21 Ružičkini dani
DANAS ZNANOST – SUTRA INDUSTRIJA
9. – 11. rujna 2026. • Vukovar • Hrvatska

University of Zagreb
Faculty of Chemical
Engineering and Technology
FKITMCMXIX

WATER QUALITY MONITORING IN MOUNTAIN STREAMS OF THE MEDVEDNICA NATURE PARK

Dajana Kučić Grgić, Anja Rakas, Lidija Furač, Laura Jaklenec, Dora Bramberger, Kristina Bule Možar, Luka Večenaj, Marinko Markić, Matija Cvetnić, Šime Ukić†, Tomislav Bolanča

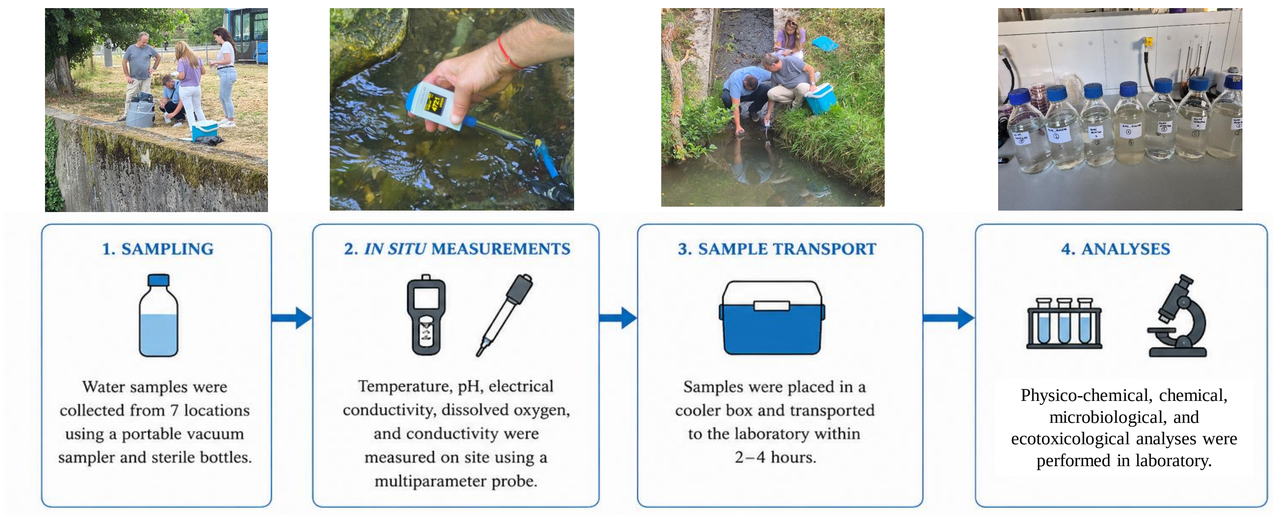
University of Zagreb, Faculty of Chemical Engineering and Technology, Trg Marka Marulića 19, 10 000 Zagreb, Croatia

INTRODUCTION

Mountain streams are sensitive indicators of water quality, as their chemical and microbiological characteristics are strongly influenced by natural processes and anthropogenic pressures within the surrounding catchment. In Medvednica Mountain, these influences may significantly affect stream water quality and downstream aquatic ecosystems.

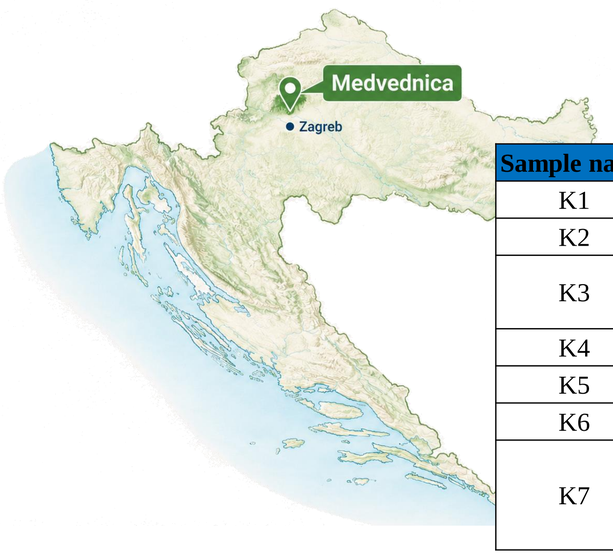
The study assessed key physico-chemical, chemical, microbiological, and ecotoxicological indicators of stream water quality. Analyses included evaluation of organic matter, major ions, selected metals, microbiological parameters, pH, conductivity, and temperature, while ecotoxicity was evaluated using *Aliivibrio fischeri*. The results provided baseline information on Medvednica stream water quality and highlighted the main factors influencing ecological conditions and downstream water systems.

METHODOLOGY



RESULTS

For tables 1.- 3., values are presented as **16 June 2026 / 16 July 2026**



Sample name	Location
K1	Medveščak / Bliznec
K2	Kraljevec (Mihaljevec)
K3	Kraljevec–Langvić Retention Basin
K4	Jelenovac Retention Basin
K5	Kustošija 221
K6	Paintball Range 363
K7	Wastewater Manhole near Faculty of Food Technology and Biotechnology

Table 1. Physico-chemical characterizaton.

Parameter	K1	K2	K3	K4	K5	K6	K7
Temperature, °C	13.20 / 20.30	16.60 / 19.50	14.50 / 19.90	18.50 / 20.90	21.30 / 21.54	16.50 / 20.19	23.30 / 20.30
pH, -	7.80 / 7.22	7.87 / 7.32	8.00 / 7.48	8.07 / 7.58	8.39 / 7.74	8.24 / 7.41	7.87 / 7.30
Conductivity, µS/cm	474.00 / 498.10	435.80 / 476.40	437.00 / 458.30	645.00 / 729.80	679.00 / 628.90	674.50 / 725.10	1085.00 / 977.00
Dissolved O_2, mg/L	9.78 / 8.72	9.18 / 8.76	9.64 / 8.70	9.20 / 9.09	10.60 / 9.14	9.39 / 9.12	6.23 / 2.10
Alkalinity, mg $CaCO_3$/L	232.00 / 248.00	330.00 / 340.00	254.00 / 262.00	518.00 / 632.00	582.00 / 490.00	590.00 / 596.00	682.00 / 754.00
$KMnO_4$ consumption, mg O_2/L	2.92 / 6.89	2.59 / 2.04	2.65 / 4.78	8.26 / 5.67	2.98 / 2.29	5.02 / 2.41	28.24 / -

Table 2. Ion chromatography – cation and anion concentrations.

Ion, mg/L	K1	K2	K3	K4	K5	K6	K7
Ca^{2+}	82.726 / 85.570	85.310 / 83.984	75.776 / 79.679	96.598 / 105.214	138.471 / 117.123	143.403 / 138.686	116.740 / 122.296
Mg^{2+}	10.655 / 12.606	15.607 / 20.018	15.607 / 14.540	41.987 / 61.821	20.236 / 23.110	16.494 / 17.463	38.994 / 45.788
Na^{+}	13.446 / 12.637	13.860 / 11.579	14.096 / 12.537	20.866 / 22.377	17.679 / 21.229	13.306 / 15.935	48.428 / 72.618
NH_4^+ - N	n.d. / n.d.	n.d. / n.a.	n.d. / n.d.	n.d. / n.d.	0.713 / n.d.	n.d. / n.d.	9.676 / n.a.
Cl^-	59.965 / 70.256	35.255 / 35.424	47.705 / 41.341	36.753 / 51.449	21.374 / 26.155	18.899 / 28.464	55.265 / 55.313
F^-	n.d. / 0.046	n.d. / 0.052	n.d. / 0.027	n.d. / 0.040	n.d. / 0.018	n.d. / 0.055	0.110 / n.a.
SO_4^{2-}	12.689 / 14.040	16.567 / 16.646	13.631 / 13.191	25.798 / 14.233	31.543 / 31.641	24.267 / 27.758	43.935 / 39.893
NO_3^- - N	0.675 / 0.053	0.919 / 0.536	0.695 / 0.052	0.611 / 0.502	1.504 / 2.303	2.375 / 3.628	0.371 / 0.109
NO_2^- - N	n.d. / n.a.	n.d. / n.a.	n.d. / n.a.	n.d. / n.a.	0.099 / 0.247	n.d. / n.a.	0.803 / n.a.

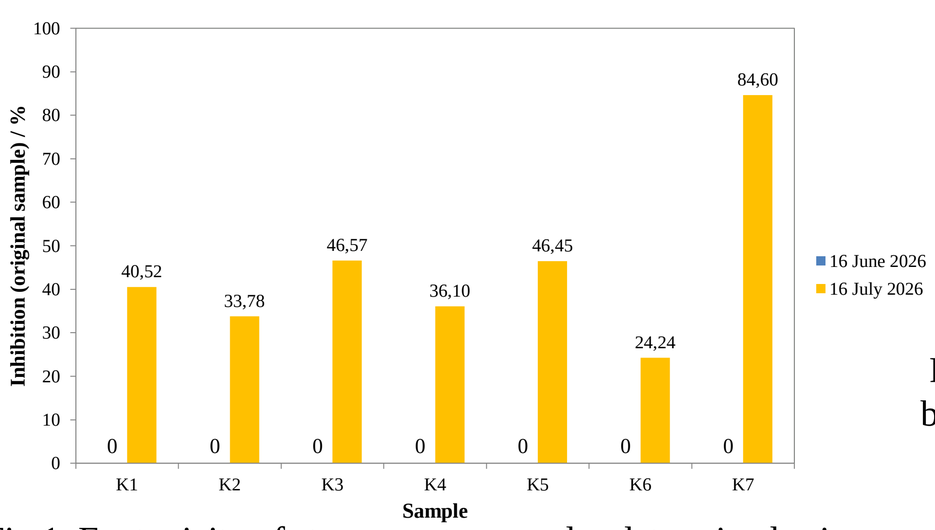


Fig 1. Ecotoxicity of stream water samples determined using *Aliivibrio fischeri.*

Fig 2. Bioluminiscent bacteria *A. fischeri* for ecotoxicity testing.

Table 3. Microbiological analysis results.

Sample	Key findings	Main evidence (16 June 2026 / 16 July 2026)
K1	High fecal contamination; strong increase in fecal coliforms	**Fecal coliforms**: 320 / 8.000 T + 6.900 AT; ***C. perfringens*** present
K2	Very high coliform and fecal contamination in the second sampling	**Coliforms**: 860 / 1.900 T + 13.400 AT; **fecal coliforms**: 920 / 1.300 T + 7.400 AT
K3	Lowest overall bacterial loads among K1–K6, but contamination remained present	**Colony count 37 °C**: 19 / 105; **coliforms**: 40 T + 51 AT / 100 T + 3.700 AT
K4	Marked fecal contamination and high ***Clostridium*** load	**Fecal coliforms**: 880 / 2.000 T + 11.000 AT; ***C. perfringens***: 1.200 in July
K5	Very high initial coliform contamination; persistent microbiological impact	**Coliforms**: 6.400 T / 6.100 T + 65 AT; **enterococci**: TNTC / 80 T + 30 AT
K6	Only site with detected ***Pseudomonas aeruginosa*** in June; high ***Clostridium*** in July	***P. aeruginosa***: 11 / ND; ***C. perfringens***: 4.900 in July
K7	Most severely contaminated site; multiple parameters were too numerous to count	**Colony counts, coliforms and enterococci**: TNTC; ***Salmonella/Shigella*** screening also TNTC

T – typical colonies; AT – atypical colonies; TNTC – too numerous to count; ND, n.d. – not detected; NA, n.a. – not analysed.

CONCLUSION

Pronounced spatial and temporal variability in water quality was observed across the investigated sampling sites, indicating differences in local environmental conditions and potential contamination sources between locations and sampling periods. Rainfall during the second sampling date (16 July 2026) may have contributed to the observed changes in microbial loads and water quality parameters through increased surface runoff and contaminant transport. **K7** was identified as the most impacted site, showing both pronounced microbiological contamination and the highest ecotoxicological response.

EUROPSKI STRUKTURNI I INVESTICIJSKI FONDOVI
Operativni program KONKURENTNOST I KOHEZIJA
This research was supported by the European Regional Development Fund under the PKK 2021-2027 programme, project Upravljanje rizicima od pluvijalnih poplava kroz mjere prilagodbe klimatskim promjenama na urbanim područjima (HORUS) grant number PK.3.4.17.0009.