ASSESSMENT OF DRINKING WATER QUALITY IN FIER DISTRICT, THROUGH THE MICROBIOLOGICAL AND CHEMICAL PARAMETERS

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ABSTRACT

Water is life and water quality is an essential measure of quality of life or, to be clearer, the existence of life. Improving access to safe drinking-water can result in tangible benefits to health. Efforts must be made to achieve a drinking-water quality as safe as possible. Water supply in relation with the standards and rules settled for the bacterial levels, offers the possibility for a hygienic environment which of course serves as an antidote to many infective diseases which originate from water. This study will create the conditions for the full evaluation of water standards in Fier, the third biggest region in the country. The monitoring process of the standards will be made by microbiological and physical-chemical indicators. Samples are gathered every month during June 2014-June 2015 period, in 29 different locations scattered in different communes, water deposits and rural water supply centers. Most Probable Number index is used for evaluation of *Escherichia coli*, while the number of heterotrophic bacteria is determined by counting colonies on plates with PCA. Chemical testing includes parameters like pH, ammonia, chloride, nitrite and dissolved oxygen that are estimated using standard methods. According to preliminary results, water standards in the city are satisfactory having no positive causes, meanwhile in some communes there are different cases found positive on microbiological indicators like *E. coli, S. faecalis*.

Keywords: Physicochemical analysis, Most Probable Number index, faecal indicators, water quality.

INTRODUCTION

Water is the most vital liquid for maintaining the life on the earth. Water is one of the three major components of the environment; therefore, there exists a close linkage between the quality of water and the quality of life (1). Safe drinking water is a basic need for good health and it is also a basic right of humans. A majority of rural water sources for drinking are still the traditional ones wells, rivers, streams which might harbor waterborne and vector-borne diseases (9). The importance of water, sanitation and hygiene for our health is reflected in the outcomes of a series of international policy forums (13). Generally, the drinking water contamination can arise from chemical (industries and farms) and other sources.

LITERATURE REVIEW

Many factors influence water quality but the greatest impacts are usually from point sources associated with the discharge of treated wastewater from municipalities and industries (17). Fier district has abundant freshwater sources which exist as rivers, natural springs and groundwater aquifers. The drinking water at the source is of good quality, however there are many problems concerning drinking water supply and quality especially in municipalities

where the lack of drinking water at the tap is a crucial problem (3). Drinking water can be carefully evaluated for microbial contamination to ensure informative updates on the quality of water (11). Microbial monitoring exercise ensures safe supply of drinking water without compromising on the people's health (10). In municipality's water supply the most typical method normally advised for inactivating microbes, water treatment, is disinfection with hypochlorite (12).

Escherichia coli have traditionally been used to monitor drinking water quality, and it remains an important parameter in monitoring drinking water quality. Water intended for human consummation should contain no fecal indicator organisms (16; 17). The concept of using organisms such as *E. coli* and *Clostridia* as microbial fecal contaminant indicators is a well-established practice in the assessment of the quality of drinking-water. Overall, the community drinking water sources and even the municipal water systems require accurate and reliable microbial evaluation of the quality of drinking water (2). Water quality is the physical, chemical, and biological characteristics of water in association to the set of standards (3). Both physical and chemical parameters of collected water samples have been tested from the regional laboratory of Health directory in Fier. Important chemical parameters have been tested were chloride, nitrite, ammonia and free chlorine (6). The results were then matched and discussed with WHO standards. Many of the water that we drink contain toxic chemicals. These chemical substances that are found in water are due to natural processes or human activities (14).

Fier is part of one of the 36 territorial divisions of the Republic of Albania called districts. Fier is the second largest region. It lies in the western region of the country occupying the southern part of the field of Myzeqe. Fier district is surrounded in the north with Lushnja, in the east by Berati district, in the southeast by Mallkastra district, while in the south by Vlora district. A land area of 793 km^2 and a population of 254,123 inhabitants lie within the limits of this district. This area includes the cities of Fier, Patos, Roskovec and 117 villages that are organized in 13 municipalities (15) which are included in our study. Every municipality has one or more sampling points depending on their size.

METHODOLOGY

The water samples for chemical-bacteriological analysis were collected from selected water sources in different municipalities, commonly used by the community. This is a descriptive and analytic study. We have studied and analyzed 403 samples collected during the period june 2014 - june 2015 in order to see the trend of chemical parameters value, the contamination level of the drinking water and presence of faecal indicators organisms. We collect water in 2 different clear bottles and put a label to distinguished them, one for microbial analysis (*Escherichia coli, Streptococcus faecalis* and *Clostridium perfrigens*) (4) and one for physical and chemical parameters like $\boldsymbol{NH_4^+}$ ***mg/l,*** $\boldsymbol{NO_2^-}$ ***mg/l,*** $\boldsymbol{Cl^-}$ ***mg/l,*** $\boldsymbol{Cl_2}$ ***mg/l*** and ***pH*** which is analyzed at the moment of sampling with ph-meter (6; 8; 18; 19). Water samples are collected in sterile sample containers with leak proof lids. Water samples were collected in 200 ml sterile vials that were fitted with screw caps. Sterilizations of the vials were performed by autoclaving at 121 ° C for 15 minutes prior to sampling. Samples were transported to the laboratories of Public Health Institute in Fier within 2 hours on the same day (21).

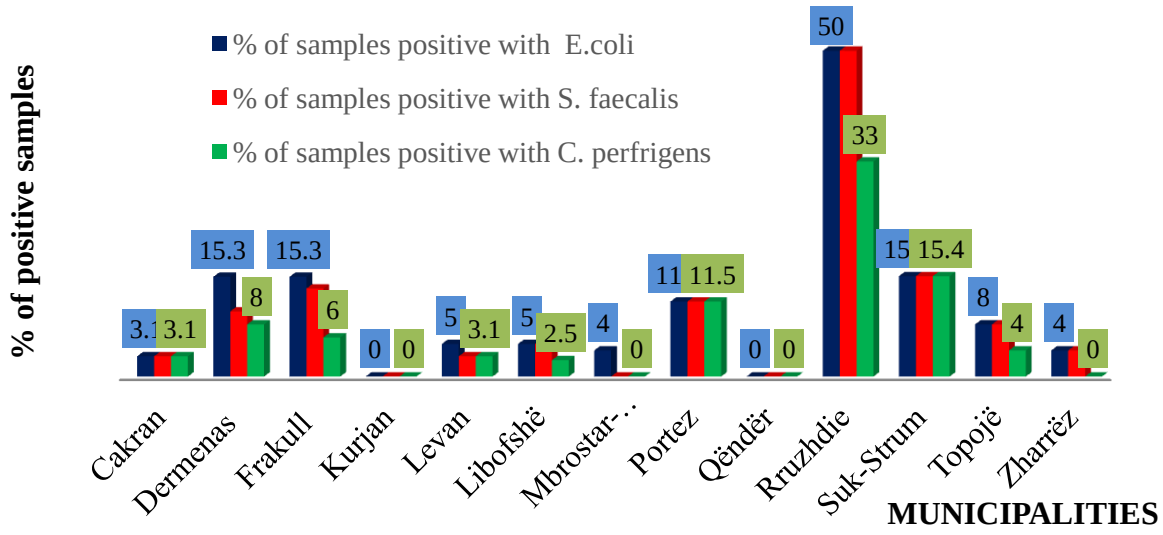
Chloride is mainly obtained from the dissolution of salts of hydrochloric acid. We have used titration with silver nitrate for chloride determination with silver nitrate ($AgNO_3$) as titrant

(8).We have used the O- toluidines method or the DPD method for chlorine determination(6). Nitrite determination is carried out as the water samples react with the reagent NEDA {*N*-(1-naphtyl) ethylenediamine}then the measurements are done in a spectrophotometer (19). We have used spectrophotometric determination of ammonium nitrogen with the Nessler reagent (9; 23). Fecal indicators (*Escherichia coli, Streptococcus faecalis* and *Clostridium perfrigens*) were determinate by five tubes MPN technique with selective medium for each indicator. For *Clostridium perfrigens* we have used Wilson Blair medium and then the samples were incubated for 44-48 hours at 37 °C. The presence of these bacteria is noticeable when sulfhidric gas is produced in the Durham tubes (4; 6). We have used Lactose Broth medium for *E. coli* and then samples were incubated in 44.5°C (a temperature that allows only the growth of E. *coli*) (6;19).

RESULTS AND DISCUSSION

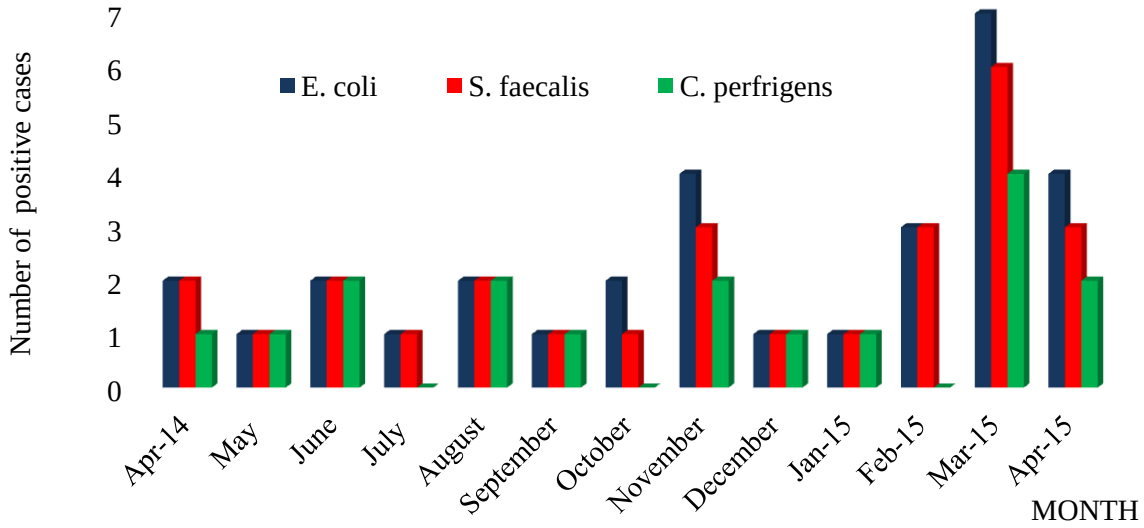
The pH of pure water is refers to the measure of hydrogen ions concentration in water. It ranges from 0 to 14. In general, water with a pH of 7 is considered neutral. Normally, water pH ranges from 6 to 8.5 (20). It is noticed that water with low pH is tend to be toxic and with high degree of pH it is turned into bitter taste (1). According to WHO standards pH of water should be 6.5 to 8.5. In Fieri district pH value ranges from 7.2 to 8. I have analyzed 403 samples in 13 municipalities during June 2014-June 2015, in oder to have a clear view of drinking water quality in Fier district. Water intended for human consummation should contain no faecal indicator organisms (1; 4; 11; 13). According to WHO or EPA the guideline level of faecal indicators (*E. coli, S. faecalis* and *C. perfrigens*) in drinking water is zero(5; 10; 11). According to our data concerning microbiological analysis, we can put in evidence that:

Most of the cases for the presence of *E. coli, S. faecalis* and *C. perfrigens* belong to the samples collected in Rruzhdie where 6 out 13 samples resulted positive for at least one microbiological indicator. In Dërmenas from 39 samples collected, 6 resulted positive for at least one of the indicators. In Frakull from 52 samples, 8 resulted positive for at least one of the indicators. In Kurjan and Qëndër from 52 samples collected, no one resulted positive for at least one of the fecal indicators. For the percentage of positive samples for the presence of faecal indicators in 13 communes during the period june 2014 - june 2015 we can see graph 1.



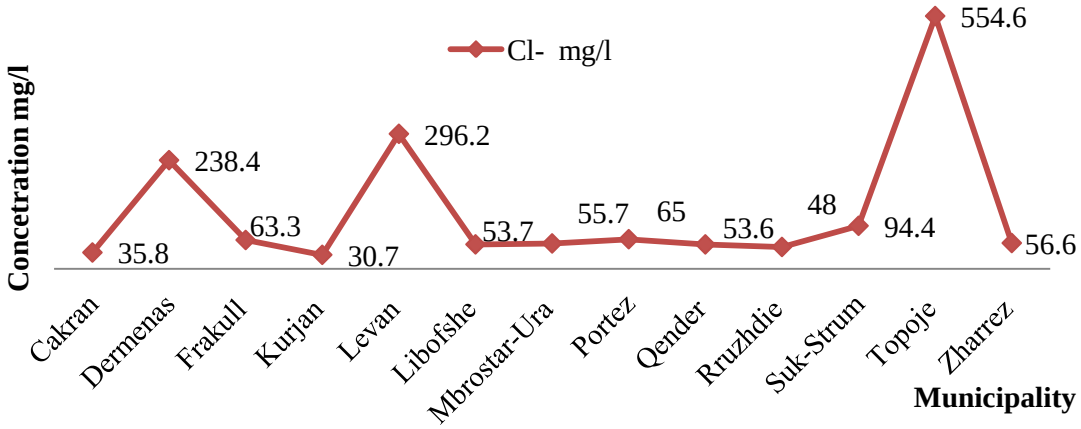
Graph 1. The spread of positive cases of fecal indicators in Fier district during Apri 2014 - April 2015

In graph 2, we can notice that 8.7 % of the total number of the samples have resulted positive with *E. coli*, 7.4 % have resulted positive with *S. faecalis* and only 4.7 % are positive with *C. perfrigens*. The greatest numbers of positive samples with fecal indicators are noticed in March 2015, November 2014 and April 2015. Not always the same sample results positive for the three indicators. The lowest numbers of positives samples with faecal indicators are noticed in January, February, May and July.



Graph 2. The distribution of positive cases of faecal indicators in Fier district

According to WHO in 1993 Guidelines, a guideline value of 250 mg/l was established for chloride, based on taste considerations. No health-based guideline value for chloride in drinking-water was proposed although it was confirmed that chloride concentrations in excess of about 250 mg/l can give rise to detectable taste in water (8). In study areas the chloride average value ranges from 35.8 mg/l in Cakran to 554.6 mg/l in Topojë municipality which is located near the seacost.



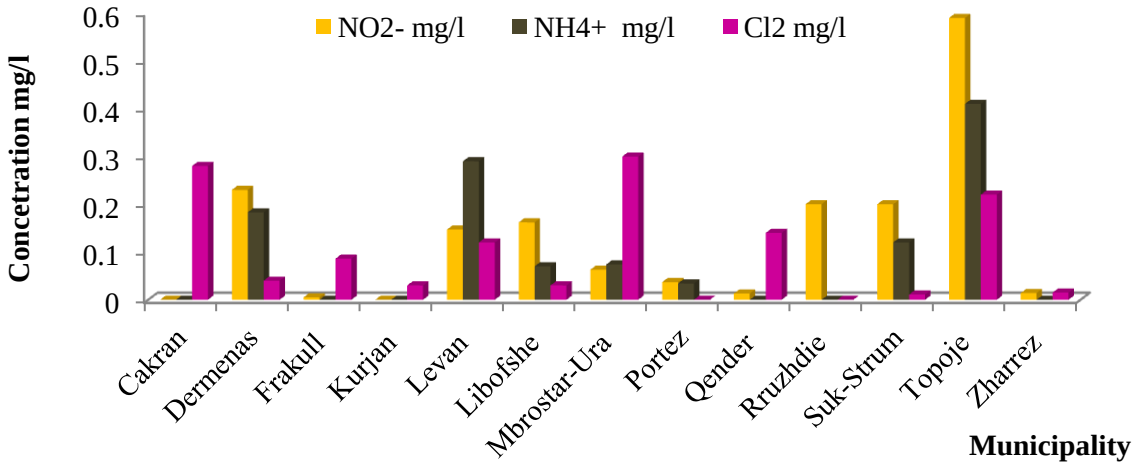
Graph 3. Average amount of Chloride (mg/l) in Fieri district munipalicity

In USA maximum contaminant level (MCL) for nitrite in drinking water is 1 mg/L or 1 ppm according to EPA (Enviromental Protection Agency)(8). According to WHO maximum level for nitrites is 3 mg/l (10; 11).

According to our data concerning chemical analysis, we can put in evidence that:

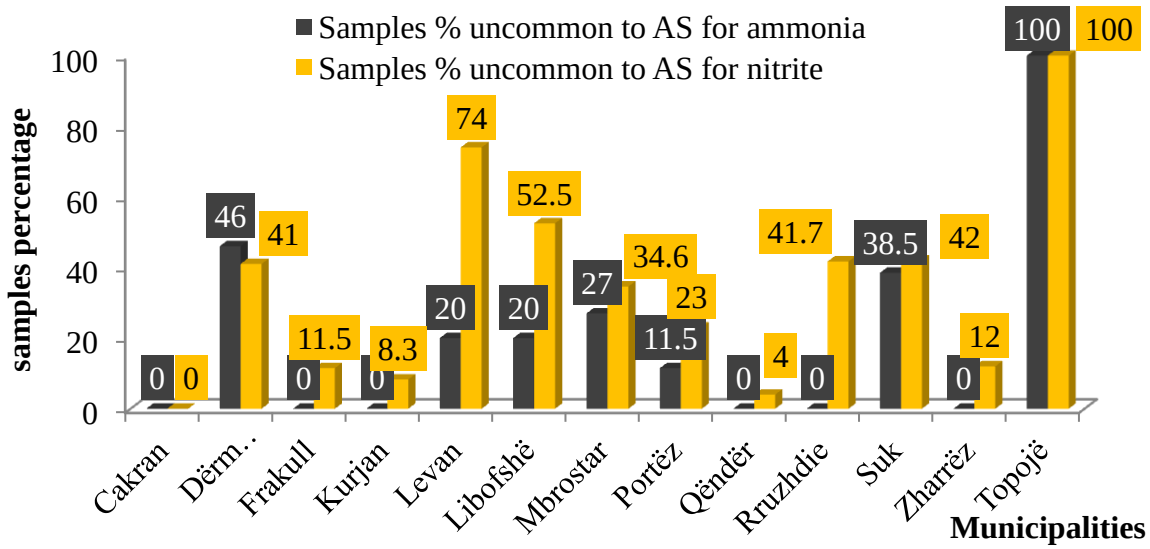
The highest average concentration of nitrite is noticed in Topojë, while in Topojë and Dërmenas the amount of nitrites (mg/l) are the highest during March and April 2015. In November the highest amount is noticed in Levan. According to WHO ammonia is not of direct importance for health in the concentrations to be expected in drinking water (20). The highest concentration of ammonia (mg/l) is noticed in Bishan of the Levan municipality and Topojë municipality during all the period of study. In graph 4 we can see these datas:

- NH_4^+ mg/l – the highest level was recorded on September 2014 and the lowest on January 2015;
- NO_2^- mg/l – the highest level was recorded on March, April 2015 and the lowest on June and July 2015;
- Cl^- mg/l - the highest level was recorded on May 2014 and the lowest on February 2015
- Chlorine (Cl_2) mg/l - the highest level was recorded on June 2015 and the lowest on February 2015.



Graph 4. Comparison of NH_4^+ *mg/l*, NO_2^- *mg/l* and Cl_2 *mg/l* average levels based on municipalities

According to Albanian Standard (AS) a guideline value of 0.5 mg/l was established for free chlorine. In Albania maximum contaminant level (MCL) for nitrite and ammonia in drinking water is 0.05 mg/l, according to Albanian Standard (20). In chart no.5 we have shown the samples percentage which are uncommon to Albanian Standard for ammonia and nitrite, for each municipality during our study period. The chart no. 5 plots that in Topojë (100 %), in Levan (74 % for nitrite) of the samples have NH_4^+ *(mg/l)* and NO_2^- concentration, uncommon to Albanian Standards (0.05 mg/l). In Cakran, Frakull, Kurjan, Portë z, Zharrë z and Që ndë r all the samples have NH_4^+ *(mg/l)* concentration within the maximum level (0.05 mg/l).



Graph 5. Samples percentage uncommon to Albanian Standards for NH_4^+ *mg/l*, NO_2^- *mg/l* in Fier district administrative units.

CONCLUSIONS

The laboratory analysis of physical and chemical parameters of collected water samples disclosed the fact that there is no risk of contamination in drinking water. The findings of these parameters either were near the permissible values established by WHO or going below the average limits. The values of chloride in Topojë were 554.6 mg/l, which is above the permissible limits of 250 mg/l established by WHO. There are 8.7 % of the total number of tha samples have resulted positive for at least one fecal indicators especially in Frakull, Rruzhdie and Dërmenas municipality and it shows that improvements can be made for an effective disinfection process during treatment. The information provided by this article is u useful tool for describing the state of drinking water quality and it may be of interest to consumers and suppliers

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