

HYGIENIC BACTERIOLOGICAL INVESTIGATIONS IN THE TISZA REACHES BETWEEN CSONGRÁD AND SZEGED (1975—1978)

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Abstract

In case of water utilization demanding the hygienic qualification of the surface waters, it is indispensable to carry out investigations for the quantitative and qualitative determination of the usual and facultative faecal indicator bacteria.

The authors performed investigations in the longitudinal section of the Tisza between Csongrád and Szeged, for establishing the hygienic bacteriological quality of the river and the change in pollution in time and space.

For the purpose of investigations, between 1975 and 1978, they took 440 water samples from the longitudinal section of the Tisza in County Csongrád and have carried out of this approximately 2700 investigations. The changes in the investigated hygienic bacteriological parameters are shown in figures and tables.

On the basis of results it was established that the hygienic water quality of the Tisza changed in a disadvantageous direction in the river stretch in County Csongrád between 1975 and 1978. The "somewhat polluted" water quality of the river became "polluted". The authors are calling the attention to that it is demanded by the protection of water quality, the administration of water quality, and by water utilization requiring a more and more increasing hygienic evaluation, that the river Tisza should be protected from further pollutions.

Introduction

In the Tisza valley, water is a factor of production which is only available in a minimum degree. 70 percent of the water requirement of the country presents itself here but only 20 percent of the water supply is to be found here. As it is known, only 3 percent of water flowing through the river-basin of the Tisza is of Hungarian origin. The other parts originate from the adjacent countries. In the following years, the quantity of foreign water curtailment increases prospectively more and more in our rivers and, owing to this, the water amount will decrease in this country. As the waters from the depth get more and more exhausted, as well, we must care for supplying the population with drinking-water of river origin. It is a known fact, too, that parallel with the increase in water demands, the amount of the issued sewage-water also increases (SIMÁDY 1977).

All these factors: the very changing and fluctuating water output of the Tisza, the sewage disposals of increasing volume, the construction of the Tisza river barrages strongly influence, change the microbiological conditions of river water.

In the last decade, more than one researcher dealt with investigating into the

Tisza. Longitudinal section investigations were carried out by PAPP (1961, 1964) on the Tisza and its tributaries for a long time, of the results of which he rendered accounts in more than one publication. In his work: "Felszíni vizeink minősége" (Quality of our surface waters) (1965) he established on the basis of the investigated chemical and bacteriological parameters that the Tisza arrives clean in the country. The river suffers a major pollution in three places: at the mouth of the Sajó, as well as in the area below Szolnok and Szeged. He measured the maximum bacterial content below Szolnok (120,000/ml), the minimum below Szeged (220/ml).

At the same time, the values of the coliform count/ml reached 1.5—192. On the basis of average values, he found the water quality of the Tisza reaches at Szeged of class I (clean) above Szeged and of class II (a little polluted) in the reaches below the town.

In the summer period (VII—IX), in the Tisza reaches at Szeged, at 11 sampling sites, a detailed investigation was carried out by VETRÓ—KISS—MINDSZENTY (1966). On the basis of the results of the investigations, carried out for five years, they established that at the sewage disposals the value of coliform count in the Tisza water is unfavourable but the water quality of the places assigned for bathing is not endangered by these disposals. In the longitudinal section of the Tisza, Deák—Schiefer's investigations (1971) meant the first detailed survey, including both the bacteriological and biological parameters. It was shown by the results of the investigations, carried out by them, that the water quality of the Tisza became one category worse during the last ten years, i.e., the "clean" water quality became a little polluted. They have referred to, as well, that the microbiological conditions of the river will probably be changed by the Tisza II-river barrage, then being in the course of construction. TAKÓCS—ANDRIK (1973, 1974, 1975) and ESTÓK—ANDRIK (1977) called the attention to the pollution of the Tisza stretch in Northern Hungary and of the tributaries, as well as to the pollution of these by pathogenic bacteria. ESTÓK—ANDRIK—CSÉPAI (1978) published the results of hygienic bacteriological investigations, registered in the Northern-Hungarian longitudinal section of the Tisza, after the Tisza II river barrage had begun functioning. They have established that the bacterial pollution of the Tisza had increased. Hegedűs—Kiss—Berényi, as mentioned in a former publication, reported on the salmonella contamination of the Tisza reaches in County Csongrád and of the two major tributaries. At present, we are demonstrating the changes in time and space and in quality of the investigated bacteriological parameters in the Tisza reaches between Csongrád and Szeged.

Materials and Methods

We have sampled the longitudinal section of the Tisza in County Csongrád (246—162.5 riv. km) from 1975, at six points, generally with a monthly frequency. Sampling sites are: Csongrád, pontoon-bridge 246.0 riv. km, Szentes, railway-bridge 242.0 riv. km, Mindszent, ferry 216.2 riv. km, Tápé, pontoon-bridge 176.5 riv. km, Szeged, open air bath 174.0 riv. km, as well as the area of Tiszasziget, 168—162.5 riv. km (Fig. 1). In 1978, our investigations increased. We could, namely, carry out cross-section investigations in the Hungarian—Jugoslav border-section, in order to register the effect of the outlet water from Szeged on the river reaches below the town.

The tributaries and major channels, discharging into the Tisza, were also systematically investigated in the past years. But we speak of these results only tangentially and report on them in detail in a later publication. For the purpose of investigations, 100 ml water samples were taken, 20 cm below the surface, from the streamline. The samples were brought, refrigerated, into the laboratory. They were processed there on the day of sampling but latest in 24 hours.

We have determined the bacterial count of coliform, faecal coliform, faecal streptococcus, resp. the streptococcus faecal, *Clostridium* and all the heterotrophic, psychrophilic, mesophilic bacteria.

The bacteriological investigations were carried out on the basis of the standard of the "Methodological Guide" (1977) and the "Bacteriological investigation into the drinking-water" (1971), published by the Water-hygienic Department of the National Institute of Public Health. The determination of the coliform and faecal coliform counts was made on the basis of the "most probable number (MPN)" principle in a lactose-bouillon culture medium. The cultures were incubated at 37 °C and 44 °C for 48 hours. They were streaked from acid- and gas-containing test tubes on an endo-laminated culture medium. The lamellae were incubated at 37 °C for 24 hours, then the colonies of metallic

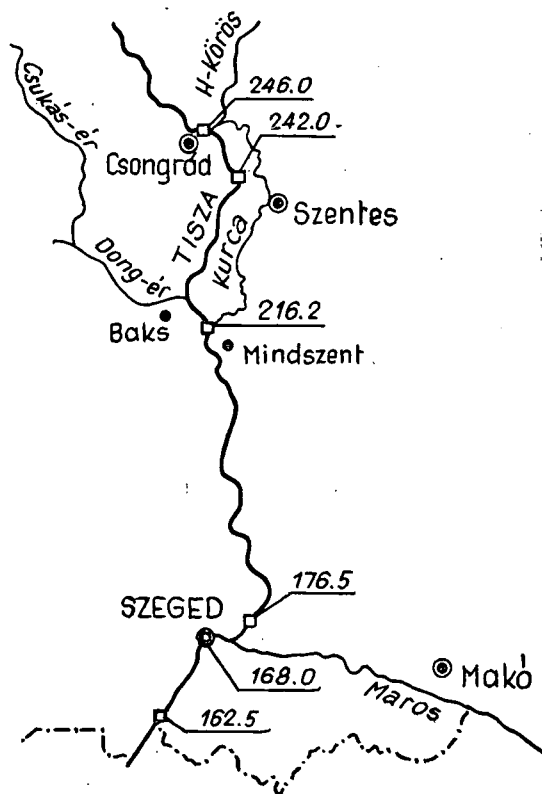


Fig. 1. Sampling sites in the Tisza reaches in County Csongrád (between 246—162.5 river kilometers).

lustre were evaluated. The heterotrophic bacterial count was determined in an agar culture medium with laminar casting method. The lamellae were incubated at 37 °C for 48 hours and at 20 °C for 96 hours. Then the colonies were counted. In 1975—1976, the streptococcus faecalis was determined in Litsky-Mallmann's culture medium with MPN method. The cultures were incubated at 37 °C, for 48 hours. The positive tubules were streaked on Szita's E⁶⁷ laminar culture medium. Lamellae were placed into the thermostat at 37 °C for 24 hours, then the heat test was carried out at 60 °C for 30 minutes. From 1977, the bacteria belonging to the faecal streptococcus group were determined in Slanetz-Bartley's (M enterococcus agar) culture medium, with membrane filter. The clostridium count was determined in Wilson's bismuth-free glucose agar culture medium, incubated at 46 °C (± 0.5 °C) for 24 hours.

At the hygienic water qualifications, the following indices were taken into consideration, according to the limiting values mentioned below, on the basis of Deák's data (1977). (Table 1).

Results

The results of the bacteriological investigations carried out in 1975—1976 are the following (Fig. 2): It can be established on the basis of the average values of the coliform count/ml that the water quality in the longitudinal section of the Tisza in County Csongrád changed unfavourably in 1976. In the areas of Mindszent and Tiszasziget, there was already shown a strongly polluted water quality of class IV by the maximum values. At the sampling sites of Csongrád and Szentes, the water quality of the Tisza belonged, on the basis of the hygienic water qualification, to the

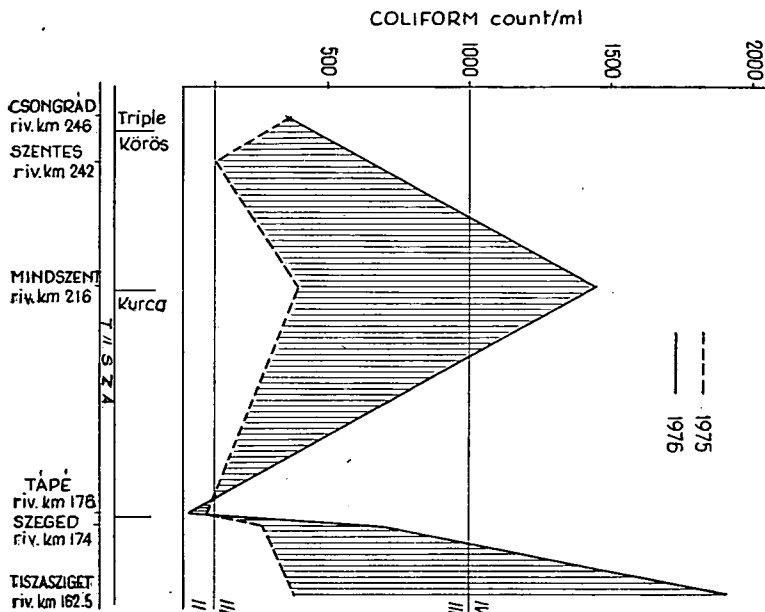


Fig. 2. Mean values of coliform count/ml at each sampling site in 1975—1976

polluted category III. In 1976, the most favourably water quality was to be found in the water area at Táapé of the longitudinal section of the river in County Csongrád. In this area, in annual mean value, the value of the coliform count/ml was below 100. Of the other investigated bacteriological parameters, the following can be said, in brief: They changed in the six water areas analysed so far similarly to the mean values of the coliform count. At the maximum of the coliform count, the other bacteriological parameters showed a maximum value, as well. In late July and early August, 1976, in the Yugoslav Tisza stretch, the Törökbecse river barrage began its trial operation. They began damming up the water without giving a previous information.

After it had become known to us that impoundment began, sampling was carried out more frequently for the purpose of bacteriological investigations between 168 and 160 river kilometers. The aim of the more frequent sampling was to be able to register the effect of impoundment in the boundary section. Then every investigated bacteriological parameter showed a maximum, as compared with the investigational results of the whole year.

As we can see from the water samples taken on 12 August (Fig. 3), the maximum

value of the coliform count was approximately 9000/ml. The value of the faecal coliform count is one order of magnitude lower than this. The values of the streptococcus faecalis and clostridium counts follow the tendency of the formers. After the vertical line, the data of the investigation of the cross-section are given.

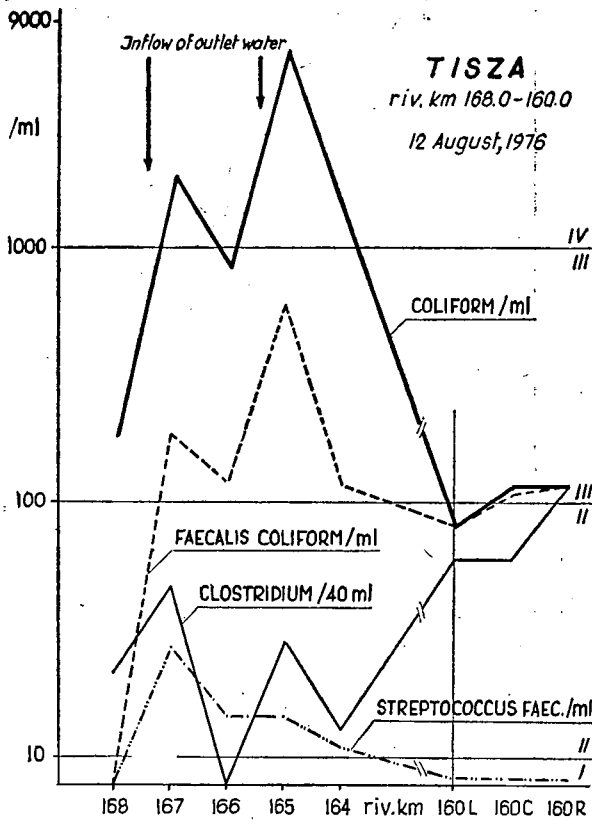


Fig. 3. Results of the bacteriological investigations into the water samples taken on 12 August, 1976.

I should like to observe that, in this time, the speed of the Tisza water was considerably slow down, showing almost the character of a standing water, and even, for a short time, it was flowing back. As damming began without any previous information, water speed could not be measured by the Water Conservancy of the Lower Tisza Region.

The bacteriological conditions of our water samples taken on 17 August (Fig. 4) are still more unfavourable. It is probable that in this time water speed continued slowing down and the local faecal indication could be measured well. The value of the coliform and faecal coliform count/ml was stagnant at a maximum between 1000 and 5000 between 167 and 164 river kilometers. In the same way, the streptococcus faecalis count also stagnated at maximum.

The unfavourable change in the water quality of the Tisza may have been caused by several factors:

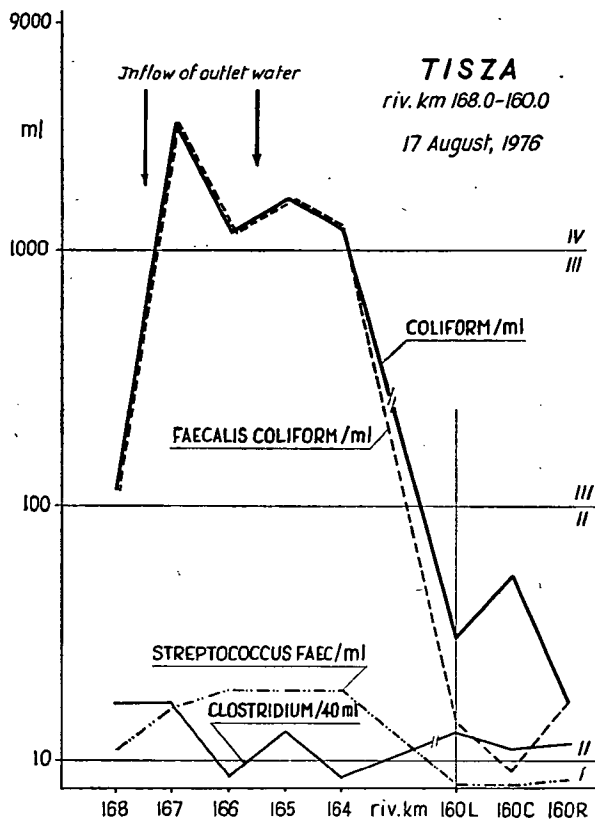


Fig. 4. Results of the bacteriological investigations into the water samples taken on 17 August, 1976.

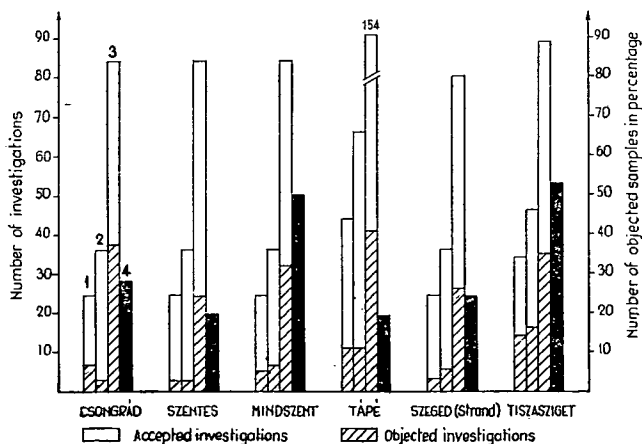


Fig. 5. Statistical evaluation of the results of the bacteriological investigations carried out in 1977
 1 Number of investigations carried out for demonstrating heterotrophic bacteria
 2 Number of investigations carried out for demonstrating *E.coli*
 3 Number of investigations carried out for demonstrating other bacteria.

- 1) In the summer and autumn months, the water-level of the Tisza was very low.
- 2) In this time, the Tisza II river barrage already operated for three years.
- 3) The water quality of the Tisza was unfavourably affected in the area of Szeged by the polluted water quality of the Maros, as well.
- 4) In the Yugoslav Tisza stretch, damming began and the impoundment considerably changed the speed of the river in the area of Szeged.

About the results of the bacteriological investigations carried out in 1977, we are presenting here a statistical evaluation (Fig. 5). The number of investigations taken from different bacteriological parameters is given for each sampling site. Within the column, the accepted (light part) and the objected investigation numbers (shaded part) are indicated. In column 1, the investigations aimed at demonstrating the heterotropic bacteria (20 °C, 37 °C); in column 2, those of *E. coli* (coliform, faecal coliform, *E. coli* I.) bacteria are given; and in column 3, the number of other bacteriological (clostridium, faecal streptococcus and in column 4 *Salmonella*) investigations are shown.

The percentage of the objected samples is designated with a straight line.

On the basis of the statistical evaluation, it can be established that in 1977, similarly to 1976, the most unfavourable water quality in the longitudinal section of the Tisza was registered in the areas of Mindszent and Tiszasziget. But at the sampling site of Tápé a change followed in the water quality of the Tisza.

The values of the bacteriological investigations, carried out at the sampling site of Tápé in 1977, indicated a water quality of category III. For instance, the mean value of the coliform count/ml in 1977 was already 272, as opposed to 92/ml in the previous year.

As far as we know, there was no new introduction of a considerable quantity of outlet water in the vicinity of the sampling site. It is probable that the deterioration of water quality in the water of the Tisza at Tápé is a lasting result of the impoundment.

Table 1. *Limiting values of the hygienic water qualification*

Bacteriological parameters	Categories of water qualification			
	I	II	III	IV
Coliform count/ml	0—10	10—100	100—1000	1000
Faecal coliform count/ml	0—1	1—10	10—100	100
Faecal streptococcus (Stanetz) count/ml	0—1	1—10	10—100	100
<i>Streptococcus</i> faecal count/ml	0	0—1	1—10	10
<i>Salmonella</i> positivity percentage	It can be demonstrated in a lower quantity than 33 p.c.			

On the basis of the hygienic bacteriological investigations in 1977, we can establish that the water quality of the Tisza is polluted (category III) at every sampling site in its longitudinal section in County Csongrád.

As the results of investigations in the past three years were most unfavourable at two sampling sites of the longitudinal section of the Tisza, in 1978 we systematically took water samples from the water of two channels, discharging into the Tisza at Mindszent. And in the Hungarian—Yugoslav boundary section of the Tisza, we have carried out cross-section investigations for ten months.

The Kurca is a channel of small water output, which collects the purified and not-purified outlet water of the town Szentés and flows, together with the Kórogyér, into the Tisza, at the left riverside (Fig. 1).

At the right bank of the Tisza, on the other hand, the Dongér Main Channel and the Csukásér, communicating with that, flow into the Tisza in the area of Mindszent. Their water quality is shown in a table (Table 2), compared with the water quality of the Tisza at Mindszent.

Table 2. Mean values of the bacterial investigations in 1978

Sampling site	Mean values			Water quality
	Coliform count/ml	Faecal coliform count/ml	<i>Clostridium</i> count/ml	
Csukásér Main Channel Tömörkény	48.000	4142	90	IV strongly polluted
Dongér Main Channel Baks	46.546	8087	326	IV strongly polluted
Kurca Below the town Szentés	1236	146	89.3	IV strongly polluted
Tisza Mindszent, riv. km 216	116.4	89.3	33.9	III polluted

The results are speaking for themselves. The water quality of the Dongér Main Channel at Baks, before discharging into the Tisza, is strongly polluted (category IV). The mean value of the coliform count/ml was 46546, that of the faecal coliform count/ml 8087. The value of the faecal streptococcus count reached 700/ml, and the clostridium count the value 800/40 ml.

The water quality of the Kurca channel was somewhat more favourable but similarly very polluted (category IV), on the basis of the investigated hygienic bacteriological parameters.

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On the basis of the results of the hygienic bacteriological investigations into the longitudinal section of the Tisza in County Csongrád in 1975—1978, the following may comprehensively be established:

1) The hygienic water quality of the Tisza in the Tisza reaches of County Csongrád is polluted (category III).

2) The Tisza reaches at Mindszent (216. 2 riv. km) and Tiszasziget (162.5 riv. km) are considerably loaded by the introduced not-purified outlet water.

3) The water quality of the Tisza at Tápé (176.5 riv. km) deteriorated one category in the past two years, i.e., the water category, "polluted a little" became "polluted". The cause of this may be the putting into operation of the river barrage at Törökbecse. The registration of this fact, however, demands still further investigations.

4) As it is known, the river barrages built and functioning in the Tisza so far, have been constructed for the aims of water management and the economy of water-supplies. At the same time, we have to reckon with with the fact that the microbiological conditions of the river have been altered by the river barrages. Owing to impoundments, the river Tisza also becomes more and more a channel.

5) It is, therefore, required by the protection of water quality, the economy of water quality and the water utilization demanding a more and increased hygienic decision that the river Tisza should be protected from further pollutions.

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Higiénés bakteriológiai vizsgálatok a Tisza Csongrád és Szeged közötti szakaszán

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Kivonat

Szerzők a Tisza említett hossz-szelvényében végeztek vizsgálatokat a folyó higiénés bakteriológiai minőségének, a szennyezettség tér- és időbeli változásának a megállapítására. Vizsgálataik a Tisza Csongrád megyei hossz-szelvényében 1975—78 között 2700 analízis alkalmazásával 440 víz-mintára terjedtek ki. Megállapításaik során a vizsgált higiénés bakteriológiai paraméterek változását mutatták ki. Eszerint a Tisza higiénés vízminősége a Csongrád megyei szakaszon 1975 és 1980 között kedvezőtlen irányban változott. Így a folyó „kissé szennyezett” vízminősége „szennyezett”-té vált. Rámutattak, hogy a vízminőségvédelem és vízhasznosítás megköveteli, hogy a Tisza folyót a további zennyeződésektől meg kell óvni.

ГИГИЕНИЧЕСКИ-БАКТЕРИОЛОГИЧЕСКИЕ ИССЛЕДОВАНИЯ ВОДЫ Р. ТИСА НА УЧАСТКЕ МЕЖДУ ЧОНГРАДОМ И СЕГЕДОМ

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Резюме

Авторами проведено исследование воды реки Тисы на указанном участке по определению её гигиенически-биологического качества, а также степени её загрязнённости в разных пространствах и в разное время. В ходе исследования в 1975—78 гг. продольного профиля Тисы в обл. Чонград было проведено 2700 анализов с 440 образцами воды. Как показывают определения, в исследуемых гигиенически-бактериологических параметрах наблюдались изменения. Установлено, что гигиеническое качество воды на участке обл. Чонград с 1975 по 1980 изменялось в неблагоприятном направлении. Имевшая ранее место оценка «несколько загрязнённая» изменилась на «загрязнённую».

Авторы указывают, что охрана качества воды и её использование требуют обязательного предохранения Тисы от дальнейшего загрязнения.

Sanitarно-bakteriološka ispitivanja na deonici Tise Csongrád—Szeged

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Abstrakt

Autori su na pomenutom uzdužnom profilu Tise vršili ispitivanja kvaliteta reke u odnosu na sanitarno-bakteriološka svojstva kao i utvrđivanje promena zagadjenosti u prostornoj i vremenskoj funkciji. Na uzdužnom profilu reke u županiji Csongrád u toku 1975—78 izvršeno je 2700 analiza iz 440 proba. Pri ovim ispitivanjima utvrđivane su promene u odnosu na sanitarno-bakteriološke parametre. Na osnovu toga je utvrđeno da je u vremenu od 1975 i 1980 došlo do promene sanitarnog kvaliteta vode Tise u negativnom smislu na deonici županije Csongrád. „Manja zagadjenost“ jg postala „zagadjena“. Autori ukazuju da zaštita kvaliteta vode i njeno korišćenje zahtevaju sprečavanje dalje zagadjivanje reke Tise.