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Professional paper

MICROBIOLOGICAL AND PHYSIC-CHEMICAL ASSESSMENT OF THE SEA WATER IN ZVËRNECI COAST, VLORË, ALBANIA

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Abstract

The development of coastal truism in Albania during the last decade has had a huge impact on the seawater quality. As a result, it is shown that the recreative water quality is affected sometimes by the presence of different types of microorganisms, some of them potential pathogens for humans. This study has the main focus on the assessment of the seawater in the bathing site of Zvërnec Beach in Vlore Albania. The examination of the seawater is based on the evaluation of the microbiological indicators such as total coliforms and E coli and also the physical-chemical parameters like pH, temperature, conductivity, DO, and salinity. The study was conducted over eight months from June 2022 to January 2023. The samples were collected in six different sites and have been analyzed for both microbial and physic-chemical parameters. The method for the fecal bacteria assessment is the standard technique of MPN. The results show that one station has large values of bacterial pollution, and there is a correlation between fecal contamination and temperature. Every station displays seasonal differences, during summer there is a higher contamination, compared with winter. Therefore, seawater monitoring of microbiological elements must be performed continuously in all the coastal areas of Vlora City.

Keyword: Fecal contamination, MPN, seawater quality, seasonal variation.

1. Introduction

The development of coastal truism in Albania during the last decade has had a huge impact on the seawater quality. As a result, it is shown that the recreative water quality is affected sometimes by the presence of different types of microorganisms, some of them potential pathogens for humans. This study has the main focus on the assessment of the seawater in the bathing site of Zvërnec Beach in Vlore Albania. The examination of the seawater is based on the evaluation of microbiological indicators such as total coliforms and E coli and also the physical-chemical parameters like pH, temperature, conductivity, DO, and salinity. The study was conducted over eight months from June 2022 to January 2023. The samples were collected in six different sites and have been analyzed for both microbial and physic-chemical parameters. The method for the fecal bacteria assessment is the standard technique of MPN. The results show that one station has large values of bacterial pollution, and there is a correlation between fecal contamination and temperature. Every station displays seasonal differences, during summer there is a higher contamination, compared with winter. Therefore, seawater monitoring of microbiological elements must be performed continuously in all the coastal areas of Vlora City.
According to the Bathing Water Directive (BWD, European Union 2006/7/EC) the two microbiological parameters for seawater classification: are intestinal enterococci and Escherichia coli. (Figueras et al., 2016). Several other studies consider indicator bacteria of water contamination: total coliforms (TC), fecal coliforms (FC), and fecal streptococci (FST). (World Health Organization, 2021).

Fecal indicators can resist various environments, including soil, sediment, beach sand, aquatic plants, underwater reefs, and near seashores (Field and Samadpour, 2007; Harwood et al., 2014). Therefore, it is essential to monitor various pollution sources to improve the evaluation related to health risks.
The fecal bacteria presence is linked with the physical and chemical parameters of the water. One major factor influencing bacterial growth is temperature. Numerous studies have demonstrated that water temperature has an impact on the existence of bacteria (Tiefenthaler et al., 2009).
The microbial contamination in water bodies can be impacted by nutrient coordination and form farms (Karakassis et al. 2001). The quality of the water can also be affected by total dissolved solids (TDS). A relationship between TDS and water quality during seasonal change was found in numerous studies (Karakassis et al. 2001).
In this study, we assessed the water quality of Zverneci Beach based on microbiological and physic-chemical analysis. This area is near the old industrial zone of Vlora City, and also it approximately the historical and cultural site of Saint Mary Monastery on Zverneci island. As this is one of the most frequenting sites during summer it needs to be monitored to ensure a good quality for the tourists but also to prevent the disturbed in the biodiversity of the area.

2. Material and Methods

Study area

Zverneci Beach is one of the most important areas in Vlora city, it is near the Protected Landscape Narte Pish Poro. It is known for its high biodiversity and sandy beach. (Miho et al., 2013). This is well known and frequented by many tourists especially familiar ones as the water is shallow and appropriate for the kids. For this study, we took 6 sample points in an area of 7 Km, near facilities like bars, and restaurants.
This study was carried out within the time frame June 2022 - January 2023, where we sampled six stations of the coastline of Zvërneci.
Samples were analyzed in the Microbiological Laboratory, Department of Biology, University of Vlora. The sampling stations were selected after the study and inspection of the areas, as well as the frequency of the beach by tourists. Sampling was carried out by the World Health Organization ISO 5667-6:2020 Water Quality — Sampling for microbiological analysis (ISO 5667-6:2020; ISO 19458:2006).

Figure 1: Study area zoomed of Zverneci region
(Source: Google maps modified by Kiçaj et al., 2024)

Sampling Point

The typology of the sampling area is sandy, and untouched by urbanism continues. Near the beach, there are services for many family vacationers.

Station 1 is next to the Regina complex, it is a quiet, slightly urbanized sandy beach, widely frequented by casual vacationers. The beach is public, but there are private spaces such as bars and restaurants. **Station 2** has a stretch near the pine forest. Also, nearby is the Natural restaurant, which offers services to vacationers with fresh seafood and local dishes.

Table 1: Geographic coordinates of sampling stations evaluated with GPS device.

Nr.	Name	Latitude	Altitude
1.	Regina	19°27'13.6	40°28'11.5
2.	Natyral	19°28'19.5	40°27'14.5
3.	Pashaj	19°29'10.9	40°27'03.2
4.	Kapiteni	19°29'37.9	40°26'12.8
5.	Jon	19°28'46.6	40°21'43.8
6.	Triport	19°28'46.6	40°20'35.0

(**Source:** Data by Kiçaj et al., 2024)

Station 3 is located near the Pashaj restaurant, which also offers services for vacationers, umbrellas, and sunbeds. This station is also frequented by family vacationers. **Station 4** is near the Kapiteni complex. The beach is frequented and populated during the summer season. **Station 5** is next to Joni 2 beach. **Station 6** is near the fishing port (Triport). Stations 5 and 6 are near the Fishing Port, which can also affect water pollution.

Microbiological analysis

Microbiological sampling was carried out according to the World Health Organization, Water quality — sampling for microbiological analysis (ISO 5667-6:2020; ISO 19458:2006).Water samples for bacteriological analysis were taken with sterile 500 ml bottles, 10–30 cm from the water surface at each station. The samples were placed in a thermos box and transported within 2 hours to the laboratory (ISO 5667–5:1991). This mode of transport does not allow the replication of bacteria. Samples were analyzed on the same day they were collected.

The microbiological analysis was carried out in the Laboratory of Microbiology at the Faculty of Technical and Natural Sciences, University “Ismail Qemali” of Vlora. The sampling and the tests were performed by the International Standard Methods (ISO 1991; CEC 1978; WHO 1984; ISO 1999; UNECE 1994; Camper et al. 1996). MPN index was used for the evaluation of total coliform and fecal coliform in water. Total and. fecal coliform was determined by MPN methods and EC media in a combination of 3 tubes (Bakaj et al., 2017; Bakaj et al., 2022). MPN index was calculated using the MPN statistical tables and is expressed as the number of organisms per 100 ml (MPN/100 ml).

Physic–Chemical Analysis

In this study, microbiological and physic-chemical analysis of water samples was performed using standard methods according to APHA-AWWA-WEF and Directive 2000/60/EC of the European Parliament and the Council (APHA-AWWA-WEF 2005; Council Decision 77/795/EEC).

We measured 7 physicochemical parameters, which include pH, electrical conductivity (EC), turbidity, total dissolved solids (TDS), total suspended solids (TSS), dissolved oxygen (DO), etc., from surface water systems used for this study. A thermometer was placed at a depth of 10 cm to take the water temperature in situ. The other parameters were analyzed by using water probe AQUAREAD 2000. These parameters were selected because many studies show that there is a correlation between them and the bacterial contamination of water.

Analytical Statistics

SPSS was used for the statistical analysis of this study. Seasonal changes in Fecal coliforms distribution were noticed by using a box plot between stations and months. Spearman's correlation analysis in SPSS was used to determine the relationship between the bacterial levels and the variables. For differences between the components, the significance threshold was set at 0.01.

3. Results and discussion

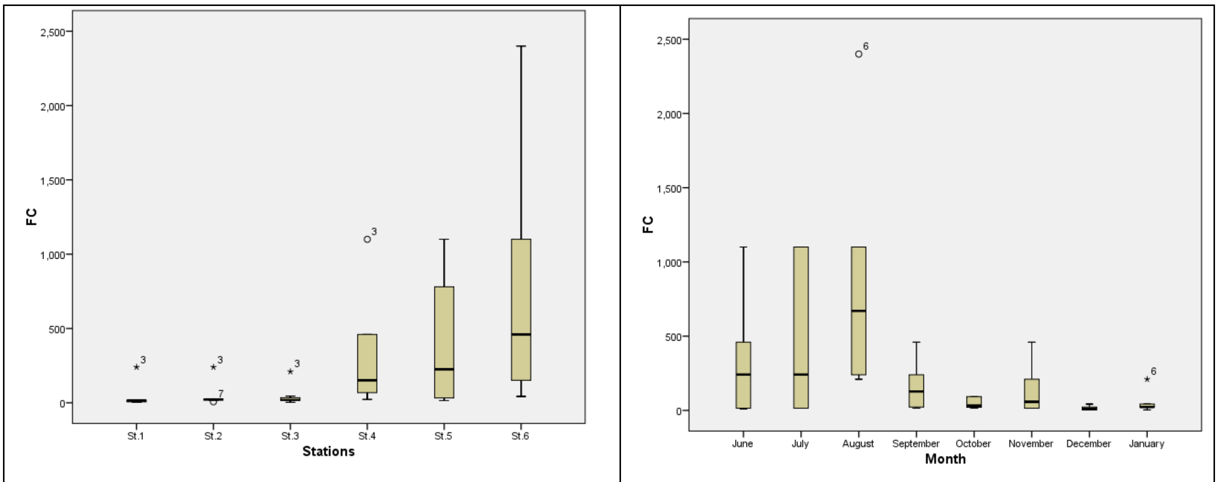
The microbiological evaluation of seawater is expressed as MPN/100 ml. Table 2 shows some statistics of fecal coliforms in each station. Based on this we see that stations 1, 2, and 3 have a mean range between 40.3 to 47 MPN/100 ml which shows a good quality of seawater in this station. Stations 5 and 6 show a moderate value of bacterial contamination from 422 – 710 MPN/100 ml.

Table. 2 All sampling stations' descriptive statistics (MPN 100 ml-1) are listed in the table

Statistics						
	St.1	St.2	St.3	St.4	St.5	St.6
Mean	40.30	47.15	43.70	310.25	422.25	709.88
Median	15.00	23.00	19.00	151.50	225.00	460.00
Mode	15	23	15	93[a]	210[a]	460[a]
Std. Deviation	80.918	78.136	68.236	363.895	439.661	809.131
Variance	6547.691	6105.266	4656.206	132419.357	193301.929	654692.411
Skewness	2.797	2.797	2.665	1.719	1.066	1.460
Kurtosis	7.866	7.872	7.274	3.048	-.538	2.122
a. Multiple modes exist. The smallest value is shown						

(**Source**: *Data by Kiçaj et al., 2024*)

For a clear analyze of fecal coliform contamination of the study area we have made the Boxplot stations and months. During summer the FC value are quite elevate, rather than winter.



(A) (B)

Figure 2: Box plot of microbial distribution in different sampling stations (A) and in different months (B), (**Source**: Data by Kiçaj et al., 2024)

Even though station 6 represents high level of FC during all months of sampling, and it goes higher during the summer on August it 2400 MPN/100 ml. Station 1, 2 and 3 have a lower amount of bacterial contamination almost during all the study time.
The variation of FC it is quite significant during summer than winter. August is the month with the high level of FC, especially for station 6. We have to take in consideration that this station is near the fishing port (Triport). The fishing boats, waste of fishing activities and unprocessed fuel have an important effect on water quality.
For the evaluation of water quality, we have taken in consideration also the physic -chemical parameter, such as: T, pH, DO, EC, ORP, and TDS. Table 3 shows some statistic values of those parameters.

Table 3: All sampling stations' descriptive statistics of physic-chemical variables are listed in the table

Statistics

	FC 48	T	pH	ORP	DO %	DO mg/l	EC ms/cm	TDS g/l
N Valid	48	48	48	48	48	48	48	48
Mean	262.254	20.865	7.4400	74.650	95.467	7.5717	48.6283	31.7167
Median	43.000	22.000	7.5200	65.000	95.200	7.5900	49.5750	32.1750
Std. Deviation	460.2633	5.9980	.20169	23.3208	.9792	.20299	3.07069	1.95277
Variance	211842.308	35.976	.041	543.860	.959	.041	9.429	3.813

(**Source**: *Data by Kiçaj et al., 2024*)

Based on the physic – chemical parameters of the sampling sites we can understand better the correlation pattern between this parameters and FC. According to the Pearson correlation the Fecal coliforms show significant correlation with Temperature, pH, DO EC and TDS.

Table 4: Table of sea water data Pearson product moment correlation coefficients

Correlations

	FC 48	T	pH	DO %	EC ms/cm	TDS g/l
FC 48	1					
T	.551**	1				
pH	.359*	.063	1			
DO %	.437**	.059	.579**	1		
EC ms/cm	-.388**	-.049	-.638**	-.679**	1	
TDS g/l	-.396**	-.051	-.680**	-.686**	.998**	1
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

(**Source**: *Data by Kiçaj et al., 2024*)

Total suspension solids may be associated with the survival of coliform bacteria. Those can promote bacterial protection from unfavorable conditions such as metal toxicity, UV radiation (An et al., 2002; Medema et al., 2003), and predation, and may also provide nutrients for coliform bacteria (Pachepsky & Shelton, 2011). Raising Temperature, pH, DO levels, and a lack of salinity all accelerate the die-off rate. (An et al., 2002; Evanson & Ambrose 2006; Chigbu et al., 2005; Kirschner et al., 2004).

4. Conclusions

This study was focused on Zverneci beach seawater quality. The water analysis was conducted based on the fecal indicator bacteria and physic-chemical parameters.
The sampling stations were selected in different points, to cover all the most frequented beaches. Based on our data station 6 is most contaminated with fecal coliforms.

This station is near the fish port (Triport) and is exposed constantly to fishing activities that affect the water quality. In general, Zverneci has a good quality beach with the potential for furthermore development of the region. Considering this we can suggest the application of periodic monitoring of water quality to prevent biodiversity loss and water quality management in support of ecology and economy of the area.

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