Evaluation of seawater quality of Vlora bay, Albania

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Abstract- Introduction: Swimming in waters with high levels of fecal contamination increases the chance of developing illness (fever, nausea or stomach cramps) from pathogens entering the body through the mouth, nose, ears, or cuts in the skin. For this reason estimation of microbiological water quality is very important for public health. The aim of this study is to determine the hygienic quality of coastal waters in Vlora seacoast. Settings and Design: Is performed, a bacteriological and a chemical study from March to September for two consecutive years on Vlora bay. Water samples were taken from 7 stations evenly distributed on this coast line. Methods and Material: Total coliform, fecal coliform and fecal streptococci were estimated using MPN method, while environmental parameters like temperature, pH, ammonia, phosphate, nitrite and nitrate where estimated using standard methods. The Most Probable Number (MPN) method is a statistical, multi-step assay consisting of presumptive, confirmed and completed phases. In the assay, serial dilutions of a sample are inoculated into broth media. Results: One of the environmental factors that have a strong impact on organisms is temperature. During the investigation period the temperature varied from 11.6°C in March to 23.7°C in summer time. Our data show that during 2016, in general, bacterial indicators were decreased compared to 2015 and August was the month with the highest concentration of fecal bacteria in most of the sampling stations. This month register the highest values of total coliform bacteria for the two years in most of the sampling stations. This could be due to the high number of people visiting the beaches in the coast line during summer time. High concentration of fecal bacteria was associated with high concentration of nitrite and ammonia. Conclusions: The present study indicates that seawater along the Vlora seacoast is under high anthropogenic impact. We observed an improvement in the quality of seawater of Vlora bay. Nevertheless, there is still much work to do in order the water of this area become safe for bathing.

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I. INTRODUCTION

The coastal ecosystems are considered as a major economic asset for Albania, being one of the main driving forces for the development of tourism the control of the environment is done not only to guarantee healthy ecosystems but also to put in evidence if they present any risk for humans [1].

The priority sea water pollution source in Albania is solid waste. There are no sanitary landfills at the coast and the waste is being disposed in dumpsites close to rivers and streams or near the sea. Eventually, much of this waste is washed into Adriatic and Ionian, polluting beaches and the marine environment [2].

Another important pollution source is untreated wastewater discharges that in summer months present health risks for the local population and tourists. The identified priority pollution hotspot sites are Saranda Bay, Karavasta Bay - Fieri area and Vlore Bay. All of these are quickly developing tourist destinations in Albania and the absence of proper solid waste and wastewater management is seriously jeopardizing such prospects [2, 3].

Our study is focused on the seacoast line of Vlora, which is one of the priority pollution hotspot. The aim of the study was monitoring the seawater quality, as well as to evaluate the role of seasonal changes of the environmental parameters, on the dynamic of fecal bacteria indicators. Seawater is the natural environment populated with fish, aquatic insects, and naturally occurring microorganisms such as bacteria and protozoans. While most of these organisms are not so harmful to humans, quantities of pathogenic bacteria might be present at certain times [4].

Evaluation of water quality is performed by measurement of some bio-chemical parameters and concentration of pollution indicators organisms [5]. The bio-chemical parameters analyzed were: temperature, pH, ammonia, phosphate, nitrite and nitrate. Total coliforms, fecal coliforms and fecal streptococci were analyzed as pollution indicator organisms.

Fecal coliform bacteria are microscopic organisms that live in the intestines of warm-blooded animals. They also live in the waste material, or feces, excreted from the intestinal tract. When fecal coliform bacteria are present in high numbers in a water sample, it means that the water has received fecal matter from one source or another. Although not necessarily agents of disease, fecal coliform bacteria may indicate the presence of disease-carrying organisms, which live in the same environment as the fecal coliform bacteria [6].

Coliform bacteria are widely used as indicators of fecal contamination of both fresh and marine waters. Certain members of the coliform group live outside of the gastrointestinal tract in the environment and may create a false indication of fecal contamination [7]. A more specific indicator of fecal contamination is Escherichia coli. These organisms may be separated from the total coliform group by their ability to grow at elevated temperatures and are associated only with the fecal material of warm-blooded animals.

Coliforms were easy to detect, their association with fecal contamination was questionable because some coliforms are found naturally in environmental samples [8, 9]. This led to the introduction of the fecal coliforms as an indicator of contamination. The fecal coliform group consists mostly of *E. coli* but some other enteric such as *Klebsiella* can also ferment lactose at these temperatures and therefore, be considered as fecal coliforms [10, 11]. The inclusion of *Klebsiella spp* in the working definition of fecal coliforms diminished the correlation of this group with fecal contamination. As a result, *E. coli* has reemerged as an indicator, partly facilitated by the introduction of newer methods that can rapidly identify *E. coli*.

Currently, all 3 groups are used as indicators but in different applications. Detection of coliforms is used as an indicator of sanitary quality of water or as a general indicator of sanitary condition in the food-processing environment¹². Fecal coliforms remain the standard indicator of choice for shellfish and shellfish harvest waters; and *E. coli* is used to indicate recent fecal contamination or unsanitary processing. Almost all the methods used to detect *E. coli*, total coliforms or fecal coliforms are enumeration methods that are based on lactose fermentation [13]. The Most Probable Number (MPN) method is a statistical, multi-step assay consisting of presumptive, confirmed and completed phases. In the assay, serial dilutions of a sample are inoculated into broth media.

Swimming in waters with high levels of fecal contamination increases the chance of developing illness (fever, nausea or stomach cramps) from pathogens entering the body through the mouth, nose, ears, or cuts in the skin. Diseases and illnesses that can be contracted in water with high fecal coliform counts include typhoid fever, hepatitis, gastroenteritis, dysentery and ear infections [14]. For this reason estimation of microbiological water quality is very important for public health. Normally beaches where swimming is allowed should be tested for water quality before the swimming season begins, to get a baseline of contamination due to natural wildlife or run-off and each week thereafter until the area closes [14].

II. MATERIAL AND METHODS

Bacteriological and chemical study was carried out by us from March to September for 2 consecutive years (2015-2016) on the seacoast of Vlora.

The seawater samples were taken bimonthly from 7 stations: (Plazhi i vjetër, Triporti, Kompleksi Marina, Vefa, Plazhi i ri, Kala and Jonufër) evenly distributed on this coast line.

Total coliforms fecal, fecal coliforms and fecal streptococci were estimated using MPN method [15-17], while environmental parameters like temperature, pH, ammonia, phosphate, nitrite and nitrate where estimated using standard methods [18]. In this paper we will present only a part of these parameters.

MPN for total coliforms fecal, fecal coliforms was determined by fermentation test on lactose broth for preliminary test, and on brilliant green bile confirmatory test. While MPN for fecal streptococcus was determined by fermentation test on azid dextrose broth for preliminary test and TTC agar for confirmatory test [18, 19].

III. RESULTS AND DISCUSSION

The region under our study was the seacoast of Vlora as one of the most visited beaches in Albania and in the same time one of the identified pollution hotspot sites. The objective of our study was monitoring the seawater quality, as well as to evaluate the role of seasonal changes of the environmental parameters, on the dynamic of fecal bacteria indicators.

The number and the type of bacterial populations in an aquatic community are determined in part by the physical and chemical properties of the water body [20]. One of the environmental factors that have a strong impact on organisms is temperature. During the investigation period the temperature varied from 11.6° C in March to 23.7° C in summer time (Fig. 1). Temperature changes were a result of climatic conditions and season.



Fig. 1. Temperature changes in the seawater of Vlora bay.

Coliform bacteria are widely used as indicators of fecal contamination of both fresh and marine waters.

In our study we used two parameters for fecal contamination: concentration of total coliform bacteria and the presence of *Streptococcus fecalis*. In Fig. 2 are presented seasonal changes of the total coliform concentrations, measured with MPN method. During 2015 the highest number of total coliform bacteria was registered in June and in July.



Fig. 2. Dynamics of total coliform bacteria during the investigation period

This result is common for the season because of the high temperature of water, as well as in some stations a source of seawater pollution, is inflow from untreated wastewater discharges in the sea.



Fig. 3. Dynamics of water quality parameters during March – September 2015

Our data show that in general the number of total coliform bacteria was lower during investigation period of 2016 compared with 2015, except August. This month register the highest values of total coliform bacteria for the two years in most of the sampling stations. This could be due to the high number of people visiting the beaches in this coast line during summer time.

High concentration of fecal bacteria were associated with high temperature [21]. Comparison of these parameters is very important in determination of water quality (Fig. 3 and 4).

The presented data confirm the known ecological phenomena consisting in the cooperation of biotic and abiotic factors of the environment influencing the life, dynamics and distribution of microorganisms in the waters [22-24].

The presence of fecal streptococci was another parameter for determination of fecal pollution of seawater [24-26].



Fig. 4. Dynamics of water quality parameters during March – September 2016

The presence of these bacteria in water could be of human or animal origin. In our study we made a qualitative estimation and not a quantitative one, for these bacteria in seawater (Fig. 5).



Fig. 5. Percentage of sampling stations where fecal streptococci were present

During 2016 investigation period, we observed an increase in the number of sampling stations where fecal streptococci were present.

IV. CONCLUSIONS

The present study indicates that seawater along the Vlora seacoast is under high anthropogenic impact. Waste water from the settlements located in the watershed, especially on the shore, have distinct human impact on the water quality. Apart from this, we observed an improvement in the quality of seawater in Vlora. If this is a tendency, is very important for the people that visit this area during summer time. Nevertheless, there is still mach work to do in order the water of this area become safe for bathing.

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