

# COMPREHENSIVE EVALUATION OF THE RESULTS OF THE DAPHNIA TEST CARRIED OUT AT THE TISZA-SECTION AND MAJOR DISTRICT WATERS IN SZOLNOK COUNTY (1977—87)

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(Received December 22, 1987)

## Abstract

Between 1977—1987 acute toxicological studies were carried out with *Daphnia magna* at eight points of the Tisza-section in Szolnok county and at the major district waters of the region. It was determined that in the periods studied 19,4% of the Tisza water samples and 4,8% of the samples originating from the district waters were of toxic effect on the *Daphnia*. From 1975 on the positivity of the Tisza water samples taken frequently above the area of the Surface Water Works in Szolnok showed strongly decreasing tendency, falling back from 74% to 1%. The observed phenomenon can be explained most probably by the beneficial effect of the Kisköre storage lake, since the drastic decrease of the high rate of objection observed previously coincided with the filling up of the lake between 1979—1983.

## Introduction

Since 1974 the Water Microbiological Laboratory of the Service of Public Health and Epidemiology of Szolnok County carries out regular chemical, bacteriological, biological and toxicological studies with the aim to reveal the environmental effects. Within the complex hygienic programme the importance of these acute toxicological studies was emphasized several times, in the frame of which biological tests were accomplished in respect to the Tisza river in Szolnok county, and the major district waters of the region, as well as the drinking water of the city of Szolnok, provided from the Tisza river. Here we would refer to some of the data published earlier on this topic (CSÉPAI 1975, 1976, SCHIEFNER 1979, KÁDÁR 1983). In the following a review is given on the results of the *Daphnia* toxicity tests carried out in the period between 1977 and November 30, 1983.

## Materials and Methods

The water samples were taken from the sites given in Fig. 1 and the tables, 5 cm below the surface, transported in refrigerated state and processed within 24 hours after temperation to room temperature. The *Daphnia* toxicity tests were performed and the results evaluated according to the specifications of the Hungarian *Daphnia* test (Water Toxicological Studies, 1982). The principle

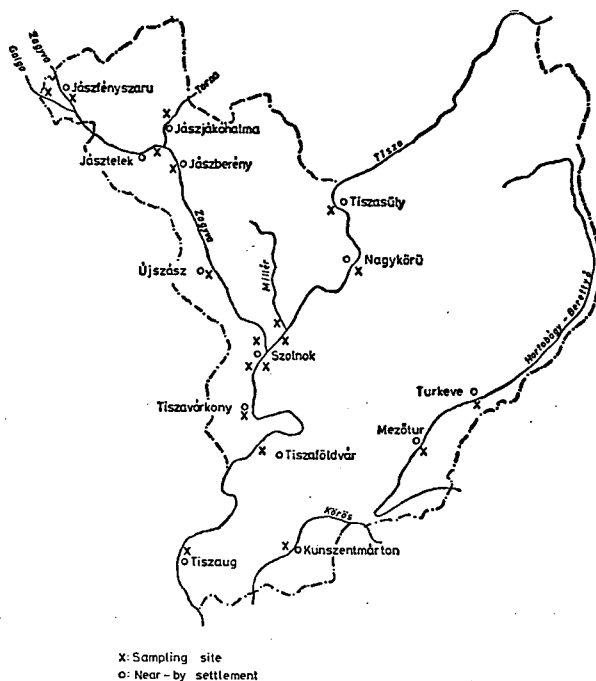


Fig. 1. Regional distribution of the sampling sites

of the test is that for negative qualify those samples in which half of the *Daphnia* survive a 48 hours' period of exposure; in the opposite case, the result of the *Daphnia* test is regarded as positive.

The *Daphnia* toxicity tests were carried out using 4 days-old organisms of the strain *Daphnia magna* S cultivated in our laboratory. The sensitivity of *Daphnia* to chromate corresponded to the requirements of the Hungarian *Daphnia* test mentioned above.

## Results and Evaluation

In connection with the results to be described below, we should mention that the findings of the tests carried out in the period 1974—1978 at the Tisza-section in Szolnok county have been previously discussed by SCHIEFNER (1979) as a part of the studies performed on the whole length of the river on the territory of Hungary.

According to our results, within the period studied 19,4% of the total samples taken from the Tisza-section in Szolnok county proved to be *Daphnia* positive (Table 1). The data show that the river water is toxic for *Daphnia* primarily in autumn, winter and early spring months. These findings prove the role played by the temperature factors in the realization of the effect of the toxic microcontaminants occurring in the Tisza water. The toxicity of the district waters was low: the positive samples amount to 4,8% of the total samples studied (Table 2). From the point of view of the seasonal distribution of the positive results, the relationship is similar to that experienced during the course of the studies at the Tisza river.

Tests of the unrefined surface water obtained by the Szolnok Surface Water Works were carried out by us at least once, more often twice a week. The results are shown in Fig. 2.

Table 1. Months

Szamplng sites Tisza		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	1977—1987 Total	
Tiszasüly right bank	positive	2	2	1	—	—	—	—	2	1	—	1	1	10	positive negative total
	negative	1	5	2	9	1	10	—	8	—	10	—	7	52	
Nagykörü right bank	positive	2	1	1	—	—	—	—	2	—	1	1	1	9	positive negative total
	negative	—	2	1	3	1	4	—	2	1	3	—	2	19	
Unrefined water obtained by Szolnok Water Works	positive	2	3	1	—	—	—	—	3	1	2	1	2	15	positive negative total
	negative	—	4	2	9	1	10	—	7	—	8	—	6	47	
Szolnok left bank below Zagyva	positive	2	2	1	—	—	—	—	2	1	2	1	2	13	positive negative total
	negative	—	4	2	9	1	9	—	8	—	8	—	6	47	
Szolnok right bank below Zagyva	positive	2	1	1	—	—	1	—	2	1	2	1	2	13	positive negative total
	negative	—	1	1	3	1	4	—	2	—	2	—	1	15	
Tiszaföldvár left bank	positive	—	2	1	—	—	—	—	1	—	2	—	—	7	positive negative total
	negative	1	4	2	9	—	10	—	9	1	8	—	7	51	
Tiszavárkony right bank	positive	1	2	—	—	—	—	—	1	—	2	1	—	7	positive negative total
	negative	—	4	3	9	1	10	—	9	1	8	—	8	53	
Tiszazug, from the bridge, middle line	positive	1	1	1	—	—	—	—	1	—	2	1	—	7	positive negative total
	negative	—	6	2	9	—	10	—	9	1	8	—	7	52	
Positive samples		12	14	7	—	—	1	—	14	4	13	8	8	81	positive (19,4%) negative total
Negative samples		1	30	15	60	6	67	—	54	4	55	—	44	336	
Total		13	44	22	60	6	68	—	68	8	68	8	52	417	

Table 2. Months

Sampling sites (in every case from the bridge, middle line)	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	1977—1987 Total	
Galga														
above Jászfényszaru	—	—	—	—	1	—	—	—	2	—	—	—	3	positive
negative	3	1	9	3	7	2	5	2	8	1	10	—	51	negative
													54	total
Tarna														
above Jászkóhalma	—	—	—	—	—	—	—	—	3	—	1	—	4	positive
negative	3	1	9	3	8	2	5	2	7	1	9	—	50	negative
													54	total
Zagyva														
below Jászfényszaru	—	—	—	—	1	—	—	—	1	—	1	—	3	positive
negative	3	1	9	2	7	2	5	2	9	1	9	—	50	negative
													53	total
Zagyva														
below Jászberény	—	—	—	—	1	—	—	—	2	—	—	—	3	positive
negative	—	1	3	2	2	1	—	1	2	1	4	—	17	negative
													20	total
Zagyva														
below Jásztelek	—	—	—	—	—	—	—	—	1	—	—	—	1	positive
negative	3	1	8	3	8	2	5	2	9	1	10	—	52	negative
													53	total
Zagyva														
below Újszász	—	—	—	—	1	—	—	—	2	—	—	—	3	positive
negative	—	1	2	2	2	1	—	1	2	1	4	—	16	negative
													19	total
Zagyva														
Szolnok, below TB Hospital	—	—	—	—	1	—	—	—	1	1	—	—	3	positive
negative	3	1	9	3	7	2	5	2	9	—	10	—	51	negative
													54	total
Miller														
above Szolnok	—	—	—	—	1	—	—	—	—	—	—	—	1	positive
negative	2	1	8	3	7	2	5	2	10	1	10	—	51	negative
													52	total
Körös.														
Kunszentmárton	—	—	—	—	—	—	—	—	—	—	—	—	—	positive
negative	3	1	9	3	8	2	5	2	10	1	10	—	54	negative
													54	total
Hortobágy-Berettyó														
below Mezőtúr	1	—	—	—	1	—	—	—	—	—	1	—	3	positive
negative	2	1	9	3	7	2	5	2	10	1	9	—	51	negative
													54	total
Hortobágy-Berettyó														
below Túrkeve	—	—	—	—	1	—	—	—	—	—	—	—	1	positive
negative	3	1	8	3	7	2	5	2	10	—	10	—	51	negative
													52	total
Positive samples	1	—	—	—	8	—	—	—	12	1	3	—	25	positive (4,8%)
Negative samples	25	11	83	30	70	20	45	20	86	9	95	—	494	negative

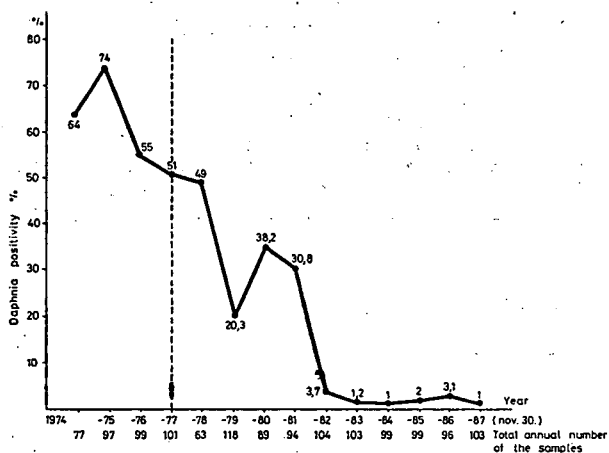


Fig. 2. The *Daphnia*-test positive results in the samples of unrefined water obtained by the Szolnok Surface Water Works between 1977—1987

The aim of the biological tests is to reveal the toxic effects (microcontaminations, unknown interactive effects) which can not be detected by analytical methods. For these reasons we are not in the position to identify the chemical background of the observed phenomena. However, we feel that the reasons for the significant decrease of toxicity reflected by our results (Fig. 2) can be satisfactorily interpreted. Namely, the drastic improvement coincides with the filling up of the Kisköre storage lake (lately named Tisza-lake) to its present level in the period 1979—1982. The significant drop in the toxicity of the storage lake can be due to the simultaneous effect of the favourable sedimentation originating from the decrease of the flow-rate, the increase in the intensity of the volumetric irradiation by the sunlight and in the oxygen uptake from the air due to the increased surface, and finally to the filtering effect of the aquatic vegetation. Our calculations based on the available data (volume and surface of the stored water, average water output) show that the operation of the storage lake led to 3,9-fold increase in the specific surface per unit volume of the water, and 3,1-fold decrease in the average flow-rate as compared to that of the river. Although quantitative estimation can not be given, an inspection of the storage lake shows a convincing increase in the vegetation.

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## A Szolnok megyei Tisza-szakasz és a fontosabb mellékvizek *Daphnia*-teszt eredményeinek összefoglaló értékelése (1977—1987)

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### Kivonat

1977—1987 között akut toxikológiai vizsgálatokat végeztünk *Daphniákkal* a Tisza Szolnok megyei szakaszának 6 pontján és a megye fontosabb mellékvizein. Megállapítottuk, hogy a vizsgált időszakban a Tisza hossz-szelvény víz mintáinak 18,3%-a, a mellékvizekből származó minták 4,3%-at volt *Daphniákra* mérgező hatású. A szolnoki felszíni vízmű felett nagy gyakorisággal vett Tisza víz minták pozitivitása 1975. után napjainkig erősen csökkenő tendenciát mutat; 74%-ról 1%-ra esett vissza. E jelenség okai nagy valószínűséggel olyan kedvező hatások érvényesülésével magyarázhatók, ahol az összetevők között jelentős szerepe van a Kiskörei víztározónak, mert környezeti adottságai révén nagy mértékben elősegíti a szerves- és toxikus anyagok kémiai és mikrobiológiai oxidációját. De nem hagyhatjuk figyelmen kívül a környezetvédelem területén hozott állami intézkedések hatását sem az ugyancsak lassan, de a társadalmi céloknak megfelelő irányban változó lakossági szemlélettel együtt.

## Общая оценка результатов тестов, основанных на *Daphnia*, воды реки Тиса и ее основных притоков, протекающих по территории области Солнок (1977—1987 гг.)

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### Резюме

В период 1977—87 гг. проводились токсикологические исследования при помощи теста на *Daphnia magna* в восьми участках Тисы и ее основных притоков, протекающих по территории области Солнок. Было установлено, что за исследуемый период 19,4% водных проб продольного отрезка Тисы и 4,8% проб ее притоков оказались токсичными для *Daphnia*.

Пробы, которые брали с большой частотой над водонапорной станцией в Солноке свидетельствуют о тенденции значительного снижения позитивности водных проб Тисы с 1975 г. до настоящего времени (снижение с 74% до 1%). Предполагается, что возможным объяснением наблюдаемых результатов является благоприятное влияние водохранилища в Кискёре, поскольку резкое снижение наблюдаемого ранее высокого процента позитивности совпало по времени с эксплуатационным заполнением водохранилища в Кискёре в период 1979—1983 гг.

## Ukratko procenjivanje rezultate test-Daphnie vršenim u reci Tisa i u važnijim sporednim vodama u županiji Solnok

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### Abstrakt

Uzvršili smo akutne toksikološke istraživanje sa Daphnijama na 6 tački Tise u županiji Solnok i u važnijim sporednim vodama između 1977—87 god. Došli smo do zaključka da za vreme istraživanja Tise je bila toksična u 18,3% na Daphnije a sporedne vode u 4,3%.

Od 1975. godine pozitivitet izvađenog vodenog uzorka iz Tise kod Solnoškog hidrocentrala pokazuje opadanje tendencije, pad je od 74% do 1%. Ova pojava opravda se sa takvim povoljnim uslovima gde između ostalim gradientima Kiškere Rezervoar za Vodu igra veliku ulogu, on ima takvih ekoloških okolnosti koji omogućavaju što bolju hemijsku i mikrobiološku oksidaciju organskim i toksičnim materijama. Ali da ne izostavimo državne odredbe za odbranu ekoloških okolnosti koje zajedno sa mentalitetom stanovništva lagano ali sigurno se menjaju prema društvenim ciljama.

Table 1. *Results of the Daphnia-test carried out at the Tisza-section in Szolnok County between 1977—1987*

Table 2. *Results of the Daphnia-test carried out at the district waters of Szolnok County between 1977—1987*