MICROBIOLOGICAL STUDY OF THE TIMIS AND BEGA RIVERS

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Introduction
The water quality of the most important rivers in the Timis-Bega watershed is the result of human activity and demographic characteristics on the one hand and urbanization and industrialization on the other. The discharge of untreated wastewater from industry, households and pollution from agriculture are the main causes of pollution of surface water resources and groundwater in this region. In accordance with the Romanian Water Framework Directive, three microbiological indicators were analyzed: total coliform bacteria, *Escherichia coli*, intestinal Enterococci. Bacteria colonize any habitat and are the most numerous microorganisms present in aquatic ecosystems. The purpose of the work was to determine the degree of infestation of water bodies with different types of bacteria.

Materials and methods
In this study, water samples were taken from the Timis and Bega rivers in such a way that their entire flow area was covered. The water samples were collected starting from the area of the springs up to the border with Serbia. Microbiological parameters were monitored in 6 sampling points on the Timis River and in 5 sampling points on the Bega River. In the present study we used the method that are based on Most Probable Number (MPN) to determine the number of bacteria present in the water samples. The monitoring period was in the months of March, April and May of 2019. This study is part of an extensive research project that took place over several years (2019-2022) and in which the water quality of the Timis and Bega watersheds was monitored. The water samples were taken in compliance with the norms present in the ISO-19458 standard-"Water quality. Sampling for microbiological analysis". The microbiological analyzes were carried out according to the ISO 9308 (Enterolert-IDEXX) standard in an accredited laboratory.

Results and conclusions
Tables 1 (Timis river) and 2 (Bega river) show the minimum and maximum values of the analysed microbiological parameters (total coliform bacteria, *Escherichia coli* and intestinal Enterococci) for certain sectors on the two rivers. The results of the microbiological evaluation related to the Timis River are presented in Table 1. The minimum and maximum values of the three samples are presented.

Regarding the total number of coliform bacteria, relatively low values was observed, in some cases being even <1 (T-6). There is only one exception, namely point T-3 which differs from the rest with a microbiological load of 6 196 MPN/100 mL.

Table 1. Microbiological analysis of sampling points on the Timis River

Sampling points	Total coliform bacteria (MPN/100 mL)	Escherichia coli (MPN/100 mL)	Intestinal Enterococci (MPN/100 mL)	Location
T-1	1 - 2	<1	<1	Source area
T-2	17 - 20	1	1 - 2	Upstream Caransebes city
T-3	3471 – 6196	<1	<1	Downstream of the urban sewage treatment plant
T-4	36 - 41	<1	<1	Upstream Lugoj city
T-5	24 - 52	<1	<1	Downstream of the urban sewage treatment plant and downstream of the evacuation of the waste deposit
T-6	<1	<1	<1	Surgani tributary downstream

*Results marked with "<" represent the values situated below the determination limit of the method

This may be due to the location of this sampling point downstream of the treatment plant of the city of Caransebes, which can influence the water quality in this sector of the river to a large extent. In the case of the other two determined microbiological parameters, all river sectors do not show *E. coli* or Enterococci, with the exception of sampling point T-2.

The results of the microbiological analyses related to the Bega River are presented in Table 2. The minimum and maximum values of the three samples are presented.

Table 2. Microbiological analysis of sampling points on the Bega River

Sampling points	Total coliform bacteria (MPN/100 mL)	Escherichia coli (MPN/100 mL)	Intestinal Enterococci (MPN/100 mL)	Location
B-1	67 - 161	<1	1	Source area
B-2	35 - 63	<1	<1	Downstream of the former chemical factory discharge
B-3	16 - 20	<1	<1	Upstream of the Timis-Bega canal
B-4	18 - 26	<1	<1	Downstream of the Timisoara city sewage treatment plant
B-5	21 - 35	1 -2	2- 3	Downstream Timisoara city

*Results marked with "<" represent the values situated below the determination limit of the method

In the case of total coliform bacteria, no notable differences was observed in the presence of them. They are found in all river sectors with a minimum at sampling point B-3 (16 MPN/100 mL) and a maximum at point B-1 (161 MPN/100 mL). In the case of the other two microbiological parameters determined, we observed a

minor infestation with intestinal Enterococci at sampling point B-1 (1 MPN/100 mL). The highest level of total coliform bacteria in the river is also present at this sampling point. This part of the river is in the source area, being a hilly area with numerous species of wild animals, but also grazing activities, which indicates that this infestation can be attributed exclusively to animals. The sampling point B-5 is the most loaded in terms of the number of *E. coli* (max. 2 MPN/100 mL) and intestinal Enterococci (max. 3 MPN/100 mL). This fact was to be expected, because the sampling point is located downstream from the city of Timisoara. Most of the companies and commercial enterprises in the border area of the city discharge into the river. The rest of the sampling sectors do not show presence of bacteria.

As a general conclusion, from a microbiological point of view, the studied river sectors do not present alarming bacterial infestations with one exception-point T-3. The explanation for the reduced pressure exerted on the Bega and Timis water bodies is the large investments made in the waste water management infrastructure.