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HYGIENIC ASSESSMENT OF THE PURIFIED DRINKING WATER

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Abstract. *The purpose of the work is to provide a hygienic assessment of purified drinking water, which is produced at purification plants and sold from filling points in an industrial city (in dynamics for 2016-2021).*

Materials and methods. Purified drinking water (from filling points) produced by purification plants in the city of Dnipro was chosen as the "main" or experimental subject. As "control" - drinking water supplied to the water distribution network of the city of Dnipro from the Lomovskaya, Kaydatskaya and Aulskaya pumping and filtering stations.

Data were obtained that indicate that, on average, for 2016-2021, drinking tap water in the city of Dnipro did not meet the requirements of current sanitary legislation in terms of nickel ($p<0.05$), aluminum ($p<0.05$) and permanganate oxidizability ($p<0.05$), and the content of chloroform in drinking tap water, on average, during the observation period, exceeded the established hygienic standard by 1.63-2.1 times ($p<0.05$).

It was established that purified drinking water, which is sold from filling points, does not meet current hygienic requirements for the content of chloroform - the frequency of exceeding the maximum permissible concentration is 2.5-9.2 ($p<0.05$). When tap drinking water is purified at purification plants, the level of chloroform decreases by 2.16-6.52 times ($p<0.05$). The efficiency of further purification of drinking tap water by the content of sulfates, chlorides, total iron, lead and arsenic is 1.43-2.61 times ($p<0.05$). The total hardness, dry residue, copper and zinc content are reduced by 1.38-2 times ($p<0.05$) due to additional cleaning.

It was determined that the risk of consuming tap drinking water that comes to water consumers from the distribution network of Dnipro is 130-167 estimated additional cases of cancer, when consuming treated drinking water - 20-74 additional estimated cases of cancer in the population cohort 1 million, which is 2.16 - 6.5 times less ($p<0.05$) than when using tap water.

Analysis of research results made it possible to propose and implement a complex set of measures to ensure responsibility for existing hygiene requirements of the purified drinking water, which is sold from bottling points.

Key words: *water consumption, water pipe-line drinking water, purified drinking water, hygienic assessment, carcinogenic risk.*

Introduction.

The safety of drinking water resources is a priority area of state policy and is considered one of the most important factors in the sustainable development of

society and the preservation of the health of the population. One of the leading conditions for providing the population with good-quality drinking water is the constant monitoring of its quality and safety indicators, both at the stages of water preparation and directly at consumers.

A source: [1]

Main text

The purpose of the work is to provide a hygienic assessment of purified drinking water, which is produced at purification plants and sold from filling points in an industrial city (in dynamics for 2016-2021).

Materials and methods. Purified drinking water (from filling points) produced by purification plants in the city of Dnipro was chosen as the "main" or experimental subject. As "control" - drinking water supplied to the water distribution network of the city of Dnipro from the Lomovskaya, Kaydatskaya and Aulskaya pumping and filtering stations.

According to organoleptic, physico-chemical, microbiological, sanitary-toxicological indicators, the quality and safety of the water of the Dnipro River, which enters the water intakes of the Lomovskaya and Kaydatskaya pumping and filtering stations, and the drinking water supplied to the population of the city of Dnipro from the Lomovskaya, Kayadatskaya, and Aulskaya pumping stations, were evaluated. - filtering stations and purified drinking water of three powerful producers of Dnipro.

When choosing companies for further purification, the schemes of further purification that they use were taken into account. Enterprise No. 1 refines tap drinking water coming from the Aul pump-and-filter station with the help of the "UDPV-0 additional treatment plant for fresh water", which includes a rough filter, purification from organic substances, reduction of hardness, ozonation, and then additionally undergoes the stages of filtration through activated carbon and fine finishing; enterprise No. 2 refines tap drinking water from the Kaidatka pumping and filtering station at the TOTEM-23.7 ONR installation using the following methods: illumination, softening, microfiltration, reverse osmosis, sorption, disinfection by UV

irradiation. The cleaning system works fully automatically. At the first stage of purification, lightening, softening and microfiltration filters are used, and then the water is desalinated using the reverse osmosis method. Desalinated water is accumulated in storage tanks with a volume of up to 3 m^3, and in the process of water intake, the water is additionally filtered through activated carbon, which dechlorinates the water, cleans it of organic substances, removes tastes and smells, and UV disinfection; enterprise No. 3 produces purified drinking water, which enters the centralized water supply network from the Kaidak pumping and filtering station, by purifying tap drinking water with five stages of a water purification system using filters from "Enting water conditioning Inc" (USA) and a device for ultraviolet disinfection of water Simex (Belgium). All three enterprises sell purified water from filling points to the consumer's personal containers.

The study of indicators of the quality and safety of water of the Dnipro River, tap water and purified water was conducted on the basis of the Dnipropetrovsk Regional Center for Disease Control and Prevention of the Ministry of Health of Ukraine.

Hygienic assessment of drinking tap water and purified drinking water was carried out in accordance with DSanPiN 2.24-171-10 "Hygienic requirements for drinking water intended for human consumption".

Determination of carcinogenic risk was carried out in accordance with the methodological instructions of MU 2.2.4-122-2005 "Assessment of carcinogenic risk to public health from consumption of chlorinated drinking water."

Medical statistical processing included the calculation of primary statistical indicators, the identification of differences between groups by statistical characteristics, the establishment of relationships between variables using parametric correlation analysis and was carried out using statistical analysis programs Microsoft Excel2003®Statistica v 6.1 (Statsoft Inc / USA) (persons No. AGAR909E415822FA).

The results. It was established that the drinking water supplied to the water distribution network of the city of Dnipro did not meet the requirements of DSanPiN

2.24-171-10 "Hygienic requirements for drinking water intended for human consumption" according to the group of sanitary and toxicological indicators ($p<0.05$): an excess of the maximum allowable concentration of nickel by 50% ($p<0.05$), aluminum by 14% ($p<0.05$) and permanganate oxidation by 48% ($p<0.05$) was registered.

Exceeding the hygienic standard according to the integral sanitary-toxicological indicator - permanganate oxidizability, is connected with the unsatisfactory sanitary-hygienic condition of the source of domestic drinking water supply (Dnipro River) and existing imperfect water treatment technologies.

Exceeding the hygienic standard for aluminum content is associated with the use of aluminum compounds during coagulation to improve the processes of lightening and discoloration of water from the water intake.

Attention is drawn to the significant (1.63-2.1 times higher than the MPC) content of chloroform in the drinking tap water consumed by the residents of Dnipro.

The analysis of the results of the studies of purified drinking water made it possible to establish that according to the indicators of odor, color, turbidity, pH, total hardness, dry residue, sulfates, chlorides, total iron, lead, and arsenic, the purified water meets the requirements of DSanPiN 2.24-171-10 " Hygienic requirements for drinking water intended for human consumption".

As a result of additional purification of tap drinking water, the content of chloroform decreases by 2.16-6.52 times ($p<0.05$). The multiplicity of additional purification is significantly different ($p<0.05$), which is connected with the use of various water purification schemes used at enterprises.

The generalization of the obtained results indicates a decrease in chloroform in purified drinking water compared to tap water. However, the level of chloroform in purified drinking water during the entire observation period significantly exceeds ($p<0.05$) the established hygienic standard (6 μg/dm3) in all three manufacturers.

It should be noted that as a result of additional cleaning, the level of total stiffness decreased by almost 2 times, the indicators of dry residue decreased by 1.38-1.7 times ($p<0.05$). The levels of sulfates and chlorides decreased by 1.25-1.77 times

($p<0.05$). The content of total iron decreased by 1.88-2.61 times ($p<0.05$), the content of lead decreased by 1.75 times ($p<0.05$); indicators of copper, zinc, manganese and arsenic decreased by 1.01-1.43 times ($p<0.05$).

Based on the obtained results, the carcinogenic risk was calculated when consuming tap drinking water (per 1 million people) and purified drinking water sold from filling points in the city of Dnipro.

When assessing the calculated carcinogenic risk according to four risk ranges in accordance with the World Health Organization's human health risk assessment approaches, it was established that the risk when consuming tap drinking water that comes to water consumers from the distribution network of the city of Dnipro belongs to the third range of risk – individual lifetime risk greater than 1•10-4 but less than 1•10-3. Such a risk is acceptable for professional groups, but not accepted for the population as a whole and requires the development and implementation of planned health measures.

The risk when consuming purified drinking water belongs to the 2nd risk range - more than 1•10-6, but less than 1•10-4. This risk corresponds to the upper limit of accepted risk. This level of risk is subject to constant monitoring, and in some cases, additional measures can be taken to reduce it.

On the basis of the received data, a set of measures to optimize water consumption in the conditions of an industrial city was substantiated and implemented.

Conclusions

The results of studies of potable tap water entering the water distribution network of the city of Dnipro from the Lomov, Kaidatka, and Aul pump and filter stations and purified drinking water (from the filling points) produced by the purification enterprises of the city of Dnipro were reviewed.

Data were obtained that indicate that, on average, for 2016-2021, drinking tap water in the city of Dnipro did not meet the requirements of current sanitary legislation in terms of nickel ($p<0.05$), aluminum ($p<0.05$) and permanganate oxidizability ($p<0.05$), and the content of chloroform in drinking tap water, on

average, during the observation period, exceeded the established hygienic standard by 1.63-2.1 times ($p<0.05$).

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