

MICROBIOLOGICAL AND PHYSICO-CHEMICAL PARAMETERS AT
SEVERAL POINTS ALONG DRIN RIVER

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Abstract

Drin River has a length of 285 km, has a mountainous character, where the average slope is 2.4%. The Black Drin originates from Lake Ohrid, at an altitude of 694 meters above sea level. Drin River has two distributions, one of which flows directly into the Adriatic Sea and the other into the Buna River, in Shkodra. The Drin River area is beautiful and very important for the Albanian economy. Surface water quality continues to be a major requirement for water quality monitoring; therefore, assessing the presence of pathogenic bacteria in water represents a major concern for protecting the health of the population. Our study provides an assessment of the state of water quality of the Drin River in the sampling points Dea Spathar, Ganjollë 1, Ganjollë 2, Vukatanë, Kuç, Qafë, Bahçallek and Drini-Buna connection point. The water quality assessment at these sampling points was carried out in accordance with Directive 2006/7/EC of the European Parliament. From the microbiological parameters were determined; *heterotrophic bacteria*, *Escherichia coli*, *Intestinal enterococci* and physico-chemical parameters *pH*, *temperature*, *chloride*, *conductivity*, *turbidity*, and *dissolved oxygen*. This study was conducted at the Center for Microbiological Diagnostication "Wolfdieter Sixl", at the University of Shkodra "Luigj Gurakuqi".

Keywords: *Escherichia coli*, *Intestinal enterococci*, *heterotrophic bacteria*, *chloride*, *turbidity*, *etc.*

Introduction

The Drin River is the largest river in Albania and in the entire eastern coast of the Adriatic and Ionian seas. Black Drin originates from Lake Ohrid, with a height of 694 meters above sea level (Pano, 1995). The water temperature of the Drin River in January is 5.3°C on average, while in August it is 20.8°C on average (Dhora, 2005). The content of dissolved oxygen in the waters of the Drin River results in values from 8.5-9.91 mg/l O₂, because it came from the influence of the urban discharges of the city as well as the mixing of the

waters of the Drin River with Buna. The content of NBO_5 in the river Drin is in values from 0.57-0.9 mg/l O_2 . The content of total phosphorus in the Drin River has small and stable fluctuations from 0.01-0.015 mg/l P. In the Drin River, the trend of the nitrate content has the highest values since the waters of this part are under the influence of the city's urban discharges of Shkodra. Values fluctuate for the Drin River from 0.3-0.26 mg/l N-NO_3 , (MMPAU, 2009). At the station of Bahçallek, the trend of nitrate content has the highest values since the waters of this part of the Drin River are under the influence of the urban discharges of the city of Shkodra. The Drin station has the value of this indicator from 0.14-0.17 mg/l N-NO_3 which is classified as medium quality waters (MMPAU, 2009, BUSHATI, 2013). Lakes, rivers, and seas are used for a variety of recreational activities including bathing, diving, fishing, and sailing. If these activities are to be enjoyed safely, attention must be given to health hazards such as sewage pollution (Bartram & Rees, 2000). The presence of *Escherichia coli*, *intestinal enterococci* and the other *coliform bacteria* in surface water depends on input waste waters, septic drainage, agricultural sources, animal waste, during rainfalls, etc. *Escherichia coli* are an indicator of fecal pollution and water contamination (Todar, 2007). *Intestinal Enterococci* are bacteria that live in the intestinal tracts of warm-blooded animals, including humans, and therefore indicate possible contamination of streams and rivers by fecal waste. These pathogens can sicken swimmers and others who use rivers and streams for recreation or eat raw shellfish or fish. Other potential health effects can include diseases of the skin, eyes, ears, and respiratory tract (www.epa.gov). The *Intestinal Enterococci* group has been used as an indicator of fecal contamination. In human feces, the number of *Intestinal Enterococci* is generally lower than the number of *Escherichia coli*. *Intestinal Enterococci* can survive longer than *Escherichia coli*, (WHO 2008; Payment, 2003). Humans have very high numbers of enterococci, while animals contain large numbers of streptococci (Wilson, 2005).

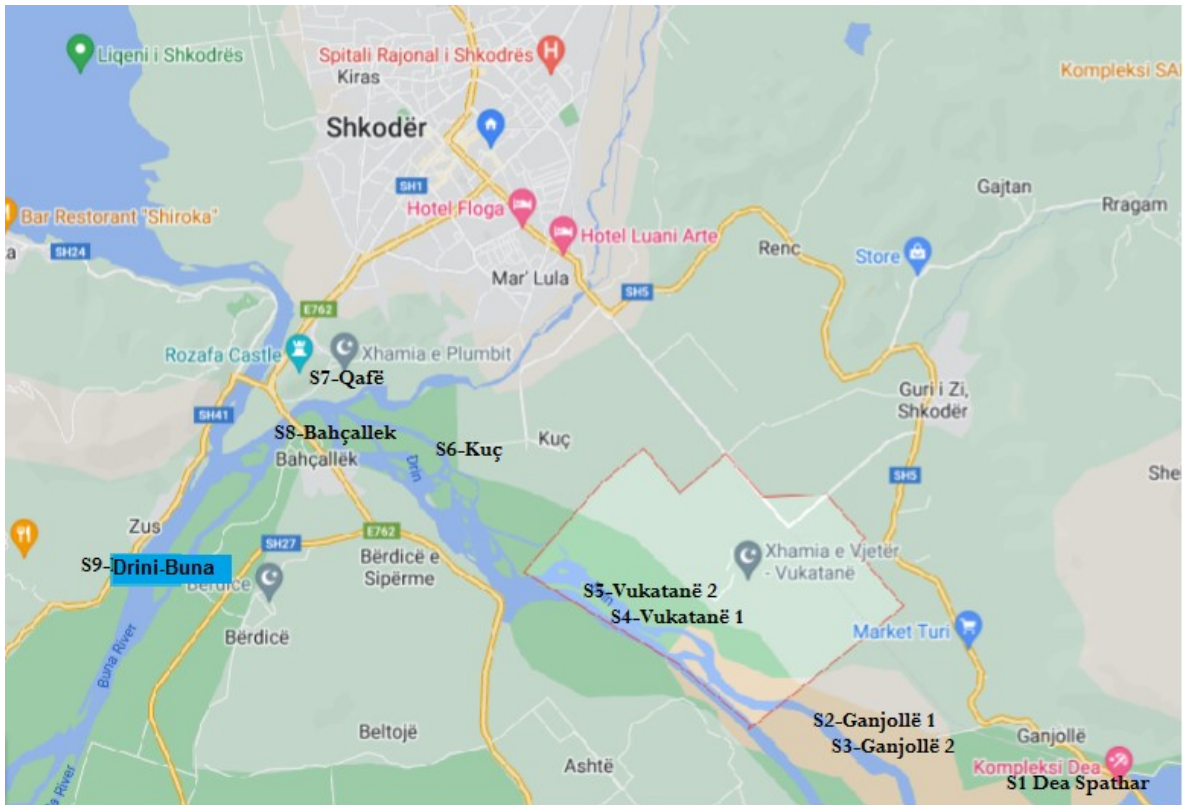


Figure 1. Map of Drin River with sampling points

MATERIALS AND METHODS

The study was carried out on April, May, and June 2022. Sampling stations were selected based on the impact of the source of anthropogenic pollution, being positioned near the inhabited areas of the Drin River (Figure 1). The sampling stations were nine: Dea Spathar, Ganjollë 1, Ganjollë 2, Vukatanë, Kuç, Qafë, Bahçallek, and Drini-Buna connection point. The analyzes of surface water samples of the Drini River were analyzed at the Center for Microbiological Diagnostication "Wolfdieter Sixl", University of Shkodra. Water samples were taken at different points of the station names.

- ◆ Stacioni S1(Dea Spathar)
- ◆ Stacioni S2 (Ganjollë 1)
- ◆ Stacioni S3 (Ganjollë 2)
- ◆ Stacioni S4 (Vukatanë 1)
- ◆ Stacioni S5 (Vukatanë 2)
- ◆ Stacioni S6 (Kuç)
- ◆ Stacioni S7 (Qafë)

- ◆ Stacioni S8 (Bahçallek)
- ◆ Dubai S9 (Drin-Buna connection point)

Water sampling and storage was carried out in accordance with the Standard Methods for the Examination of Water (APHA, AWWA, WEF 1995; WPCF 1998). The sampling period was April-June 2022. Determination of pH, temperature and conductivity was done at the sampling points using the AQUALYTIC system, a portable pH meter (in situ). Turbidity was measured using Turb 430 IR/T. The calibration of the device was carried out with standard solutions of 0.02 NTU/FNU, 10.0 NTU/FNU, and 1000.0 NTU/FNU. Rapid Enterococci ChromoSelect Agar medium was used for the cultivation of *Intestinal enterococci*. Filters containing filtered water were placed in Petri dishes with Rapid Enterococci ChromoSelect Agar medium for 18-24 hours at 35°C. After 24 hours, the colonies were evaluated for blue-green colonies, which were *Intestinal enterococci*. *Escherichia coli* were cultivated in Endo-Agar for 48 hours at 44.5°, which appear with a metallic shiny.

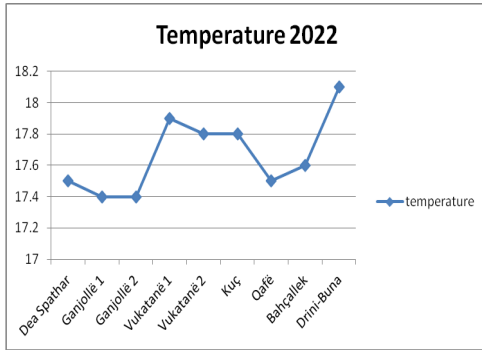
RESULTS AND DISCUSSIONS

Microbiological and physico-chemical parameters for the months of April, May and June 2022 are presented through tables and histograms with the mean values of all parameters analyzed. According to table 1, the results of physico-chemical parameters showed that the mean temperature values of Drin river varied from 17.4° C to 18.1°C, mean pH values varied from 8.13 to 8.39, mean conductivity values varies from 208 µS/cm to 265 µS/cm, mean chlorides values varies from 7.9 to 24.2 mmol/L, mean turbidity values varies from 0.31 NTU/FNU to 1.02 NTU/FNU (fig 2, a, b, c, d, e, f). Microbiological parameters show different degree of microbial loading from April to June 2022, figure 3 (g, h, i). The highest load in terms of heterotrophic bacteria is represented by the point of Dubai where Drin joins river Buna with a loading of 2400 CFU/100 ml, Bahçallek with microbial load 2200 CFU/100 ml and point Qafë with 1600 CFU/100 ml. The mean value of *Intestinal enterococci/Enterococci faecalis* during the measurement period was 97.4 measured in CFU units/100 ml of water. Directive 2006/7/EC of the European Parliament classifies them in class A, which goes up to 200 CFU/100 ml. The values of *Intestinal enterococci/ Enterococci faecalis* in these waters are also confirmed by other works found for Lake Shkodra and the rivers Drini and Buna by (Anonymous 2001, Bushati, 2002, 2003, 2006, 2013). During the measurement period, the value of *Intestinal enterococci/Enterococci faecalis* varied from 0.00-766 CFU/100 ml. The highest load is represented by the confluence of the Drin River

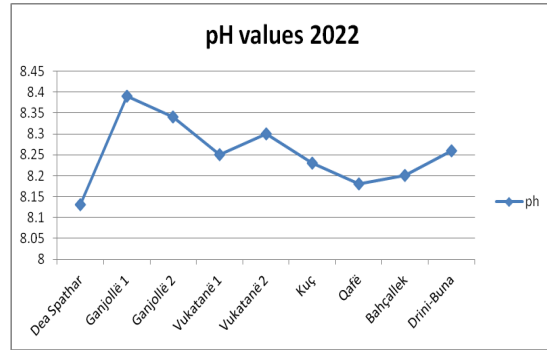
with the Buna River with a load of 766 CFU/100 ml, which classifies this point as sufficient quality or Class C. The presence of *Intestinal enterococci/ Enterococci faecalis* indicates old sources of pollution, which originate from sewage discharges. According to figure 3 (i) the highest values for *Escherichia coli* resulted at the connection station of Drin with Buna River, where *Escherichia coli* at this point is 640 CFU/100 ml of water, followed by the point of Bahçallek with 270 CFU/100 ml water. These values classify the Drin-Buna sampling station in class C according to Directive 2006/7/EC (500-1000 CFU/100ml), table 3, followed by the Bahçallek sampling station with 270 CFU/100ml, while the other sampling stations are classified in class A according to Directive 2006/7/EC, table 3 for *Escherichia coli*. The mean value of *Escherichia coli* was 108 CFU/100 ml. During the measurement period, the value of *Escherichia coli* varied from 0.00 to 640 CFU/100 ml, showing that these values have fluctuations in different points of the Drin River based on the growth requirements of *Escherichia coli*. Other sampling points are classified as class A of directive 2006/7/EC as very cleanest surface waters for *Escherichia coli* and for *Intestinal enterococci*.

Table 1. Mean values of physico-chemical parameters at sampling stations Drini River surface waters for April, May, June 2022.

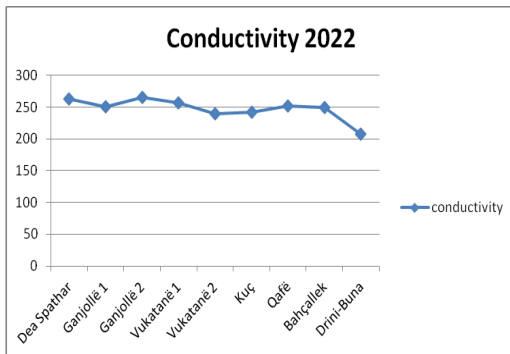
Sampling points	*Temperature	*pH	*Conductivity	*Chlorides	*Dissolved oxygen	*Turbidity
Dea Spathar	17.5	8.13	263	24.2	98	0.48
Ganjollë 1	17.4	8.39	250	9.9	97	0.54
Ganjollë 2	17.4	8.34	265	9.7	96	0.56
Vukatanë 1	17.9	8.25	257	8.3	97	0.69
Vukatanë 2	17.8	8.3	239	8.5	98	0.32
Kuç	17.8	8.23	242	7.9	96	1.02
Qafë	17.5	8.18	252	8.2	98	0.33
Bahçallek	17.6	8.2	249	9.7	98	0.31
Drin-Buna	18.1	8.26	208	9.8	98	0.59



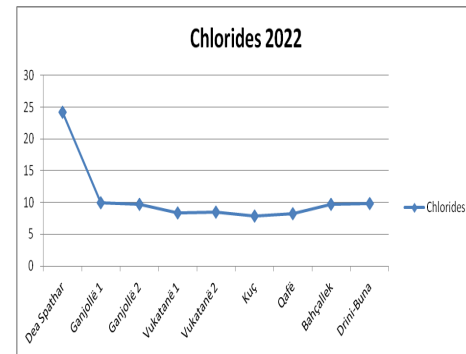
(a)



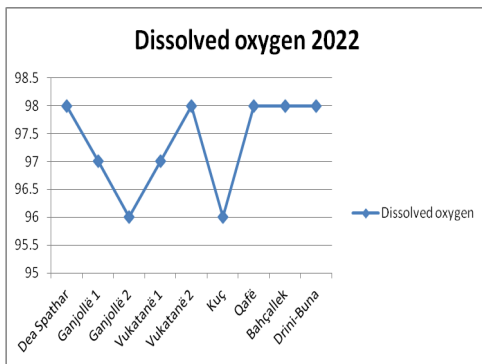
(b)



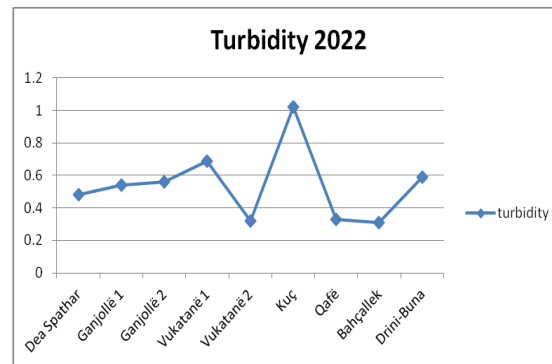
(c)



(d)



(e)

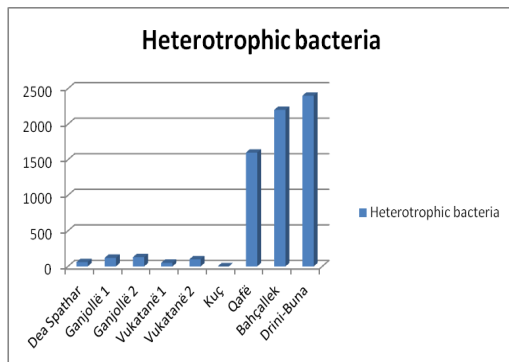


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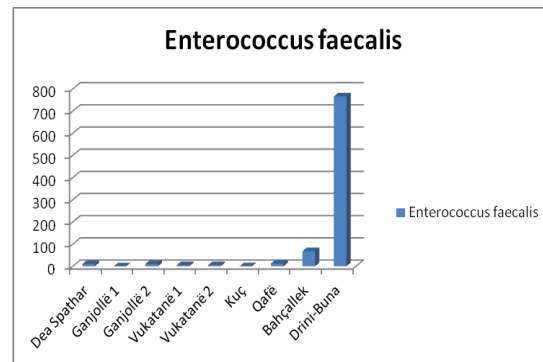
Figure 2. (a, b, c, d, e, f,) Graphics with mean physico-chemical parameters

Table 2. Mean values of microbiological parameters at sampling stations Drin River surface waters for April, May, June 2022

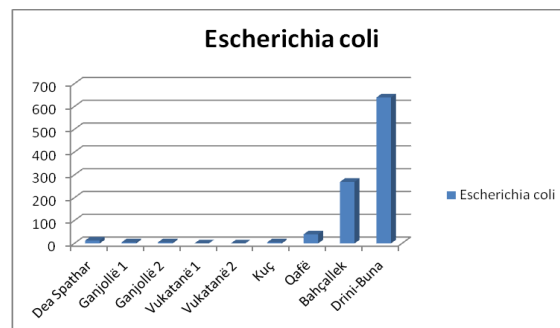
Stations	Heterotrophic bacteria	Escherichia coli	Enterococcus faecalis
Dea Spathar	60	13	10
Ganjollë 1	120	5	0
Ganjollë 2	130	5	10
Vukatanë 1	50	0	5
Vukatanë 2	100	0	5
Kuç	0	5	0
Qafë	1600	40	13
Bahçallek	2200	270	68
Drini-Buna	2400	640	766



(g)



(h)



(i)

Figure 3 (g, h, i) Graphics with microbiological parameters

Table 3: Directive 2006/7/EC on surface water

<i>Parameter</i>	<i>Excellent quality (A)</i>	<i>Good quality (B)</i>	<i>Sufficient quality (C)</i>
<i>Intestinal Enterococcus (cfu/100ml)</i>	200	400	330
<i>Escherichia coli (cfu/100ml)</i>	500	1000	900

CONCLUSIONS

Based on Directive 2006/7/EC for surface water, the sampling station Drin-Buna (the connection of Drin and Buna River) represents the highest load in terms of *Escherichia coli* with 640 CFU/100 ml which classifies them in class (B). Drin-Buna sampling station, in terms of *Intestinal enterococci/ Enterococci faecalis* is classified in class B and C, while the other points are classified as class A of directive 2006/7/EC as very cleanest. The highest load for *heterotrophic bacteria* is represented by the point of Drin-Buna with 2400 CFU/100 ml of water.

The low bacterial loads that appear in the Drin River at all sampling points indicate a very good quality. Water at all sampling points is classified as very good quality or class A apart from the Drini-Buna point. All the other sampling points along Drin River met the Directive 2006/7/EC with excellent quality Class A.

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