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ASSESSMENT OF DRINKING WATER SAMPLES OF DIFFERENT LOCALITIES IN FIER DISTRICT

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Abstract
This research aims to evaluate the quality of drinking water in 13 rural administrative units of Fier district and compare the results with WHO standards, in order to ensure the supply of clean drinking water. This study was carried out to give a complete view regarding water quality in rural areas of Fier and to identify issues that may affect public health. The monitoring process of the standards will be made by microbiological (*Escherichia coli, Streptococcus faecalis* and *Clostridium perfrigens*) and physical-chemical($NH4^+$ mg/l, NO_2^- mg/l, Cl^- mg/l and pH) indicators. The samples are collected every month, from January 2014 until February 2015, in different locations scattered in 13 different administrative units. Study and analyzing all the data and comparing them in order to see the trend of the pollution level of the drinking water, and the number of positive cases with faecal indicators. MPN index is used for evaluation of *Escherichia coli*, while the number of heterotrophic bacteria is determined by counting colonies on plates with PCA. Our results show that the physical and chemical quality of the water is at line with WHO standards. The majority of drinking water samples are free from contamination with faecal indicator, but 5.7 % of the samples were found positive with at least on microbiological indicator E.coli, 3% of samples were found positive for 3 faecal indicator Escherichia coli, Streptococcus faecalis and Clostridium perfrigens.
Key words: *Microbial analysis, chemical analysis, MPN index, faecal indicators, drinking water.*

INTRODUCTION

Water is essential to life and one of the most important of all natural resources known on Earth. An adequate, safe and accessible supply must be available to all. Improving access to safe drinking-water can result in significant benefits to health (WHO 2008). It is necessary that the quality of drinking water should be checked at regular time intervals, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases (Basavaraja, *et al*.2011). There is no single or simple measurement for water quality. Determining water quality has been adopted as one of the main criteria for the establishment of water use, because these standards seek the safety of the consumer population. This is due to the fact that water quality is not necessarily a state of purity, but is configured by its chemical, physiological and biological characteristics (Merten and Minella, 2002). In developing countries, a large portion of the population, suffers from health problems associated with either lack of drinking water or due to the presence of microbiological contamination in the water (Van Leeuwen, 2009). Many factors influence water quality, including climate and precipitation, soil type, human activities contamination from water pipes and storage tanks (Parag and Roberts, 2009) in the absence of proper and periodic maintenance; but the greatest impacts come from point sources associated with the discharge of untreated wastewater from municipalities and industries. According to WHO, faecal indicator are defined as a group of organisms that indicate the presence of faecal contamination, hence they only indicate whether pathogens may be present (WHO

2008). *E.coli* is the best coliform indicator of fecal contamination from human and animal wastes. *E.coli's* presence is more representative of faecal pollution because it is present in higher numbers in faecal material and generally not elsewhere in the environment (Hurst et al., 2002). The *Enterococci* are a group of bacteria that have been most often suggested as alternatives of coliform. Enterococcus are formed by the splitting of *Streptococcus faecalis* and *Streptococcus faecium* (Schleifer and Klipper-Balz, 1984). Generally, for water examination purposes *enterococci* can be regarded as indicators of fecal pollution. *C. perfringens is* the only reliable indicator of faecal contamination and is being proposed for use in establishing satisfying water quality standards. *C. perfringens* spores were identified as the best indicator of faecal pollution and were the only indicator group significantly correlated to any of the pathogen groups in the water column (*Giardia sp. and Aeromonas sp.)* (Gleeson and Gray, 1996)

MATERIALS AND METHODS

There is a data collection of results from microbiological, physical and chemical analysis of 433 samples of drinking water for the period of January 2014-February 2015. The collected drinking water samples have been tested in the regional laboratory of Health directory in Fier. Water samples for this study were obtained from 13 administrative units of Fier district, from the monitoring points 1 to 31, these are state-approved locations. Water samples are analyzed once a month for every monitoring point. Sample bottles are sterilized in autoclave for 20 minutes at 121°C (Borrell and Winkler, 2006). Transport and storage of samples (before analysis) were carried in a cool box or refrigerator at temperature 4-7°C. The samples were analyzed during the same working day (Figueras, *et al*. 2000). The water was collected in 2 different vials and labels were put to distinguish them, one for microbial analysis (*Escherichia coli, Streptococcus faecalis* and *Clostridium perfrigens*) and one for physical and chemical parameters such as $NH4^+$ *mg/l,* NO_2^- *mg/l,* Cl^- *mg/l* and *pH* which is analyzed at the moment of sampling with ph-meter (Hutchins *et al.* 1997). For identification of *Escherichia coli* we have used Lactose peptone broth media. In tubes was noticed the presence of gas bubbles we have blown indole, change of color indicates the presence of *Escherichia coli*. All samples were incubated at 36°C for 48 hours (Hysko, 2004). For *Clostridium perfrigens* we 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 (Payment and Franco 1993). Faecal indicators (*Escherichia coli, Streptococcus faecalis* and *Clostridium perfrigens*) were determinated by five tubes MPN technique with selective medium for each indicator (Wolf 1972). Nitrite determination is carried out as the water samples react with the reagent NEDA {*N*- (1-naphtyl) ethylenediamine} then the measurements were finalized in a spectrophotometer. Chloride is mainly obtained from the dissolution of salts of hydrochloric acid. Titration with silver nitrate was used for chloride determination with silver nitrate ($AgNO_3$) as titrant (Hutchins *et al.* 1997). We have used the O- toluidines method or the DPD method for chlorine determination (Palin 1957). It was used spectrophotometric determination of ammonium nitrogen with the Nessler reagent (Demutskaya and Kalinichenko, 2010).

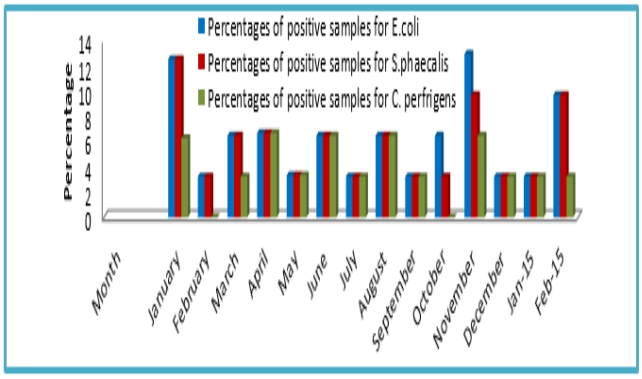
RESULTS AND DISCUSSION

From the data analysis the results are:

For the period from January 2014-February 2015 there were collected and analysed 433 drinking water samples in total as shown in the table and graphic no.1. 6.21 % of the samples resulted positive for at least one of the faecal indicators, and 15 samples (3.5 %) resulted positive for 3 faecal indicators. According to WHO the guideline level of faecal indicators (*E. coli, S.phaecalis* and *C. perfrigens*) in drinking water is zero. In table no.1 it can be observed that 6.21 % of the total number of the samples have resulted positive with *E.coli*, and only 3.71 % are positive for 3 faecal indicators. The greatest number of positive samples with faecal indicators is noticed in January and November 2014.

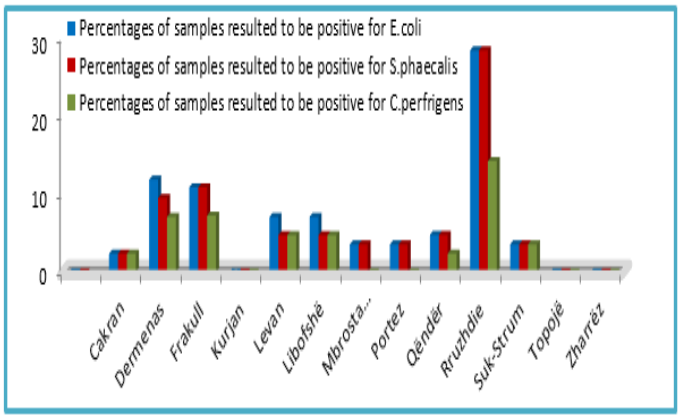
Table 1. Number of collected samples and percentages of positive samples for every fecal indicator.

Month	Collected samples	Percentages of positive samples for *E. coli*	Percentages of positive samples for *S. phaecalis*	Percentages of positive samples for *C. perfrigens*
January	32	12.5	12.5	6.25
February	31	3.22	3.22	0
March	31	6.45	6.45	3.22
April	30	6.66	6.66	6.66
May	30	3.33	3.33	3.33
June	31	6.45	6.45	6.45
July	31	3.22	3.22	3.22
August	31	6.45	6.45	6.45
September	31	3.22	3.22	3.22
October	31	6.45	3.22	0
November	31	12.90	9.67	6.45
December	31	3.22	3.22	3.22
January 15	31	3.22	3.22	3.22
February 15	31	9.67	9.67	3.22
Total	**433**	**6.21**	**5.75**	**3.5**



Graphic no.1. Percentages(%) of samples resulted positive with fecal indicators, comparing to the total number of the collected drinking water samples for every month during January 2014-February 2015

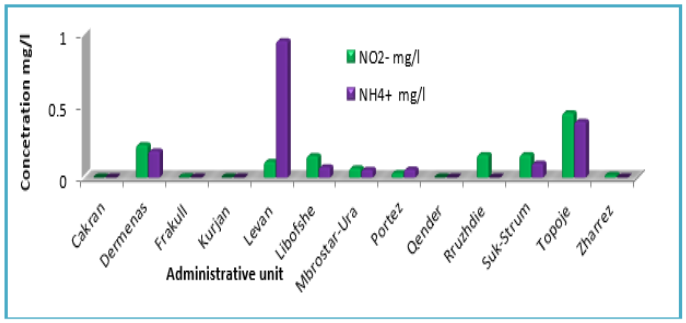
In order to have a clear view of drinking water quality in rural administrative units of Fier district we have presented the main conclusions in Graphic no. 2. It could be observed that most of the cases for the presence of *E.coli, S.phaecalis* and *C.perfrigens* belong to the samples collected in Dërmenas (11.9%), Frakull and Rruzhdie (28.5%).



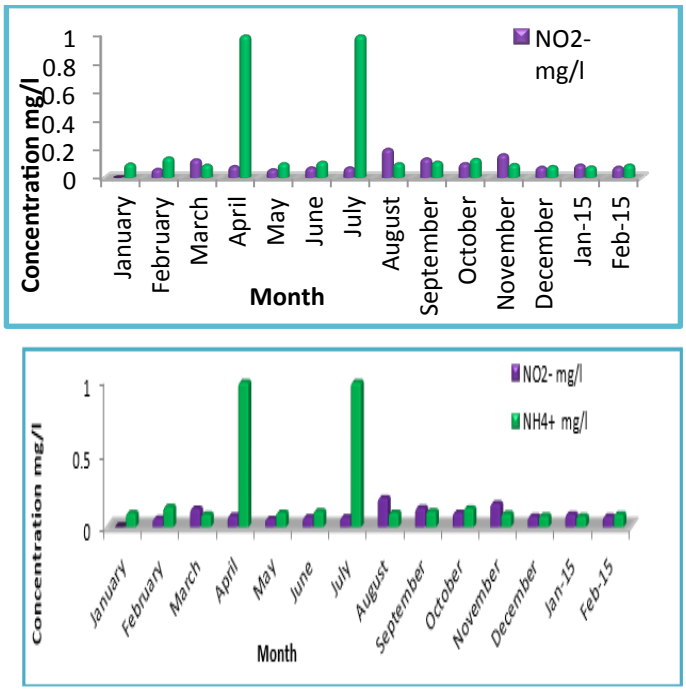
Graphic no. 2. Percentages (%) of samples resulted positive with faecal indicators, comparing to the total number of the collected drinking water samples for every rural administrative unit during January 2014-February 2015.

According to WHO (2008), ammonia is not of direct importance for health in the concentrations to be expected in drinking-water. In the USA maximum contaminant level (MCL) for nitrite is 1 mg/L or 1 ppm according to EPA (Environmental Protection Agency). According to WHO (2008), the maximum level for nitrites is 3 mg/l. The results concerning chemical
analysis of samples collected during January 2014-February 2015 are presented in Graphic no. 3 and no. 4. The highest concentration of ammonia (mg/l) is noticed in Levan (average concentration 0.95 mg/l), Tropojë (average concentration 0.38 mg/l). During all the study period is noticed that NH_4^+ mg/l highest average concentration in Seman/Tropojë, in Bishan/Levan, in Darzezë/Dërmenas (regions near the seacoast). NO_2^- *mg/l* highest average concentration is in Tropojë/Darzezë on August and November 2015

and the lowest average concentration is in Cakran, Kurjan administrative units.

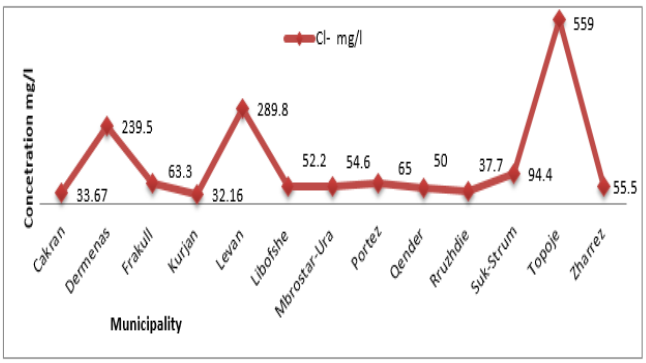


Graphic no. 3. Comparison of NH^{4+} *mg/l,* NO_2^- *mg/l* average levels based on administrative units



Graphic no. 4. Comparison of NH_4^+ *mg/l,* NO_2^- *mg/l,* average concentration for every month on all samples analyzed during January 2014-February 2015

According to WHO in 2008 Guidelines, based on taste considerations, a guideline value of 250 mg/l was established for chloride. 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 (WHO, 2008). In graphic no. 5 are presented the chloride average values for 13 administrative units of Fier.



Graphic no. 5. Average concentration of Chloride (mg/l) in Fieri district rural administrative unit

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 were below the average limits. The values of chloride in Topojë were 560 mg/l, which is above the permissible limits of 250 mg/l established by WHO. The average concentration of ammonia and nitrites, in 433 samples of drinking water is within the the maximum contaminant level estabilished by WHO or going below the average limits (WHO 2008). The results of the bacteriological analysis of drinking water showed that 6.21 % of the total number of the samples have resulted positive for at least one faecal indicators (*E,coli*) especially in Rruzhdie, Dërmenas and Frakull administrative unit and it shows that improvements can be made for an effective disinfection process during treatment.

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