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Research Article

Microbial indicators of coastal water in Velipoja beach, Albania

Hajrije Dibra

*Water Study Center for Shkodra Region, Faculty of Natural Sciences,
University of Shkodra, Albania*

Nevila Bushati

*Water Study Center for Shkodra Region, Faculty of Natural Sciences,
University of Shkodra, Albania*

Abstract

The Albanian coastline is about 450 km long, with wide access to the Adriatic and Ionian seas. It has become popular in recent years for its many unexplored rocky and sandy beaches, crystal waters, curative sand rich in iodine, which has given a great impact in tourism and economy. Velipoja beach is located on the northwest of Adriatic Sea. Coastal waters of Velipoja are used for bathing, fishing and tourism, but in recent years these waters are exposed to various sources of pollution, which are related to restaurants and agricultural activities, wastewater discharge, etc. The quality of coastal water in Albania is particularly analysed by the Public Health Institution. It was considered reasonable to monitor the microbiological quality of coastal waters on Velipoja beach through microbiological parameters during summer season. Evaluations of the results were done based on Directive 2006/7/EC for inland waters, coastal and transitional waters. Seawater samples were tested mainly for *E. coli*, *E. faecalis*, *S. faecalis, heterotrophs* in accordance with European Standards using the membrane filtration method. Water samples were taken monthly from May-September 2023.

Based on the data received, during the monitoring period the bacterial concentration for *E. faecalis* varied from 0 CFU /100 ml to 228 CFU/100 ml. The concentration for *S*. *faecalis* varied from 0 CFU /100 ml to 128 CFU/100 ml. The concentration for *E. coli* varied from 0 CFU /100 ml to 134 CFU/100ml. Velipoja Center has the highest concentration of *E. coli, E. faecalis.* The concentration of bacteria increases during the months of July and August, probably due to the large number of tourists visiting Velipoja beach during this period. According to Directive 2006/7/EC of the European Parliament, the quality of coastal waters of Velipoja during the period of investigation for *E. coli* is in the category "Excellent quality".

Monitoring for the presence of pathogen bacteria are essential water quality assessment, which directly or indirectly leads to serious problems to human health. Enterococcus faecalis is an

indicator of an old faecal pollution (EN ISO 7899-2, 2000). The European Community (2006) recommended the following parameters: Escherichia coli/100 ml (500/1.000), and Intestinal enterococci/100 ml (200/400) categorized in the class A and B. Urban wastewaters are major sources for surface and groundwater pollution in the Shkodra lake basin.

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Keywords: coastal waters, indicator bacteria, *E. faecalis*, waterborne diseases.

1. Introduction

As a result of the free movement of the population, the number of coastal areas used for bathing and the number of public beaches has increased in recent years. The constructions on the Albanian coast without any kind of criteria and the increasing number of the population in coastal areas, has not been coordinated with the necessary management and treatment of urban water discharges as well as with the construction of the relevant infrastructure (Bode et al., 2015). As a result, almost all aquatic environments are more or less threatened. This is most evident in the Western Adriatic Lowlands, which is the most populated area of the country (INSTAT, 2014). The number of the population has increased excessively, including Velipoja and especially the number of vacationers during summer. The potential health risk of infective diseases caused by water can be measured based in the presence of important microbiological pathogen indicators, i.e. Fecal coliform and Fecal streptococci (Foden, 2008). Swimming, fishing in polluted water sources or eating food exposed to contaminated water can caused diseases, known as waterborne diseases. While diarrhoea and vomiting are the most commonly symptoms of waterborne diseases other symptoms can include respiratory, skin, ear, or eye problems. Lack of clean water supply, sanitation and hygiene are major causes for the spread of waterborne diseases in a community. These have been documented by various researches (Shuval, 2003; Colford et al., 2007). Estimation of microbiological water quality is very important for public health (Borrego, 1991). Bathing Water Directive (2006/7/EC) involves monitoring *E. coli* and *E. intestinalis*. Their origins are from human faeces and organic waste in the sewage, as well as animal faeces in the runoff and disposed of in the water bodies without any sanitation systems (Amorim et al., 2014). But other bacteria including *Pseudomonas aeruginosa*, a gram-negative opportunistic human pathogen, and HPC bacteria may also be useful in defining seawater body quality (Carter et al., 2000). The measurement of heterotrophs includes all microorganisms of the natural microflora of the aquatic environment and organisms spread over a wide range of pollution sources. They are found in greater numbers in water sources. Beaches where swimming is allowed should be tested for

water quality before the swimming season begins, during the season and in the end of the season. It was considered reasonable to monitor the quality of coastal waters in Velipoja through microbiological parameters during summer season. Velipoja is one of the largest beaches on the Albanian coast, with endless spaces filled with black sand, lagoon and natural reserves. The Buna estuary has a surface area of approximately 90.7 km², with a shape of a large triangle, which is created by the deposits of Buna River. The lagoon of Viluni is located 2 km east of the beach of Velipoja, surrounded by wetlands. It communicates with the sea through a natural channel, in which the water changes direction very often. In the southeast of Velipoja, is situated Rrjolli, with a virgin beach with crystal water and black sand rich with iodine. The results of the analysis were used to assess the quality of the bathing waters of Velipoja beach and to provide information to the public on the quality of water in the concerned bathing sites.

2. Material and Methods

The purpose of this study was to evaluate the quality of sea water in the northwest of the Adriatic Sea, along the seacoast of Velipoja, focusing on the concentration of microbial indicators by comparing them with Directive 2006/7/EC of the European Parliament, for coastal waters and transitional waters (table 1). Water samples were taken mainly on Sundays, as this is the optimal frequency during season. Each, seawater samples were collected from 30 cm under the surface at a distance 10-20 m by sea coast, using single-use sterile plastic containers, with a volume of 250 ml (WHO, 2003). Transport and storage of samples before the testing was done with boxing freezer temperature 4-7°C and analyzed within 24 hours so that there is no change in parameters (Figuers & Borrego, 2000).

Table 1. Directive 2006/7/EC of the European Parliament, for coastal waters and transitional waters

Escherichia coli Directive 2006/7/EC for coastal waters and transitional waters					
	A	B	C	D	E
1	Parameter	Excellent quality	Good quality	Sufficient	Reference methods of analysis
	Escherichia coli (cfu/100 ml)	250 (*)	500 (*)	500 (**)	ISO 9308-3 or ISO 9308-1
Intestinal enterococci Directive 2006/7/EC for coastal waters and transitional waters					
	A	B	C	D	E
2	Parameter	Excellent quality	Good quality	Sufficient	Reference methods of analysis
	Intestinal enterococci (cfu/100 ml)	100 (*)	200 (*)	185 (**)	ISO 7899-1 or ISO 7899-2
(*) Based upon a 95-percentile evaluation. See Annex II.					
(**) Based upon a 90-percentile evaluation. See Annex II.					

The seawater samples were taken monthly from May 2023 - September 2023 at five stations: Buna Estuary, Ada beach, Velipoja Center, Viluni lagoon, and Rrjoll (figure 1).

Figure 1. Map of monitoring stations on the coastline of Velipoja beach, Albania
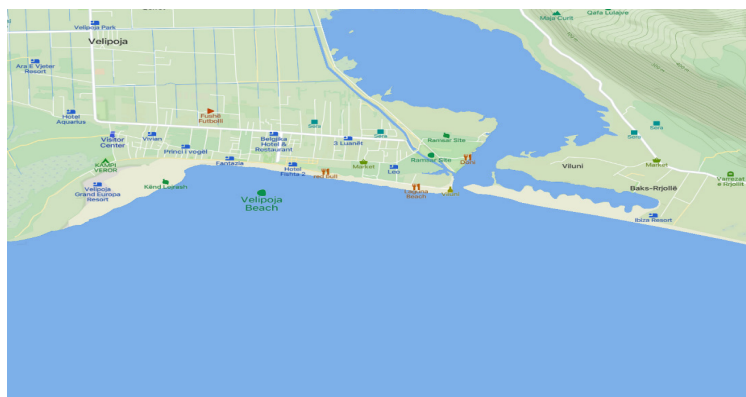
Seawater samples were tested mainly for *E. coli*, *E. faecalis, S. faecalis, heterotrophs* in accordance with European Standards Methods ISO 7899-2 and Methods ISO 9308-3, of Filtration Membrane (MF). To determine *Escherichia coli,* 100 ml of water was filtered through bacteriological filters 0.45 µ and the filters were placed in Petri dishes with Endo Agar that was incubated at a temperature of 37°C (± 0.5 °C) for 24 hours. *S. faecalis* were assessed by membrane filtration, and an appropriate volume (from 1 to 100 mL) and filters were placed on Slanetz-Bartley agar plates. Plates were incubated at 37.5 °C for 48 h. *Heterotrophs* were determined by the usage of Yeast Extract Agar (YEA) and the incubation at 37 °C for 48 hours. All location beaches were evaluated using the Directive 2006/7/EC for management of bathing water quality.

3. Results and Discussion

Summary data for *E. faecalis, S. faecalis* and *E. coli* in water samples of Velipoja are presented in figure 2 and 3. Based on the data received, during the monitoring period the bacterial concentration for *E. faecalis* varied from 0 CFU/100 ml to 228 CFU/100ml. The concentration for *S. faecalis* varied from 0 CFU/100 ml to 128 CFU/100ml. The concentration for *E. coli* varied from 0 CFU /100 ml to 134 CFU/100ml. Velipoja Center has the highest concentration of *E. coli, E. faecalis.* The concentration of bacteria increases during the months of July and August, probably due to the large number of people visiting Velipoja beach during this period.
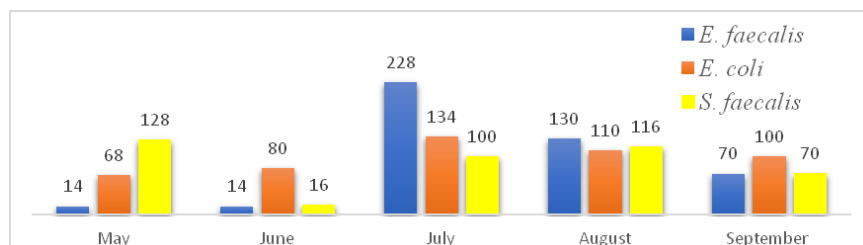
Figure 2. Dynamics of water quality parameters of Velipoja during May – September 2023

a   b
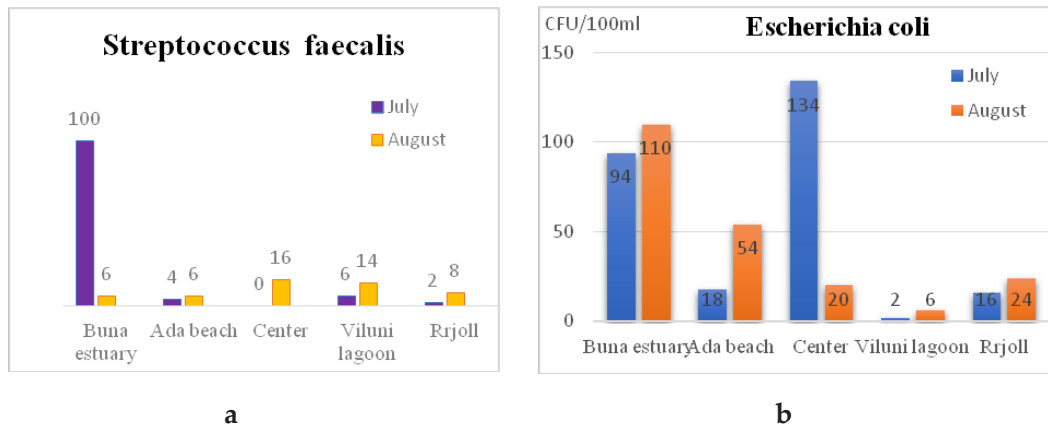
Figure 3 a-b. Microbiological parameters for *E. coli* and *S. faecalis* during July ang August

Based on the data shown at table 2 for values of *heterotrophs* the maximal value was recorded at Buna estuary with 20000 CFU/100ml, while the minimal value was 0 CFU/100ml.

Table 2. The values of *heterotrophs*, mean, minimum and maximum values

Indicator bacteria	Station	Mean	Min	Max	May	June	July	August	September
Heterotrophes (Cfu/100 ml)	Buna Estuary	5680	500	20.000	20.000	2000	1400	500	4500
	Ada beach	360	0	1000	1000	0	300	500	0
	Velipoja Center	1200	0	2000	2000	2000	900	1100	0
	Vilun lagoon	1440	0	5000	5000	2000	0	200	0
	Rrjoll	1020	0	4000	0	4000	1100	0	0

4. Conclusion

Based on the Directive 2006/7/EC of the European Parliament, for coastal waters and transitional waters, the quality of coastal waters for *E. coli* along the costal of Velipoja during the period of investigation is in the category "Excellent quality" and "Good quality" for *E. faecalis, S. faecalis.* The pollution of the sea water may have come as a result of water discharges from the hotels and restaurants of area directly or indirectly into the sea without being treated, as well as the increase of the population in the summer season mainly during July and August.

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