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ASSESSMENT OF THE LOWER JIU RIVER WATER QUALITY

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ABSTRACT

This study presents the evaluation of Jiu river water quality parameters in the lower course. The measurements were carried out biannually, *representing the dry season (April to July) and the rainy season (September to December). The analysis encompassed physico-chemical parameters that provide a holistic view of river water quality and water contamination levels. The results showed that nitrite and nitrate exceeded the water quality standard, which places the Jiu river in the second quality class, meanwhile, the other parameters were in accordance with the quality standard. Effective continuous river water quality monitoring regarding the quality status and potential pollution of surface waters is essential for sustainable water resource management.*

INTRODUCTION

Currently, surface water is one of the most important sources of water and is widely used for agricultural, industrial and domestic activities. Rivers, as one of the surface waters, are used as the main source of clean water.

Hazardous substances in freshwater, which lead to poor chemical status, can harm aquatic life and pose a risk to human health (Varol and Tokatli, 2023).

Hazardous substances are released into waters in a range of substances through many different pathways and from a variety of sources, including industry, agriculture, transport, mining and waste disposal, as well as from homes, from where chemicals found in household products are discharged (Babuji et al., 2023). Pesticides used in agriculture have been widely detected in surface and groundwater. Mining, landfills and contaminated land from historical industrial and military activities all exert localised but significant pressure on waters in parts of Europe (Zhang et al., 2022).

The quality of natural water in rivers, lakes and reservoirs and underground depends on a number of interrelated factors. In its movement on and through the surface, water has the ability to react with minerals occurring in soil and rocks and to dissolve a wide range of materials, so that its natural state is never pure (Fergus et al., 2020; Peng et al., 2021).

In addition, water can carry large amounts of insoluble materials that are held in suspension. Both the amounts and types of impurities found in natural water

vary from place to place and time of year, and depend on a number of factors such as geology, climate, topography, biological processes, and land use (Lu et al., 2023).

The aim of this study was to asses the water quality of the lower Jiu river by analyzing several physico-chemical parameters that are significant to river pollution assessment.

MATERIAL AND METHODS

The sampling points of the Jiu River water were located in Răcari area (S1) and Işalnița area (S2), Dolj County, Romania (Fig. 1).

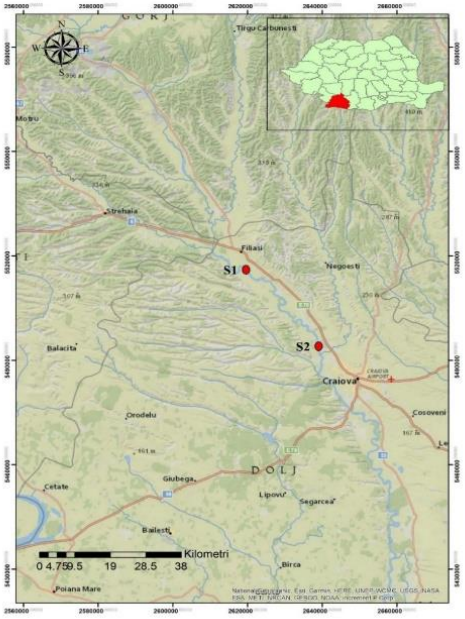

Figure 1. Water sampling sites in the lower Jiu River sector

To capture variations in the hydrologic factors, the samples were collected during the dry season (April to July) and wet season (September to December) of the year 2024. For each month taken into consideration for the dry and wet seasons, three samples of water were collected from each site, at approximately 20 cm below the water surface and approximately 50 meters apart, and were sufficiently mixed together in 1L plastic containers.

The plastic bottles were thoroughly washed and rinsed with the sampled water before taking the sample for analysis. The water samples were collected safely and sealed with appropriate labeling. Aeration during sampling was avoided as much as possible. The water samples were carefully transported to the laboratory and stored at 4 ^{o}C for further analysis.

The water quality parameters determined included:

- physical parameters: total dissolved solids (TDS), electrical conductivity (EC), temperature, transparency, turbidity.

- chemical parameters: pH, dissolved oxygen (DO), biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), calcium, chlorides, sulfate (SO_4^{-2}), phosphate (PO_4^{3-}), nitrites (NO_2^-), nitrates (NO_3^-), ammonium (NH_4^+).

Physical indicators were determined in situ using appropriately calibrated digital multi-probe field instruments like: conductivity meter 4071 ELE International, Jenway DO_2 meter 970, turbidimeter Hanna Instruments HI 93703, pH meter Hanna Instruments HI 9025. The rest of the chemical parameters were analyzed in the laboratory with DR2010 Spectrophotometer.

The obtained results were compared with Normative 161/2006 of the Romanian legislation regarding the classification of surface water quality.

RESULTS AND DISCUSSIONS

The health of a river depends on the quality of its water, which is influenced by the presence of pollutants. Water quality is generally assessed by a series of parameters, which express the physical, chemical and biological composition of the water.

The composition and hydrochemical regime of rivers is related to the rapid exchange of water in the riverbed, the hydrological regime and climatic conditions, the good interaction between water and the atmosphere, and the soils and rocks located above the erosion base.

The pH of the analyzed water samples ranged from 7.05 in sample S1 to 7.64 in sample S2 in the dry season, and from 7.2 in sample S2 to 7.9 in sample S1 in the wet season. The recorded pH values indicate that anthropogenic activities around the rivers did not have much effect on the acidity of the Jiu River.

The electrical conductivity in the study area ranged between 227 µS/cm in sample S1 and 359 µS/cm in sample S2 in the dry season and 229 µS/cm in sample S1 to 357 µS/cm in sample S2 in the wet season (Tables 1 and 2), all samples being within the standard quality level of natural waters.

Total dissolved solids in the study area range from 21.0 to 38.0 mg/l in the dry season, both recorded in sample S2, and from 12.2 to 29.6 mg/l in the wet season, both for sample S1. These values meet the quality standard of river water intended for common use.

The variation of turbidity concentration was in the range of 9 NTU units in April, Răcari locality -19 NTU units in April, Ișalnița locality. The lowest value, of 13 NTU units measured in the cold season, was in October at the sample in Răcari locality, while the highest, of 28 NTU units was in September in Ișalnița locality. Higher turbidity values indicate a richer presence of colloidal organic particles, silt, plankton, clay and other suspended solids (Li et al., 2024).

Dissolved oxygen (DO) levels ranged from 8.3 (S1) to 9.7 mgO_2/l (S2) in the dry season, placing the Jiu River waters in quality class I; and in the wet season it ranged from 7.4 (S1) to 8.4 mg O_2/l (S2), placing the Jiu River in quality class II. This is an important parameter because its depletion could enhance the reduction of sulfate and nitrate to sulfide and nitrite, respectively, by microorganisms in the water (Bhatt et al., 2024).

Biochemical oxygen demand (BOD_5) levels ranged from 3.5 (S2) to 4.6 mgO_2/l (S1) in the dry season and from 4.2 to 5.9 mgO_2/l in the wet season, placing the Jiu River water in quality class II.

In the present study, COD values ranged from 2.31 (S1) to 5.59 mg/l (S2) in the dry season and 2.00 (S2) to 2.72 (S1) mg/l in the wet season (Tables 1 and 2).

According to WHO, the recommended COD value is 8.00 mg/l, so the analyzed samples are within the appropriate limit.

Nitrite and nitrate in all water samples ranged between 0.032 and 0.064 mg/l and, respectively, 1.65 to 4.92 mg/l, a value recorded in April in the sample collected from the locality of Ișalnița in the dry season, and in the wet season they ranged between 0.014 and 0.063 mg/l and, respectively, 1.27 to 4.50 mg/l, a value recorded in September in the water sample from the locality of Ișalnița, which places the river water in the II quality class. Improper disposal of household wastewater and washing clothes on watersides could contribute to their presence in surface water samples.

Ammonium levels in all water samples ranged from 0.016 (S1) to 0.039 mg/l (S1) in the dry season and 0.016 (S1, S2) to 0.235 mg/l (S1), respectively, suggesting no adverse health effects.

Table 1

Physico-chemical parameters of Jiu water in the dry season

Parameter	Răcari (S1)				Ișalnița (S2)			
	April	May	June	July	April	May	June	July
Temperature (°C)	12	11.5	23.2	30.5	14	16	21.3	27.0
Conductivity (µS/cm)	233	235	262	227	266	250	289	359
TDS (mg/l)	27.0	29.0	24.0	29.0	38.0	27.0	21.0	23.0
Transparency (cm)	40	30	35	40	40	45	45	50
Turbidity (NTU)	9	13	16	17	19	16	16	9
pH	7.55	7.05	7.54	7.52	7.48	7.52	7.64	7.37
DO (mgO_2/l)	9.6	9.2	8.9	8.3	9.7	9.7	9.5	8.9
BOD_5 (mgO_2/l)	4.6	3.9	4.5	3.9	4.4	3.0	3.5	3.5
COD (mg/l)	2.31	2.41	2.50	4.59	2.78	2.32	2.35	5.59
NH_4^+ (mg/l)	0.016	0.016	0.039	0.035	0.016	0.016	0.027	0.023
NO_2^- (mg/l)	0.045	0.046	0.063	0.047	0.064	0.033	0.033	0.032
NO_3^- (mg/l)	2.85	3.04	3.26	3.10	4.92	2.55	2.47	1.65
PO_4^{3-} (mg/l P)	0.05	0.03	0.06	0.09	0.07	0.04	0.07	0.03
Chlorides (mg/l)	14.04	9.87	11.05	16.37	14.11	13.00	15.89	18.52
Calcium (mg/l)	50.43	36.00	61.32	50.81	42.20	50.60	51.81	36.44
Sulphate (mg/l)	36.02	26.77	21.70	32.45	32.80	31.41	35.70	40.32

High phosphate concentrations in water can be caused by the decomposition of organic matter, the degradation of minerals in rocks, the use of fertilizers and household and industrial waste. In this study, the values determined were between 0.03 and 0.09 mg/l P in both the dry and wet seasons, at both locations studied, falling within the maximum permitted concentrations.

Sulphate values ranged from 21.70 (S1) to 40.32 mg/l (S2) in the dry season and from 20.78 (S1) to 40.34 mg/l (S2) in the wet season. The presence of SO_4^{2-} in water was probably due to the dissolution of pyrite and gypsum (a natural process), although anthropogenic activities may increase its levels in water samples.

The chloride content of the analyzed samples ranged between 11.05 (S1) and 18.52 mg/l (S2) in the dry season (Table 3.1) and 9.73 (S1) to 15.89 mg/l (S2) in the wet season.

Calcium concentrations in the study area ranged from 36.44 (S1) to 61.32 mg/l (S1) in the dry season and from 31.00 (S2) to 62.56 mg/l (S1) in the wet season. All samples in the study area are within the limits of natural freshwater. The high Ca

concentrations in surface waters may be primarily due to domestic discharges into the river and the presence of CO_2 which causes the dissolution of $CaCO_3$ (Mishra et al., 2023).

Table 2

Physico-chemical parameters of Jiu water in the wet season

Parameter	Răcari (S1)				Ișalnița (S2)			
	Sept	Oct	Nov	Dec	Sept	Oct	Nov	Dec
Temperature (°C)	22.5	18	16	6.4	24	18	15	8.7
Conductivity (µS/cm)	308	262	229	234	289	357	264	249
TDS (mg/l)	29.6	19.6	16.8	12.2	27.02	25.4	17.3	18.2
Transparency (cm)	40	30	35	40	50	45	40	40
Turbidity (NTU)	29	13	17	25	28	25	25	17
pH	7.8	7.9	7.7	7.3	7.4	7.5	7.7	7.2
DO (mgO_2/l)	8.4	8.1	7.9	7.4	7.8	7.7	7.7	7.9
BOD_5 (mgO_2/l)	4.9	5.8	5.9	4.2	5.4	4.5	4.9	4.9
COD (mg/l)	2.72	2.50	2.21	2.53	2.63	2.03	2.25	2.00
NH_4^+ (mg/l)	0.235	0.016	0.016	0.016	0.016	0.016	0.016	0.082
NO_2^- (mg/l)	0.063	0.051	0.037	0.033	0.033	0.032	0.014	0.06
NO_3^- (mg/l)	3.27	3.10	2.15	3.19	4.50	2.47	2.24	1.27
PO_4^{3-} (mg/l P)	0.06	0.09	0.06	0.04	0.07	0.03	0.06	0.04
Chlorides (mg/l)	14.05	9.73	10.04	15.05	13.05	15.89	13.75	12.00
Calcium (mg/l)	62.56	41.30	54.67	44.47	48.63	47.68	31.00	27.32
Sulphate (mg/l)	37.02	26.73	20.78	23.14	31.52	35.70	40.34	33.51

CONCLUSIONS

From a qualitative point of view, the Jiu River on the Filiași-Ișalnița section has good ecological potential and good chemical status, falling into the second quality class in terms of nitrite and nitrate values and dissolved oxygen. The existence of households and animal activities in the lower sector of Jiu river, and the improper disposal of wastewater can be the cause of river pollution. Regarding the rest of the physico-chemical indicators that were considered in this study, the results showed that the values recorded at the two sites, namely the Răcări locality and the Ișalnița locality, placed the water of the Jiu River in class I of quality. Water quality monitoring should not be performed only in rivers that are the target of pollution control programs, but also in rivers that have not been polluted, because it will be useful for developing better water quality conservation measures.

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