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Variation of Microbial Pollution in Water of Vjosa And Drino Rivers

Biology

KEYWORDS : water pollution, urban discharges, microbial pathogens

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ABSTRACT

Rivers are important sources of surface waters in Albania. Monitoring and evaluation of environmental conditions of rivers is an indispensable need for determining the quality of aquatic ecosystems. This study is carrying out to monitor the seasonal variation of microbial pollution of Vjosa and Drino rivers based on microbiological indicators. Samples of water are collected every season from Summer 2012 till Autumn 2013 in five stations along these rivers. MPN index is used for evaluation of Fecal Coliforms and Fecal Streptococci. The levels of contamination of water with FC and FS bacteria near urban areas are 4 to 5 times higher than the allowed levels by EU and Albanian legislation. A seasonal change is observed in bacterial parameters. The human impact in the water quality of these rivers is more than evident, because the urban discharges flow directly into them without any previous treatment.

INTRODUCTION

Rivers are important sources of surface waters in Albania. Rapid industrial development, uncontrolled urban and rural movements are associated with negative effects on the quality of rivers water. Monitoring and evaluation of environmental conditions of rivers is an indispensable need for determining the quality of aquatic ecosystems.

Vjosa and Drino like many other rivers in Albania are exposed to anthropogenic contaminants from various sources. Untreated industrial and urban discharges, untreated wastewater, agricultural runoff, solid waste, gravel excavation, deforestation, domestic sewers and many other sources have significant effects on the water quality of these rivers.

Vjosa and Drino are two main rivers located in southern part of Albania and they are shared between Albania and Greece. Drino river flows into the Vjosa river near the town of Tepelena and they come together into the Adriatic sea.

The objective of this study is to monitor the variation of microbial pollution of Vjosa and Drino rivers, based on microbiological indicators and to evaluate the role of seasonal changes of environmental parameters, and human impact on these indicators (Reiss & Chapman, 2000).

Since the FC and FS are the better indicators of microbial contamination in water, we analyzed their presence in Vjosa and Drino rivers. The water quality of rivers depends on the substances and microbial organisms in it. If they are found in large quantities, they affect negatively not only in the community and in the environmental health, but also in the population health (Puto et al., 2012). The purpose of monitoring is not only knowledge about the situation, but also how to improve it and how to protect it as a part of a series of life activities that are performed around the rivers, as irreplaceable sources of life for the present and the future.

MATERIAL AND METHODS

The microbiological examination of water samples collected from five stations were performed in 6 seasons: from Summer 2012 till Autumn 2013, in the Laboratory of Biotechnology Department, FNS, University of Tirana, Albania.

The selection of sampling stations was based on the monitoring scheme of liquid discharges.

St1 - Pacarela - *Drino river* - after the industrial waste discharges of leather shoe factory.

St2 - River Bridge - *Drino river* - after the discharge of urban pollution in Gjirokastra city.

St3 - Virua – *tributary of Drino river*, after the urban discharges and untreated wastewater of different restaurants in this area.

St4 - Kelcyra - *Vjosa river* - after the discharge of urban pollution in Kelcyra city.

St5 - Tepelena - *Drino & Vjosa rivers* - at their intersection in Tepelena city.

Figure 1 shows the position of these stations along Drino and Vjosa rivers.

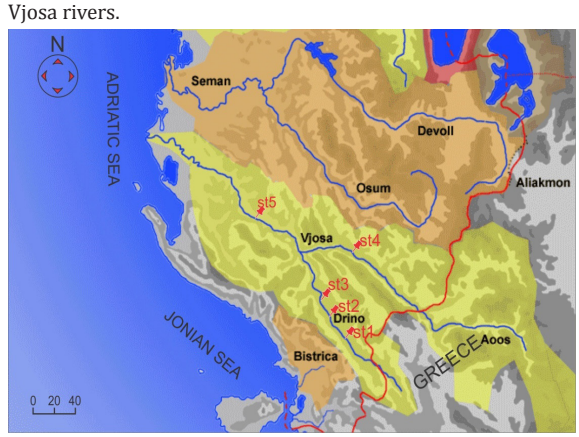

Figure 1: The sampling stations along Drino and Vjosa rivers

The microbiological examinations of water samples were made to monitor the seasonal variations of Faecal Coliforms (FC) and Faecal Streptococci (FS) in these rivers.

The samples taken and the examinations used to determine these variations were done according to the European and World Standard Methods. Sample bottles were sterilized in an autoclave for 20 minutes at 121^{0}C (Borrell Fontelles & Winkler, 2006). The quantity of water was 500 ml. Our water samples were brought to the laboratory while maintained in refrigerated conditions at 4^{0}C. Two analyses for FC and FS were performed for each sample of water within 24 hours. Multiple tube fermentation technique was used and the table Most Probable Number (MPN) index served for the determination of the number of bacterial cells.

FC were determined by inoculating 1ml, 0.1ml, 0.01ml, etc. (up to 6 dilutions) of the water, first in **LSB** *(Lauryl pepto broth)* preliminary test, at 35^{0}C for 24 - 48 hours and then in **ECB** *(EC broth),* conformation test, at 44.5 ^{0}C for 24 hours. Positive reaction is indicated by turbidity and gas presence in the Durham pipes.

FS were determined by inoculating 1ml, 0.1ml, 0.01ml, etc. (up to 6 dilutions) of the water, first in ADB *(Azide Dextrose Broth)*, preliminary test, at 35^{0}C for 24-48 hours and then in **EVAB** *(Ethyl Violet Azide Broth),* conformation test, at 35^{0}C for 24 hours. The presence of a purple colored precipitate at the bottom of the test tube indicates the presence of FS.

RESULTS AND DISCUSSIONS

There were analyzed in total 60 water samples from 5 sampling stations in 6 seasons:

30 water samples for FC

30 water samples for FS

The variation of FC and FS in water samples of Drino and Vjosa rivers in the seasons under study is shown respectively in Tables 1 & 2.

River Bridge station in Drino River is more polluted than other two monitored stations, but the other two are polluted as well. The pollution indicator (FC) in River Bridge station varies from 4.3x10^4 bacteria/100 ml (summer 2012) to 1.2 x 10^7 bacteria/100ml (summer 2013).

Tepelena station in Vjosa river is, in general, more polluted than Kelcyra station. Indicator of pollution (FC) in Tepelena station varies from 7500 bacteria/100ml (spring 2013) to 2.3 x 10^5 bacteria /100 ml (summer 2013).

Table 1: Feacal Coliforms, MPN/100ml/thousand

Year		2012			2013	
Season	Summer	Autumn	Winter	Spring	Summer	Autumn
PACARELA	75	93	46	460	460	93
RIVER BRIDGE	43	1500	1500	9300	12000	750
VIRUA	1.5	4.6	1.5	0.75	75	24
KELCYRA	1.5	460	93	2.1	93	11
TEPELENA	15	46	150	7.5	230	93

The most polluted station in Drino River for FS is again River Bridge station with the value of MPN from 430 bacteria/100ml (summer 2012) to 2.3 x 10^4 bacteria/100ml (summer 2013).

Table 2: Feacal Streptococci, MPN/100ml/thousand

Year		2012			2013	
Season	Summer	Autumn	Winter	Spring	Summer	Autumn
PACARELA	4.3	6.5	7.5	9.3	12	4.3
RIVER BRIDGE	0.43	15	15	6.4	23	7.5
VIRUA	0.09	0.24	0.23	0.43	2.3	0.43
KELCYRA	0.43	1.5	1.5	0.23	7.5	2.3
TEPELENA	4.3	7.5	1.5	0.75	9.3	4.3

In Figures 4 & 5 we can show clearly the variation in time and level of pollution with FC and FS in Drino and Vjosa Rivers.

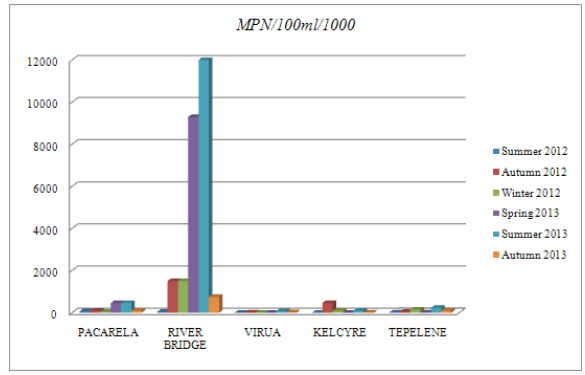

Figure 2: Drino & Vjosa River, *Faecal Coliforms*, variation in time

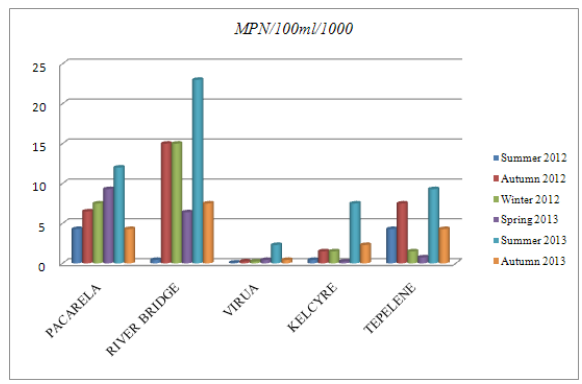

Figure 3: Drino & Vjosa River, *Faecal Streptococci*, variation in time

River Bridge is the most polluted station along the Drino river due to the urban discharges from the town of Gjirokastra and the highest water temperature compared with the other stations (Table 3). The temperature of the water in Drino river upstream (Pacarela & River Bridge station) is higher than in its downstream (Virua station). This is because of the fact that some natural water resources flow directly into the Drino River such as Viroi, Kardhiqi, Uji i Ftohte Tepelene etc.

The water in Tepelena station is more polluted than in Kelcyra station due to the urban discharges from the town of Tepelena. Also, in this station Drino and Vjosa rivers come together and flow into the Adriatic sea. The temperature of the water in Kelcyra station is lower than in Tepelena one, because of various downloadable spills along Vjosa river in this station (table 3).

Table 3: Water temperatures (t^{0}C) in 5 stations for the seasons under the study

Year		2012			2013	
Season	Summer	Autumn	Winter	Spring	Summer	Autumn
PACARELA	26	20	11	16	25.5	21
RIVER BRIDGE	26	20	13	16.5	27	22
VIRUA	26	19	11.5	13.5	24	18.5
KELCYRA	24	18	11	9	25	19
TEPELENA	25	18	12	12	26.5	21

There are many environmental factors that influence the presence of fecal bacteria in water, and one of them is the air temperature. The highest values of FC and FS in both rivers are registered in summer 2013 in River Bridge station in Drino river, which in our opinion could be due to higher temperatures during this season. On the other hand, we observe an increase of bacterial load in winter 2012, despite the low temperatures.

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These apparently abnormal values for the season could be due to heavy rain conditions, which can result in great amounts of fecal pollution flowing downstream from sewage discharge points.

The level of contamination in both rivers is very problematic and shows that the waters discharging into them are not managed.

CONCLUSIONS

Referring the standards of UNEP (1996)/WHO (2012) and Directive 2006/7/EC concerning the management of recreational water quality, the present results are 4 to 5 times higher than the allowed levels, until 1.2 x 10^7 FC/100ml and 2.3 x 10^4FS/100ml in Drino River, 4.6 x 10^5 FC/100 ml and 9300 FS/100ml in Vjosa River. Drino River is more polluted than Vjosa River, but both of them are highly polluted as well.

The highest values of FC and FS are registered in warmest seasons, or in the other seasons after heavy rains.

According to common water quality standards a level over 2000 bacteria/100 ml of water indicates that swimming may be unsafe and in this contest the water of Drino and Vjosa rivers is unsafe for swimming, fishing, irrigation etc.

The human impact in the water quality of Vjosa and Drino rivers is more than evident, because the urban discharges flow directly into the river without any previous treatment.

The lack of the water management and wastewater system is the main cause of the microbial pollution to these rivers.

In these circumstances, it is strong recommended to begin as soon as possible the treatment of urban wastewater before discharging into the rivers.

Also, it is necessary the public health surveillance for infectious diseases from pathogen microorganisms in pollution water.

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