RESEARCH ARTICLE (Open Access)

Monitoring of Microbiological Parameters on the Coast of Durres, Albania

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Abstract

The microbial water quality of coastal beaches located in Durres, were monitored from January to December 2014 - 2015. Water samples were taken from 18 stations eventually distributed on this coast line. Fecal *coliform* and *E. coli* was estimated using standard *Coliform* MPN test. This test for fecal coliforms was determined by fermentation test on lactose broth for preliminary test, and on brilliant green bile confirmatory test. *E. coli* and fecal *coliforms* counts, showed a seasonal dependence, with highest values in summer and autumn suggesting a negative relationship with rainfall and a positive relationship with temperature. This could be due to the high number of people visiting the beaches in the coast line during summer time. Out of the 18 stations monitored only three showed the poorest water quality so the highest level of coliform and *E. coli*. The poorest water quality is especially in the urban discharged points and in the areas close to them.

Keywords: *E. coli, f*ecal *coliforms*, monitoring; microbial indicators, water quality.

1. Introduction

Albanian coastal waters are widely used for a range of recreational activities, such as bathing, sailing, boating, etc. Maintaining and protecting the quality of this recreational water is therefore an important environmental health and resource management issue. All the guidelines for assessing the public health risk of using recreational waters have been largely based on microbiological fecal indicator counts.

In very functional bays (such as Durrës bay) the pollution problem becomes even more worrying because, for different reasons, are requested also the physical, chemical and biological parameters standards of the waters [28, 38]. Durres bay is located near urban areas and some beaches are located near stream discharges. Based on this we may say that in the Durrës bay are identified these sources of the pollution, from: the portal activity, that even though completed with an aquarium, has a relation with the beach as a whole, due to the mixture of the water column by contributing mainly in pollution with heavy metals and hydrocarbons the beach through sewage waters, diffused and also point ones agriculture activities/livestock that are particularly exercised in the lowland area of Kavaja [36].

Coastal marine environments are highly vulnerable to anthropogenic pollution from municipal sewage, industrial effluents as well as agriculture run-off and river discharges [23, 27, 45]. Fecal contamination not only impairs water quality but also potentiates human health risks [12, 25]. In urbanized areas, possibly sources of fecal pollution can include deficient sewage treatment and leaks due to wastewater treatment plant outflows [30, 40, 45]. Many coastal beaches are located near urban areas, others near river discharges, with input from agricultural and industrial wastes, so that potential risks of contamination may exist, whenever sewage treatment is not effective [9, 27]. Therefore regular monitoring of the quality of coastal waters has been suggested [34, 42], employing different sampling strategies, according to the specific characteristics of the recreational area in terms of physical-chemical and microbiological parameters [6, 10].

The fecal pollution of coastal environments may involve health risks leading to human exposure to pathogenic organisms, such as protozoa, bacteria and virus [3, 15, 23, 41]. The health risk of infectious diseases transmitted by water can be measured by detection the universal microorganisms indicators of fecal contamination, the coliforms bacteria and fecal streptococci [3].These indicators provide information about fecal discharges that may affect the local biota and water use [24].

Water contaminated by human or animal excreta may contain a range of pathogenic (disease-causing) micro-organisms, such as viruses, bacteria and protozoa. These organisms may pose a health hazard when the water is used for recreational activities such as swimming and other high-contact water sports. In these activities there is a reasonable risk that water will be swallowed, inhaled [16], or come in contact with ears, nasal passages, mucous membranes or cuts in the skin, allowing pathogens to enter the body.

Indicator bacteria, including total coliform (TC), fecal coliform (FC) and fecal streptococci (FS), have been used and accepted in water quality studies to assess the level of fecal contamination in water bodies [13]. The presence of these organisms has also been used to estimate the potential human health risks of other pathogenic organisms of fecal origin.

The term "coliform" was coined to describe this group of enteric bacteria. Coliform is not a taxonomic classification but rather a working definition used to describe a group of Gram-negative, facultative anaerobic rod-shaped bacteria that ferments lactose to produce acid and gas within 48 h at 35°C. In 1914, the U.S. Public Health Service adopted the enumeration of coliforms as a more convenient standard of sanitary significance.

A number of studies demonstrated that Enterococci were the group with higher resistance to environmental stress [29, 31, 32, 37, 43]. They may therefore be more suitable as indicators of fecal contamination due to their higher survival in water and their inability of multiplying in polluted waters [22].

Coliforms were easy to detect, their association with fecal contamination was questionable because some coliforms are found naturally in environmental samples [2, 14]. 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 [8, 17]. 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.*

2. Material and Methods

2.2 Location of sampling points

Bacteriological study was carried out by us from January to December for two consecutive years (2014-2015) on the seacoast of Durres. The seawater samples were taken bimonthly from 18 stations: Currila beach 1, Currila beach 2, Aragosta, Castle, Kok’s plaza, Vollga, Dajlani bridge, Red wheel, Teuta beach, Apollonia beach, Hekurudha beach, Adriatik beach Iliria’ plaza (small), Iliria’ plaza (big), Plepa, After Plepa stream, Bleart beach and Benilva beach, evenly distributed on this coast line.

2.3 Sampling methods for microbiological analysis

All samples were taken 30 centimeters under the water surface and in waters which are not less than 1 meter deep. The bottles/containers which were used for the bathing waters sample taking, before their usage they were sterilized in autoclave not less than 15 minutes in 121°C.

Each sample was collected in bottle with the cap securely tightened. After collection, the samples were immediately placed in ice coolers for transportation to the laboratory where they were then transferred to the refrigerator. Laboratory analyses commenced the same day and within 30 min of arrival at the laboratory in every case.

2.4 Methods for bacteriological analyses

Almost all the methods used to detect *E. coli*, total coliforms or fecal coliforms are enumeration methods that are based on lactose fermentation [1]. Total *coliform* fecal, fecal *coliform* and *E. coli* were estimated using *Coliform* MPN method [4, 19, 20, 33, 44]. The Most Probable Number (MPN) method is a statistical, multi-step assay consisting of presumptive, confirmed and completed phases. This test for fecal coliforms was determined by fermentation test on lactose broth for preliminary test, and on brilliant green bile confirmatory test.

3. Results and discussion

The region under our study was the seacoast of Durres as one of the most visited beaches in Albania and in the same time one of the identified pollution hotspot sites. The aim 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.

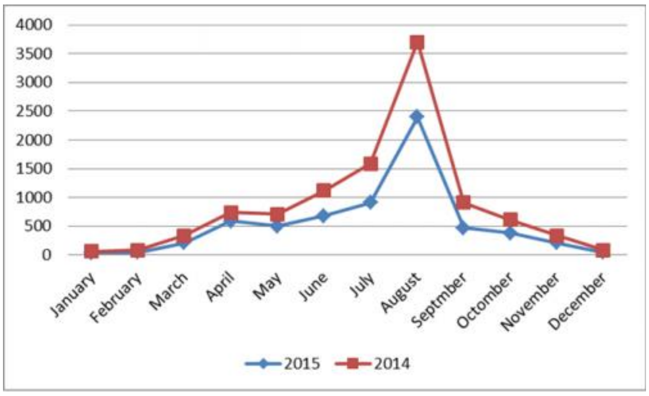

Figure 1. Dynamics of total coliform bacteria during the investigation period

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 *E. coli*. In Fig. 1 are presented seasonal changes of the total coliform concentrations, measured with MPN method. During 2014 - 2015 the highest number of total coliform bacteria was registered in June, July and especially in August.

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.

Our data show that in general the number of total coliform bacteria was lower during investigation period of 2015 compared with 2014, 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.

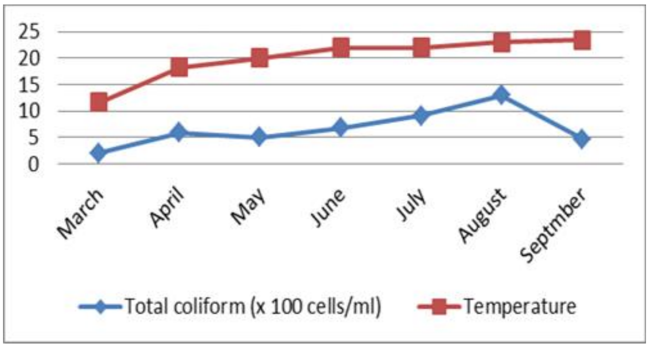

Figure 2. Dynamics of water quality parameters during March – September

High concentration of fecal bacteria were associated with high temperature [11]. Comparison of these parameters is very important in determination of water quality. As we know the temperature is higher in the summer time compared with the other seasons as shown in figure 2. 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 [18, 21, 39].

The hygiene-sanitary evaluation of Durres bay during the touristic season in 2014 and 2015 is presented in figure 3 and 4. Regarding the presence of total *coliform* we can say that during the year 2015 we may see an improvement of the bathing waters quality status along the Durres bay.

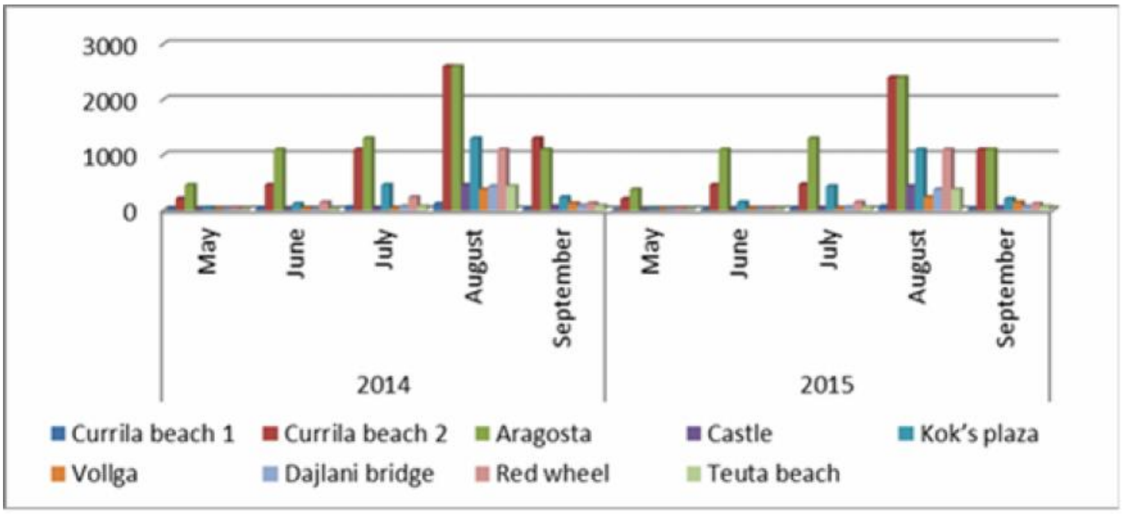

Figure 3. Dynamics of water quality parameters during May – September in first nine sampling stations.

Where only 3 points out of 18 monitored results showed the poorest water quality so the highest level of coliform and where it is categorically prohibited people bathing.

The three monitored points are Currila beach 2, Aragosta, After Plepa stream. The highest level of coliform in Currila beach 2 and also in Aragosta can be due to the fact that these beaches are overcrowded with visiting people in the touristic season. Also in these beaches there are a considerate number of social services that work almost in the summer time. So we may say that urban liquid discharged in the coastal bathing waters by the social services subjects that operate in these touristic areas is still a problem.

After Plepa stream is a particular area where it is discharged the high altitude waters stream of Shkallnuri. This stream collects not only the urban waters but also other high altitude waters. This area of the beach is still not connected with sewerage system and also with the pumping station. Except this, along the beach of Benilva beach was found a sewerage stream which passed across the grass and discharged in the sea.

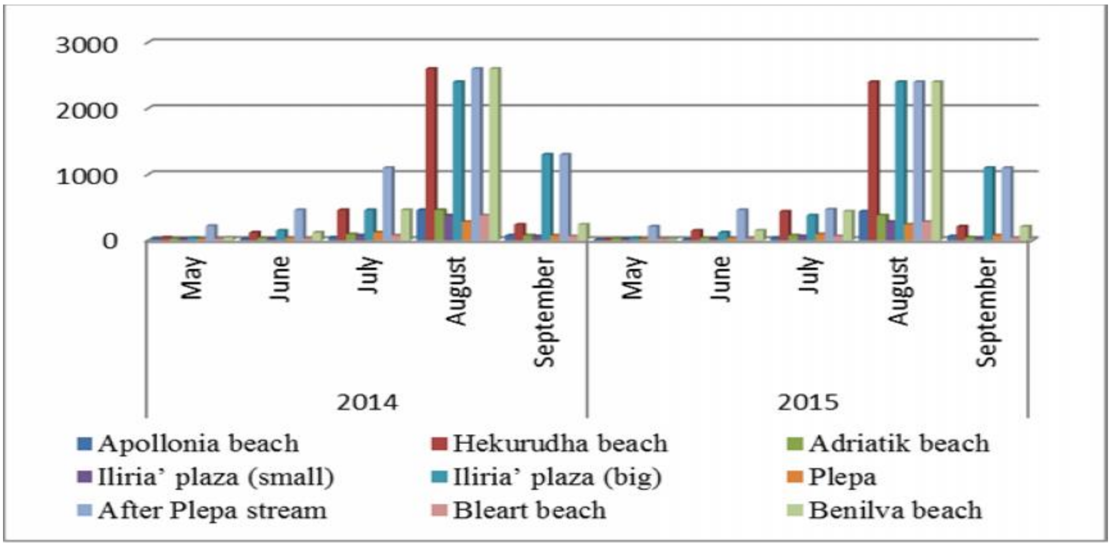

Figure 4. Dynamics of water quality parameters during May – September in second nine sampling stations.

Four out of 18 sampling stations have a “not good” status during the study period. These monitored points are: Kok’s plaza, Hekurudha beach, Iliria’ plaza (big), and Benilva beach. The remaining sampling stations have a very good or a good status.

An increased risk for the transmission of waterborne diseases may exist in waters with high levels of indicator bacteria, which are associated with fecal contamination [5, 7, 26, 35]. Our results showed that the levels of indicator bacteria in the recreational waters sampled were highly variable between beaches and with the time of the year (figure 1 - 4).

4. Conclusions

The present study indicates that seawater along the Durres seacoast is under high anthropogenic impact. Urban discharges continue to be discharged into the sea, without being treated, causing a considerable microbiological pollution.

In conclusion comparing our data for the years taken in analyze for hygiene-sanitary evaluation we may say that in 2015 are being made notable improvements in the water disciplining of urban discharges in the sea, but still is not enough.

We observe is a growing public awareness for cleaning time after time the beaches and the most important maintaining them clean. If this is a tendency, it should be preserved in time. This 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 3 points that showed the poorest water quality become safe for bathing. Despite this we can say that in Durres bay there are many beaches very safe for bathing, makeing it very good attraction during summer.

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