

THE DOMINANT BACTERIOFLORA IN THE WATER OF THE RIVER TISA AND THE MRTVA TISA (YUGOSLAVIA)

SLAVKA GAJIN, M. GANTAR, M. MATAVULJ, ZORICA OBRECHT and
M. ERBEŽNIK

*Institute of Biology, University of Novi Sad, N. Sad, Yugoslavia
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Abstract

During 1987 the dominant microflora of the river Tisa and the Mrtva Tisa was investigated. The result obtained indicate that the bacterioplankton of waters analyzed had far better conditions for count expression on media being poorer in nutrient contents than on standard nutrient agar.

In this respect, when using microbiological parameters as indicators of surface water quality we also recommend determination of number of the dominant, i.e. oligotrophic microflora of surface water. For this component of bacterioplankton both per se and in relation to viable count gives important information about the conditions of water investigated.

Introduction

Microbiological examinations of surface waters in Yugoslavia are mainly limited to smaller number of analyses prescribed by our law and regulations. These analyses are mainly limited to the sanitary aspect of water condition estimate, which is doubtless important. However, the results of recent investigations in the world indicate that in such examinations oligotrophic bacteria — the dominant microflora of surface waters — were not included (ISHIDA and KADOTA 1977, 1979, 1981, ISHIDA *et al.* 1979, 1982; KUZNECOV *et al.* 1879). This very component of microflora is the active factor whose enzymes of wide range of activities are of primary importance in surface water autopurification processes.

For this reason, in this work, an attempt was made to examine the quality of water according to microbiological indicators in the water of the Mrtva Tisa and the Tisa, paying special attention in these examinations to oligotrophic microflora.

The Mrtva Tisa is the old flow of the river Tisa, formed by cutting the river bed in the last century (in 1858). Considering that in the Mrtva Tisa a large number of fish species find favourable life conditions, the Mrtva Tisa has been used for fishing, while recently this region has been developing fishing tourism. Considering the importance of bacterioplankton as a mineralisator of organic matter, but also in the first chain in the cycle of fish nutrition, in our opinion too little attention was paid to this component, since the data about the bacterioflora in the water of the Mrtva Tisa are sparse (RISTIĆ *et al.* 1974). This work includes study of the water quality of the Mrtva Tisa on the base of microbiological indicators, while in order to compare the water condition, a parallel water quality examination was conducted for the Tisa, upstream and downstream of the Mrtva Tisa.

Materials and Methods

The samples for microbiological analyses of the Mrtva Tisa water (at Čurug and Bačko Gradište) and the Tisa (at Novi Bečej and Žabalj) were taken during the year 1987, under aseptic conditions, and analyzed in the microbiological laboratory of the Institute of Biology in Novi Sad. The total number of bacterioplankton was determined by a direct method of Bacteriological filtration (RAZUMOV 1932), using membrane filters „Sartorius” No. 2. The viable count of heterotrophic bacteria was determined on nutrient agar. The count of oligotrophic bacteria was also determined by cultivation on nutrient agar which was diluted ten, one hundred, and one thousand times respectively, as well as on F-5 medium (ISHIDA and KADOTA 1977).

In addition, water phosphatase activity was determined on paranitrophenyl-phosphate (pNPP) as a substrate (MATAVULJ et al. 1982). The categorization of waters investigated was made both on the basis of viable count of bacteria (KOHLE 1975) and on the index of enzyme activity (MATAVULJ et al. 1982). The water condition assessment was made on the basis of T/H index (e.g. ratio between total number of planktonic bacteria and viable count of bacteria) as well as on O/H index (e.g. ratio between oligotrophs and viable count). The results obtained are shown as average values for the year 1987.

Results and Discussion

The data presented in this report suggest that the bacterioplankton of the water tested had far better conditions for growth on media which are poorer in nutritious matter than on standard nutrient agar (Fig. 1). For example, in the water of the river Tisa at Novi Bečej and Žabalj the number of colonies on diluted nutrient agar was 3.5 and 5.5 times higher than that on nutrient agar (MPA), while in the Mrtva Tisa at Čurug — 3 and at Bačko Gradište — 7.2 times higher. This fact indicates a considerable error of standard methods for examination of surface waters, and at the same time shows the domination of autochthonous microflora over the heterotrophic, i.e. points to the satisfactory power of autopurification. It is also noticeable in the results shown in Fig. 1 that the largest number of bacterioplankton (obtained by cultivation on nutrient media) was recorded on agar diluted ten or even hundred times, while on medium F-5 (proposed for this purpose for counting of oligotrophic bacteria in surface waters by ISHIDA and KADOTA 1977) the number of colonies was far smaller.

When comparing the total number of bacterioplankton, obtained by direct method, with the count of colonies grown on media differing in nutrient contents, it can be noticed that the latter is much closer to the former if media applied were poorer in nutrients (Fig. 2.). In all the samples analyzed the viable count obtained on poor nutrient media was higher than that achieved on standard nutrient agar. However, at Žabalj locality the viable count has even reached the total number of bacterioplankton (Fig. 3).

For all these reasons, we would suggest the use of diluted nutrient media for the study of microbiological indicators of surface water quality which also include oligotrophic, i.e. dominant microflora of surface waters.

The results of microbiological examinations of the water from the Tisa and the Mrtva Tisa in 1987 indicate that the Tisa water at Novi Bečej belonged to 2nd to 3rd class (after KOHL), that is, to polluted waters (according to T/H ratio), whereas at Žabalj water was even more polluted (Table 1). In the Mrtva Tisa the water at Čurug belonged to the same category as at Žabalj (according to Kohl and T/H ratio) and was of better quality at Bačko Gradište. Only according to enzymatic activity the Tisa water belonged to 3rd-B category, and the Mrtva Tisa water even

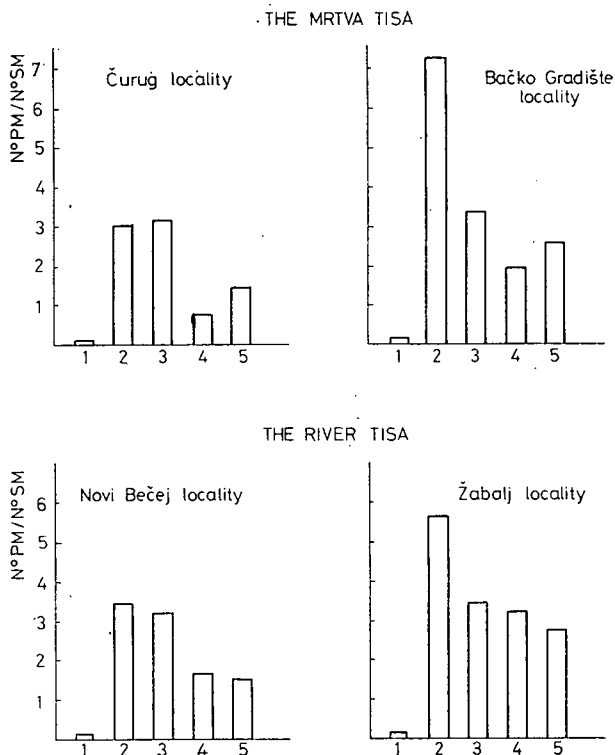


Fig. 1. Ratio of the number of bacteria counted on poor nutrient medium (PM) and number of bacteria counted on standard nutrient agar (SM). (1 — standard nutrient agar, 2 — diluted 10 times; 3 — diluted 100 times; 4 — diluted 1000 times; 5 — F-5 medium)

Tab. 1. The river Tisa and the Mrtva Tisa water quality according to microbiological and enzymological indicators

Indicator of water quality \ Locality	After Köhl (1975)	T/H index	Phosphatase activity index
The river Tisa Novi Bečej	II—III	polluted	IIIB
The river Tisa Žabalj	III—IV	highly polluted	IIIB
The Mrtva Tisa Čurug	III—IV	highly polluted	IVB
The Mrtva Tisa Bačko Gradište	II	moderately polluted	IVB

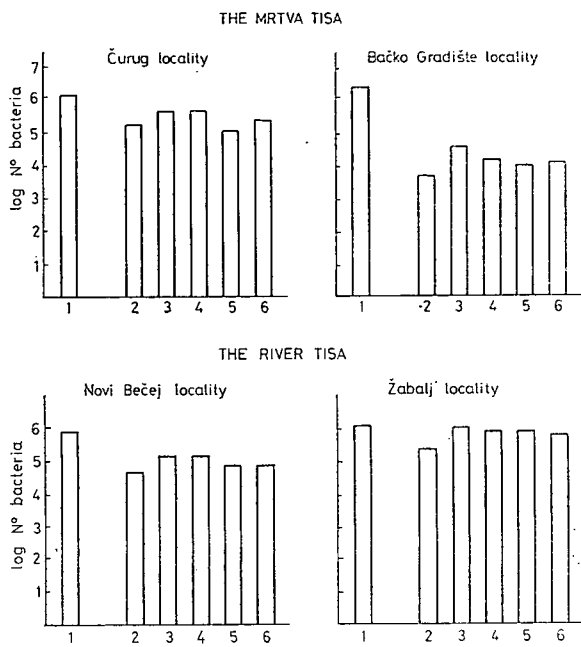


Fig. 2. Total count of bacteria and number of bacteria counted on different media. (1 — total number; 2 — standard nutrient agar; 3 — nutrient agar diluted 10 times; 4 — nutrient agar diluted 100 times; 5 — nutrient agar diluted 1000 times; 6 — F-5 medium)

to 4th-B category, which was possibly due to phytoplankton bloom. It should be mentioned that in the Mrtva Tisa in the summer period 800 000 individuals of phytoplankton per ml were recorded, with the prevalence of cyanobacteria.

Conclusion

According to the results obtained by estimation of dominant microflora in the water of the Tisa and the Mrtva Tisa during the year 1987, we can conclude the following:

The bacterioplankton had far better growing conditions on media which are poor in nutritious matter than on standard nutrient agar.

For examination of microbiological indicators of surface water quality by cultivating methods, we suggest the use of diluted nutrient agar media which maintain the oligotrophic, i.e. dominant microflora of surface waters.

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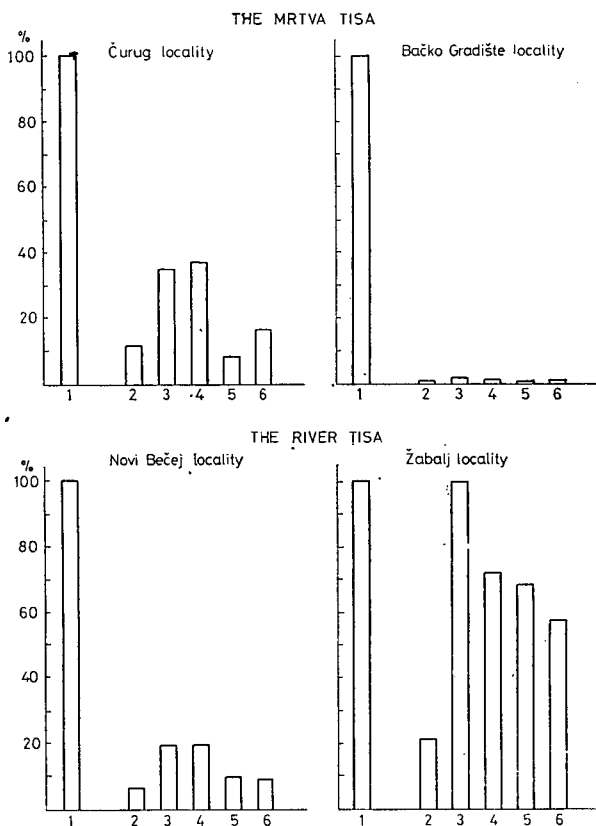


Fig. 3. Percentage of number of bacteria counted on different media related to total number of bacterioplankton

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A Tisza és a Holt-Tisza domináns bakterioflorája (Jugoszlávia)

GAJIN SLAVKA, GANTAR M., MATAVULJ M., OBRECHT ZORICA és
ERBEŽNIK M.

Egyetemi Biológiai Intézet, Újvidék

Kivonat

A Tisza és a Holt-Tisza domináns mikroflórájának 1987-ben végzett vizsgálata alapján megállapítást nyert, hogy a nutrien anyagokban szegényebb táp messzemenőleg kedvezőbbnek bizonyult a bakterioplankton számbeli gyarapodására, mint a hagyományos táptalaj.

A szerzők a kapott eredmények alapján, a felszíni édesvizeket indikáló mikrobiológiai paraméterek alkalmazása mellett, javasolják a felszíni vizek domináns, vagyis oligotróf mikroflórájának mennyiségi meghatározását is. Ugyanis a bakterioplankton e komponense magában is, valamint a heterotróf baktériumok mennyiségéhez viszonyított aránya is, a vizsgált vizek állapotáról megbízható adatokat szolgáltat.

Доминирующая бактериофлора воды реки Тиса и мертвая Тиса (Югославия)

Гайин Славка., Гантар М., Матавуль М., Обрехт Зорица, Зрбежник М.

Институт по биологии Естественного-математического факультета г. Нови Сад

Резюме

В течение 1987 года выполнялись испытания доминирующей микрорастворимости реки Тиса и Мертвая Тиса. Полученные результаты указывают на то, что для бактериопланктона подвергавших анализу вод, существовали лучшие условия для увеличения его количества на средах, с пониженным содержанием питательных веществ, чем на стандартных питательных средах.

Учитывая эти результаты, при применении микробиологических параметров как индикаторов качества воды пресноводных поверхностных экосистем, рекомендуется также и определение численности доминирующей, т.е. олиготрофной микрорастворимости поверхностных вод. Этот компонент бактериопланктона, сам по себе, а также и его отношение к численности гетеротрофных бактерий, дает ценные данные о состоянии испытываемых вод.

Dominantna bakterioflora vode reke Tise i mrtve Tise (Jugoslavia)

GAJIN SLAVKA, GANTAR, M., MATAVULJ, M., OBRECHT ZORICA i ERBEŽNIK, M.

Institut za biologiju, Prirodno-matematički fakultet u Novom Sadu

Izvod

Tokom 1987. godine istraživana je dominantna mikroflora reke Tise i Mrtve Tise. Dobijeni rezultati ukazuju na to da je bakterioplankton analiziranih voda imao daleko bolje uslove za ekspresiju brojnosti na podlogama siromašnijim u sadržaju nutrijenta nego na standardnoj hranljivoj podlozi.

Imajući u vidu ove rezultate, kada se koriste mikrobiološki parametri kao indikatori kvaliteta voda slatkovodnih površinskih ekosistema, preporučujemo takodje i određivanje brojnosti dominantne, tj. oligotrofne mikroflore površinskih voda. Ova komponenta bakterioplanktona, kako sama za sebe, tako i njen odnos prema brojnosti heterotrofnih bakterija, pruža dragocene podatke o stanju ispitivanih voda.