Microbiological and Physico-Chemical Data of Shkodra Lake for Months June-July-August

Nevila Bushati[1]

Anila Neziri[1]

[1]*Department of Biology-Chemistry, Faculty of Natural Sciences, University of Shkodra, Albania*
Email: nevilabushati@yahoo.com

Doi:10.5901/mjss.2017.v8n1p372

Abstract

Lake Shkodra is closely connected with the change of weather conditions, which are associated with the increased runoff of streams and rivers that flow into the lake, especially in spring and fall season, increased rainfalls, snow, erosion phenomenon, flooding, etc. Water's central role in the biosphere implies several of the large issues confronting humanity which are in fact related to water: pollution, infections from pathogenic species, mismanaged agricultural lands, eutrophication etc. Shkodra watershed is exposed to various sources of pollutions, which are related with the discharge of waste waters, industrial and urban pollution, agricultural activities etc. Data on the lake Shkodra water quality will be presented at the article based in general physico-chemical and microbiological parameters. Water samples were collected according to Europian recommendations and WHO legislation. The physico-chemical and microbiological measured parameters were: pH, conductivity, turbidity, temperature, Enterococcus intestinales, Escherichia coli. The data presented here include months June, July and August for the years 2011 and 2012. Water samples were collected from 8 points of Lake Shkodra named stations. This study was conducted at the Microbiological Diagnostical Center "Wolfdieter Sixl", at the University of Shkodra "Luigj Gurakuqi".

Keywords: *pH, conductivity, turbidity, temperature, Enterococcus intestinales, Escherichia coli*

1. Introduction

The quality of Shkodra lake water is typically determined by monitoring microbial presence, especially faecal coliform bacteria (FC), *Enterococcus intestinales* etc (APHA-AWWA-WEF 1995). Different studies have shown the presence of many pathogens in lakes, rivers, groundwaters. All these pathogens can pose risks to human health. In many countries surface reservoirs serve as the main source of drinking water, and these surface water bodies are often vulnerable to pathogen contamination (Kistemann et al.2002). Weather events and pollution are a few of the external factors which affect physico-chemical parameters such as temperature, pH and dissolved oxygen (DO) of the water. These parameters have major influences on biochemical reactions that occur within the water. Standard Methods shows that the number of *faecal coliform, Escherichia coli* and *Enterococcus intestinal* indicates the origine of water pollution. The organisms most commonly used as indicators of faecal pollution are the coliform bacteria, particularly *Escherichia coli* and other faecal coliforms, (Chapman D, 1992). *Escherichia coli* is a species of fecal coliform bacteria that is specific to fecal material from humans and other warm-blooded animals (Draft International Standards ISO/DIN 8199). *Enterococcus intestinal* generally occur in the digestive systems of humans and other warm-blooded animals. In the past, *Enterococcus intestinal* were monitored together with fecal coliforms and a ratio of fecal coliforms to Enterococcus was calculated. This ratio was used to determine whether the contamination was of human or nonhuman origin. Standard Methods for the Examination of Water and Wastewater 20th Edition were used during collection, preservation and estimation of different parameters.

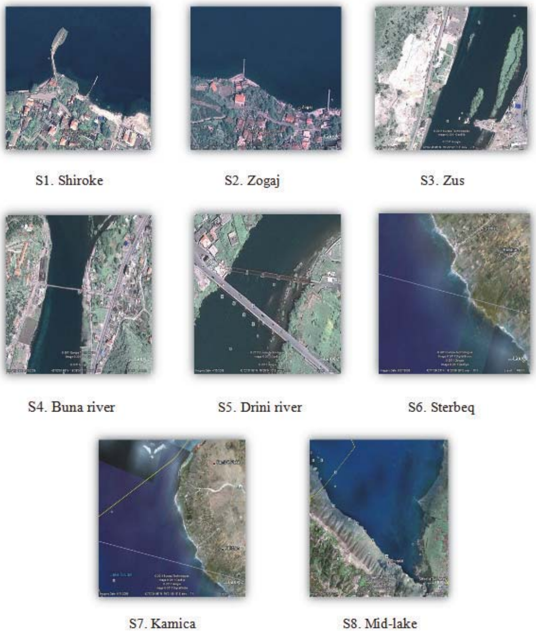


Figure 1: Sampling stations, (Image from Google Earth) (S1, S2, S3, S4, S5, S6, S7, S8)

Table 1. Geographical coordinates of sampling points

Nr.	*Sampling points*	*Geographical coordinates*
1.	*Shiroka*	(42'03'35.47° N, 19°27'25.30"E)
2.	*Zogaj*	(42°04'19.25"N, 19°23'57.00"E)
3.	*Zus*	(42°02'48.86"N 19°29'14.17"E)
4.	*Buna river*	(42°03'01.98"N, 19°29'30.81"E)
5.	*Drini river*	(42°02'31.98"N, 19°29'34.10"E)
6.	*Sterbeq*	(42°11'26.33"N, 19°23'36.38 E)
7.	*Kamica*	(42°12'34.98"N, 19°21'40.18 E)
8.	*Mid-lake*	(42°04'31.83"N, 19°26'15.10 E)

2. Methods

The monitoring was carried out from June-July-August (2011-2012). The monitored stations were eight: (S1) Shiroka (42'03'35.47° N, 19°27'25.30"E), (S2) Zogaj (42°04'19.25"N, 19°23'57.00"E), (S3) Zus (42°02'48.86"N 19°29'14.17"E), (S4) Buna river (42°03'01.98"N, 19°29'30.81"E), (S5) Drini river (42°02'31.98"N, 19°29'34.10"E), (S6) Sterbeq (42°11'26.33"N, 19°23'36.38 E), (S7) Kamica (42°12'34.98"N, 19°21'40.18 E), (S8) Mid-lake (42°04'31.83"N, 19°26'15.10 E). Sampling sites were defined on basis of anthropogenic pollution, water samples were taken with 250 ml sterile bottles by means of a TeleScoop sampler which is a versatile telescopic sampling system with exchangeable sample container holders and were transported in cool box. The following parameters were measured: i) pH, temperature and conductivity were measured in situ with equipment type of AQUALYTIC system ii) turbidity was measured using Turb 430 IR/T, a handheld precision turbidimeter providing the maximum degree of operating comfort, reliability and measuring certainty for all applications, iii) microbiological content was defined by the standard method, Most Probable Number (MPN) for *Escherichia coli*. In the MPN method, fermentation tubes are arranged in 3 rows, with 3 tubes per row, with varying dilutions of the samples in the tubes. A series of fermentation tubes that contains lactose broth are inoculated with the water sample and incubated for 48 hours at 44°C. A 10 mL of sample was inoculated into three tubes each consisting of double strengths lactose tubes, 1 mL was inoculated into the second three single–strength lactose tubes, and 0.1 mL sample into each of the other three tubes, all containing lactose broth medium (Fig.2). ISO 8199, (1988); ISO 5667-2, (1995); ISO 7704, (1985) followed to conduct sampling properly. Standard Methods for the Examination of Water and Wastewater 20th Edition and ISO 9308-1, recommended use of membrane filtration method, where incubation temperature is 44ºC and incubation time 48 hours. An appropriate volume of a water sample (100 mL water) was filtered through a 0.45-µm pore size nitrocellulose membrane filter that retains the bacteria present in the sample and was than transfered in *Endo Agar* and *Slanetz Bartley Agar* plates.

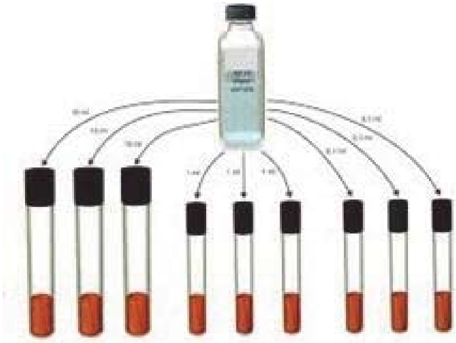
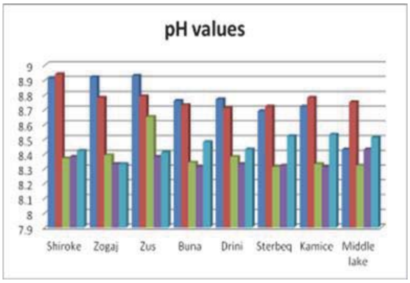


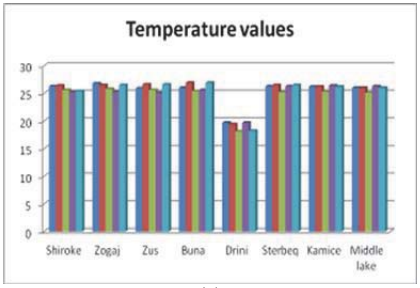
Figure 2. MPN/E.coli with lactose broth

3. Results and Discussion

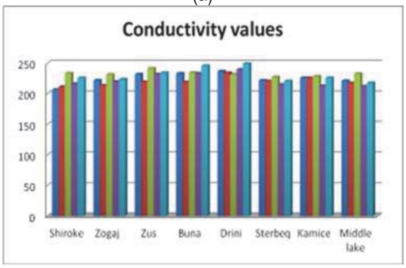
Additionally, the monthly variations of physico-chemical properties were given in Fig. 3 a-d and microbiological parameters were given in Fig. 4 a-b. The results of our study are presented with graphics. Fig.3.a. present pH data for month June-July-August 2011-2012, which varies from 8.31-8.94. Temperature data for months June-July-August 2011-2012, vary from 18.2-26.9°C (Fig. 3 b). Conductivity data for months June-July-August 2011-2012, varies from 206.7µS/cm-248.8 µS/cm Fig.3-c. Turbidity data for months June-July-August, varies from 0.61-3.24 NTU/FNU. *Escherichia coli* ranged from 2-420 CFU/100 ml for months June-July-August 2011-2012 (Fig.4-a). *Enterococcus intestinales* for months June-July-August 2011-2012 varies from 4-383 CFU/100 ml (Fig. 4-b). The higher temperature in summer influence to the higher microbial content of samples. *Enterococcus intestinales* for Kamice (S1), Mid-lake (S4), Shirokë (S6) and Sterbeq (S5) was ≤100 CFU/100 ml water (excellent quality). Meanwhile *Escherichia coli* for Kamice (S1), Mid-lake (S4) and Sterbeq (S5) was lower ≤80 CFU/100 ml. Sampling points were characterized by a monthly change of microbial loading due to high temperature, pH changes, discharge of waste waters, etc. Microbiological data for *Enterococcus intestinales* and *Escherichia coli* are presented also with dendrograms conducted *by Minitab 17.* From figure 5. and figure 6. *Dendrogram for Escherichia coli* and *Enterococcus intestinalis* shows that the sampling points represent similarities in function of the parameters set. The highest similarity for *Escherichia coli* and *Enterococcus intestinales* with respect to specified parameters represented sampling points Kamicë and Sterbeq which are gjeographically near to each other, these points appear as clean by microbiological indicators. Two other points Zogaj and Shiroka has similarity with each other ,because of the same source of water pollution, which is highly influenced from the untreated sewage waters discharged from Shiroka and Zogaj villages. Dendrogram for *Enterococcus intestinales* represent Zus and Buna river with the same source of pollution. From figure 5. Dendrogram for *Escherichia coli* represent two sampling points Zus and Drini river, which has the same similarity for *Escherichia coli* parameter, also Sterbeq and Kamice has the highest similarity the same as in figure 6. The hydrological system Drini-Buna is complicated because these rivers mixed together and this is the reason that the similiarities of these points are different in two dendrograms of figure 5 and figure 6. Sampling stations S(2)-Buna and S(3)-Drini rivers, S(8)-Zus are characterised from highly bacterial loading, which is linked with sewage water pollution from two main rivers, which are polluted from municipal waste waters.



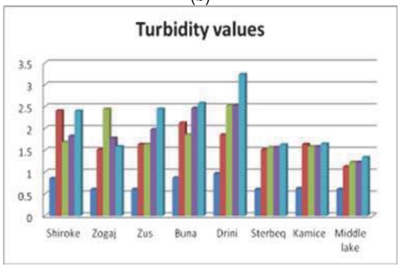
(a)



(b)

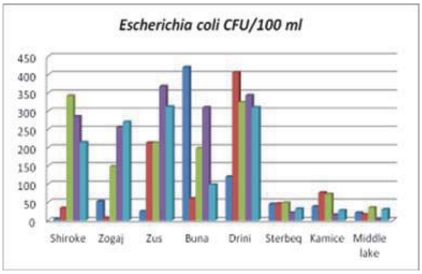


(c)

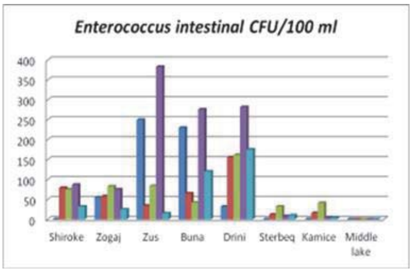


(d)

Fig. 3 a-d: Graphics with physico-chemical parameters a). pH b). temp c). conductivity d). turbidity



(a)



(b)

Fig. 4 a-b: Graphics with microbiological parameters a). Escherichia coli b). Enterococcus intestinales

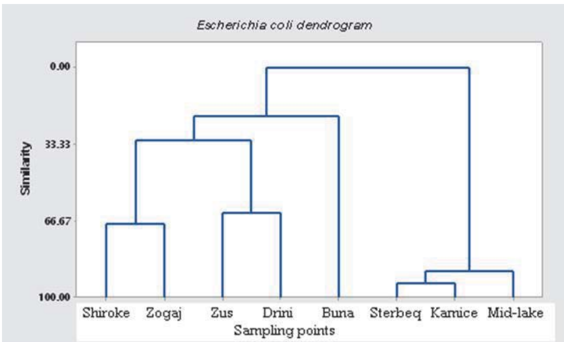


Fig. 5. Dendrogram for *Escherichia coli* (1. Shiroke, 2. Zogaj, 3. Zus, 4. Buna river, 5. Drini river, 6. Sterbeq, 7. Kamica, 8. Mid-lake)

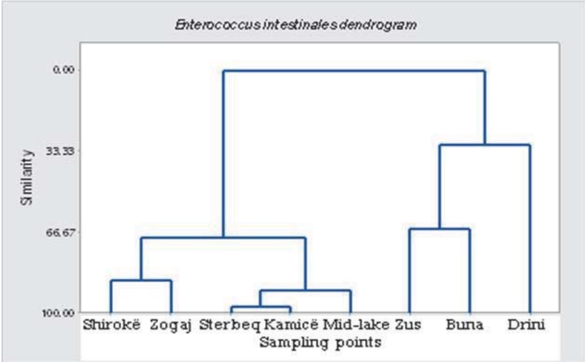


Fig. 6. Dendrogram for *Enterococcus intestinales* (1. Shiroke, 2. Zogaj, 3. Zus, 4. Buna river, 5. Drini river, 6. Sterbeq, 7. Kamica, 8. Mid-lake)

4. Conclusions

The microbiological and physico-chemical data aims providing some assessment to water quality of Shiroka, Zogaj, Zus, Mid-lake, Drini and Buna rivers, Kamice and Sterbeq. The higher temperature in summer influence to the higher microbial content of samples. Sampling stations S(2) Buna and S(3)-Drini rivers, S(8)-Zus are characterised from highly bacterial loading, which is linked with sewage water pollution from two main rivers which are polluted from municipal waste waters. *Enterococcus intestinales* for Kamice (S1), Mid-lake (S4), Shirokë (S6) and Sterbeq (S5) was ≤100 CFU/100 ml water (excellent quality). Meanwhile *Escherichia coli* for Kamice (S1), Mid-lake (S4) and Sterbeq (S5) was lower ≤80 CFU/100 ml represent (excellent quality). Sampling points were characterized by a monthly change of microbial loading due to high temperature, pH changes, discharge of waste waters, etc. Quality of bathing water, EU Parlament (2006) values for inland waters *Escherichia coli* and *Enterococcus intestinales* were met in Mid-lake, Kamice, Sterbeq and Shiroke. Based on the same directive, Shiroka and Sterbeq result with excellent water quality for the years 2011-2012. From the results taken during this study we can conclude that the quality of the Shkodra lake water is of good quality according to the *Quality of Bathing Water, DIRECTIVE 2006/7/EC* for inland waters.

References

APHA, AWWA, WEF 1995: Standard Methods for the Examination of Water and Wastewater 19th Edition Washington, American Public Health Association.

Chapman, D., 1992. Water Quality Assessments - A Guide to Use of Biota, Sediments and Water in Environmental Monitoring

DIRECTIVE 2006/7/EC. European Parliament and European Council (EU and EC). 2006. The management of bathing water quality and repealing directive 76/160/EEC, L64/37.

ISO/DIS 8199 (1986) Technical Committee of International Organization for Standardization ISO/TC 147. Draft International Standard Water quality. General guide to the enumeration of microorganisms by culture.

ISO 8199:1988, Water quality -- General guide to the enumeration of micro-organisms by culture TC 147/SC 4.

ISO 5667-2:1991, Water quality -- Sampling -- Part 2: Guidance on sampling techniques, TC 147/SC6.

ISO 7704:1985, Water quality -- Evaluation of membrane filters used for microbiological analyses TC 147/SC 4.

ISO 9308-1, Second edition 2000-09-15:2000. Detection and enumeration of Escherichia coli and coliform bacteria. Part 1: Membrane filtration method.

ISO 9308-2. First edition 1990-10-01. Detection and enumeration of coliform organisms, thermotolerant coliform organism and presumptive *Escherichia coli*. First edition. Part 2: Multiple tube (most probable number) method.

Kistemann, T.; Classen, T.; Koch, C.; Dangendorf, F.; Fischeder, R.; Gebel, J.; Vacata, V.; Exner, M.: Microbial load of drinking water reservoir tributaries during extreme rainfall and runoff. *Applied and Environmental Microbiology*, 68(5): 2188-2197; 2002.

SMEWW (1995), *Standards methods for the Examination of Water and Wastewater 20th Edition, Part 9010,* Microbiological examination, American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Association (WEF). Washington, DC.