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BACTERIOLOGICAL SURVEY OF DRINKING WATER IN PRIZREN

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Abstract

The study presents the process of controlling and monitoring water quality for human consumption, especially bacterial contamination. Sampling was carried out in cooperation with the Laboratory of the Institute of Public Health in Prizren, where bacteriological analyses were also carried out. Within 2-3 hours of collection, all samples were transported in icebox containers to laboratories for testing. All samples were tested for counting Total coliform bacteria, Coliform bacteria of fecal origin, Total bacteria of aerobic mesophilic bacteria, and Streptococcus of fecal origin. For large analysis or R3 for testing, 16 water samples were taken. The samples were taken at different collection points such as: at the sources known as the "40 wells" and at households. 8 water samples were taken at water sources and 8 other samples were taken at different points in households or schools. It turns out that out of 16 drinking water samples, only one is outside the standards. The same sample comes from the direct source and represents the untreated water. From the results found, it appears that the consumption of untreated water should be avoided. First-line protection of water sources should be added. Water treatment and production plants should increase cooperation with laboratories for water analysis and compliance with drinking water quality standards.

Keywords: Pollution, Bacteria, Water Monitoring, Membrane Filter, Samples.

1. INTRODUCTION

Prizren is one of the largest cities in Kosovo, with a population of 177,781 inhabitants, spread over a territory of 627 km² or 5.94% of the territory of Kosovo. This municipality has 76 settlements, with an urban population of 94,517 inhabitants and a rural population of 83,264 inhabitants (Figure 1) [1].

In terms of geographical extent and the number of inhabitants, this city comes immediately after the capital, Pristina, so it poses a challenge for the supply of safe drinking water [2].

The city's clean water supply is provided by a single drinking water company, which supplies water from underground sources, while a good part of the settlements is supplied from their own local sources, including reservoirs and catchments [3].

Figure 1: Map of Prizren with rural settlements.

Water is the basic material for all living organisms, and in case of its contamination, health can be directly endangered. Therefore, providing clean water is a problem for many countries in the world, but also for Kosovo, which is poor in rivers and underground water. Since water can carry a number of different organisms to a large number of consumers and over wide areas, then the relevant contamination should be detected early for prevention [4]. The city of Prizren provides drinking water from underground sources, which are managed by the Water Company alone. These sources are secured and monitored 24/7 [5]. So, the monitoring of the sources as well as the reservoirs that supply drinking water should be checked for the quality and quantity of the water they use, if the same is with or without pollution. Great risks from microbes in water are associated with the consumption of drinking water that is contaminated with human and animal excreta, or even from other similar sources of pollution. Communicable diseases caused by pathogenic bacteria, viruses and parasites (diarrhea, dysentery, cholera, typhoid, infectious hepatitis, etc.) are the most common and widespread health hazard associated with drinking water [6].

The safety of drinking water is not only related to fecal pollution. Some of the organisms grow in piped water distribution systems, while others occur in surface water and can cause epidemic outbreaks and individual cases [7]. Drinking water surveillance is "the continuous and vigilant assessment of public health and the review of the safety and acceptability of drinking water supplies [8]. WHO has recommended continuous surveillance of water for human consumption, building the external and internal audit process, as well as direct surveillance? In our case, water surveillance is carried out precisely through external and internal audit, monitoring the bacteriological and physic-chemical quality [9]. The purpose of this work was the audit of the bacteriological quality of drinking water in Prizren, the collection and analysis of R3 level samples (where R1 and R2 are also included) for the eventual presence or absence of bacteria as an indicator of pollution [10]. The samples were collected throughout the year 2022, in different months of the year and the same were analyzed in the relevant laboratories and were analyzed for the eventual presence of bacteria. Samples for analysis were collected at two main points, at the source where the water has not yet undergone processing and at the household level, where the water is practically disinfected [11].

MATERIALS AND METHODS

The largest number of inhabitants of is concentrated in the urban area and their largest supply of drinking water is realized through the water supply system. The Regional Institute of Public Health in Prizren is the only one authorized to conduct external monitoring of water for human consumption, which is produced by the Water Company and distributed to citizens. For our work, 16 samples of type R3 are planned in advance, through which the "big analysis" is carried out, monitoring the physic-chemical and bacteriological parameters. The samples were treated with the Membrane Filter method, which method uses a membrane filter with a size of 0.45 μm, sufficient to stop microorganisms. This membrane filter technique is mainly used in our laboratory for water analysis and allows testing a larger volume of samples, suitable for our region. Samples of 100 ml were passed through the filter membrane, while then the limited microbial mass on the surface of the membrane filter was transferred to the food in the Petri dish with nutrient medium. We read the findings of colonies or not as well as the type of microorganisms through selective bases (Table 1).

Table 1: Media used for Identification of Bacteria ([5]

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, and	M- TGE / Trypticase Soy USP
Streptococcus of fecal origin	KF- Streptococcal

RESULTS AND DISCUSSION

The sources of water for human consumption in Prizren are underground and are known as '40 wells'. These sources lie at the foot of the mountains of Shari and to a large extent the amount of water in them depends on the snowfall. The city of Prizren in its urban part has over 100,000 inhabitants and about 30,000 households [12]. During 2022, we continuously audited the quality of drinking water in terms of physical, chemical and bacteriological aspects. The audit was conducted according to the control model R1, R2, R3. R3 represents the quality control of drinking water with a wider range of physical-chemical and bacteriological parameters. Respectively, the parameters of models R1 and R2 are also included [10] [13]. According to UA 10/2021, harmonized with the European Directive 98/83/EC [14], in the bacteriological quality plan we research the following parameters: Total number of coliform bacteria, Coliform bacteria of fecal origin, Total number of aerobic mesophilic bacteria, and Streptococcus of fecal origin. For the purpose of the research, 16 samples were taken, of which 8 samples were taken directly from the water sources '40 wells' as raw water and 8 other samples were taken from the housewives' plots, directly before use by the citizen. We did this to compare finding the same water before and after treatment. Housewives' samples were taken at different points, such as at home, school or even in ambulances. Samples were taken of 100 ml for analysis, in sterilized containers and according to the sampling technique, which were then transported to the microbiological laboratory for analysis within 3 hours. In the laboratories, all samples were subjected to the 'membrane filter' method for further analysis. External monitoring of water for human consumption is vital, because many diseases in the world are of water origin [15]. For this purpose, in the Municipality of Prizren, over 1300 samples are taken within the year on a daily basis to monitor water quality. During

2022, physical-chemical samples were carried out, monitoring parameters such as 'turbidity', 'color', 'taste', 'pH', ammonia, nitrites and nitrates, etc. In table 2 we have presented general results for the water supply sources of the city of Prizren. In table 3, we see that out of 16 samples, only one is found outside the standards according to UA 10/2021, respectively expressing water pollution for consumption. This contamination is analyzed before the water is subjected to treatment at the water factory of Hidroregjioni Jugor, a water resources management company. Sample PRZ 33-T1-260522-57698 expressed biological parameters outside the required standards and as such this made such water unusable, even dangerous for health if not treated in time. Since the springs are underground, the contamination with bacteria seems to come from the penetration of surface water into the springs. The water in these springs comes from the mountains of Shari, as a result of melting snow.

Table 2: Samples Collected for Microbiological Analysis and Indicator Samples

No	Collected samples	The investigated microbiological parameters					Indicator parameters				
		Samples day	Escherichia coli	Coliform bacteria	Enterococcus	TNAM Bacteria in 37 °C	Residual chlorine	Turbidity	pH	Nitrites	Nitrates
		Standards UA 10/2021 EU Standards	0	0	0	0	0.2-0.5	0-1.0	6.5-9.5	0.5	50
1	PRZ 33-T1-240322-56709	24.03.2022	0	0	0	0	0	Pa	8.49	0	0.5
2	PRZ 5-T1-240322-56704	24.03.2022	0	0	0	0	0.3	Pa	8.51	0	0.1
3	PRZ 33-T1-260422-57341	26.04.2022	0	0	0	0	0	Pa	8.71	0.01	0.02
4	PRZ 4-T1-260422-57337	26.04.2023	0	0	0	0	0.1	Pa	8.71	0.01	0
5	PRZ 33-T1-260522-57698	26.05.2022	300	5	5	15	0	Pa	8.41	0.01	0.3
6	PRZ 6-T1-260522-57694	26.05.2022	0	0	0	0	0.3	Pa	8.73	0.01	0.5
7	PRZ 33-T1-230622-58181	23.06.2022	0	0	0	0	0	Pa	8.73	0.01	0.3
8	PRZ 24-T1-230622-58179	23.06.2022	0	0	0	0	0.1	Pa	8.67	0.01	0
9	PRZ 33-T1-280722-58579	28.07.2022	0	0	0	0	0	Pa	8.73	0.01	0.1
10	PRZ 21-T1-280722-58578	28.07.2022	0	0	0	0	0.2	Pa	8.82	0.01	0.5
11	PRZ 33-T1-250822-58980	25.08.2022	0	0	0	0	0	Pa	8.94	0.01	0.5
12	PRZ 50-T1-250822-58981	25.08.2022	0	0	0	0	0	Pa	8.9	0	0.5
13	PRZ 33-T1-220922-59305	22.09.2023	0	0	0	0	0	Pa	8.96	0.01	0
14	PRZ 6-T1-220922-59302	22.09.2023	0	0	0	0	0.2	Pa	8.92	0.01	0.5
15	PRZ 33-T1-271022-59888	27.10.2022	0	0	0	0	0	Pa	8.94	0.01	0.3
16	PRZ 32-T1-271022-59887	27.10.2022	0	0	0	0	0.1	Pa	8.94	0.01	0.5

At the time when the sampling was carried out (May 26, 2022), there was a lot of rain, creating floods and pollution of other sources as well. In general, the bacteriological quality of water for human consumption in Prizren is good and safe for consumption. This is confirmed by other samples (15) which result within the standards according to UA 10.2021 and Standards for drinking water [16] [17]. This quality of drinking water, especially the water collected from the fields where people consume it directly, ensures undamaged health for citizens and prevents diseases of water origin. The same is confirmed by the indicator parameters, such as turbidity, pH, ammonia, nitrites and nitrates, which are found in the norm (Figure 2).

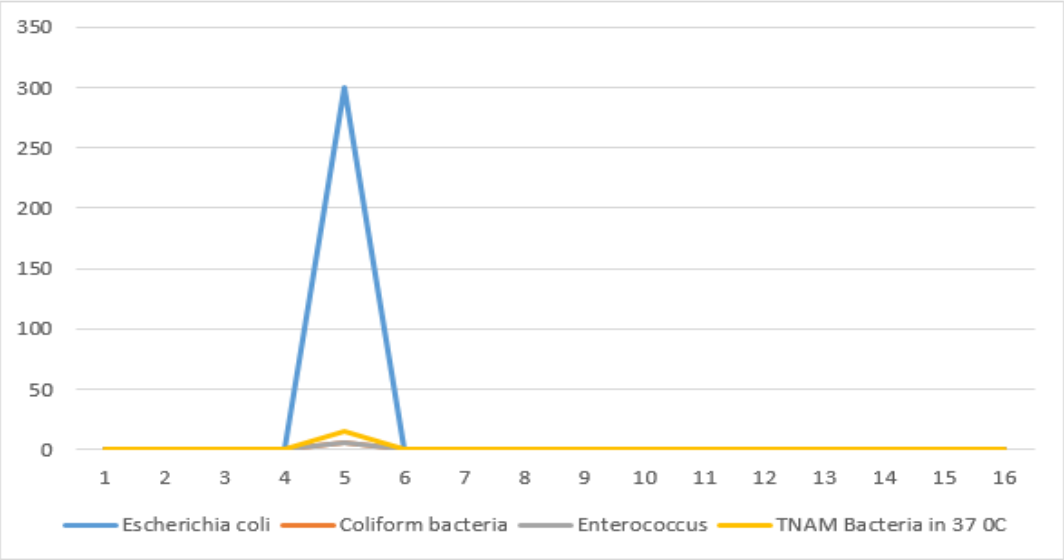

Figure 2: Graphic Representation of Sample with Contamination

Indicator bacteria, such as *Escherichia coli*, *Enterococci*, etc., are present in the only sample found with contamination. *E.Coli* in sample 5 and shown in Figure 3 was found in the sediment remaining in the filter membrane and the same is pathogenic for humans, just like *Enterococcus faecalis* .

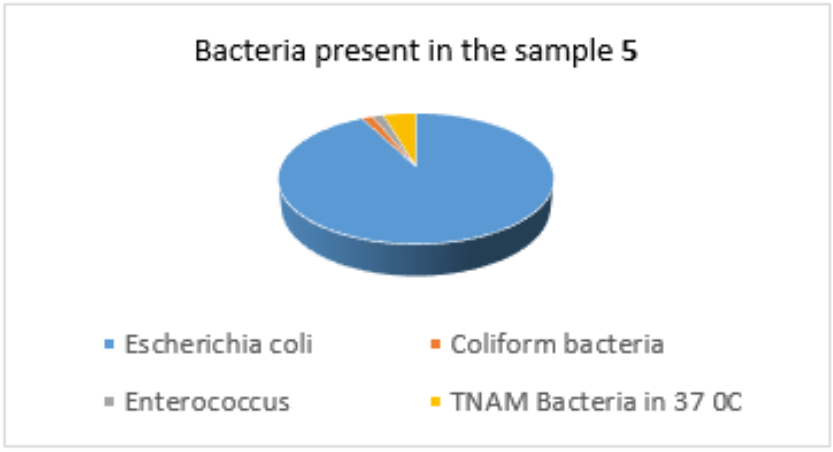

Figure 3: Bacteria Present in the Sample

After treating the water with Chlorine, no presence of bacteria is found in the citizens' supply lines. On the contrary, in all cases we encounter the presence of residual chlorine, which provides security for water consumption.

Other indicator parameters, such as turbidity, ammonia, nitrites and nitrates are within the required standards. The pH of the water analyzed in all samples is within the standards, while its value is between 8.42 - 8.96, or an average of 8.225 units.

CONCLUSIONS

The results of this study showed contamination with naturally occurring microorganisms in water, soil, or vegetation that indicates a problem with the overall quality of the produced water that may be due to lack of treatment or inadequate treatment, but does not indicate contamination with wastewater or animal waste. Of course, the heavy rainfall, or the rapid melting of snow from the mountains has influenced the occurrence of floods and the pollution of sources. But this has not affected the supply of residents with safe drinking water. The months of May and June in our country are characterized by heavy rains, respectively temperature changes and this affects the quality of water in the supply sources. In Prizren during the year 2022, we will not have any concerns regarding drinking water. Citizens, according to our research, are provided with safe drinking water. The disinfection of the water produced by the Southern Hydroregion, as the only company that deals with the provision of drinking water in Prizren and its region, is giving a positive effect in the prevention of diseases of water origin. The supply company must increase the care of surveillance the water processes and supplies to citizens, especially its employees who deal with the disinfection of drinking water for human consumption [5]. External audit is very important for the prevention of water pollution for consumption, as well as for the prevention of water-borne diseases. This creates good opportunities to ensure safe water in the process of supplying citizens.

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