WATER QUALITY OF THE ZRENYANIN-BANATSKA PALANKA STRECH OF THE MAJOR CANAL OF THE DANUBE-TISZA-DANUBE CANAL SYSTEM ACCORDING TO MICROBIOLOGICAL PARAMETERS

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ABSTRACT

In the frame of complex investigations of the biodiversity of Voyvodinian Danube-Tisza-Danube (DTD) canal system, the investigations of the qualitative and quantitative composition of microorganisms, have also been undertaken. Sapromicrobiological, hydrobiological and biochemical (enzymological) parameters of the water quality of the main, magistral canal of the Danube-Tisza-Danube canal net at the Zrenyanin–Banatska Palanka strech have been investigated. The seasonal fluctuations of the number of bacterioplankton, amount of chlorophyll "a", and water phosphatase activity, have been studied at the 5 sampling sites: Botosh, Banatska Dubica, Yermenovci, Vlaykovac and Banatska Palanka.

The obtained results point to the satisfactory good water quality, as well as good selfpurification ability. Compared with the results obtained in period of time before 1984, when the Canal waters belonged mainly to III and on some sampling sites to IV class of water quality according to Kohl classification (7), in the 2000 year, canal waters belonged mainly to the II-III class. Results of biochemical analyses of rate of heterotrophic activity, confirmed the results obtained by sapromycrobiological and hydrobiological analyses of water quality.

According to the results obtained, we point to the necessity of undertaking of strict measures of protection of canal ecosystem. The anticipated intensification of industrial production and transportation in the main canal region could endanger the ecological balance and wise, sustainable use of canal ecosystem becomes permanent task of our society.

1. INTRODUCTION

The main net of the irrigation and transportation Danube-Tisza-Danube (DTD) canal system in the northern Serbian Voyvodina province of the length of about 1000 km consists of interconnected artificial canals and watercourses which, being regulated, have lost some of their original natural properties, and are being under the permanent anthropogenic influence. This canal net has been of the great significance for the region, first of all for an agricultural artificial irrigation, for transportation too, and also for fish culture and water supply under the condition of satisfactory quality of water.

Since in the Canal riparian zone numerous settlements and industrial centers are situated, and also the agricultural production is being more and more intensive, the DTD canal water quality depends primarily on the degree of wastewater purification, not only in our country, but also in the states upstream of the river Danube, the river Tisza (Tisa, Theiss) and other smaller watercourses (Begey, Tamish, Brzava, Moravica, Karash, etc.) coming from the neighbouring Romania.

Considering the fact that a small percentage of regional wastewater has been treated before discharging into canal water as a recipient, and since the canal water turbulence and flow rate are almost irrelevant as a selfpurification factors, rather high water saprobity degree has been found (3, 11, 13), especially at the certain sections. Awareness of the importance of solving the problems of canal water pollution forced the regional water authorities to undertake numerous measures in order to improve a condition of surface waters in general, and especially in the regions where the water selfpurification has a reduced natural capacity. Since fourteen years ago a condition of canal waters of the Zrenyanin-Banatska Palanka section was very bad with a very low quality of water, the aim of our investigations was to determine a recent quality of water of the same object in order to compare the condition before and after all measures undertaken for the protection and conservation of natural surface watercourses of DTD system.

2. MATERIAL AND METHODS

During the course of four seasons (seasons order given at the figures: winter, spring, summer, autumn) of the 2000, water sampling was done at the sites: Botosh (Botoš), downstream of the lock of canal; Banatska Dubica, downstream of the river Brzava mouth; Yermenovci (Jermenovci), at the Yermenovci–Yanoshik bridge; Vlaykovac (Vlajkovac) - railway bridge, and Banatska Palanka, upstream of the point where the canal empties into the river Danube.

The samples for microbiological analyses were taken from the middle of the watercourse from the 1 m depth. Viable organotrophic (heterotrophic) bacteria count was determined on nutrient (Torlak, Belgrade) agar. The facultative oligotrophic bacteria count as well as the number of physiological groups of bacteria (proteolytic, lipolytic,

saccharolytic) was determined as described in Petrovicy *et a.l*'s manual (13).

Water phosphatase activity was determined in original, untreated water sample on p-Nitrophenylphosphate as a substrate according to modified method of Flint and Hopton (5), as described earlier (2, 8, 9).

The water quality estimation was carried out according to Kohl's classification (6), based on the number of heterotrophic bacteria, and also according to the water phosphatase activity level (8).

Chlorophyll *a* concentration was determined according to standard method (9) and used for the water trophic level according to Felföldy (3).

3. RESULTS AND DISCUSSION

Results of microbiological analysis of water of Zrenyanin–Banatska Palanka strech of DTD canal system in the course of 2000 point to characteristic variations of qualitative and quantitative composition of microbial population between different sampling sites, as well as depending on season at the same locality.

According to the quantitative composition of heterotrophic bacterioplankton shown (Fig. 1) in the course of 2000, canal water had relatively even quality belonging to slightly polluted waters - II class according to Kohl (7), with a few exceptions. One of them was Vlaykovac locality where water quality in the spring season belonged to the category of polluted - III class according to Kohl (7), and another was Banatska Palanka locality with water quality belonging to the slightly polluted (II-III class) category of waters.

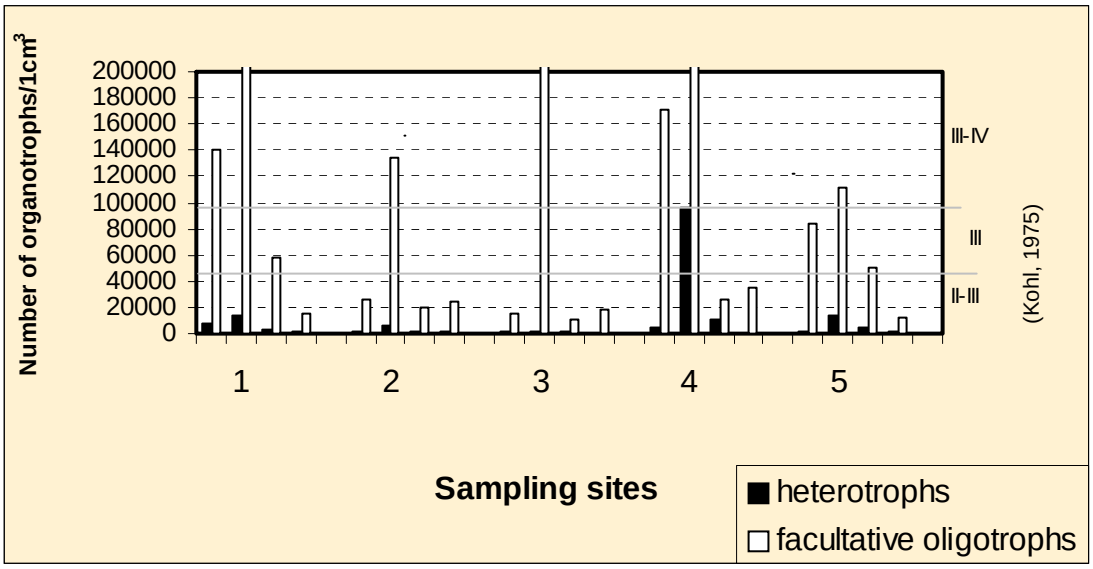

Figure 1. DTD Canal water quality estimation according to organotrophic bacteria number (Sampling sites: 1 – Botosh, 2 – Banatska Dubica, 3 – Yermenovci, 4 – Vlaykovac, 5 – Banatska Palanka)

The abundance of facultative oligotrophic microflora was in all cases greater than the number of heterotrophic bacteria, revealing the dominance of autochthonous microflora. The ratio between facultative oligotrophic and heterotrophic bacteria number ranged between 2.5 and 177.5. This fact was a good indication of an outstanding regenerative power of these watercourses, what was revealed by positive changes considering water quality, when compared with the water condition 1984 [6].

Considering the abundance of bacteria belonging to different physiological groups (Tab. 1), relatively low number during 2000 and at all investigated localities was recorded, consequently the investigated canal water was slightly and relatively evenly loaded by organic matter differing in chemical composition. Only slightly higher count of lipolytic bacteria was noted, pointing to the slight prevalence of pollutants of fatty nature. Follow number of naphta-degrading and phenol-degrading bacteria indicating increased pollution by this kind of pollutants, especially at the lowest section of canal, just before empting water into the river Danube. The relatively low number of mold particles point to the low amount of organic pollutants in investigated waters (Tab. 1).

Table 1. Seasonal distribution of physiological groups of microorganisms at different localities (CFU/cm^3)

Sampling sites	Season	Physiological groups of microorganisms						
		1	2	3	4	5	6	7
Botosh	Winter	30	3470	1800	1450	7500	2010	130
	Spring	2220	470	24300	7080	6320	970	36
	Summ.	600	2800	2200	7300	4500	20	40
	Autum.	300	80	640	900	340	10	170
	Mean	**788**	**1705**	**7235**	**4182**	**4665**	**753**	**94**
Banatska Dubica	Winter	1110	490	450	150	370	170	190
	Spring	300	580	12150	4450	3200	370	28
	Summ.	100	1200	800	1800	1150	600	40
	Autum.	230	70	330	830	200	30	210
	Mean	**435**	**585**	**3433**	**1808**	**1230**	**293**	**117**
Yermenovci	Winter	1330	430	1000	860	330	80	40
	Spring	530	430	5270	3600	3320	180	35
	Summ.	100	400	600	2700	1800	100	50
	Autum.	50	60	330	310	250	50	140
	Mean	**503**	**330**	**1800**	**1868**	**1425**	**103**	**66**
Vlaykovac	Winter	3450	8500	6370	1920	4370	1080	220
	Spring	6330	1520	60670	11450	13730	2480	80
	Summ.	1000	1600	3500	9800	11900	150	3
	Autum.	230	120	970	640	500	70	190
	Mean	**2753**	**2935**	**17878**	**5953**	**7625**	**945**	**123**
Banatska Palanka	Winter	610	390	1270	940	550	400	30
	Spring	2000	6000	24700	11480	3550	1610	42
	Summ.	1500	700	800	7500	5000	10	70
	Autum.	400	30	110	440	60	40	50
	Mean	**1128**	**1780**	**6720**	**5090**	**2290**	**515**	**48**

Legend: 1 - proteolytic bacteria; 2 - saccharolytic bacteria; 3 – lipolytic bacteria; 4 – naphta-oxidizing bacteria; 5 – phenol-degrading bacteria; 6 – total coliforms; 7 – molds

At almost all localities the coliform bacteria count was considerably higher during the spring and summer than during autumn and winter seasons. In term of sanitary status, waters of the DTD canal in the course of 2000 were found to be slightly to moderately polluted according to the classification after Kavka (5).

According to the values of chlorophyll "a" content, the level of nutrients content (trophic level) of canal water et the Banatska Dubica and Yermenovci sampling sites, belonged to oligo-mezotrophic waters; at the Botosh locality water belonged to the mezotrophic category, and at the Banatska Palanka and the Vlaykovac sampling sites water belonged to mezo-eutrophic category (14).

In the same time, since they do not indicate the current state of water, but reflect a certain previous state considering level of organic pollution, saprobiological and microbiological analyses should be supplemented and completed by biochemical, enzymological analyses that indicate contemporary eco-physiological status of investigated water environment (9, 11).

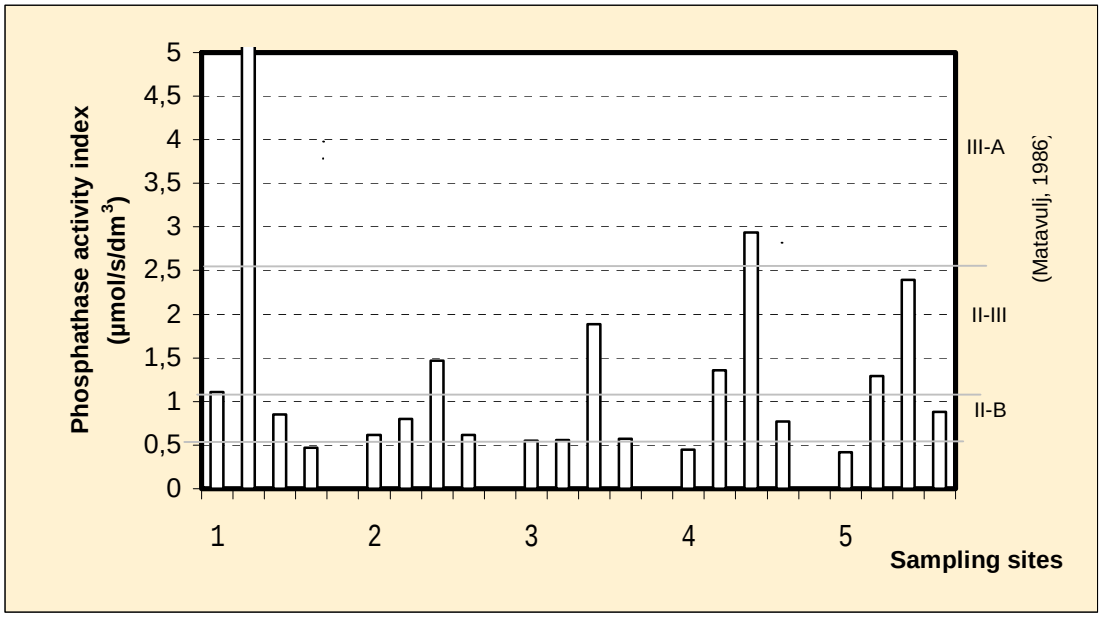

Figure 2. DTD Canal water quality estimation based on phosphatase activity index

The level of enzyme phosphatase activity of water testifies to slightly to moderately polluted waters during the period of investigations (Fig. 2). According to the phosphatase activity index (PAI) the canal waters belonged mainly to II-B class, e.g. to slightly polluted water category according to Matavuly (8), or to the II-III class or moderately polluted category. Only samples taken at Botosh in the spring and at the Vlaykovac during the summer season belonged to the III-A class, or to the category of polluted waters.

It should be also emphasized the high level of positive correlation between the enzyme activity of water and other microbiological indicators of water organic load. Mean values of heterotrophic bacteria count and phosphatase activity index for the whole 2000 point to the slightly to moderately polluted canal water of the majority of samplings (Fig. 3).

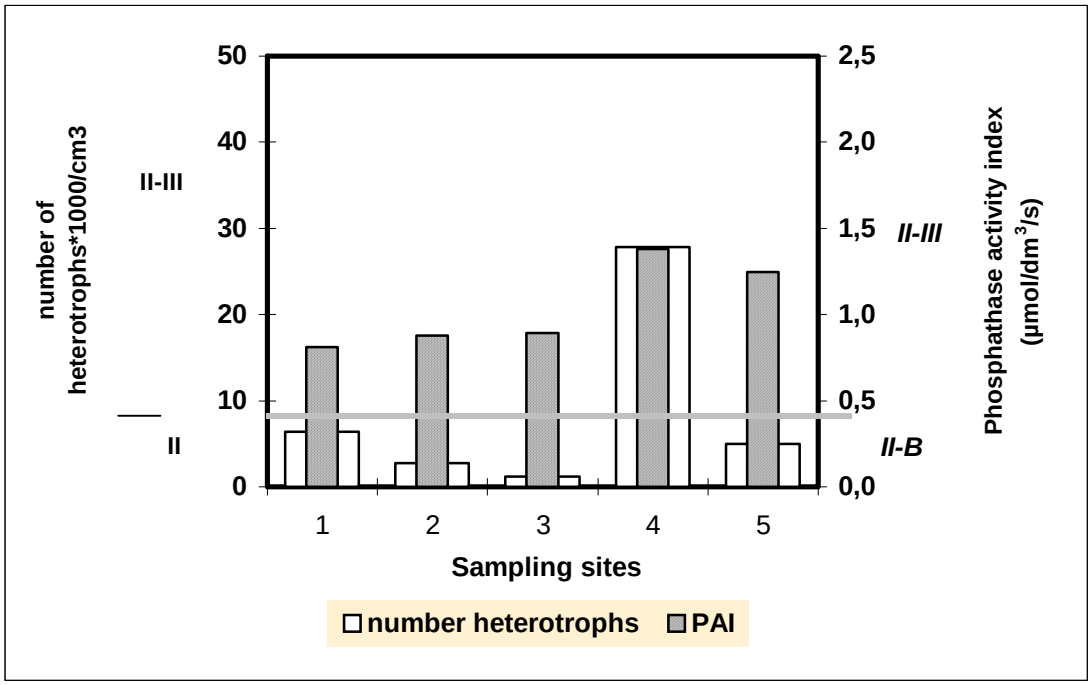

Figure 3. DTD Canal water quality estimation based on mean values of number of heterotrophs and phosphatase activity index (Sampling sites: 1 – Botosh, 2 – Banatska Dubica, 3 – Yermenovci, 4 – Vlaykovac, 5 – Banatska Palanka)

4. CONCLUSIONS

Comparing the quality of water of the canal DTD in 1984 with the condition sixteen years later, significant improvement of water quality due to measures of protection and conservation undertaken and also due to reduced water transportation and industrial production has been recorded at the Zrenyanin – Banatska Palanka strech of Main canal of DTD canal net.

Since chemical analyses do not explain the ecological status of water organisms, and since saprobiological and microbiological parameters indicate certain previous condition of water organic pollution, the biochemical, enzymological parameters, indicating contemporary water condition should be employed as parameters of water condition appraisal.

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