EEET ECOLOGICAL ENGINEERING & ENVIRONMENTAL TECHNOLOGY

Ecological Engineering & Environmental Technology 2023, 24(5), 195–201
https://doi.org/10.12912/27197050/165903
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Received: 2023.03.24
Accepted: 2023.05.20
Published: 2023.06.05

Drinking Water Quality Assessment in the Suhareka Municipality

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ABSTRACT
Reliable access to safe drinking water is one necessity for humans to live without concern for major health risks. The overall goal of this research is to analyze some physic-chemical and bacteriological parameters aspects of the quality of water for human consumption. In this study, water samples were collected from January to May month of 2022 from 25 stations throughout at Suhareka Region. Considering the results of the analysis, in terms of physic-chemical the water is within the required standards, while bacteriologically it found samples with the presence of bacteria, which are the result of carelessness, old installations, or even irresponsible disinfection. Officials of Suhareka Municipality must increase the monitoring of the work in the water disinfection or chlorination process.

Keywords: anthropogenic effects, drinking water, physic-chemical and bacteriological parameters, Suhareka municipality, water quality.

INTRODUCTION

Helping people gain access to safe drinking water is one of the most important health-related infrastructure programs in the world. As of 2007, around 1.1 billion people we're still using unsafe water (WHO, 2017). WHO and the International Water Association (IWA) are promoting the use of a comprehensive drinking water risks management approach, commonly referred to as water safety plans (Bartram, et al, 2009).

Limited freshwater resources are among the most significant and adversely affected components of environment and pollution-contamination caused by anthropogenic activities decreases the quality and potential of the limited freshwater day by day (Çiçek et al., 2013; Tokatlı et al., 2014; Köse et al., 2015).

Clean and safe water is an absolute need for health and productive life. The quality of the water supplied is important in determining the health of individuals and whole communities (Sharma et al., 2005; Gautam and Sapkota, 2012). Changes in water quality are reflected in its physical, biological and chemical conditions, which are influenced by physical and anthropogenic activities (Diwakar et al., 2008). Some chemicals, notably iron, ammonia, nitrates, and arsenic have adverse public health impacts. The transmission of waterborne diseases is still a matter of major concern, despite worldwide efforts and modern technology being utilized for the production of safe drinking water (Anonymous, 2006).

Access to safe drinking water is essential for health, is included in basic human rights, and represents an important component in health protection policies. So, from the local, and regional to the national level, access to safe drinking water is important as a health and development issue for a country. Every investment in water supply and sanitation has its own impact on economic benefits (WHO, 2004). Water is an integral part of the effort to achieve all the Millennium Development Goals of the UN. The Millennium Development

Goals (MDG) target for water was to halve the proportion of people without access to safe drinking water and to provide basic sewerage.

The aim of this research was to evaluate the quality of water for human consumption in the Municipality of Suhareka, through the analysis of samples collected at the source of water and at the water taps in the households of the residents.

MATERIAL AND METHOD

The Municipality of Suhareka is located in the southern part of Kosovo Republic, at latitude 42° 15' in the south and 42° 30' in the north, while in the east it is bordered by the mountains of Jezerc (21° 00'), and in the west by the municipality of Rahovec (20° 45') (Figure 1). The Region of Suhareka covers an area of 361.78 km^2, with a population of 57 524 inhabitants located in 42 settlements and with a population density of 165 inhabitants per km^2. About 10 422 residents live in the city, while the rest live in rural areas (Ulaj R. et al, 2021).

There are several sources of water in the Suharek Region. The local officials make continuous commitments to improve the supply in each of its localities. The Suhareka Municipality is supplied with drinking water from an almost single water source and several underground boreholes. These water sources are managed by the local company known as 'Hidroregjioni Jugor' (Southern Hydroregion), from the source to the citizen's tap. The Southern Hydroregion is responsible for providing and treating this water, while the same is audited by the Regional Institute of Public Health in Prizren, on a daily and weekly basis (Kryeziu, 2013).

The water quality analysis confirms if the water supply is contaminated, respectively if the state of the water in physic-chemical terms is within the parameters or standards required by regulations (WHO, EU, Kosovo). Regarding fecal contamination, the most preferred method used in the analysis of fecal coliforms is the membrane filter technique (Cheesbrough, 2005).

The monitoring and assessment of the quality of drinking water in the source and water supply network was done by the Regional Institute of Public Health (RIPH) in Prizren, through the analysis of the physicochemical and bacteriological quality in its laboratories (Kryeziu, 2013).

The study area was the Municipality of Suhareka, while the sampling points were determined at the source of water from which the residents of this municipality are supplied, as well as in the consumer groups such as households and various institutions. We have taken care that the sampling from the taps was carried out at the points of the distribution network where there are more users of water for human consumption, such as schools, preschools, and health institutions.

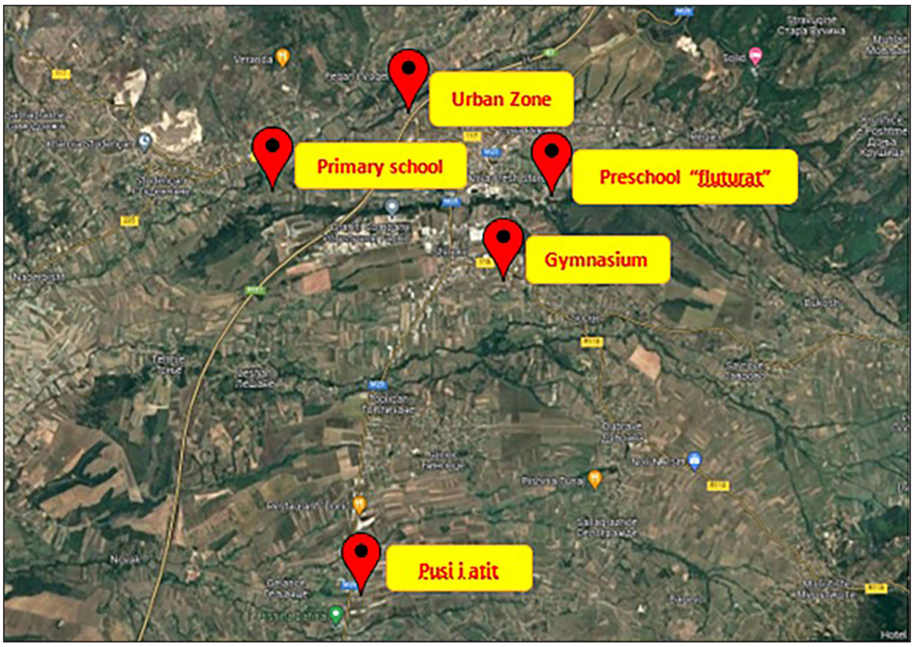

Figure 1. Map of sampling points from source to household tap

Drinking water supply is a challenge for every country or its government. Thus, the Municipality of Suhareka is challenged with the supply of drinking water for all its residents. This municipality lies in the south of the country and has insufficient water sources. Water for human consumption is mainly provided from underground sources (boreholes) and is not sufficient for all residents. Some of the villages have their own sources, while the urban area is supplied by the "Pusi i Atit" sources and several underground boreholes.

The main source of water for the municipality of Suhareka comes from Pusi i Atit, which lies at a distance from the town of about 10 km, while it is an underground source. The amount of water from this source does not meet the general needs of the inhabitants of the municipality, therefore the inhabitants are forced to turn to other sources to meet their drinking water needs.

Sampling for the purpose of our research was carried out during the months of January–May 2022. Sampling was carried out by a professional team consisting of the Sampler and the Chemistry Engineer of RIPH in Prizren. The sampling was carried out according to the standards for taking samples [(ISO 5667–5:2006 (E); ISO 19458:2006 (E)]. The samples, according to the standard, were taken to the RIPH laboratory in Prizren and were analyzed in terms of physicochemical and bacteriological.

In the physicochemical plan, we have researched the temperature, smell, taste, color, turbidity, pH, $KmNO_4$ consumption, free chlorine, chlorides, ammonia, nitrites, nitrates, iron, manganese, and conductivity. meanwhile, in the bacteriological research, we investigated total coliform bacteria, coliform bacteria of fecal origin, the total number of aerobic mesophilic bacteria, and streptococcus of fecal origin.

Physic-chemical research

The samples were analyzed in the physic-laboratory plan in the laboratory and that the temperature was measured in the field, at the time of sampling at the sampling point with a Hanna instruments digital thermometer (HI93510). Taste and aroma with the organoleptic method, until the color was determined through the comparison of the color Co-Pt visual and colorimetric form, with standard series. Turbidity was measured with a turbidimeter from Hanna Instruments (HI 93703). Conductivity or electrical conductivity in our research was determined with Toledo-Mettler, seven compact duo.

Chemical parameters

The pH value was determined at the sampling site with the CONSORT C830 multi meter instrument. In our research, we have analyzed these chemical parameters: ammonia (NH_3), nitrites (NO_2^-), nitrates (NO_3^-), manganese (Mn), oxygen consumption (O_2) and residual chlorine. The determination of nitrites (NO_2^-), Nitrates (NO_3^-), Chlorides (Cl), Ammonia (NH_4), Iron (Fe^+) and Manganese (Mn^+) were carried out with a Spectro quant photometer (NOVA 60 ser. WTW).

Bacteriological research

The bacteriological research was carried out in accordance with ISO 19458:2006. According to UA 16/2012, harmonized with the European Directive 98/83/EC, in terms of bacteriological quality as in the Table 1.

In the process of microbiological analysis of water in our research, the samples were subjected to the membrane filter (MF) method. This method made use of the membrane filter with a predetermined size of 0.45 µm, sufficient to capture different types of microorganisms. The membrane filtration technique is widely used in our laboratory for water analysis and allows testing a larger volume of samples in a short time. Samples of 100 ml were passed through the filter membrane with 0.45 µm pores, then the limited microbial mass on the surface of the membrane filter was transferred to the grocery in the Petri dish with nutrient medium. We read the findings of colonies or not as well as the type of microorganism through selective grounds. The findings are presented in tabular form.

Table 1. Media used for identification of bacteria

Microorganisms in water	Nutrient medium used
Total number of Coliform bacteria	MF – Endo
Coliform bacteria of fecal origin	M – FC
Total number of aerobic mesophilic bacteria	M-TGE/Trypticase Soy USP
Streptococcus of fecal origin	KF – Streptococcal

RESULTS AND DISCUSSION

External monitoring or auditing of the quality of water for human consumption ensures a safe supply of drinking water. Human pathogens are present in water including *E. coli*, *Vibrio cholera*, *Yersinia enterocolitica*, *Campylobacter species*, Klebsiella, and various other forms of viruses such as *Hepatitis A*, *Hepatitis E*, *Rotavirus*, and parasites such as Entamoeba histolytica and *Giardia species.*

A total of 25 water samples were collected during the five months of 2022. Temperature, residual chlorine, and pH testing were done at the sampling site. All samples were transported within 6 hours to laboratories for analysis. The same was registered and submitted within the standards.

The samples were submitted according to the months they were received. The results of the 25 samples are presented in tabular form (Table 2). After the physic-chemical analysis we found the following:

The temperature of the samples was brought from 6°C to 15°C. This shows that the water samples in terms of temperature are within the standards required for drinking water for human consumption. In no sample were there any changes or findings outside the standards for these parameters: aroma, taste, and color.

The pH is within the standards for drinking water according to UA 16/2012 and the European Standards for drinking water (Lenntech, 2022) (MSH, Ministria e Shëndetësisë së Kosovës, 2012).

Table 2. Results of physic-chemical analyzes of the researched samples

Month	Sample locations	Temperature °C	Turbulence (NTU)	Smell	Color	Taste	Responsiveness	PH	Residual chlorine (mg/l)	Ammonia (mg/l)	Nitrates (mg/l)	Nitrite (mg/l)	Iron (mg/l)	Mn (mg/l)	O_2 Consumption	$KMNO_4$
Max limit allowed		K/°C	0 – 1 NTU	Pa / me	Co-Pt	Pa / me	$\mu S/cm$	6.5–9.5	0.2–0.5	0.50	0.05	0.01	0.20	0.05	10.0	8–12
January	B_1	8	0.00	pa	pa	pa	512	8.9	0.4	0.05	0.2	0	0.04	0.04	0	0
	U_1	10	0.00	pa	pa	pa	541	8.8	0.0	0.03	0	0	0.02	0.05	0.71	2.84
	L_1	6	0.00	pa	pa	pa	536	7.9	0.3	0.03	0	0	0.04	0.05	0.53	1.83
	M_1	9	0.00	pa	pa	pa	531	8.5	0.1	0.03	0	0	0.03	0.02	0.72	2.85
	Q_1	13	0.00	pa	pa	pa	530	8.4	0.5	0.02	0	0.01	0.01	0.02	1.26	5.05
February	B_2	11	0.00	pa	pa	pa	534	8.3	0.0	0.05	0.01	0	0.04	0.04	0	0
	U_2	13	0.00	pa	pa	pa	530	8.5	0.0	0.02	0	0	0.03	0.05	0.69	0
	L_2	8	0.00	pa	pa	pa	537	8.5	0.0	0.05	0	0	0	0.05	0	1.83
	M_2	6	0.00	pa	pa	pa	420	8.4	0.3	0.02	0	0	0.01	0.03	0.57	1.39
	Q_2	12	0.00	pa	pa	pa	420	8.1	0.2	0.05	0	0	0.02	0.04	0	1.37
March	B_3	10	0.00	pa	pa	pa	608	8.2	0.0	0.03	0.2	0	0.03	0.02	0	0
	U_3	11	0.00	pa	pa	pa	555	8.6	0.1	0	0	0	0.04	0.05	0	0
	L_3	11	0.00	pa	pa	pa	560	9.0	0.06	0.03	0	0	0.2	0.4	0	1.72
	M_3	14	0.00	pa	pa	pa	573	8.69	0.2	0.03	0.2	0.01	0.02	0.05	0.43	0
	Q_3	15	0.00	pa	pa	pa	381	8.13	0.0	0.05	0.6	0.01	0.03	0.05	0	0
April	B_4	15	0.00	pa	pa	pa	615	8.35	0.01	0.02	0	0	0.02	0	0	0
	U_4	15	0.00	pa	pa	pa	531	8.78	0.2	0.03	0.31	0	0.05	0.01	0.37	0
	L_4	14	0.00	pa	pa	pa	522	8.66	0.3	0.02	0.52	0	0	0	0	0
	M_4	13	0.00	pa	pa	pa	490	9.02	0.3	0.01	0	0	0.06	0.01	0.41	0
	Q_4	14	0.00	pa	pa	pa	501	8.43	0.1	0.03	0.23	0	0.01	0.05	0.44	0
May	B_5	14	0.00	pa	pa	pa	635	8.59	0.02	0.01	0	0	0.03	0.04	0	0
	U_5	15	0.00	pa	pa	pa	430	8.43	0.2	0.05	0.04	0	0.05	0.01	0.44	0
	L_5	15°	0.00	pa	pa	pa	336	8.31	0.1	0.05	0.03	0	0.06	0.05	0.43	0
	M_5	13	0.00	pa	pa	pa	445	8.34	0.05	0.05	0.05	0	0.02	0.02	0.41	0
	Q_5	15	0.00	pa	pa	pa	557	8.63	0.0	0.03	0.24	0	0.01	0.02	0	0

Note: the sampling was carried out in the first five months of 2022. The samples are identified with letters such as B – (alb. Burimi) water source, U – sample from urban area/tap, L – for secondary school, M – for primary school, and Q – preschool institution.

According to our findings, none of the samples in the physicochemical plan is outside the standards required according to UA 16/2012 (MSH, 2012) (EU, 2015). Only in the month of March, we captured a slightly increased value of Manganese (L_3=04), which seems to come as a result of the installation of the supply network at the sampling point.

In the next table (Table 3) the bacteriological findings are summarized. From the 25 analyzed samples, 8 (32%) resulted in the presence of bacteria or water pollution. According to our findings, the most contaminated samples were captured in the month of February, which is characterized by increased atmospheric precipitation. Out of 8 samples, only in the month of February, 3 samples were identified as contaminated, at three different supply points.

The sample with bacteria presents in January 2022 comes from the public tap, while in February they are located in Burim*, public taps* and high school*. In the month of March, we find bacterial contamination in the samples from the source and the preschool institution, while in April and May we find at the preschool institution.

CONCLUSIONS

The physic-chemical and bacteriological analyzes of the drinking water quality for the parameters presented in table 1 and 3 show that the drinking water in the research area is within the standard of the administrative instruction 16/2012 and the European Directive on drinking water (MSH, Ministria e Shëndetësisë së Kosovës, 2012) (EU, 2015) for drinking water samples.

Table 3. Bacteriological analysis results of researched samples

Month	Sample location	Total coliform bacteria	Coliform bacteria of fecal origin	Total number of aerobic mesophilic bacteria	Streptococcus of fecal origin
Max value allowed					
January	B1	0	0	0	0
	U1	0	10	0	0
	L1	0	0	0	0
	M1	0	0	15	5
	Q1	0	0	0	0
February	B_2	0	0	10	5
	U_2	0	0	10	35
	L_2	0	15	10	5
	M_2	0	0	0	0
	Q_2	0	0	0	0
March	B_3	0	0	20	5
	U_3	0	0	0	0
	L_3	0	0	0	0
	M_3	0	0	0	0
	Q_3	0	0	15	50
April	B_4	0	0	0	0
	U_4	0	0	0	0
	L_4	0	0	0	0
	M_4	0	0	0	0
	Q_4	0	0	0	0
May	B_5	0	0	0	0
	U_5	0	0	0	0
	L_5	0	0	0	0
	M_5	0	0	0	0
	Q_5	0	0	15	10

Note: the sampling was carried out in the first five months of 2022. The samples are identified with letters such as B – (alb. Burimi) water source, U – sample from urban area/land, L – for secondary school, M – for primary school and Q – preschool institution.

In the analysis of water for human consumption, in the month of March we found increased values for Mn. The other researched parameters were within the required standards. In the bacteriological research, we found 8 samples with the presence of bacteria, which raises our concern about the use of untreated water. These samples are related to the month of February, when the rainfall was greater and caused pollution. The findings of bacteria in some of the tested samples speak for human carelessness in the process of monitoring water for consumption, old installations, and improper chlorination. We found that households that are supplied with drinking water from tested sources receive safe drinking water, with good physicochemical and bacteriological quality.

The supply company must increase the care of monitoring the water which processes and supplies to citizens, especially its employees who deal with the disinfection of drinking water for human consumption.

We consider that the water sources that supply this part of the municipality of Suhareka are good, qualitative, and safe for human consumption.

Acknowledgments

We thank the laboratory staff of the Regional Institute of Public Health in Prizren for the help provided.

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