Sand and Bathing water quality analysis, management and assessment needs: an integrated assessment for Adriatic coastal ecosystems

Edjona BICI 1*, Spase SHUMKA 2, Anilda KOKALI 1,

1*Institute of Public Health, University of Medicine, Tirana, Albania, Email: Edjona.Bici@ishp.gov.al
2Agricultural University of Tirana, Faculty of Food and Biotechnology, Tirana, Albania, Email: sperspa@gmail.com
1 Institute of Public Health, Tirana, Albania, tobi_ani@yahoo.com

ABSTRACT

This contribution aims to present a rapid assessment of the water and sand quality of the Albanian coastal beaches situated at the Adriatic coast. The results presented here cover the period of year 2023. Coastal environments include several different habitat typologies, from coastlines to estuaries, rocky, sandy and muddy environments. All these ecosystems are very sensitive to anthropogenic pressures, climate changes, emphasizing the need to study and monitor their quality condition. One of the major hypotheses that leads study is that the effects of water pollution in coastal areas are not only devastating for humans, but also for animals, fish and birds. Contaminated water is unsuitable for consumption, recreation, agriculture and industry. Pollution reduces the aesthetic quality of coasts and beaches. More seriously, contaminated water destroys aquatic life and reduces their ability to reproduce. Ultimately, it is a risk to human health. No one can escape the effects of water pollution.
Key words: coastal environment, water quality, sand, Adriatic, assessment, microbiology.

INTRODUCTION

Bathing waters have a major significance for ecosystems and people who derive multiple benefits from them. The change of water quality constitutes an essential environmental risk that affects a significant and wide number of interested parties and multiple interests, especially those who participate in recreational activities based on the coast and the surrounding nature (Mancini et al. , 2006; Bergamasco et al., 2021; Petri et al., 2022). Thus, water quality plays a very important role in the well-being of the people, animals and plants that populate this area (Chiswell, 1996). Microbiological contamination of marine water bodies is one of the biggest environmental concerns in coastal zones subjected to rapid population growth (Mongruel, R et al., 2013). Fecal bacteria (e.g., Escherichia coli and Enterococci) originating from human feces and organic waste in the sewage, as well as animal feces in run-off, disposed of in the water bodies without any sanitation systems, constitute essential sources for the marine environmental contamination (Schares et al., 2005, Botturi et al., 2020). Consequently, human health can be seriously endangered and a bad bathing water quality can have adverse effects on the tourist industry and many recreational and economic activities (Campisano et al., 2013).

MATERIAL AND METHODS

The study includes the sandy beaches of our country, along the Adriatic Sea, starting from the Drin Bay in the north to the Vlora Bay in the south (Velipoja Beach-VE, Shëngjini Beach-SH, Durrës Beach-DR, Lalzi Bay-LA, Kavaja Beach-KA, Vlora Beach-VL) (Fig 1). The assessment of the quality of coastal bathing waters was carried out based on 57 sampling stations during the period May-September 2023. The number of samples is the same as for coastal bathing waters and sand, sampling was carried out in the same coordinates.
During the study, the following indicators were evaluated:
(i)Microbiological indicators: Intestinal Enterococci (IE) – ISO 7899-1 and Escherichia coli (E. coli) – ISO 9308-3 by the Filter Membrane Method in water and sand;
(ii)Chemical indicators measured in water (in situ): temperature (in 0C) and pH (In pH unit).
Sampling of bathing water, transport and analyses is done based on Directive 2006/7/EC, dated February 15, 2006 "On the management of washing water quality". Beach sand sampling and analysis is done based on Guidelines On Recreational Water Quality Volume 1 Coastal and Fresh Waters World Health Organization 2021.

Fig. 1 Study Area, station sampling

RESULTS

In total were analyzed 285 bathing water and sand samples. For E.coli in bathing waters, the highest value is observed in Durrës Beach (2.5x103 CFU/100 ml of water) and in sand (2.2x103 CFU/gr sand) in Kavaja Beach. For Enterococci in bathing waters, the highest value is observed in Durrës Beach (1.8 x103 CFU/100 ml of water) and in the sand (2.4 x103 CFU/gr of sand) was found in Kavaja beach (Table 1). The physical-chemical parameters measured in-situ: pH values vary from 7 to 7.5 pH unit and the temperature values vary from 19 to 30°C. For microbiological parameters measured in bathing waters, there is a significant differences between: month of monitoring and E. coli in VE, SH, LA and KA; sampling stations and E. coli in VE, DR and KA; month of monitoring and Enterococci in LA and KA; sampling station in sand Enterococci in VE and DR. In sand was found a significant differences between: month of monitoring and E. coli in VE, SH and KA; sampling station in sand E. coli in DR; month of monitoring and Enterococci in VE, SH, LA, and KA; sampling stations and Enterococci in DR.
Referring to the Guidelines for the Quality of Recreational Waters (WHO, 2021) as well as the European Directive on Bathing Waters (Sabino et al., 2011), the classification of beach sand for the presence of the microorganism E. coli have shown that 79.6% of the samples are above the reference value of 25 CFU/1g of sand. Enterococci, 51.2% of the samples are above the reference value of 60 CFU/1g of sand.

Code/Beach Name		Sample	E. coli			Enterococci		
			Min	Max	Mean	Min	Max	Mean
VE	Velipoja	Water	5	180	53.6	3	120.0	44.0
		Sand	10	136	61.0	3	306	70.8
SH	Shëngjini	Water	7	420	144.3	5	280	109.8
		Sand	6	730	151.3	2	508	159.4
DR	Durrës	Water	6	2520	143.6	3	1890	96.5
		Sand	6	569	58.1	8	625	69.3
LA	Lalzi	Water	1	110	25.8	0	82	19.4
		Sand	10	508	49.8	18	80	36.5
KA	Kavaja	Water	15	2300	388.9	12	1300	196.6
		Sand	5	2250	318.8	1	2400	269.9
VL	Vlora	Water	20	1360	311.0	8	1260	283.7
		Sand	21	1840	598.9	32	1862	642.1

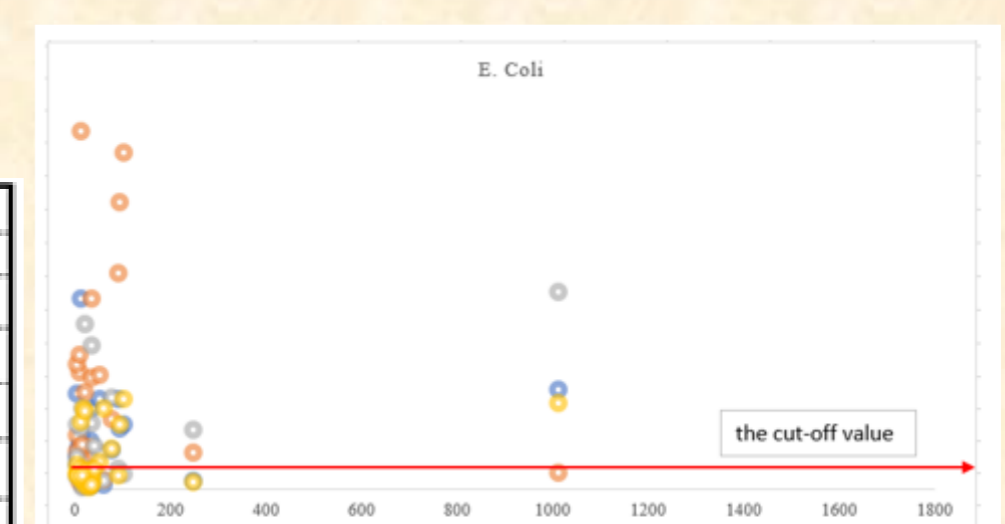*Tabele 1. Min, Max and Mean value for E. coli and Enterococci*

Fig. 2 Cut-off for E. coli

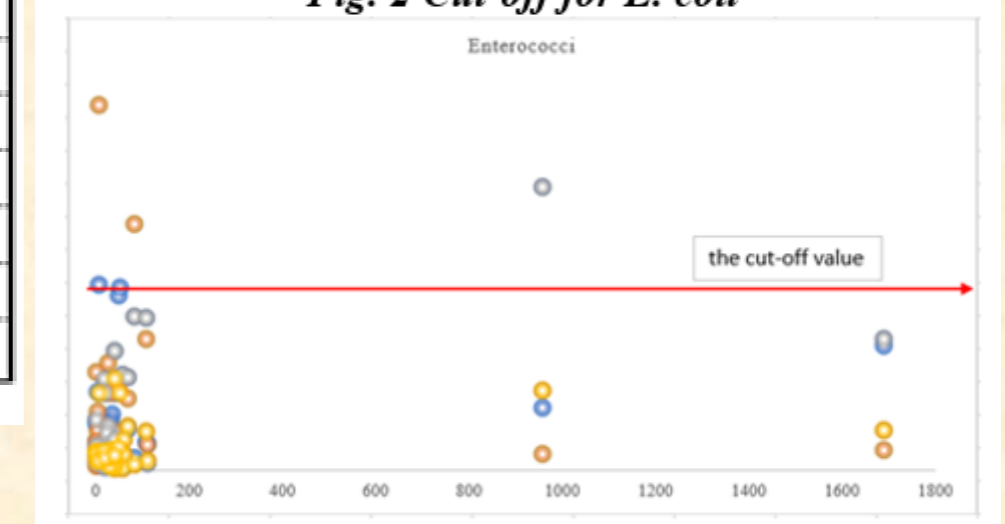*Fig. 3 Cut-off for Enterococci*

CONCLUSIONS

Microbiological contamination of bathing waters with the presence of E. coli and Enterococci microorganisms was found in all sampling stations, with the exception of only 2 (two) sampling stations in Lalzi Bay (May 2023). For the assessment of the quality of the sand, microbiological contamination was found with the presence of two microorganisms, E. coli and Enterococci, in all sampling stations, but higher contamination was found in the beach of Kavaja and Vlora.
In bathing waters the highest microbiological contamination was determined by the presence of the microorganism E. coli, which is associated with high human fecal contamination, while in the sand by the presence of the microorganism Enterococci which is related to a potential fecal contamination from animals. The high presence of these microorganisms can increase the risk of public health infections. Throughout the monitoring period, the pH values range from 7 to 7.5 pH units, while the T values range from 19 to 30°C (variable values depending on the month of monitoring).
Referring to the Guidelines for the Quality of Recreational Water according to WHO (2021) and the European Directive for Bathing Water, was found a high percentage of sand samples above the cut-off value for both microorganisms (E. coli and Enterococci). Furthermore, ANOVA study has shown that there are significant differences between bacteria and the various groups considered in the factors studied. Thus, it can be observed that the beaches Velipoja, Shëngjini, Lalzi Bay and Kavaja have a significant differences between month of monitoring and E. coli, while the Kavaja Beach and Lalzi Bay with Enterococi and month of monitoring. Sampling stations and E. coli in Velipoja, Durrësi and Kavaja Beach, and Enterococci in Velipoja and Durrësi Beach.
It is also noted that was found a significant differences between month of monitoring and bothmicroorganism measured in sand in Velipoja, Shëngjini and Kavaja beach, while Enterococci also in Lalzi Bay. A significant differences between sampling stations and both microorganism in Durrësi Beach.

REFERENCES

•Bergamasco, A., Nguyen, H.Q., Caruso, G., Xing, Q., Carol, E. 2021. Advances in Water Quality Monitoring and Assessment in Marine and Coastal Regions. Water, 13, 1926. https://doi.org/ 10.3390/w13141926.
•Botturi, A.; GozdeOzbayram, E.; Tondera, K.; Gilbert, N.I.; Rouault, P.; Caradot, N.; Gutierrez, O.; Daneshgar, S.; Frison, N.; Akyol, C.; et al. Combined sewer overflows: A critical review on best practice and innovative solutions to mitigate impacts on environment and human health. Crit. Rev. Environ. Sci. Technol. 2020, 1–34.
•Campisano, A.; Ple, J.C.; Muschalla, D.; Pleau, M.; Vanrolleghem, P. Potential and limitations of modern equipment for real time control of urban wastewater systems. Urban Water J. 2013, 10, 300–311.
•Chiswell, B. 1996.Review of aquatic monitoring program design. Water Res., 30(9): 1935-1948.
•European Commission. Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC. Off. J. Eur. Union 2006, L64, 37–51.
•Mongruel, R.; Vanhoutte-Brunier, A.; Fiandrino, A.; Valette, F.; Ballè-Béganton, J.; Pérez Agúndez, J.A.; Gallai, N.; Derolez, V.; Roussel, S.; Lample, M.; et al. Why, how, and how far should microbiological contamination in a coastal zone be mitigated? An application of the systems approach to the Thau lagoon (France). J. Environ. Manag. 2013, 118, 55–71.
•Mancini, L., Marcheggiani, S., Cara, E. 2006. Rischio microbiologico e qualità delle sabbie marine costiere: due campagne di monitoraggio a confront. Rapporti ISTISAN 06/31.
•Petri, O., Ulqinaku, D., Kika, B., Abazaj, E. 2022. Trends of recreational water quality in Albania's coastal during 2016–2020, Journal of Environmental Science and Health, Part A, 57:4, 327-334, https://doi.org/ 10.1080/10934529.2022.2075653.
•Schares, G.; Pantchev, N.; Barutzki, D.; Heydorn, A.; Bauer, C.; Conraths, F. Oocysts of Neospora caninum, Hammondia heydorni, Toxoplasma gondii and Hammondia hammondi in faeces collected from dogs in Germany. Int. J. Parasitol. 2005, 35, 1525–1537.
•WHO, 2021: Guidelines nn Recreational Water Quality — Volume 1: coastal and fresh waters ISBN 978-92-4-003130-2 World Health Organization 2021.