo*AM	C D	
NOB*Ls*	DE	
NOB*Bo*, CA*Ls*, CA*Bo*	E	
NOB*Ls*AM	A	Root fresh weight (g)
CA*Ls*AM	A B	
NOB*Bo*AM, CA*Bo*AM, NOB*Ls*	B C	
CA*Ls*, NOB*Bo*, CA*Bo*	C	
CA*Ls*, CA*Bo*	A	Root fresh weight/ aerial part fresh weight (g)
NOB*Ls*, NOB*Bo*, CA*Ls*AM, CA*Bo*AM	A B	
NOB*Bo*AM, NOB*Ls*AM	B	
NOB*Bo*	A	Aerial part dry weight/ aerial part fresh weight (g)
NOB*Bo*AM	B	
CA*Bo*	B C	
CA*Bo*AM	B C D	
CA*Ls*	C D E	
NOB*Ls*	D E	
CA*Ls*AM, NOB*Ls*AM	E	

NOB*Ls*AM, CA*Ls*AM	A	Stem diameter (mm)
NOB*Ls*, CA*Ls*, NOB*Bo*AM, CA*Bo*AM	B	
NOB*Bo*, CA*Bo*	C	
NOB*Ls*AM, CA*Ls*AM	A	Leaves number
NOB*Ls*, CA*Ls*	B	
CA*Bo*AM, NOB*Bo*AM	B C	
NOB*Bo*	CD	
CA*Bo*	D	
NOB*Bo*AM	A	Leaf area (cm^2)
NOB*Ls*AM	B	
CA*Ls*AM, CA*Bo*AM	C	
NOB*Ls*, NOB*Bo*	D	
CA*Ls*	D E	
CA*Bo*	E	

Table S2. Elements concentration [mg kg^{-1} dry weight] ± SD in *L. sativa* aerial part. NOB= plants grown in Nobile soil, CA= plants grown in Campana soil, AM = amendment.

	NOB without AM	**NOB with AM**	**CA without AM**	**CA with AM**
Al	29 ± 1	18 ± 1	276 ± 23	72 ± 3
As	0.016 ± 0.002	0.0967 ± $1\ 10^{-4}$	0.29 ± 0.03*	0.29 ± 0.03**
Ba	3.5 ± 0.1	5.85 ± 0.06	63.5 ± 0.3	37.93 ± 0.03
Ca	9122 ± 123	8251 ± 22	22971 ± 481	20925 ± 487
Cd	0.166 ± 0.005	0.073 ± 0.001	0.18 ± 0.01*	0.088 ± 0.003**
Co	0.050 ± 0.003	0.031 ± 0.001	0.22 ± 0.01	0.083 ± 0.008
Cr	0.193 ± 0.006	0.11 ± 0.01	1.7 ± 0.2	1.0 ± 0.1
Cu	3.2 ± 0.2	1.57 ± 0.02	3.5 ± 0.5	1.68 ± 0.04
Fe	45.7 ± 0.7	54.6 ± 2	312 ± 10	121 ± 9
K	29313 ± 427	59220 ± 789	18185 ± 170	57041 ± 1772
Mg	1520 ± 13	1758 ± 22	1885 ± 26	2993 ± 343
Mn	23.1 ± 0.1	26.8 ± 0.2	41 ± 1	50 ± 2
Na	204 ± 3	5051 ± 129	280 ± 8	7823 ± 527
Ni	0.88 ± 0.02	0.144 ± 0.009	1.9 ± 0.2	0.55 ± 0.03
P	1453 ± 23	3097 ± 37	2586 ± 25	2546 ± 154
Pb	0.105 ± 0.002	0.050 ± 0.001	2.3 ± 0.1	0.65 ± 0.04
Sr	11.7 ± 0.2	13.3 ± 0.3	53.8 ± 0.4	39 ± 1
Ti	3.43 ± 0.09	0.44 ± 0.06	8 ± 2	2.12 ± 0.03
V	0.054 ± 0.002	0.033 ± 0.001	0.6 ± 0.1	0.16 ± 0.02
Zn	21.3 ± 0.2	19.5 ± 0.3	36 ± 1	34.3 ± 0.4

* [As] (mg kg^{-1} fresh weight) = 0.040 ± 0.009, [Cd] (mg kg^{-1} fresh weight) = 0.025 ± 0.005.

** [As] (mg kg^{-1} fresh weight) = 0.020 ± 0.004, [Cd] (mg kg^{-1} fresh weight) = 0.006 ± 0.001.

Table S3. Elements concentration [mg kg^{-1} dry weight] ± SD in *L. sativa* roots. NOB= plants grown in Nobile soil, CA= plants grown in Campana soil, AM = amendment.

	NOB without AM	NOB with AM	CA without AM	CA with AM
Al	347 ± 21	534 ± 63	4157 ± 1577	9710 ± 67
As	0.26 ± 0.01	1.00 ± 0.03	4 ± 2	4.4 ± 0.2
Ba	8.1 ± 0.1	9.964 ± 0.002	90 ± 35	171 ± 35
Ca	5413 ± 71	5531 ± 15	7152 ± 1151	12945 ± 989
Cd	0.329 ± 0.002	0.087 ± 0.006	0.26 ± 0.07	0.34 ± 0.05
Co	0.82 ± 0.06	0.95 ± 0.01	3 ± 1	5.7 ± 0.9
Cr	1.83 ± 0.06	2.4 ± 0.1	17 ± 5	54.5 ± 0.7
Cu	26.1 ± 0.4	5.0 ± 0.1	45 ± 8	27 ± 1
Fe	316 ± 7	620 ± 12	5666 ± 2212	12436 ± 365
K	14537 ± 139	29632 ± 489	10201 ± 571	8579 ± 307
Mg	4180 ± 187	1947 ± 49	3773 ± 653	7492 ± 442
Mn	17.9 ± 0.3	30.9 ± 0.1	210 ± 83	389 ± 77
Na	2161 ± 28	3667 ± 34	1250 ± 198	1266 ± 111
Ni	6.3 ± 0.2	3.3 ± 0.1	19 ± 6	45 ± 3
P	1411 ± 28	2218 ± 33	2712 ± 257	2534 ± 141
Pb	1.16 ± 0.01	0.33 ± 0.02	40 ± 16	71 ± 3
Sr	18.2 ± 0.3	21.6 ± 0.4	32 ± 2	37 ± 6
Ti	5.70 ± 0.04	11.7 ± 0.2	87 ± 30	215 ± 1
V	1.63 ± 0.07	1.8 ± 0.1	10 ± 3	18.0 ± 0.5
Zn	40.2 ± 0.6	50 ± 2	100 ± 28	129 ± 11

Table S4. Elements concentration [mg kg^{-1} dry weight] ± SD in *B. oleracea* aerial part. NOB= plants grown in Nobile soil, CA= plants grown in Campana soil, AM = amendment.

	NOB without AM	NOB with AM	CA without AM	CA with AM
Al	3.75 ± 0.07	2.4 ± 0.3	7 ± 2	10.7 ± 0.1
As	0.05 ± 0.01	0.17 ± 0.02	0.079 ± 0.008*	0.10 ± 0.01**
Ba	8.3 ± 0.2	7.6 ± 0.2	56 ± 7	32 ± 2
Ca	23066 ± 1080	11704 ± 117	18591 ± 1144	10324 ± 444
Cd	0.060 ± 0.003	0.066 ± 0.001	0.10 ± 0.01*	0.08 ± 0.01**
Co	0.180 ± 0.008	0.16 ± 0.02	0.134 ± 0.008	0.0790 ± 0.0004
Cr	0.12 ± 0.04	0.082 ± 0.006	0.26 ± 0.03	0.17 ± 0.01
Cu	0.60 ± 0.03	0.74 ± 0.03	0.76 ± 0.03	0.95 ± 0.02
Fe	21.6 ± 0.2	21.7 ± 0.3	22 ± 3	23 ± 1
K	9890 ± 693	21747 ± 937	8063 ± 1085	23153 ± 716
Mg	1875 ± 24	1708 ± 121	1694 ± 78	1791 ± 227
Mn	30 ± 1	15.7 ± 0.8	32 ± 1	14.6 ± 0.3
Na	28 ± 4	1645 ± 84	130 ± 7	1668 ± 142
Ni	0.74 ± 0.03	0.27 ± 0.02	0.37 ± 0.06	0.14 ± 0.04
P	500 ± 10	3104 ± 164	1627 ± 165	3286 ± 198
Pb	0.021 ± 0.003	0.015 ± 0.001	0.17 ± 0.02	0.11 ± 0.01
Sr	26.5 ± 0.8	18.0 ± 0.5	43 ± 3	22 ± 2
Ti	0.05 ± 0.01	0.030 ± 0.003	0.14 ± 0.09	0.14 ± 0.02
V	0.017 ± 0.001	0.029 ± 0.001	0.082 ± 0.009	0.035 ± 0.005
Zn	9.52 ± 0.03	9.7 ± 0.6	15 ± 2	19 ± 1

* [As] (mg kg^{-1} fresh weight) = 0.018 ± 0.003, [Cd] (mg kg^{-1} fresh weight) = 0.023 ± 0.004.

** [As] (mg kg^{-1} fresh weight) = 0.019 ± 0.004, [Cd] (mg kg^{-1} fresh weight) = 0.016 ± 0.003.

Table S5. Elements concentration [mg kg^{-1} dry weight] ± SD in *B. oleracea* roots. NOB= plants grown in Nobile soil, CA= plants grown in Campana soil, AM = amendment.

	NOB without AM	NOB with AM	CA without AM	CA with AM
Al	2525 ± 273	2057 ± 39	5462 ± 590	3608 ± 895
As	1.2 ± 0.1	1.01 ± 0.04	5.9 ± 0.6	2.7 ± 0.3
Ba	23 ± 3	26.3 ± 0.7	144 ± 17	108 ± 35
Ca	8561 ± 480	10106 ± 198	14429 ± 810	18765 ± 4490
Cd	0.33 ± 0.04	0.31 ± 0.02	1.1 ± 0.1	0.41 ± 0.07
Co	2.1 ± 0.3	1.52 ± 0.09	3.4 ± 0.4	2.0 ± 0.7
Cr	16 ± 1	13.3 ± 0.1	29 ± 2	19 ± 7
Cu	13.5 ± 0.9	8.9 ± 0.5	50 ± 3	27.9 ± 0.5
Fe	2816 ± 276	2117 ± 134	6725 ± 660	3708 ± 1865
K	17417 ± 622	14736 ± 482	16340 ± 584	15362 ± 3313
Mg	3969 ± 271	3660 ± 160	3812 ± 260	3232 ± 509
Mn	127 ± 16	82 ± 4	348 ± 42	156 ± 43
Na	1028 ± 60	1516 ± 33	490 ± 29	1127 ± 121
Ni	18 ± 2	13.7 ± 0.7	25 ± 2	17 ± 6
P	1662 ± 71	4801 ± 42	4749 ± 204	5694 ± 626
Pb	1.7 ± 0.2	2.0 ± 0.2	90 ± 10	34 ± 9
Sr	25 ± 1	28 ± 1	40 ± 2	77 ± 53
Ti	51 ± 4	43 ± 1	100 ± 8	93 ± 57
V	7.4 ± 0.6	11.5 ± 0.5	33 ± 3	36 ± 5
Zn	42 ± 3	57.3 ± 0.6	140 ± 12	137 ± 4

Table S6. Summary of multiple pairwise comparisons on element concentrations in *Lactuca sativa* roots obtained with ANOVA and Tukey tests. NOB= plants grown in Nobile soil, CA= plants grown in Campana soil, AM = addition of amendment to the soil. Letter B identifies soil samples whose mean concentrations in the respective elements are significantly lower than the ones obtained for soil samples identified by letter A; the same concept applies to letter C with respect to letter B.

***Lactuca sativa* roots concentration**	**Group**	**Elements**
CA+AM	A	Cr, Ni, Pb, Ba
CA	B	
NOB, NOB+AM	C	
CA	A	Cu
CA+AM, NOB	B	
NOB+AM	C	
CA+AM, CA	A	Zn, As
NOB+AM, NOB	B	
CA+AM	A	Co
CA, NOB+AM	B	
NOB	C	
CA+AM, CA, NOB	A	Cd
NOB+AM	B	

Table S7. Summary of multiple pairwise comparisons on element concentrations in *Lactuca sativa* aerial part obtained with ANOVA and Tukey tests. NOB= plants grown in Nobile soil, CA= plants grown in Campana soil, AM = addition of amendment to the soil. Letter B identifies plant samples whose mean concentrations in the respective elements are significantly lower than the ones obtained for plant samples identified by letter A; the same concept applies to letter C with respect to letter B and letter D with respect to letter C.

***Lactuca sativa* aerial part concentration**	**Group**	**Elements**
CA	A	Cr, Pb, Co
CA+AM	B	
NOB, NOB+AM	C	
CA, CA+AM	A	As
NOB+AM	B	
NOB	C	
CA+AM, CA	A	Zn
NOB+AM, NOB	B	
CA	A	Ni
NOB	B	
CA+AM	C	
NOB+AM	D	
CA, NOB	A	Cu
CA+AM, NOB+AM	B	
CA, NOB	A	Cd
CA+AM	B	
NOB+AM	C	
CA	A	Ba
CA+AM	B	
NOB+AM	C	
NOB	D	

Table S8. Summary of multiple pairwise comparisons on element concentrations in *Brassica oleracea* roots obtained with ANOVA and Tukey tests. NOB= plants grown in Nobile soil, CA= plants grown in Campana soil, AM = addition of amendment to the soil. Letter B identifies plant samples whose mean concentrations in the respective elements are significantly lower than the ones obtained for plant samples identified by letter A; the same concept applies to letter C with respect to letter B and letter D with respect to letter C.

***Brassica oleracea* roots concentration**	**Group**	**Elements**
CA	A	Pb, As
CA+AM	B	
NOB, NOB+AM	C	
CA	A	Ni
CA+AM, NOB	AB	
NOB+AM	B	
CA	A	Cr, Co, Cd
CA+AM, NOB+AM, NOB	B	
CA	A	Cu
CA+AM	B	
NOB	C	
NOB+AM	D	
CA+AM, CA	A	Zn, Ba
NOB+AM, NOB	B	

Table S9. Summary of multiple pairwise comparisons on element concentrations in *Brassica oleracea* aerial part obtained with ANOVA and Tukey tests. NOB= plants grown in Nobile soil, CA= plants grown in Campana soil, AM = addition of amendment to the soil. Letter B identifies plant samples whose mean concentrations in the respective elements are significantly lower than the ones obtained for plant samples identified by letter A; the same concept applies to letter C with respect to letter B and letter D with respect to letter C.

***Brassica oleracea* aerial part concentration**	**Group**	**Elements**
CA	A	Pb, Ba
CA+AM	B	
NOB, NOB+AM	C	
CA	A	Cr
CA+AM	B	
NOB	BC	
NOB+AM	C	
NOB	A	Ni
CA, NOB+AM	B	
CA+AM	C	
CA+AM	A	Cu
CA, NOB+AM	B	
NOB	C	
NOB, NOB+AM	A	Co
CA	B	
CA+AM	C	
NOB+AM	A	As
CA+AM	B	
CA	BC	
NOB	C	
CA	A	Cd
CA+AM	AB	
NOB+AM	BC	
NOB	C	
CA, CA+AM	A	Zn
NOB, NOB+AM	B	

Table S10. Summary of multiple comparisons for pairs of *Lactuca sativa* BF with Tukey test. CA= plants grown in Campana soil, AM = addition of amendment to the soil. Letter B identifies BF values whose means are significantly lower than the ones obtained for BF values identified by letter A.

BF	**Group**	**Elements**
CA, CA+AM	A	As, Ba, Zn
CA	A	Cu
CA+AM	B	
CA+AM	A	Cd, Co, Cr, Ni, Pb
CA	B	

Table S11. Summary of multiple comparisons for pairs of *Lactuca sativa* TF with Tukey test. CA= plants grown in Campana soil, AM = addition of amendment to the soil. Letter B identifies TF values whose means are significantly lower than the ones obtained for TF values identified by letter A.

TF	Group	Elements
CA, CA+AM	A	As, Cu, Zn
CA	A	Ba, Cd, Co, Cr, Ni, Pb
CA+AM	B	
CA+AM	A	/
CA	B	

Table S12. Summary of multiple comparisons for pairs of *Brassica oleracea* BF with Tukey test. CA= plants grown in Campana soil, AM = addition of amendment to the soil. Letter B identifies BF values whose means are significantly lower than the ones obtained for BF values identified by letter A.

BF	Group	Elements
CA, CA+AM	A	Ba, Cu, Zn
CA	A	As, Co, Cr
CA+AM	B	
CA+AM	A	Cd, Ni, Pb
CA	B	

Table S13. Summary of multiple comparisons for pairs of *Brassica oleracea* TF with Tukey test. CA= plants grown in Campana soil, AM = addition of amendment to the soil. Letter B identifies TF values whose means are significantly lower than the ones obtained for TF values identified by letter A.

TF	Group	Elements
CA, CA+AM	A	Ba, Co, Cr, Cu, Pb
CA	A	Ni
CA+AM	B	
CA+AM	A	As, Cd, Zn
CA	B	