






SUPPLEMENTARY MATERIAL

Hydrochemical and microbiological evaluation of groundwater in an agricultural area of Ecuador

Ricardo Villalba-Briones¹⁾ ✉ , Paola Calle¹⁾ ✉ , Marynes Montiel¹⁾ ✉ ,
Mariela González-Narváez^{1), 3)} ✉ , Tomas Vitvar^{*2)} ✉  0000-0002-7504-2374

¹⁾ Escuela Superior Politécnica del Litoral, Facultad de Ciencias de la Vida, 090902, Guayaquil, Ecuador

²⁾ Escuela Superior Politécnica del Litoral, Facultad de Ciencias de la Tierra, 090902, Guayaquil, Ecuador

³⁾ Escuela Superior Politécnica del Litoral, Centro de Estudios e Investigaciones Estadísticas, 090902,
Guayaquil, Ecuador

* Corresponding author

Table S1. Summary of the analytical results and their relation to maximum permissible contents

Parameter	Permissible limit			Value in sampling site													Mean \pm standard deviation
	Ecuador ¹⁾	WHO ²⁾	U.S. EPA ³⁾	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	
Total dissolved solids (mg·dm ⁻³)	NA	1000	500	815	1060	160	260	905	496	899	946	962	749	873.00	958	811	761.08 \pm 280.35
Electrical conductivity (μ S/cm)	NA	NA	NA	1150	1741	251	352	1336	862	1351	1486	1434	1055	1278	1340	1114	1134.62 \pm 428.71
pH	NA	6.5–8.5	6.5–9.0	6.11	6.74	5.99	6.64	6.45	6.60	6.63	6.75	6.44	6.81	6.81	6.85	7.05	6.61 \pm 0.29
Ca (mg·dm ⁻³)	NA	NA	NA	70.76	88.19	14.30	22.97	153.86	34.18	147.01	136.71	133.61	86.11	107.89	162.53	105.65	97.21 \pm 50.24
Mg (mg·dm ⁻³)	NA	NA	NA	42.86	52.10	5.78	12.14	65.15	23.30	73.99	70.80	67.43	46.48	61.93	74.53	53.53	50 \pm 23.22
Na (mg·dm ⁻³)	NA	NA	NA	134.58	272.17	12.27	21.97	104.98	84.43	131.29	198.98	161.32	104.68	144.60	99.69	86.51	119.81 \pm 68.63
K (mg·dm ⁻³)	NA	NA	NA	3.45	3.24	7.36	3.67	2.60	2.86	2.91	2.84	3.45	3.04	3.07	5.28	3.64	3.65 \pm 1.30
HCO ₃ (mg·dm ⁻³)	NA	NA	NA	366	610	73.20	158.60	353.80	219.60	341.60	292.80	366	366	378.20	439.20	402.60	335.97 \pm 132.58
Cl (mg·dm ⁻³)	NA	NA	250	110.84	150.98	39.79	23.42	171.30	120.04	151.27	163.73	162.94	107.70	0.13	0.14	0.11	92.49 \pm 69.28
SO ₄ (mg·dm ⁻³)	NA	NA	250	86.72	120.93	7.36	17.54	53.79	12.01	50.81	80.58	67.71	35.21	45.57	36.65	50.20	51.16 \pm 32.09
F (mg·dm ⁻³)	1.5	1.5	4.0	0.32	0.01	0.01	0.01	0.35	0.23	0.23	0.12	0.01	0.01	0.29	0.01	0.01	0.12 \pm 0.14
Br (mg·dm ⁻³)	NA	NA	NA	0.37	0.01	0.01	0.01	1.15	0.74	0.91	0.01	1.23	0.43	0.70	0.82	0.46	0.52 \pm 0.44
Zn (mg·dm ⁻³)	NA	3	5	0.01	0.14	0.04	0.01	0.02	0.04	0.01	0.01	0.01	0.14	0.00	0.14	0.14	0.05 \pm 0.06
Fe (mg·dm ⁻³)	NA	0.3	0.3	0.00	0.01	6.41	0.39	0.01	0.97	0.01	0.01	0.00	0.17	0.04	0.39	0.06	0.65 \pm 1.75
Mn (mg·dm ⁻³)	0.4	0.1	0.05	0.00	0.00	0.59	0.08	0.02	0.04	0.01	0.00	0.00	0.10	0.60	0.04	0.01	0.12 \pm 0.22
Cu (mg·dm ⁻³)	2.0	2	1	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01 \pm 0.004
Al (mg·dm ⁻³)	NA	0.1	0.2	0.04	0.06	7.82	0.61	0.06	1.60	0.07	0.06	0.05	0.32	0.10	0.64	0.13	0.89 \pm 2.13
Cd (mg·dm ⁻³)	0.003	0.003	0.005	0.001	0.001	0.003	0.001	0.001	0.020	0.002	0.003	0.001	0.003	0.001	0.002	0.003	0.003 \pm 0.01
Cr (mg·dm ⁻³)	0.05	0.05	0.1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01 \pm 0.002
THg (μ g·dm ⁻³)	6.0	1.0	2.0	0.84	0.83	1.52	12.85	1.51	1.11	1.03	1.42	0.92	0.59	0.0001	0.61	3.22	2.035 \pm 3.336
NH ₄ (mg·dm ⁻³)	NA	NA	NA	0.16	0.20	NA	0.47	0.19	0.09	0.15	0.16	0.19	0.10	0.06	0.10	0.06	0.16 \pm 0.11
NO ₂ (mg·dm ⁻³)	0.2	3	3,284	0.01	0.01	0.00	0.07	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01 \pm 0.02
NO ₃ (mg·dm ⁻³)	50	50	44.3	1.70	1.60	0.60	1.10	1.50	22.30	1.20	1.90	2.10	0.70	2.10	0.30	1.10	2.94 \pm 5.85
PO ₄ (mg·dm ⁻³)	NA	NA	NA	0.74	1.10	2.89	1.87	0.75	0.84	1.21	0.56	1.31	0.72	0.73	0.61	0.62	1.07 \pm 0.66
NH ₃ (mg·dm ⁻³)	NA	NA	NA	0.12	0.06	1.24	0.16	0.05	0.67	0.13	0.12	0.11	0.27	0.22	0.19	0.24	0.28 \pm 0.33
Chemical oxygen demand (mg·dm ⁻³)	NA	NA	10	3	3	62	34	5	25	3	7	2	18	18	21	24	17.31 \pm 17.08
Biological oxygen demand (mg·dm ⁻³)	NA	NA	5	1.30	3.40	13.81	1.30	3.94	1.89	7.73	6.46	1.87	2.02	0.36	0.40	0.16	3.43 \pm 3.88
Total coliforms (MPN·(100 cm ³) ⁻¹)	NA	NA	0	350	>1600	>1600	>1600	1600	>1600	1700	>1600	130	>1600	33	1600	1600	–
Faecal coliforms (MPN·(100 cm ³) ⁻¹)	0	0	0	350	>1600	>1600	48	48	>1600	5.60	240	130	>1600	33	1600	1600	–
<i>Escherichia coli</i> (MPN·(100 cm ³) ⁻¹)	NA	0	0	110	10	14	20	15	5.50	5.60	240	130	1600	6,80	70	920	242.07 \pm 477.59
Well distance (m)	NA	NA	NA	50	17	10	100	20	70	20	18	19	30	45	35	30	35.69 \pm 25.43

¹⁾ INEN (2020). ²⁾ WHO (2017a). ³⁾ U.S. EPA (2021).

Explanations: bacterial presence was registered in all samples; values in bold are above the permissible limits established by WHO; NA = not apply.

Source: own study.