J. Int. Environmental Application & Science, Vol. 11(2): 207-212 (2016)

Relationship between Physico-Chemical and Bacteriological Parameters in the Hydrosistem "Radoniqi" in Gjakova

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Received April 12, 2016; Accepted June 22, 2016

Abstract: The bacteriological and physico-chemical qualities of Hydrosystem "Radoniqi" were carried out to ascertain the variation in the quality of the water between March 2014 and March 2016. This artificial lake has surface of water collection of 120 km^2 and the main water supplier is River Lumbardh of Deqani with an average flow 5m^3/s which lies at an altitude of 600-2500 m with 120 km^2. Water samples collected from three locations: 1. River Lumbardh, 2. Derivative channel and 3. Lake. The quality control of lake "Radoniqi" was monitored using physico-chemical and microbiological indicators. The bacteriological and physico-chemical analyses performed were in accordance with standard procedures. The microbiological and physico-chemical parameters monitored were: total coliforms, fecal coliforms, fecal streptococci and aerobic mesophilic bacteria, turbidity, pH, temperature, chloride, conductivity, dissolved oxygen, suspended solids; nitrate, nitrite, phosphate etc. Enumeration of bacteria is made by membrane filtration method and by counting colonies on plates with RBA, M-Endo Agar less, PCA and BEA agar. There was a positive correlation between faecal coliform count with most of the physico-chemical parameters. The results of most of the physico-chemical and microbiological parameters analyzed were shown to be higher at sampling point 1 and 2, due to different seasons and water volume. Therefore periodic monitoring of the water quality is recommended especially during the spring-summer season.

Keywords: Lake "Radoniqi", microbiological parameters, physic-chemicals analysis

Introduction

Drinking water must be free from components which may adversely affect the human health. Such components include minerals, organic substances and disease causing microorganisms. The healthy aquatic ecosystem is depended on the physico-chemical and biological characteristics (Venkatesharaju et al., 2010). A large portion of the population in developing countries suffers from health problems associated with either lack of drinking water or due to the presence of microbiological contamination in water (Van Leeuwen, 2009). Public and environmental health protection requires safe drinking water, which means that it must be free of pathogenic bacteria. As a consequence, sources of fecal pollution in waters devoted to human activity must be strictly controlled. Entero-pathogens, such as Escherichia coli O157:H7, are generally present at very low concentrations in environmental waters within a diversified microflora.

Water quality means the physical, chemical and biological characteristics of water [3] (Diersing N.2009). Bacterial contaminants such as *E.coli* and fecal coliform in drinking water represent an acute health risk. Total (TC) and fecal coliforms (FC) have traditionally been regarded as indicators of microbial contamination of waters (Clark et al., 1991). Recent reviews, however, have shown E.coli to be the best indicator for the assessment of fecal contamination (Clark et al., 1991; Edberg et al., 2000) and the possible presence of enteric pathogens (Geissler *et al*., 2000; US EPA, 2002).Parallel to the work on coliforms, a group of Gram-positive coccoid bacteria known as faecal streptococci (FS) were being investigated as important pollution indicator bacteria (Houston 1900; Winslow & Hunnewell 1902). Physical and chemical parameters include: temperature, smell, taste, color, turbidity; pH, nitrites, nitrates, ammonium, heavy metals, TSS total suspended solids. Object of our study are: River Lumbardh of Deqani; Derivative channel and Lake "Radoniqi". The main supplier of lake is the river Lumbardh of Deqani. Second supplier is river Bistrica with capacity of 2,640 m³ per hour, or 650 L/s. The lake has a voluminous capacity of 117.8 million m³ of water, maximum length 5.2 km, maximum

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width 2.5 km and maximum depth 52 m. The study was conducted to assess the statement on relationship between physico-chemical and bacteriological parameters as indicators of water quality in Hydrosystem "Radoniqi" and relationship between these parameters.

Figure 1. River Lumbardh

Figure 2. Derivative Channel

Figure 3. Lake "Radoniqi

Materials and Methods

Sample collection

Current study was carried out to examine the quality of drinking water of Hydrosystem "Radoniqi". To evaluate the water quality an effort was made to investigate the water in three locations: River Lumbardh, Derivative channel and the lake (Figures 1 - 3). Water samples were collected in sterile bottles of 500 ml and transported to the laboratory in cool box . The 192 water samples were collected twice a month over a period of two years starting from March 2014 to March 2016. Microbiological analysis of water samples was started as soon as possible after collection to avoid unpredictable changes in the microbial population (Gaudy, 1998).

Physico-chemical Parameters

The temperature of the water samples was determined in situ using a mercury thermometer, while the pH and turbidity measurements were measured immediately after collection using digital photometer. Nitrites, nitrates, ammonium, chlorides and H_2S are determined by digital photometer.

Microbiological Parameters

The water samples were analyzed for: total and faecal coliforms, streptococcus faecalis and aerobic mesophylic bacteria. Total coliform counts were determined using the membrane filtration method. The 100 ml water sample was filtered using 0.45 mm pore size, 47 mm diameter filter membrane as described by (APHA1998), incubating this filter on a selective medium and enumerating typical colonies on the filter. Faecal coliform counts were performed with m-Endo-Les agar at 37°C for 24 h (Grabow, et al., 1991). Nutrient agar (NA) was used for determination of number of aerobic mesophyl bacteria. Faecal streptococci (FS) were being investigated as important pollution indicator bacteria (Houston, A.C. (1900), on plates with Bile aesculin azide agar.

Results and Discussion

Statistical indicators of parameters such as: temperature, pH, turbidity (NTU), electrical conductance, chloride, ammonium, nitrites, nitrates, phosphates, total coliform bacteria, faecal coliform bacteria, aerobic mesophylic bacteria and *Streptococcus faecalis* are presented in table 1. For this parameters is determined the mean value, standard deviation, minimum value, maximum value.

Statistical indicators of physico - chemical parameters (temperature, pH, turbidity) for the Lake "Radoniqi"

Temperature

The average of temperature during the two years period of study varied between 4.1°C to 12.2°C in River Lumbardh, 4.2-12.2°C in Derivative channel and 4.4 – 12°C in the Lake. **(Table 1, 2, 3).** Low temperatures corresponded to the winter season. The temperature thereafter increased gradually during spring until summer when high temperatures were observed. The combined effect of elevated

temperatures and heavy rains could explain the high coliform counts observed during the spring and summer period. There were differences in temperature values between the three investigated locations.

pH

The pH of River Lumbardh and Derivative channel was within the range of 7.5–10 during the period of observation, that means are slightly alkaline (basic), **Table 1, 2, 3** .The overall pH pattern showed that the pH values were relatively high in winter compared to summer. Physical parameters, such as pH, temperature and turbidity have a major influence on bacterial population growth (Nübel et al., 1999; Byamukama et al., 2000; Goni-Urriza et al., 2000; Nishiguchi, 2000).

Turbidity (NTU)

The statistical study showed that the average value of turbidity during measurement ranged from 0.24 to 3.5 NTU. It shows that the waters of the Lake "Radoniqi" are within normal values allowed turbidity, which it classifies as category A, 5NTU/FNU. These low values indicate that the water turbidity this watershed have great self-cleaning ability, as these are the waters that flow (Table 1, 2, 3).

Electrical conductance

The electrical conductance values during the two years period March 2014-March 2016 were from 225-260 in River Lumbardh; 210-258 in Derivative channel and 170-228 in the Lake "Radoniqi". During this period of the study it was observed that there were only minor changes during different months depending on the amount of rainfall. Higher values of conductivity were observed in the Derivative channel and in the Lake "Radoniqi" sampling stations. The highest value of conductivity was 260 μS / cm and the temperature 12.2 ° C (Table 1, 2, 3).

Table 1. Statistical values of physical-chemical and microbiological parameters during the period March 2014- March 2016 in River Lumbardh.

	River Lumbardh March 2014-March 2016	Average	Min	Max	SD
Temperature	4.1-10	7.0	4.1	10	2.41
pH	7.5-10	8.60	7.5	10	1.02
Turbidity NTU	1.5-3.5	2.63	1.5	3.5	0.82
KMNO4	5.2-6.8	5.68	5.2	6.8	0.67
Electrical conductance	225-260	236.4	225	260	14.58
Dissolved Oxygen	8.9-12.5	10.71	8.9	12.5	1.47
Ammonium	0.07-0.055	0.057	0.07	0.055	0.01
Nitrite	<0.003-0.007	0.007	0.003	0.007	0.00
Nitrate	0.5-0.9	0.59	0.5	0.9	0.17
Phosphate	1.3-2.8	0.9	1.3	2.8	0.82
Total Coliform bacteria	148-306	228	148	306	64.50
Faecal coliform	133-289	201	133	289	63.86
Aerobic mesophylic bacteria	54-157	114	54	157	42.24
Streptococcus faecalis	3-18.	4.1	3.0	18.0	6.83

Total coliforms (TC)

The results indicated that the average values of total coliforms during the measurement of River Lumbardh were ranging from 148-306 CFU/100ml water and Derivative channel from 135-302 CFU/100ml water. In the lake TC counts were from 94-185 CFU/100 ml due to human activities and unhygienic practices that leads to the contamination of the water sources (Table 1, 2, 3). Based on European standards (Directive 76/160 / EEC) for total coliform content can be said that the water from Lake " Radoniqi" is classified in Grade A which allows up to 500 *CFU/100 ml. Evaluation of this parameter was made by Directive 76/160 /EEC, which contains a parameter for assessing the surface water. Total coliforms are not a measure of fecal contamination and therefore they have no connection with the change of water quality (Cabral, 2010; Anonimous, 2001; Mijovic, 2006; Bushati, 2006). Average values of TC presented above are shown in Figure 1).

Table 2. Statistical values of physical-chemical and microbiological parameters during the period March 2014- March 2016 in Derivative channel.

	Derivative channel March 2014- March 2016	Average	Min	Max	SD
Temperature	4.2-12.2	7.2	4.2	12.2	3.30
pH	7.2-9.7	8.45	7.2	9.7	1.02
Turbidity NTU	1.3-3.02	2.5	1.3	3.02	0.72
KMNO4	3.1-6.5	5.28	3.1	6.5	1.41
Electrical conductance	210-258	229.2	210	258	19.73
Dissolved Oxygen	8.0-12.3	10.5	8	12.3	1.76
Ammonium	0.001-0.055	0.046	0.001	0.055	0.02
Nitrite	<0.002-0.006	0.003	0.002	0.006	0.00
Nitrate	0.045-0.061	0.43	0.045	0.061	0.18
Phosphate	0.05-2.4	0.86	0.05	2.4	0.97
Total Coliform bacteria	135-302	209	135	302	68.32
Faecal coliform	122-277	188	122	277	63.51
Aerobic mesophylic bacteria	50-137	98.9	50	137	35.61
Streptococcus faecalis	3-18.	4.0.	3	18	7.87

Table 3. Statistical values of physical-chemical and microbiological parameters during the period March 2014- March 2016 in Lake "Radoniqi".

	Lake "Radoniqi" March 2014- March 2016	Average	Min	Max	SD
Temperature	4.4-12.0	7.8	4.4	12	3.11
pH	7.0-8.2	7.78	7	8.2	0.50
Turbidity NTU	0.24-2.26	1.43	0.24	2.26	0.83
KMNO4	2.37-5.37	3.53	2.37	5.37	1.24
Electrical conductance	170-228	206.72	170	228	23.96
Dissolved Oxygen	6.5-10.6	9.49	6.5	10.6	1.73
Ammonium	0.01-0.046	0.02	0.01	0.046	0.02
Nitrite	<0.001-0.003	0.001	0.001	0.003	0.00
Nitrate	0.002-0.45	0.36	0.002	0.45	0.19
Phosphate	0.03-1.28	0.09	0.03	1.28	0.58
Total Coliform bacteria	94-185	136	94	185	37.19
Faecal coliform	58-175	121	58	175	47.81
Aerobic mesophylic bac.	30-80	50.2	30	80	20.54
Streptococcus faecalis	0-15	2.68	0	15	6.53

Statistical indicators of microbiological parameters (Total coliforms, Faecal coliforms, Aerobic mesophylic bacteria, Streptococcus faecalis) for the Lake Radoniqi

Faecal coliforms (FC) – E. coli

The average value of faecal coliforms (FC) - *E. coli* during the period March 2014-March2016 ranged from 133-289 CFU/100ml in River Lumbardhi, 122-277 CFU/100 ml in Derivative channel and 58-175 CFU/100 ml in Lake "Radoniqi" (Table 1,2,3). Based on European standards (Directive 76/160 / EEC) for total coliform content can be said that the water from Lake " Radoniqi" is classified in Grade A which allows up to 500 *CFU/100 ml. Higher values are observed in River Lumbardh and Derivative channel during the summer period in the as a result of environmental factors. The faecal coliform counts were higher also in the rainy season. Average values of FC presented above are shown in Figure 1.

Faecal Streptococci (FC) and aerobic mesophylic bacteria

The average value of the faecal Streptococci (FS) ranged from 3CFU/100 ml in May 2015 to 18 CFU /100ml in August, 2015 (point 1). Water from three investigated points in terms of intestinal enterococci based on Directive2006/7/EC of the European Parliament are classified in class A, which

runs until 200CFU/100 ml (Table 1, 2, 3).The results of the aerobic mesphylic bacteria counts (CFU/100ml) are showed in Table 1.The average value in River Lumbardhi ranged from 54-157 CFU/100 ml, in Derivative channel 50-137 CFU/100 ml and in the Lake "Radoniqi" 30-80 CFU/100 ml (Table 1,2,3). Average values of FC and aerobic mesophylic bacteria presented above are shown in Figure 1).

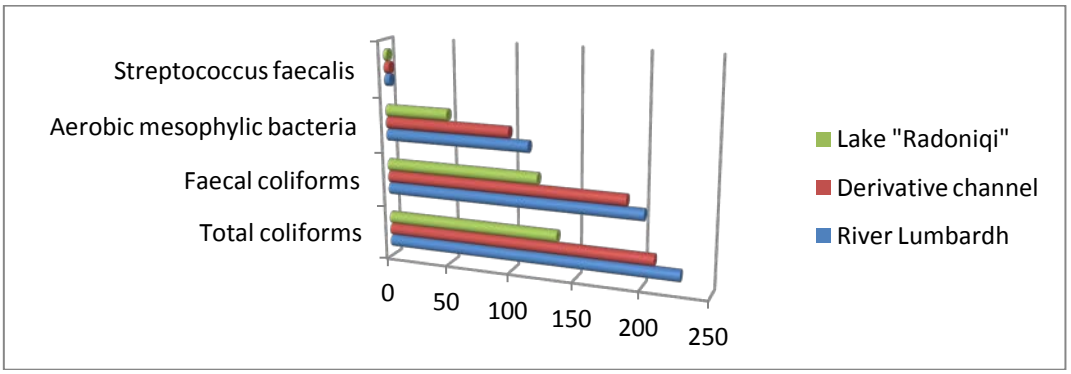

Figure 1. Chart of average values of microbial analysis during the period March 2014-March 2016

All samples collected from three investigated points have given results which according to Directive 2006/7/EC of the European Parliament for surface waters belong to the category A.

Conclusion

All the physical and chemical and microbiological parameters from three investigated points were within limits and in relationship between them. The water samples from three locations were showing microbial content, which needs to be disinfected before consumption to avoid water-borne diseases. Microbiological and physico-chemical evaluation is very important during the summer season and during the rainfall periods of the year, because all these bacteria are able to give various infections of the human body if it owns a lower immunity.

References

Venkatesharaju K, Ravikumar P, Somashekar RK, Prakash KL, (2010) Physico-chemical and Bacteriological Investigation on the river Cauvery of Kollegal Stretch in Karnataka, *J. Sci. Engin. & Tech.*, **6**, 50-59.

Van Leeuwen FXR; (2009) Food and Chemical Toxicology, 38(2000)51-58. Evalutaion of Drinking water quality in urban areas of Pakistan: A case study of Southern Lahore Pak. *J. Engg. & Appl. Sci*. **5**, 16-23

Diersing N. 2009. Water Quality: Frequently Asked Questions PDA. NOAA

Clark, D. L., Milner, B. B., Stewart, M. H., Wolfe, R. L., Olson, B. H., (1991). Comparative study of commercial 4-methylumbelliferylb-D-glucuronide preparations with the Standard Methods membrane filtration fecal coliforms test for the detection of Escherichia coli in water samples, *Appl. Environ. Microbiol*., **57** (5): 1528– 1534

Edberg, S. C., Rice, E. W., Karlin, R. J., Allen, M. J., (2000). Escherichia coli: the best biological drinking water indicator for public health protection, J. Appl. Microbiol., 88: 106S-116S.

Geissler, K., Manafi, M., Amorós, I., Alonso, J. L., (2000). Quantitative determination of total coliforms and Escherichia coli in marine waters with chromogenic and fluorogenic media, *J. Appl. Microbiol*., **88** (2): 280-285.

Houston AC, (1900) On the value of examination of water for Streptococci and Staphylococci with a view to detection of its recent contamination with animal organic matter. In Sup. 29th Ann. Report of the Local Government Board containing the Report of the Medical Officer for 1899–1900, p. 548, London City Council, London.

Winslow CEA, Hunnewell MP, (1902) Streptococci characteristic of sewage and sewage-polluted waters. *Sci*. **15**, 827.

Gaudy, F. A. Microbiology for environmental scientists and engineers. London: McGraw Hill International Book Company, 1998

American Public Health Association - APHA. Standards methods for the examination of water and wastewater. 20th edition. Washington DC, 1998

Grabow Wok (1991) Human virus in water. Water Sewage Effl. 11 16-21

Houston, A.C. (1900) On the value of examination of water for Streptococci and Staphylococci with a view to detection of its recent contamination with animal organic matter. In Sup. 29th Ann. Report of the Local Government Board containing the Report of the Medical Officer for 1899–1900, p. 548, London City Council, London

Nübel U, Garcia-Pichel F, Kühl M, Muyzer G, (1999) Quantify microbial diversity: Morphotypes, 16S rRNA genes and carotenoids of organic phototropes in microbial mats. *Appl. Environ. Microbiol.* **65**, 422-430.

Byamukama D, Knasiime F, Mach Rl And Farnleitner H, (2000) Determination of *Escherichia coli* contamination withchromocult coliform agar showed a high level of discriminationefficiency for differing faecal pollution levels in tropical waters of Kampala, Uganda. *Appl. Environ. Microbiol.* **66,** 864-868.

Goñi-Urriza M, Capdepuy M, Arpin C, Raymond N, Caumettep And Quentin C (2000) Impact of an urban effluent onantibiotic resistance of riverine *Enterobacteriaceae* and *Aeromona*spp. *Appl. Environ. Microbiol.* **66**,125-132.

Nishiguchi MK (2000) Temperature affects species distribution in symbiotic populations of *Vibrio* spp. *Appl. Environ. Microbiol.* **66** (8) 3550-3555.

Cabral P, Joao S, (2010) Water Microbiology. Bacterial Pathoges and Water. 2010. *Int. J. Environ. Res. Public Health*, **7**, 3657-3703,

Anonymous, (2001) Shkodra lake Project Conference Report 2001. HRK Project, Germany.

Mijovic S, Vukovic Z, Mazgalj A, (2006) A pan European classification of the Skadar Lake according to Environmental Standards, *Physics, Chemistry and Technology* **4**, 35-43

Bushati N, Bushati F, (2006) Studim i cilësive bakteriologjike të ujërave të Liqenit të Shkodrës. Bio & Eko, Botim i Sektorit të Liqenit të Shkodrës, Maj 2006, Nr.6.