

MONITORING OF MICROELEMENT COMPOSITION OF DRINKING WATER IN DIFFERENT REGIONS OF UKRAINE FOR 2019–2020

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Globalization in the world, particularly in Ukraine, creates the preconditions for the widespread use of industrial, agricultural and household waste, which directly or indirectly affects the quality and trace elements of water.

Deteriorating environmental conditions and unethical human interference with the natural system have strengthened concerns about improving healthy lifestyles. Deterioration of the water system is common in developing countries [1].

According to WHO, 80% of human diseases are associated with the use of poor quality water. In accordance with international drinking water quality standards, Council Directive 98/83 EC [2] and the national standard of Ukraine DSTU 7525: 2014 [3], a clear list of chemical and toxicological groups of drinking water quality indicators is defined. The problem of drinking water pollution in Ukraine is related to the imperfection of wastewater treatment systems from industrial, municipal and agricultural enterprises, erosion of soils, as well as anthropogenic disasters that have severe and long-term consequences, in particular at the Chernobyl NPP [4].

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We establish the following goals: to analyse chemical and toxicological indicators of drinking water taken from different regions of Ukraine; to determine the quantitative content of aluminium, arsenic, boron, cadmium, mercury, chromium, cobalt, copper, iron, plumbum, manganese, molybdenum, selenium, nickel, sodium and zinc in water samples.

The research was carried out on the basis of the State Research Institute of Laboratory Diagnostics and Veterinary and Sanitary Expertise, Laboratory of Atomic Absorption Spectrometry by the method of inductively coupled plasma atomic emission spectroscopy (ICP-AES) (optical emission spectrometer PlasmaQuant PQ 9000 Analytik Jena (Germany)) and atomic absorption spectrometry [5; 6]. Water samples were taken according to DSTU ISO 5667-3-2001 [7].

In the period from 2019 to 2020, tests of 227 water samples were conducted, of which 11 gave positive results (4.84%), in terms of ferrum content – 8 samples, in terms of manganese – 3 samples (Table 1).

Table 1

**Analysis of chemical and toxicological parameters of drinking water,
µg/L**

Indicator	Concentration range	Reference document	
		State Standard of Ukraine 7525:2014	Council Directive 98/83/EC
Plumbum	1.103-5.102	10	10
Cadmium	2.0-5.0	1	5
Arsenic	1.626-3.325	10	10
Mercury	0.127-1.047	0.5	1
Antimony	0.524-2.194	5	5
Nickel	3.587-6.380	20	20
Chromium	2.662-10.395	50	50
Aluminium	10.297-50.025	200	200
Copper	0.026-0.058	1000	2000
Iron	84.277-570.458	200	200
Manganese	8.741-130.295	50	50
Boron	0.117-0.394	500	1000
Selenium	3.529-7.842	10	10
Sodium	45.034-109.036	200	200000

The results of water tests showed that the quantitative content of plumbum, arsenic and cadmium in the samples was in the range of 1.103-5.102 µg/kg, which was within the normative values.

The variability of the quantitative content of chromium, cobalt, nickel and molybdenum depended on the region of the selected samples and did not exceed the maximum allowable levels.

Arsenic and mercury in all water samples were detected in minimum concentrations – trace amounts, or below the method detection limit of 0.5 µg/kg.

The quantitative content of iron in almost all water samples was at the limit of the maximum allowable concentration (MAC) and exceeded it in 8 samples (Kyiv oblast – in 2.1 times, Chernihiv oblast – in 3.1 times, Odesa oblast – in 2 times, Dnipropetrovsk oblast – in 1.2 times). The origin of iron in water can be of geogenic nature or from industrial effluents, household waste, as well as due to significant wear of the water supply system.

Pollution of drinking water with copper, boron and selenium was not detected among the regions of Ukraine. Aluminum, sodium, and zinc did not exceed the normative values. The content of sodium in water was characterized by significant variability, which is due to the peculiarities of the entry of its compounds with industrial and municipal effluents into the water, but the excess of the maximum allowable concentrations was not detected. The concentration ranges of aluminum, sodium and zinc in the water of the oblasts of Ukraine in all cases were below MACs according to the standards of both national and European legislation.

Manganese was detected in excess of MACs in three samples, accordingly, 85.62 µg/kg; 98.88 µg/kg and 130.29 µg/kg. The main sources of manganese contamination of drinking water in Ukraine are considered to be untreated wastewater from industrial metallurgical enterprises, municipal wastewater and low efficient outdated wastewater treatment systems.

It is established that 95.15% of drinking water samples that were tested and selected in different regions of Ukraine for the content of chemical elements met the requirements of current regulations. Exceedance of MACs for iron and manganese was in 4.84% of samples. The content for such toxic elements as As, Cr, Pb, Cd, Ni in the drinking water of the regions of Ukraine from which samples were tested was within the normative values. However, despite this fact, they pose a potential risk to consumer health even in low doses.

Therefore, the application of measures based on constant control (monitoring) of drinking water quality is important for public health.

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