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Determination of chronic toxicity of waters of surface sources of water service on *Daphnia magna Straus* and *Tradescantia fluminensis Vellozo*

The purpose. To raise selfdescriptiveness of biotesting of waters of surface sources of water service due to use of test-kit from *Daphnia magna Straus* and *Tradescantia fluminensis Vellozo*. **Methods.** Biotesting of quality of water according to standard and own procedures. **Results**. In researches on the test-reactions of fixation of daphnes and root-creation of spiderwort the ill effect on living organisms of waters of water reservoirs of river Teterev is specified. **Conclusions.** For biotesting of quality of waters of surface sources of water service it is offered to use test-kit from D. magna and T. fluminensis. On the basis of responses of test-objects the indexes of toxicity are calculated. Specificity is revealed of responsivity of spiderwort (on 8th day) and daphnes (on 15th day) to toxic chronic influence of these waters.

Key words: quality of water, surface sources of water service, biotesting, D. magna, T. fluminensis, index of toxicity, chronic influence.

In recent years research, along with the use of traditional methods of water quality control, it focuses on biotesting, one of the most important methods of biomonitoring [1-5]. It has been proved that the effectiveness of biotesting increases significantly with the use of non-isolated organisms, including unified, and so-called sets of test objects, which include animal and plant forms [1-4]. Daphnia (*Daphnia magna* Straus) – standardized test organisms [4-8] is most commonly used in animal forms, and plant forms are often represented by *Allium cepa* L. and *Lactuca sativa* L., which are quite sensitive and convenient for detecting adverse effects of water [2-4, 9]. However, the important aspect of testing remains the genomicity of the biomaterial, which is used in experiments. It is therefore interesting to determine the toxicity of water at plants that are genetic analogues, namely, on cuttings from cuttings from one plant, which, moreover, would be sufficiently sensitive to changes in the quality of water of surface water sources. *Tradescantia fluminensis* Vellozo has a special place among these plants, which has been widely used in the determination of toxicity, cytotoxicity and genotoxicity [5] of various environments, and was also proposed by us for biotesting of drinking water quality [10].

The purpose of the research is to increase the informativeness of the method of biotesting water of surface water sources through the use of a test kit from *D. magna* and *T. fluminensis* ..

Materials and methods of research. Experimental data on the toxicity of water of surface water sources at the Municipal Enterprise "Zhytomyrvodokanal" were obtained, using the methods of testing on daphnia and tradesscan, including those proposed by us [5, 7, 10]. Three groups of organisms were formed (n = 20), each of which was subjected to action of water. Daphnia were analogues by age (24 hours), corncrake of tradescantia – height of stems (10 cm), number and size of leaves (6 per each, length 6-7 cm). Samples of water were collected in September 2014 in an amount of 1 dm3 per group once a day according to generally accepted methods [7]. Testing of water samples was carried out in chemical containers (0,5 dm^3) with daily replacement of used water to water of appropriate quality.

The research was carried out according to the following scheme:

• *Control group* - a sample of dechlorinated (24 hours) drinking water.

• *Test group D-1*: water samples - from the Denyshivske reservoir;

• *Test group D-2*: water samples - from Vidsichne water intake.

Biotesting - by the number of active and immobilized (stationary) daphnia and the number of cuttings of tradscan with roots (the formation of the first root beam, at least 3 mm in length): on the first, 8th and 15th days.

Test Objects: young daphnia magna *(D. magna)* and tradescantia fluminensis *(T. fluminensis)*, obtained from the same plant.

The water toxicity index, which should not exceed 50%, was calculated based on the results of testing, using the generally accepted formula [5, 7].

Research results. In the biotesting of reservoirs in the Teteriv river, the following indices were determined: the number of active daphnia and the number of cuttings with developed roots (at least one root bundle). For their use, the indexes of water toxicity were calculated for the same time for animal and plant forms. The difference between the experimental groups in the water toxicity is explained by the fact that the reservoirs differ in the features of the slope runoff. Thus, the Denyshivske reservoir is more or less inferior to the Vidsichne water intake, with the arrival of nutrients, heavy metals and organic substances. The results of testing the toxic effects of water from surface water sources on daphnia are given in Table 1.

Table 1

Biotesting of water toxicity of surface water sources by definition of immobilization *D. magna*

Day of experiment/ water toxicity index (T, %)	Number of active daphnia (n=20):					
	Control group (K)		Test groups			
			D1		D2	
	individuals	%	individuals	%	individuals	%
1	20	100	13	65	15	75
T_1	-		35,00		25,00	
8	20	100	11	55	12	60
T_8	-		45,00		40,00	
15	19	95	8	40	9	45
T_{15}	-		57,90		52,63	
the number of daphnia that gave descendants	15	75	5	25	7	35
immobilized daphnia	1	5	12	60	11	55
including dead daphnia	-	-	6	30	5	25

The acute effects of water components on Daphnia were absent during the experiment. Only on the 8th day of testing the signs of approaching the toxicity of water to 50% level appeared, which is associated with the active immobilization of individuals. Exceeding the 50% limit of toxic effects of water was detected on the 15th day in both experimental groups. The smallest number of immobilized individuals was recorded on the control. The test groups for this test reaction almost did not differ - the difference between them was 5%. The dead daphnia, from the number of immobilized ones, was 5% more in the first group than in the second. On the contrary, the number of individuals who gave offspring was 10% higher in the group D2 than in the group D1. Thus, it can be assumed that the water reservoirs in the Teteriv River have chronic toxicity detected on daphnia for 15 days.

A similar situation, however, was observed earlier in the case of toxicity testing of water intended for water supply, on tradesscan. The results of the studies are presented in Table 2:

Table 2

Biotesting of toxicity of water of surface water sources by definition of root formation of cuttings *T. fluminensis*

Day of experiment / water toxicity index (T, %)	Number of cuttings with roots (n=20):					
	Control group (К)		Test groups			
			D1		D2	
	pcs.	%	pcs.	%	pcs.	%
1	6	30	-	-	-	-
T_1	-		-		-	
8	19	95	9	47,37	10	52,63
T_8	-		52,63		47,37	
15	20	100	12	60,00	13	65,00
T_{15}	-		40,00		35,00	
including cuttings with breach of roots development	-	-	5	25	4	20
cuttings without roots	-	-	2	10	1	5

In contrast to daphnia for the use of cuttlefish transducers, the chronic toxicity of water in relation to their root formation was detected on the 8th day of the experiment. The number of cuttings with roots in group 1 fell in the control group (by 40%) and in the 2nd teat group (by 5%). The value of the water toxicity index in the D1 group exceeded 50%, and in the group D2 approached, however, it did not reach the specified level. However, the violation of the development of the roots (the appearance of single roots instead of the root beam or the absence of the root system in general) failed to properly identify the 8th day of research, more clearly the defects of the formation of roots could be observed in the 15th day. Thus, for the biotesting of tradescantia, the chronic toxicity of the water reservoirs in ricver Teteriv was also confirmed. Moreover, inhibition of the growth of the roots of tradescantia in waters of lower quality was found to be more sensitive to the test response to the toxic effects of water compared with the immobilization of daphnia. Thus, the test-reaction signal accepted for a relative number of cuttings with roots is more suitable for calculating the water toxicity index in waterchannels, than in traditional measurement of the length of the roots. In addition, the difference in water quality as a result of inhibition of root formation from cuttings may be detected a week earlier than in daphnia. In addition to the definition of chronic toxicity, the advanced roots of tradesscan further studies should also be used to detect genotoxicity of water.

Conclusions

For biotesting of water quality of surface water sources, it is suggested to use a test kit from *D. magna* and *T. fluminensis*. On the basis of the test-object reactions, toxicity indices were calculated (the highest: in the group D1 - 57.90 and 52.63%, and in the group D2 - 52.63 and 47.37% respectively), which revealed the specificity of the tradescantia sensibility on 8 day and daphnia on the 15th day to the chronic effect of these waters.

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