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EVALUATION OF THE ORGANIC POLLUTION OF THE MUREŞ RIVER BASED ON THE STUDY OF THE INDICATOR MICROFLORA

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Abstract: The ecological status of Mureş river was investigated based on the study of the heterotrophic bacteria and of some indicator microorganisms (coliforms and streptococci). The releasing in the waterflow of the wastewater coming from different human activities and loaded with organic polluting agents affects the water quality, favourising the development of an abundant saprophytic microflora with an intensive degradative activity, mainly in the lower region of the river. The presence and the number of faecal coliforms and streptococci indicates a strongly polluted water with faecal materials in the sampling sites located downstream from the human settlements.

Introduction

Specific uses of the water of rivers (drinking water supply, agricultural irrigations, recreational use, fish consumption) have adverted the attention to the water quality and the main polluting agents, that interfere with the aquatic living systems.

The microflora of the rivers consists of autotrophic and heterotrophic, aerobe and anaerobe bacteria, participating together to the biogeochemical cycles of chemical elements, decomposition and mineralisation of natural organic substances and of organic xenobiotics.

The composition, the activity and the physiological condition of the microbial populations are influenced by the environmental conditions, such as the chemical composition of the river, the content of the inorganic and organic nutrients, the temperature, pH and the oxigen content of the water. Many polluting agents coming from human activities and released in different sections of the rivers affects the water quality and endanger the equilibrium of the aquatic communities. The quantitative and qualitative changes appeared in the composition, abundance and diversity of microbial populations express the degree of water contamination and the nature of polluting sources[2,3].

Materials and methods

The microbiological investigations of the water include the determination of the total number of bacteria and the number of some group of bacteria that serve as indicators of water contamination.

The sample stations for bacteriological investigations were located upstream and downstream from some of the suspected pollution sources and the major tributary streams. The water samples were taken in sterile flasks and stored at 4°C until they were analysed under laboratory conditions. For the bacteriological determinations were prepared water dilutions from 10^{-1} to 10^{-5}.

The determination of the total number of bacteria was carried out by the inoculation of the water dilutions on nutrient agar medium and after 24 and 48 hours of incubation at 37°C the developed colonies were counted.

For the detection and determination of the number of indicator bacteria presumptive and confirmatory tests were used. During the presumptive tests the water dilutions were inoculated on special media (lauryl-sulphate broth for total and faecal coliforms and azide medium for faecal streptococci respectively). The incubation temperature was 37°C for the total coliforms and faecal streptococci and 44,5°C in case of the faecal coliforms. The results (gas formation in Durham tubes for coliforms and colony growth with turbidity for the streptococci) were estimated after 24 and 48 hours of incubation. The most probable number of the indicator microorganisms was established using the McCrady table based on the number of positive tubes[6,7].

The confirmatory tests used selective media, which allow the development of a specific group of microorganisms and inhibit all other microorganisms. The selective media were inoculated from the tubes considered positive in the presumptive tests.

The Levine (EMB) medium was used for the selective cultivation of coliforms and the bromocresol purple-azide broth was the selective medium used for the confirmation of faecal streptococci. The development of characteristic colonies, the turbidity and the change of colour from red to yellow indicate the presence of coliforms and streptococci respectively.

Results and discussion

Because the heterotrophic bacteria are the main decomposers in the rivers, responsible for the degradation of different organic substances and xenobiotics, the estimation of the total number of saprophytic bacteria offers information about the organic material content of the water. A high value of the total number of bacteria indicates an abundant microflora capable to utilise natural and synthetic organic substances as nutrients and probably the microflora also contains numerous pathogenic species coming from wastewater [7].

Coliform and streptococci indicator tests are commonly used public health tests of safety of natural water and wastewater which might be contaminated with untreated sewage or treated sewage effluent [5, 8]. The number of indicator microorganisms is influenced by the seasonal environmental conditions, the recreational use of the water and the quality of wastewater released in the river [1,4].

The coliform group of bacteria that consists of members of the genera *Escherichia, Citrobacter, Klebsiella* and *Enterobacter* serve as indicator of the faecal contamination of water.

The faecal coliforms are a termotolerant subgroup of total coliforms and include mainly members of *Escherichia* and *Klebsiella*. Because the faecal coliforms are almost exclusively found in the waste of warm-blooded organisms this group reflects more accurately the presence of faecal contamination from animals in water than does the total coliform group.

Faecal streptococci have also been used as indicators of faecal contamination of water, because members of this group persist longer time in the water than coliforms.

The values of the total number of bacteria measured along the river are presented in Fig.1 and the amount of the indicator microflora are shown in Fig. 2 and Fig. 3 for the coliforms and Fig. 4 for the faecal streptococci.

The values of total number of bacteria and the number of coliforms and streptococci indicate clean, unpolluted water in the upper section of the Mureş river (Senetea and Gălăoaia) in all sampling periods. In this region the river flows far from the human settlements and the life of the aquatic communities is not perturbed by the released polluting sources. Downstream from Târgu Mureş the pollutants coming from different human activities affect the river, but the data show that the negative influence is reduced until the Mureş reaches Ungheni. The water brought by the river Arieş pollutes the water of the Mureş, the unfavourable effect is reflected by the presence of coliforms and especially of streptococci in high number at the confluence site of the Mureş with the Arieş in every sampling period, excepting September, when the values were lower.

The total number of bacteria and the number of indicators increased significantly in the lower region of the river, indicating strongly polluted water. At the confluence point of the Mureş with the Târnava river (Sântimbru) the water quality decreased because of the negative influence of the pollutants brought by the tributary stream and spread by the waterflow. Remarkable are the high values of streptococci at this sampling site, here were registered the highest values during the study. The industrial wastewater loaded with organic polluting agents has a favourable effect on the development of degradative bacteria, mainly at Vinţu de Jos. The household wastewater and the by-products coming from agriculture and animal husbandry and released in the river determine the contamination of the water with faecal materials and increase the amount of the coliform microorganisms, the highest values were registered in the last two sampling sites along the Mureş (Vinţu de Jos and Pecica). The presence of pathogens in a number above of the admissible values makes the water unsuitable even for recreational use or for irrigation of crops that serve as food or fodder.

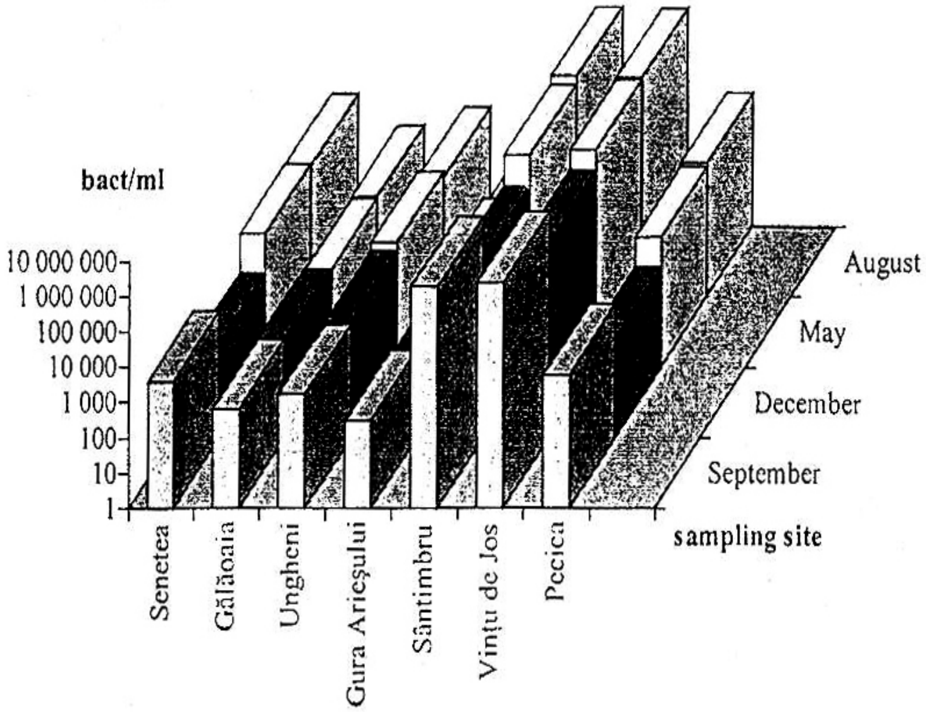

Fig. 1. Values of total number of bacteria in the studied sampling sites

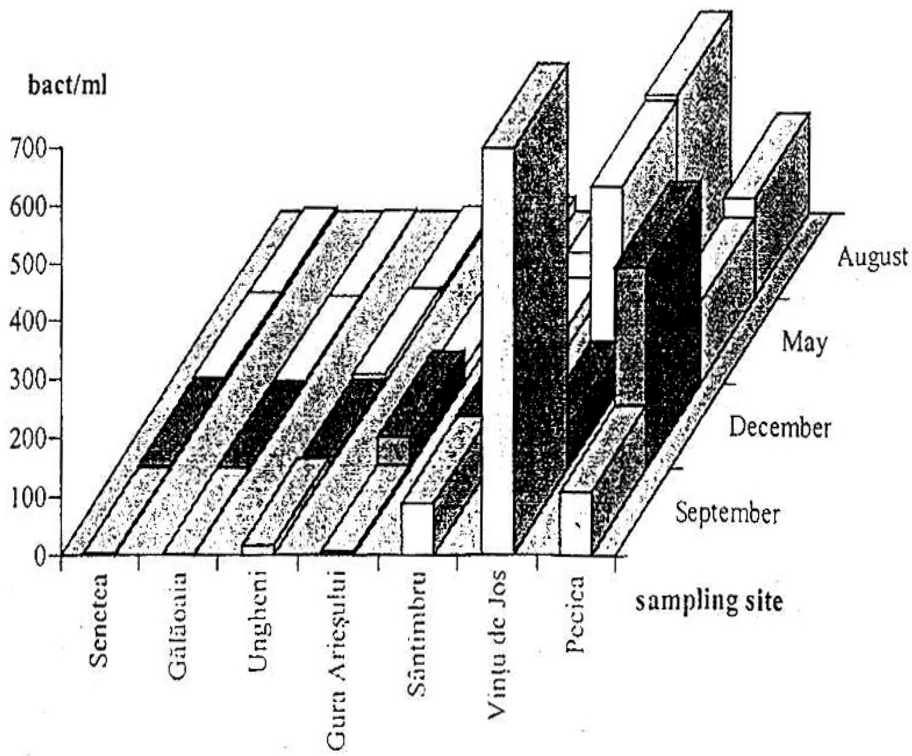

Fig. 2. Number of total coliforms in different sampling sites along the Mureş river

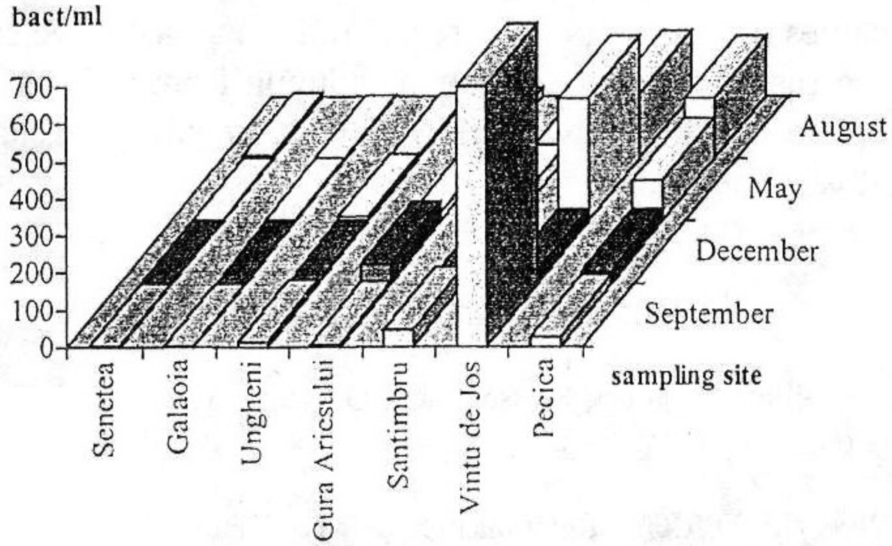

Fig. 3. Number of faecal coliforms in different sampling sites and periods

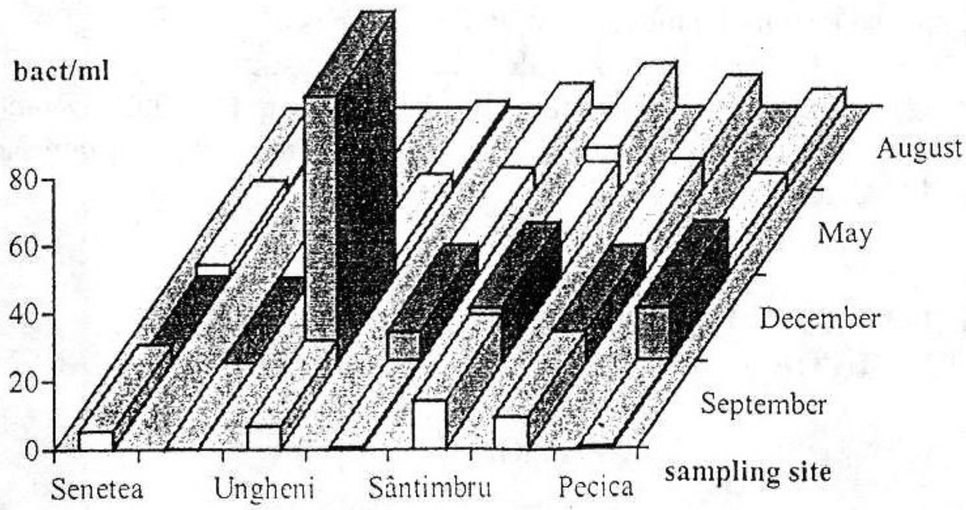

Fig. 4. Variations in the number of faecal streptococci along the Mureş river

Conclusions.

1. The two upper sampling sites (Senetea and Gălăoaia) proved to have an unpolluted water, with a low number of coliforms and streptococci.
2. The water brought by the tributary streams (Arieş and Târnava), loaded with organic materials, perturbs the natural microbial communities, increasing the number of faecal indicators, especially of streptococci.
3. The highest values of indicators were registered at the last three sampling sites, indicating that the organic pollutants coming from different human activities and released in the waterflow have a negative effect on the ecological status of the river.

REFERENCES

1. Crabill, C., Donald, R., Snelling, J., Foust, R., Southam, G., 1999, The impact of sediment fecal coliform reservoirs on seasonal water quality in Oak Creek, Arizona, *Wat. Res.*, **33**, (9): 2163-2171.
2. Crowther, J., Kay, D., Wyer, M. D., 2001, Relationships between microbial water quality and environmental conditions in coastal recreational waters: the Fylde Coast, UK, *Wat. Res.,* **35**, (17): 4029-4038.
3. Daby, D., Turner, J., Jago, C., 2002, Microbial and nutrient pollution of coastal bathing waters in Mauritius, *Environ. Internat.*, **27**: 555-566.
4. Dellile, D., Dellile, E., 2000, Distribution of enteric bacteria in Antarctic seawater surrounding the Dumont d'Urville Permanent Station (Adélie Land), *Marine Pollut. Bul.*, **40**, (10): 869-872.
5. Gauthier, F., Archibald, F., 2001, The ecology of fecal indicator bacteria commonly found in pulp and paper mill water systems, *Wat. Res.,* **35**, (9): 2207-2218.
6. George, I., Crop, P., Servais, P., 2001, Fecal coliform removal in wastewater treatment plants studied by plate counts and enzymatic methods, *Wat. Res.,* in press.
7. Mănescu, S., 1989, *Microbiologie sanitară*, Ed. Medicală, Bucureşti: 42-143.
8. Rompré, A., Servais, P., Baudart, J., de-Roubin, M. R., Laurent, P., 2002, Detection and enumeration of coliforms in drinking water: current methods and emerging approaches, *J. Microbiol. Methods*, **49**: 31-54.

EVALUAREA POLUĂRII ORGANICE A RÂULUI MUREŞ CU AJUTORUL MICROFLOREI INDICATOARE

(Rezumat)

Calitatea apei determină compoziția, diversitatea şi starea fiziologică a microflorei acvatice, precum şi abundența şi răspândirea unor specii. Orice schimbare calitativă sau cantitativă survenită în starea populațiilor microbiene permite evaluarea stării ecologice a râurilor şi natura sursei de poluare. Determinarea numărului total de bacterii dă informații despre microflora bacteriană saprofită şi eventual patogenă a apei. Coliformii totali şi fecali, precum şi streptococii fecali sunt indicatori larg utilizați pentru determinarea poluării fecale a apei. Punctele de recoltare de-a lungul râului au fost stabilite ținând cont de principalele surse de

poluare şi de afluenții Mureşului. În sectorul superior apa prezintă un grad scăzut de poluare, iar apa colectată din sectorul mijlociu şi cel inferior este puternic afectată de poluanții organici proveniți din diferite activități umane şi deversați în fluxul de apă. Valorile cele mai mari ale numărului de bacterii heterotrofe aerobe care utilizează diferite substanțe organice, naturale sau sintetice au fost caracteristice punctelor de recoltare situate în sectorul inferior al râului. Valorile cele mai mari ale numărului de streptococi fecali s-au înregistrat la punctele de confluență cu Arieşul şi Târnava pentru streptococi, respectiv la Vințu de Jos şi Pecica pentru coliformi.