Microbiological Water Safety of Community-Managed Drinking-Water Systems in Tirana

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Abstract *Diseases related to contaminated drinking water have a greater impact on human health. The purpose of this study is monitoring the microbiological characteristics of water dissolved in the water distribution system in Tirana. The method used for microbiological analysis is: membrane filter. This method is based on filtering the water with a vacuum filter equipment using membrane filters with a diameter of 47 – 50 mm, and 0.45 μm pore size. As object of this study have been some areas of Tirana: Kinostudjo, Porcelan, Don Bosko, Kombinati, Laprakë, 21 Dhjetori, Komuna e Parisit, Treni, Ali Demi, Yzberishti, Sharra, ect. The areas are codify as : (A1, A2, A3, A4, A5,A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17, A18, A19, A20). Samples for analysis were taken from this areas in two stages with difference time a month of each other just to see the difference in microbial load depending on temperature rise. Monitoring was conducted for indicator organisms (E. Coli, T. Count, Pseudomonas aeruginosa, Enterococcus fecalis). Mainly areas which result in a high contamination are codified as (A3, A4, A14, A17, A20). The reasons for these results are: amortization of distribution system, the lack of restoration of damaged items to the distribution system, illegal interference in the distribution system, construction of wells in private homes, the use of storage systems and pumping systems for individual supply in any residential apartment.*

Keywords: *indicator organisms, contamination, distribution system, samples.*

Preface

Surveillance of drinking-water quality can be defined as “the continuous and vigilant public health assessment and review of the safety and acceptability of drinkingwater supplies” (WHO, 1976).
The right of consumers to information on the safety of the water supplied to them for domestic purposes is fundamental.
Diarrhoea occurs world-wide and causes 4% of all deaths and 5% of health loss to disability. The use of water in hygiene is an important preventive measure but contaminated water is also an important cause of diarrhoea. Cholera and dysentery cause severe, sometimes life threatening forms of diarrhoea. Amongst the poor and especially in developing countries, diarrhoea is a major killer. In 1998, diarrhoea was estimated to have killed 2.2 million people, most of whom were under 5 years of age (WHO, 2000). Each year there are approximately 4 billion cases of diarrhoea worldwide.

Material and method

The method used for microbiological analysis is: membrane filter. This method is based on filtering the water with a vacuum filter equipment using membrane filters with a diameter of 47 – 50 mm, and 0.45 μm pore size. Filters with water content filter placed in Petri dishes with readily dehydrated terrain that is hydrate first with sterilized water. Then the plates are placed in the thermostat (24 – 48 hours depending on the organism) and then are count the bacterial colonies formed. As object of this study have been some areas of Tirana: (Pazari i Ri, Kinostudio, Porcelan, Oxhaku, Don Bosko, Babrru, Kombinat, Park, Laprake, Zogu i Zi, 21 Dhjetori, Fusha e Aviacionit, Komuna e Parisit, Misto Mame, Stacioni i Trenit, Uzina e Autotraktorve , Ali Demi, Yzberisht, Sharra, Koder Kamza). Zonat jane kodifikuar si me poshte: (A1, A2, A3, A4, A5,A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17, A18, A19, A20). Samples for analysis were taken from this areas in two stages with difference time a month of each other just to see the difference in microbial load depending on temperature rise. Monitoring was conducted for indicator organisms *(E. Coli, T. Count, Pseudomonas aeruginosa, Enterococcus fecalis)*.

Resultant and discussion

1. Microbiological aspects of drinking water

Given the fact that the population of Tirana is thought to have reached around 850'000 inhabitants, that is how a quarter of the country's population, ensuring the microbiological safety of drinking water is very necessary. Diseases related to contamination of drinking-water constitute a major burden on human health. Interventions to improve the quality of

drinking-water provide significant benefits to health The most common and widespread health risk associated with drinking water is microbial contamination, the consequences of which mean that its control must always be of paramount importance. In general terms, the greatest microbial risks are associated with the consumption of water that is contaminated with humans or animals faecal. Infectious diseases caused by pathogenic bacteria, viruses, protozoa and helminthes are the most common and widespread health risk associated with drinking-water. Contaminated water can be the source of large outbreaks of disease, including cholera, dysentery and cryptosporidiosis etc. Such epidemics stemming from drinking water should be avoided especially because they have higher capacity to infect both a larger number of people and potentially a higher percentage of the community. Approaches to verification include testing of source water, water immediately after treatment, water in distribution systems or stored household water.

Table 1.1 Some of the microorganisme value of Europian Standard 80/778 (Appendix I) and Albanian Standard (VKM 145, 1998) for drinking water.

Parameters	EC DESIG: 80/778		STASH 3904:1997	
	Norma	Maximum	Norma	Maximum
Total Coliform, colonies/100 ml	0	-	0	-
Streptococcus faecalis, colonies/100 ml	0	-	0	-
coliforms faecalis, colonies/100 ml	0	-	0	-

Table 1.2: Average monthly record of some microbiological parameters measured regularly by Bovilla plant before and after water treatment, during the last three years (2006-2009).

Parameters	Before Treatment			After Treatment		
	minimum	average	maximum	minimum	average	maximum
Totali coliform koloni / 100ml	2.00	17.00	36.00	0.00	0.00	0.00
Streptococcus faecalis koloni/100ml	4.00	30.00	159.00	0.00	0.00	0.00
Coliforms faecalis colonies / 100ml	1.00	15.00	49.00	0.00	0.00	0.00
General Micro (36C) colonies / ml	3.00	14.00	33.00	0.00	0.00	0.00
General Micro (22C) colonies / ml	0.00	18.00	47.00	0.00	0.00	2.00
Clostridium Colonies/20ml	0.00	0.00	1.00	0.00	0.00	0.00

2. Experimental part

2.1 The results of problematic areas

1. (Uzina e Autotraktorve) A14

SAMPLE 1: Dt: 08/06/11, Time: 9:30'

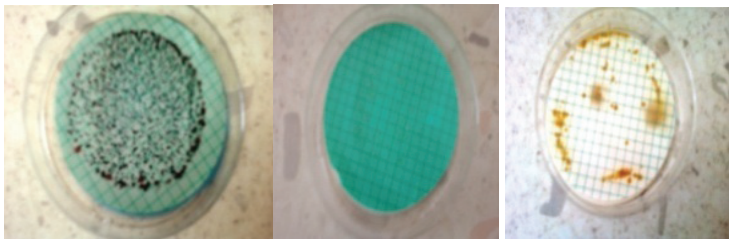


figure 2.1

SAMPLE 2: Dt: 21/06/11, Time: 13:30

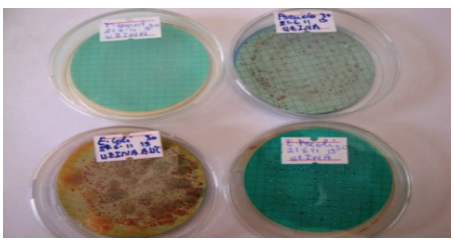


figure 2.2

-*E. Coli* after 24 hours – not counting, tan color.
-*Total count* after 48 hours – 25 colonies, yellow color.
-*Pseudomonas* after 48 hours – not counting, yellow color.
-*Enterococcus faecalis* after 48 hours – 2 colonies, tan color.

-*E. Coli* after 24 hours – not counting , tan color.
-*Pseudomonas* after 48 hours – not counting, yellow color.
-*Total count* after 48 hours – 7 colonies, yellow color.
-*Enterococci faecalis* after 48 hours – 15 colonies, red color.

Graphic

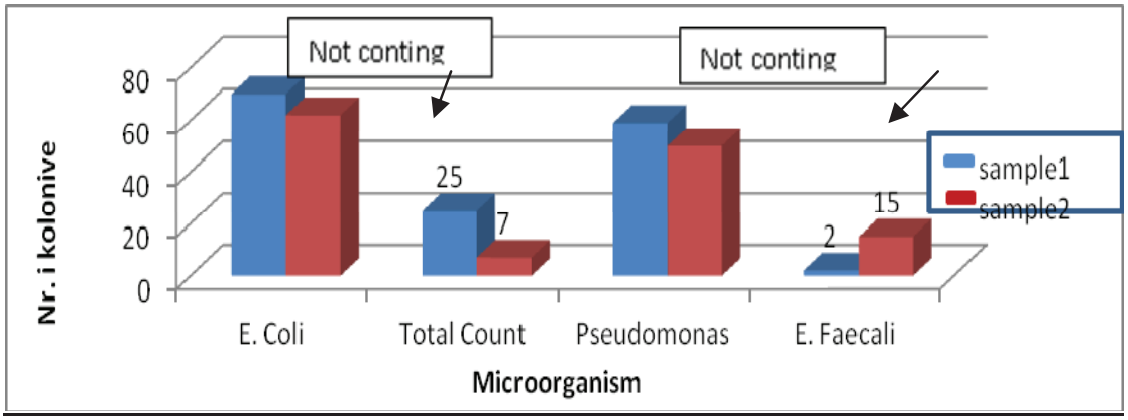


Figure 2.1 Number of colonies of E. coli, Total Count, Pseudomonas, Enterococcus fecali, formed from water samples taken in the area of Uzina e Autotraktorve.

Interpretation: The results of tests: in sample 1: the presence of *E.coli* is not counting, *T. count* is 25 colonies/1ml water sample taken for analysis, *Pseudomonas* is innumerable and *E.fecali* is 2 colonies/ 100ml. While in sample 2 results in the presence of *E. coli* is not counting, *T. count* is 7 colonies/1ml water sample taken for analysis, *Pseudomonas* is innumerable and *E. fecali* is 15 colonies/100ml water sample taken for analysis.

2. (Misto Mame) A17

SAMPLE 1: Dt: 08/06/11, Time: 13:30' **SAMPLE 2: Dt: 23/06/11, Time: 10:00**

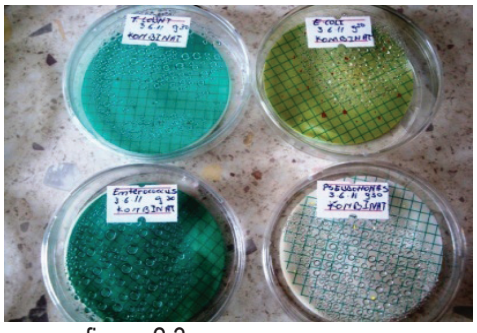


figure 2.3

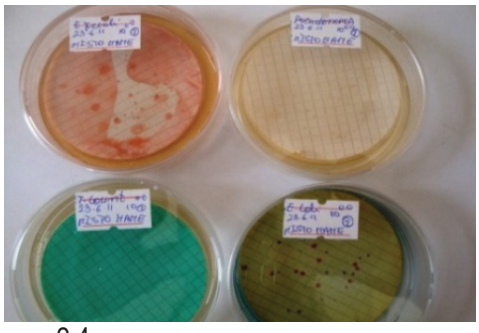


figure 2.4

E. Coli after 24 hours – 62 colonies, tan color.
Total count after 48 hours – 10 colonies, white color.
Pseudomonas after 48 hours – 1colony, yellow color .
Enterococcus faecalis after 48 hours – 0 colony.

E. Coli after 24 hours – 43 colonies, tan color.
Total count after 48 hours – 4 colonies white color.
Pseudomonas after 48 hours – 21 colonies, yellow color
Enterococci faecalis pas 48 orësh – not counting, red color

Graphic

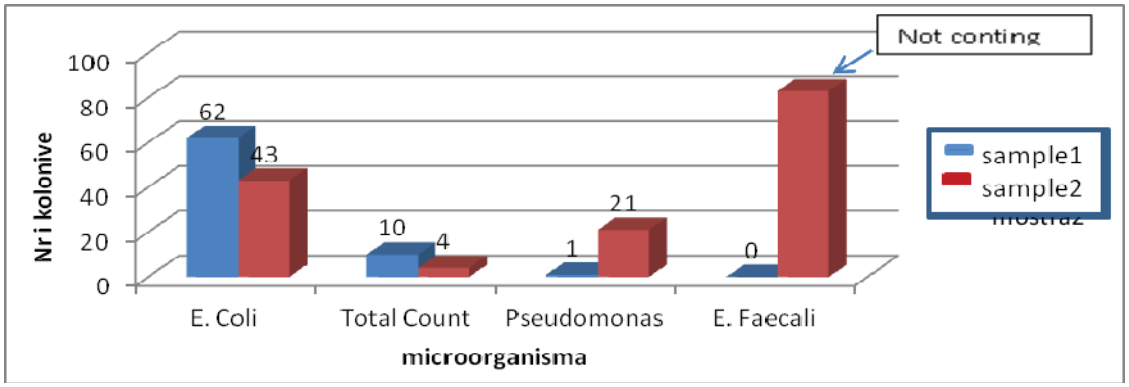


Figure 2.2 Values of E. coli, Total Count, Pseudomonas, Enterococcus fecali for 2 water samples taken in the area of Misto Mames.

Interpretation: The results of tests in sample 1: the presence of *E.coli* is 62 colonies/100ml, *T. count* is 10 colonies/1ml water sample taken for analysis, *Pseudomonas* is 1colony/100ml of water sample taken for analysis, *E.faecalis* is 0 colony/100ml water sample taken for analysis. While sample 2 results in the presence of *E.coli* at 43 colonies/100ml, *T. count* to 4 colonies/1ml water sample taken for analysis, *Pseudomonas* is 21 colonies/100ml and *E. faecalis* is not counting.

3.Graphic design of all samples for each organism, in particular

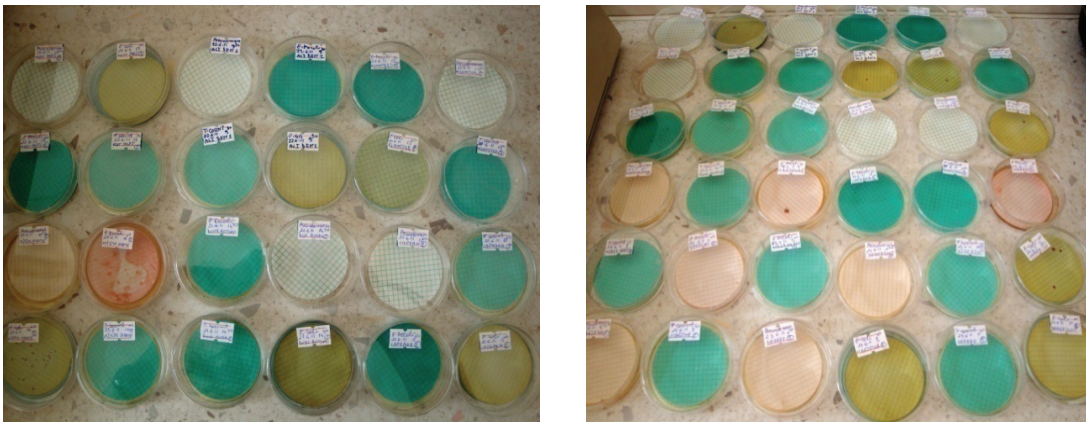
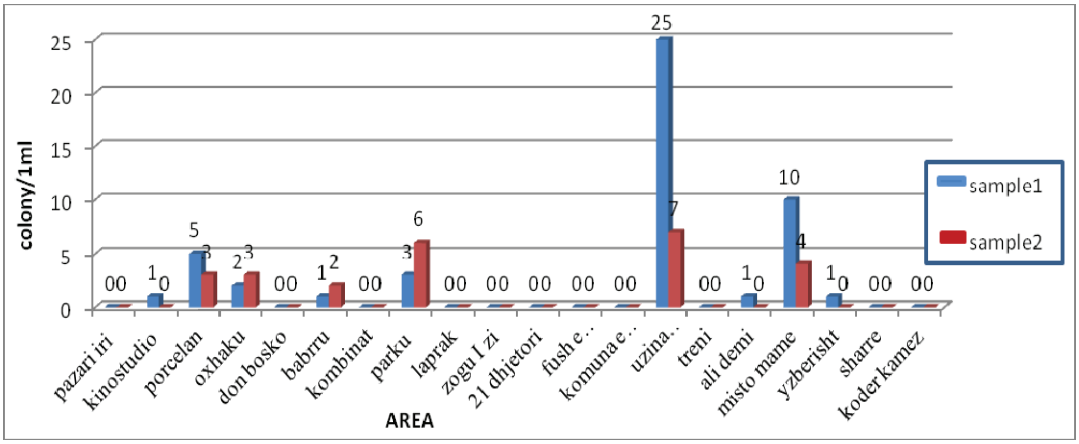


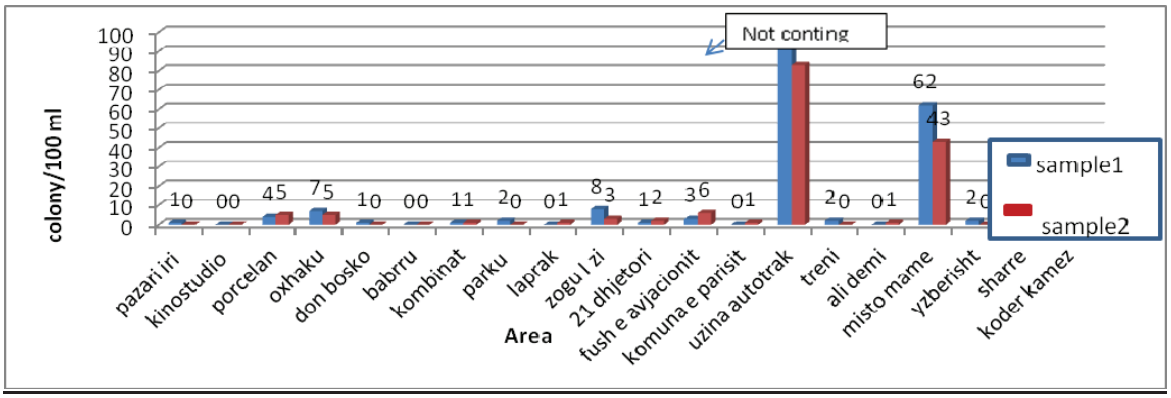
Figure 2.5 Overview 40 samples

Graphic



Graphic Fig 2.3 output of all samples for Total Count

Interpretation: The results of analysis performed for *Total count* is seen that in both Uzina e Autotraktorve samples and two samples results in Misto Mame pollution level is to higher compared with the other areas.



Graphic Fig 2.4 output of all samples for E. Coli

Interpretation: From the results of tests performed on *E. coli* can be seen that in both areas Uzina e Autotraktorve and Misto Mame two samples resulting in a higher pollution level compared with other areas where, according to EU standard, and according to Albanian Standard of drinking water, the amount of these organisms should result 0 colony/100ml water sample taken for analysis.

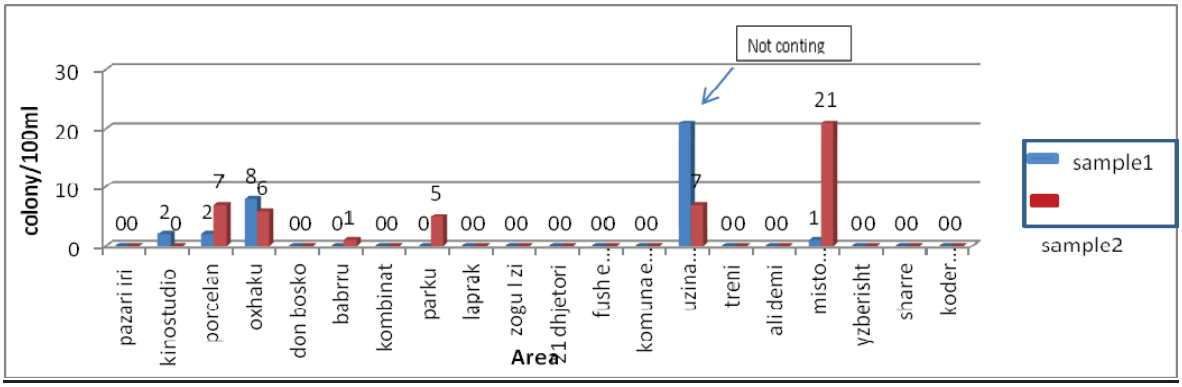


Figure 2.5 Graphical presentation of results of all samples for Pseudomonas aeruginosa

Interpretation: From the results of analysis performed for *Pseudomonas aeruginosa* can be seen that in both samples Uzina e Autotraktorve and the second sample results Misto Mame a higher pollution level compared with other areas where, according to EU Standards and according to Standard Albanian on drinking water, the quantity of these microorganisms should result 0 colonies/100ml water sample taken for analysis.

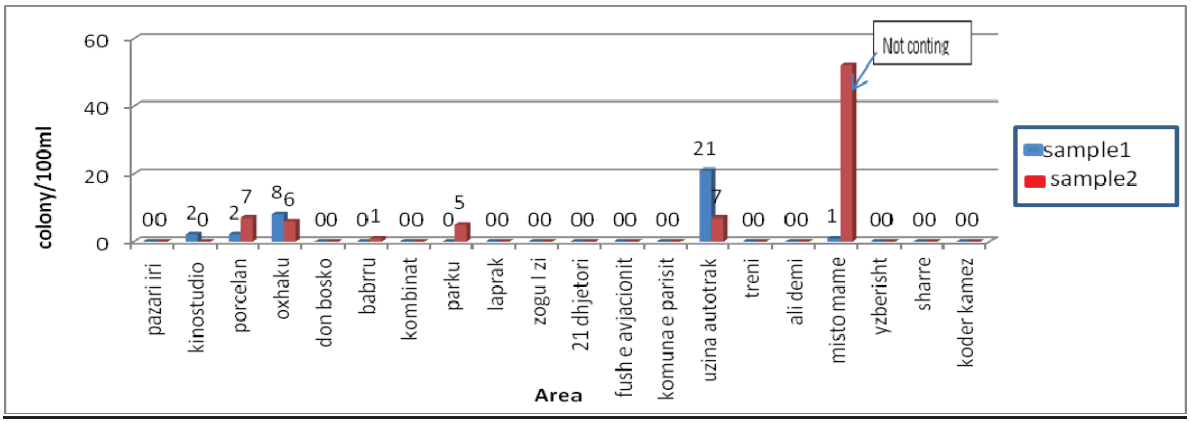


Figure 2.6 Graphical presentation of results of all samples for Enterococcus fecalis

Interpretation: From the results of analysis performed for *Enterococcus fecalis* seen that in both samples Uzina e Autotraktorve and the second sample results Misto Mame a higher pollution level compared with other areas where, according to EU standard and by Albanian standards on drinking water, the quantity of these microorganisms should result 0 colonies / 100ml water sample taken for analysis.

Table 2.1 Areas and the number of colonies of microorganisms identified in each of the samples taken (in red appear problemetike areas).

Zone	Mostra	E. Coli	T. Count	Pseudomonas aeruginoza	E. fecali
Pazari i Ri	Samples 1	1	0	0	0
	Samples 2	0	0	0	0
Kinostudjo	Samples 1	0	1	2	1
	Samples 2	0	0	0	0
Porcelani	Samples 1	4	5	2	2
	Samples 2	5	3	7	0
Oxhaku	Samples 1	7	2	8	0
	Samples 2	5	3	6	0
Don Bosko	Samples 1	1	0	0	0
	Samples 2	0	0	0	0
Babrru	Samples 1	0	1	0	0
	Samples 2	0	2	1	0
Kombinat	Samples 1	1	0	0	0
	Samples 2	1	0	0	0
Parku	Samples 1	2	3	0	0
	Samples 2	0	6	5	0
Laprak	Samples 1	0	0	0	0
	Samples 2	1	0	0	0
Zogu i Zi	Samples 1	8	0	0	0
	Samples 2	3	0	0	0
21 Dhjetori	Samples 1	1	0	0	0
	Samples 2	2	0	0	0
Fusha e Avjacionit	Samples 1	3	0	0	0
	Samples 2	6	0	0	0
Komuna e Parisit	Samples 1	0	0	0	0
	Samples 2	1	0	0	0
Uzina e Autotraktorve	Samples 1	Not counting	25	Not counting	2
	Samples 2	Not counting	7	Not counting	15
Misto Mame	Samples 1	62	10	1	0
	Samples 2	43	4	21	Not counting
Treni	Samples 1	2	0	0	0
	Samples 2	0	0	0	0
Ali Demi	Samples 1	0	1	0	0
	Samples 2	1	0	0	0
Yzberisht	Samples 1	2	1	0	0
	Samples 2	0	0	0	1
Sharrë	Samples 1	1	0	0	0
	Samples 2	3	0	0	4
Kodër Kamëz	Samples 1	10	0	0	3
	Samples 2	23	0	0	0

Conclusions

The study took into consideration 20 areas of the Tirana city to monitor the microbiological characteristics of drinking water in these areas. Samples were taken mainly to the right in the taps of 20 dwellings in the relevant areas, from which two samples were taken in parallel. Taking two parallel samples served to confirm the results.

From the results of analysis have proved 5 problematic areas, namely areas A3, A4, A14, A17, A20. As mentioned above, obtaining two parallel samples helps to confirm the results but it is clear that this study can be taken as a good basis for further studies .

In area A3 results in sample 1 are :the presence of *E. coli* to 4 colonies/100ml, *T. count* at 5 colonies/1ml water sample taken for analysis, the extent of *Pseudomonas* 2colonies/100ml water sample taken for analysis and *E. fecali* 2 colonies/100ml. While the sample 2 results in the presence of E. coli at 5 colonies /100ml, T. count in the mass 3 colonies/1ml water sample taken for analysis, the extent of *Pseudomonas* 7 colonies/100ml water sample taken for analysis and *E.faecalis* 0 colonies/ 100ml.

In area A4 results in sample 1 are: the presence of *E.coli* in 7 colonies/100ml, *T. count* in 2 colonies/1ml water sample taken for analysis, the extent of *Pseudomonas* 8 colonies/100ml water sample taken for analysis and *E.faecali* 0 koloni100/ml. While the sample 2 results in the presence of *E.coli* 5 colonies / 100ml, *T. count* 3 colonies/1ml water sample taken for analysis, *Pseudomonas* 8 colonies/100ml water sample taken for analysis and *E.faecali* 0 koloni100/ml.

In area A14 results in sample 1 are: the presence of *E.coli* is not counting, *T. count* 25 colonies/1ml water sample taken for analysis, *Pseudomonas* are not counting and *E.faecali* 2 colonies100/ml. While in sample 2 results in the presence of *E. coli* is not counting, *T. count* 7 colonies/1ml, water sample taken for analysis, *Pseudomonas* are not counting and *E. fecali* 15 colonies/100ml.

In area A17 results in sample 1 are: the presence of *E.coli* is 62 colonies/100ml, *T. count* 10 colonies/1ml water sample taken for analysis, *Pseudomonas* 1 colonies/100ml of water sample taken for analysis, *E.faecali* 0 colonies/100ml water sample taken for analysis. While in sample 2 results are the presence of *E.coli* is 43 colonies/100ml, *T. count* 4 colonies/1ml water sample taken for analysis, the presence of *Pseudomonas* are 21 colonies/100ml and *E. faecali* is not counting.

In area A20 results in sample 1 are: the presence of *E.coli* is 10 colonies/100ml, *T.count* 0 colonies/1ml, water sample taken for analysis, *Pseudomonas* are 0 colonies/100ml water sample taken for analysis and *E. faecali* ais 3 colonies/100ml. While in sample 2 results in the presence of *E.coli* is 23 colonies/100ml, *T.count* 0 colonies/1ml water sample taken for analysis, *Pseudomonas* 0 colonies/100ml water sample taken for analysis and *E.faecali* 0 colonies/100ml. While in areas A2, A5, A9, A13, A15, A18 in the second samples of each case, the results for microorganisms *E. coli, Pseudomonas, E. fecali, Total count* are 0 colonies / 100ml water sample, and in isolated cases specifically in the areas: A1, the presence of *E. coli* has resulted in 1colony/100 ml in first sample and 0 colonies/100 ml in the second sample. Area A16 has the presence of *E. coli* in 0colonies/100 ml in the first sample and 1 colonies/100 ml in second sample while the presence of *Total count* has resulted 1colonies/100 ml in the first sample and 0 colonies / 100 ml in the second sample. In areas A18 *E.coli* has resulted in 2 colonies/100 ml in first sample and 0 colonies/100 ml in the second sample, while the presence of *Total count* 1colonies/100 ml resulted in the first sample and 0 colonies/100 ml in the second sample. These results are not considered as an indicator.

1 - Depreciation of the distribution system and the lack of restoration of damaged items to the distribution system.

2 - Illegal interventions on the distribution system which not only reduce the flow of water in the system but also cause water pollution from the surrounding environment of the ordinary case of contamination by sewage.

3 - Opening of wells in private homes. For these wells from which water is used for a direct consumption, has not monitored nor consistently microbiological safety of water used.

4 - Use of water tanks and pumping systems to supply individual in any residential apartment buildings. Lack of isolation of these deposits and the lack of application of these procedures sanifikimit for storage and equipment.

Recommendations

Based on the results obtained during this study, recommend:

1 - To deepen the study of the problematic areas to understand the reasons of these results in a high level of contamination of drinking water

2 - Focusing the study on a single problem to identifying more points in indicators microorganism in this area.

3 - Continuation of the study to categorize the problems associated with interference in the distribution system.

4 - Further research in all areas related to the presence of E. coli in water, given the fact that it is predominant microorganism in the analyzed samples.

5 - Focus on the monitoring depending on the distribution depots and pumping systems appropriate for each area that ujsjellsit system.

6 - Monitoring of indicators microorganisms depending on the source that supplies the distribution system, namely, Selita, Shënmëria, old Bovilla and Bovilla reservoir,

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