Impact of urban wastewater discharges on the microbiological pollution of rivers debouching into the Adriatic Sea

Rustem Zenelaj
Institute of Biological Research, Tirana, Albania

Figali Hila
Institute of Environment, Tirana, Albania

Abstract

In this paper are represented some results of microbiological pollution of Albanian rivers that run off into the Adriatic Sea. Microbiological examination of water samples collected from 16 stations of 7 rivers in four seasons of the year before and after urban discharges indicates that river waters before urban discharges are generally pure from point of view of microbiological pollution, while after urban wastewater discharges the number of Feacal Coliforms and Faecal Streptococci is high or very high. This for the reason that urban wastewaters are not treated before discharge. It is strong recommended to begin as soon as possible the disposal and treatment of urban wastewater before discharging to the rivers, lakes, sea etc.

Introduction

The microbiological examination of water is used worldwide to monitor and control the quality and safety of various type of water. Microbiological examination of water samples is usually undertaken to ensure that the water is safe to drink or bathe in [1].

Coliform bacteria, which normally live in the intestines of humans and warm-blooded animals, although were not known to cause any illness, are referred as indicator organisms since a quantity of their presence is used to indicate the potential presence of pathogens in waters [9]. Coliforms get out through the excrements and if do not exist the necessary precautions about the disposal and treatment of the wastewaters, these bacteria pass in the environment or in waters causing their pollution. If the water contains such bacteria over the recommended limits, this indicates the pollution of this water.

The principal indicator of suitability of water for domestic, bathing, industrial or other uses is the presence-absence and number of bacteria like:

- Thermotolerant (Faecal) Coliforms (E. coli), indicators of faecal pollution.

- Faecal Streptococcal group (enterecocci), their presence is the other indicator of faecal pollution [1, 9].

If the Faecal Coliforms in water are over 200 germs/100 ml, there are great probabilities to be present even pathogenic organisms like bacteria, viruses, and parasites etc., which are present with the Faecal Coliforms in the infected persons.

WHO and different countries over the years had introduced various standards and guidelines for surface (bathing, inland) waters, including rivers, some of them have become legally enforceable, while others have been recommended by appropriate bodies and trade associations.

UNEP/WHO has established 100-1000 faecal coliforms per 100ml bathing water [8].

Council Directive of 8 December 1975 of the European Communities (Directive 76/160/EEC) has established microbiological quality for bathing water as follows [2]:

	Microbiological parameters	Guideline level	Alert level
1	*Total coliforms/100 ml*	500	10 000
2	*Faecal coliforms/100 ml*	100	2 000
3	*Faecal streptococci/100ml*	100	-

In the year 2006 The European Parliament and of the Council has adopted the Directive 2006/7/EC of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC. Microbiological standards for inland waters and coastal and transitional waters are as follows [5]:

For inland waters

	Parameter	Excellent quality	Good quality	Sufficient
1	Intestinal enterecocci (cfu/100ml)	200	400	330
2	Escherichia coli (cfu/100ml)	500	1000	900

For coastal and transitional waters

	Parameter	Excellent quality	Good quality	Sufficient
1	Intestinal enterecocci (cfu/100ml)	100	200	185
2	Escherichia coli (cfu/100ml)	250	500	500

Material and methods

Materials: Water samples from rivers Drini, Kiri, Ishmi, Erzeni, Shkumbini, Semani and Gjanica.

Methods: Samples were collected in the same points during all the time of monitoring. The quantity of water was 0.5 liters. Sample bottles are sterilized in an autoclave for 20 minutes at 121°C. [5, 6].

Transport and storage of samples before analysis was carried of in a cool box or refrigerator at a temperature of 4°C ± 3°C. The samples were analyzed on the same working day [5].

Sampling frequency is seasonal, four times a year.

The selection of monitoring stations is based on monitoring scheme of liquid discharges. In that scheme collector is considered the source of pollution to receiving surface waters. The samples are taken at the collector and also in distance 500-1000 m from point of discharge after mixing and dilution with receiving waters.

In order to analyze the impact of urban discharges to receiving waters samples are collected in:

- Water bodies with little or no human impact, which are found in downstream of rivers before entering into the city.
- Water bodies, which are under pressure of urban and industrial liquid discharges and usually are found in populated areas of cities.

For all the samples was checked number of Faecal coliforms and Faecal streptococci. For analysis were used standard methods internationally recognized such Multiple-Tube Fermentation Technique and Membrane Filter Technique [3, 6, 7].

Results

The samples are collected in seven rivers that run off in the Adriatic Sea, in four seasons of the year in two or three stations lengthwise running:

River Drini: Before and after discharge of urban wastewaters of Shkodra city.


Kiri River: Before and after urban wastewaters discharge of city Shkodra.

Ishmi river: Rinas bridge, Gjolës bridge, Ishëm (after urban wastewaters discharge of city Tirana).



Erzeni river: Mullet, (before urban wastewater discharge) and Beshiri bridge, (after urban wastewater discharge).




Shkumbini river: Krasta (before urban wastewater discharge) Toplias and Paper (after urban wastewater discharge)

Semani river: Mbrostar bridge (after urban wastewater discharge)

Gjanica river: After urban wastewater discharge of city Fier

Semani-Gjanica river: Mujalli (after urban wastewater discharge)

Results

Results are represented in tables 1 and 2.

Table 1 - Faecal Coliforms, MPN/100 ml

Nr.	Sampling stations	MPN/100ml			
		15.06.2005	14.09.2005	24.11.2005	12.04.2006
1	Drini river before pollution	230	400	230	2300-2400
2	Drini river after pollution	$1.1x10^7$	430	240	9300
		22.06.2005	21.09.2005	30.11.2005	19.04.2006
3	Mouth of Drini river	$1.5x10^4$	$4.3x10^4$	430	$4.3x10^4$
		15.06.2005	14.09.2005	24.11.2005	12.04.2006
4	Kiri river before pollution	210	400	90	2400
5	Kiri river after pollution	$1.1x10^4$	4300	240	9300
		04.05.2005	27.07.2005	20.10.2005	07.03.2006
6	Ishmi river, Rinas bridge	$1.1x10^4$	$4.6x10^6$	$2.1x10^4$	$9x10^5$
7	Ishmi river, Gjolës bridge	$4.6x10^5$	$2.3x10^5$	$9.3x10^5$	$4.3x10^4$
8	Ishmi river, Ishmi	$2.8x10^4$	$9.3x10^4$	$2.3x10^5$	$9.3x10^5$
		01.06.2005	31.08.2005	02.11.2005	29.03.2006
9	Erzeni river, Mullet	2100	2300	4300	2300
		25.05.2005	20.07.2005	25.10.2005	23.03.2006
10	Erzeni river , Beshiri bridge	$2.1x10^5$	9300	$1.5x10^4$	$2.4x10^5$
		01.06.2005	31.08.2005	02.11.2005	29.03.2006
11	Shkumbini river, Krasta before pollution.	900-930	9300	930	400-430
12	Shkumbini river, Toplias after pollution.	4300	$2.3x10^4$	4300	2300
13	Shkumbini river, Paper	$2.4x10^4$	2300	$9.3x10^4$	$1.5x10^4$
		08.06.2005	07.09.2005	09.11.2005	05.04.2006
14	Semani river, Mbrostari bridge	$2.4x10^5$	$1.1-1.2x10^5$	$3.9x10^4$	$1.5x10^4$
15	Gjanica river after pollution	$1.1x10^4$	$2.4x10^6$	$4.6x10^5$	$7.5x10^4$
16	Gjanica+Semani, Mujalli, after pollution	$9.3x10^4$	$2.1x10^5$	$1.5x10^4$	$9.3x10^4$

Table 2 - Faecal Streptococci, MPN/100ml

Nr.	Sampling stations	MPN/100 ml			
		15.06.2005	14.09.2005	24.11.2005	12.04.2006
1	Drini before pollution	150	90-93	40	430
2	Drini after pollution	$2.4x10^6$	240	900	900-930
	Mouth of Drini	22.06.2005	21.09.2005	30.11.2005	19.04.2006
3		93	$2.4x10^4$	230	9300
		15.06.2005	14.09.2005	24.11.2005	12.04.2006
4	Kiri before pollution	4	40	40-43	230-240
5	Kiri after pollution	4600	930	400	2400
		04.05.2005	27.07.2005	20.10.2005	07.03.2006
6	Ishmi, Rinas bridge	2300	$1.5x10^4$	$1.5x10^5$	$9.3x10^4$
7	Ishmi, Gjolës bridge	930	$2.4x10^4$	$4.3x10^4$	$4x10^4$
8	Ishmi, Ishmi	430	930	2000	$1.1x10^5$
		01.06.2005	31.08.2005	02.11.2005	29.03.2006
9	Erzeni, Mullet	2400	930	2300	2300
	Erzeni, Beshiri bridge	25.05.2005	20.07.2005	25.10.2005	23.03.2006
10		2100	2400	2300	$9.3x10^5$
		01.06.2005	31.08.2005	02.11.2005	29.03.2006
11	Shkumbini, Krasta before pollution.	750	390	230	230
12	Shkumbini, Toplias after pollution.	280	930	210	930
13	Shkumbini, Paper	4600	230	4600	$1.2x10^4$
		08.06.2005	07.09.2005	09.11.2005	05.04.2006
14	Semani, Mbrostari bridge	$2.4x10^4$	$2.3x10^4$	930	4300
15	Gjanica after pollution	$2.4x10^4$	$2.1x10^5$	$4.6x10^5$	$4.6x10^4$
16	Gjanica+Semani, Mujalli, after pollution	9300	$7.5x10^4$	930	2300

Discussions and conclusions

If we present graphically results of tables 1, 2 we can show clearer the variation in time (Fig. 1, 2, 3, 4) and level of pollution (Fig. 1/1, 2/1, 3/1, 4/1) with faecal coliforms and faecal streptococci of waters Drini, Kiri, Erzeni and Shkumbini rivers. Ishmi, Semani and Gjanica rivers have very high level of microbiological pollution in all stations and all periods of analysis (level 104-106 cfu/100ml for faecal coliforms and 103-105 cfu/100ml for faecal streptococci). This happens because the samples are collected after urban waste-waters discharge of city Tirana and Fier.

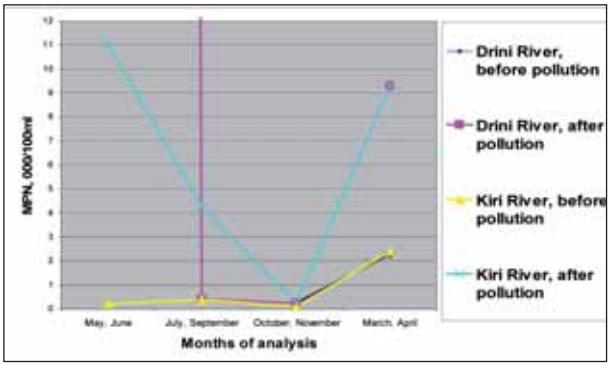

Figure 1 - Faecal Coliforms, Drini and Kiri rivers

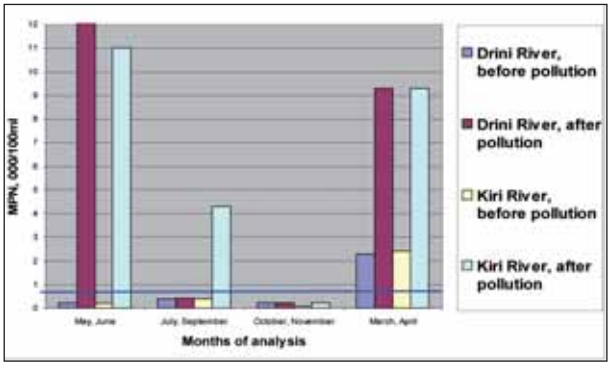

Figure 1/1 - Faecal Coliforms, Drini and Kiri rivers

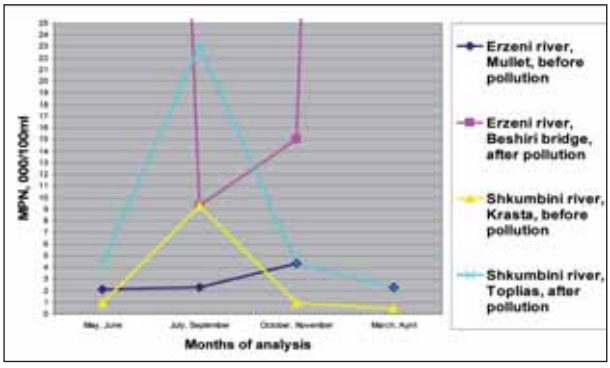

Figure 2 - Faecal Coliforms, Erzeni and Shkumbini rivers

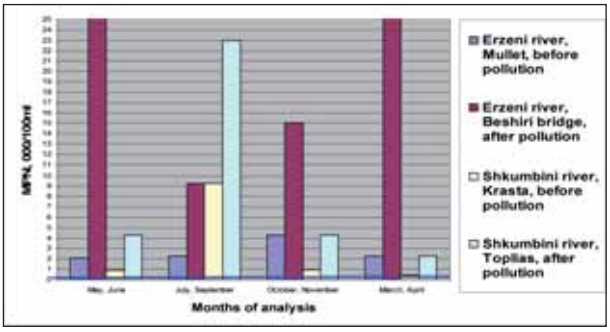

Figure 2 /1 - Faecal Coliforms, Erzeni and Shkumbini rivers

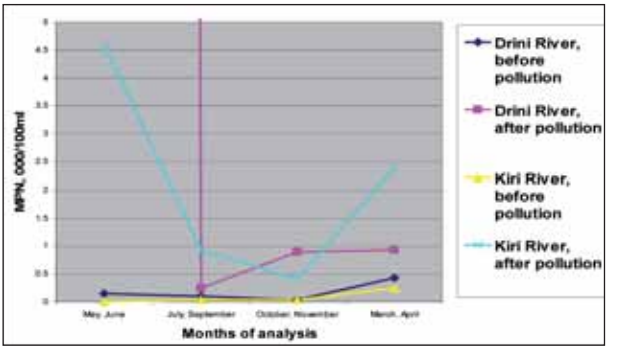

Figure 3 - Faecal streptococci, Drini and Kiri rivers

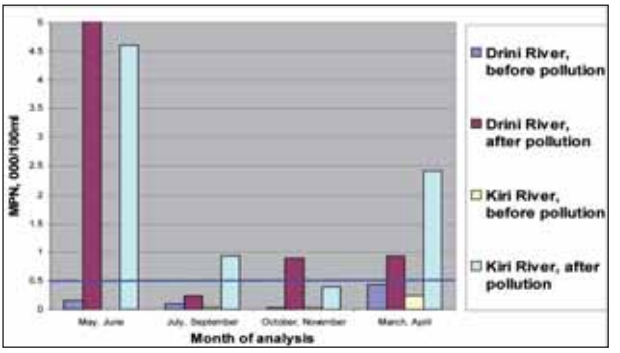

Figure 3/1 - Faecal streptococci, Drini and Kiri rivers

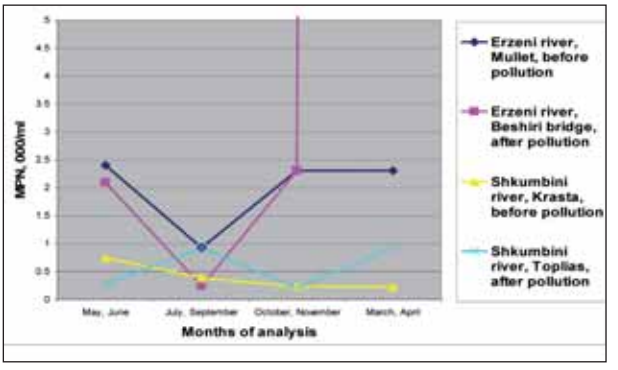

Figure 4 - Faecal streptococci, Erzeni and Shkumbini rivers

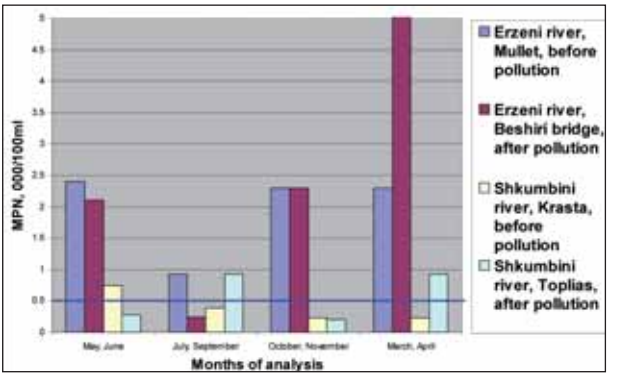

Figure 4/1 - Faecal streptococci, Erzeni and Shkumbini rivers

Drini and Kiri waters (Fig. 1, 1/1, 3, 3/1) before urban wastewater discharge contain 90-400 faecal coliforms per 100ml and 4-150 faecal streptococci per 100ml (within recommended limits). Only in April 2006, the number of faecal coliforms is 2300-2400 cfu/100ml near the imperative level. [2].

Meanwhile after urban wastewater discharge the number of faecal coliforms per 100ml surpasses several times the standards for microbiological quality of bathing waters except September and November (Fig. 1, 1/1). The exception can be explained by large fluxes during this month as a result of precipitations.

Erzeni river, Mullet (Fig. 2, 2/1, 4, 4/1) is not as much polluted, but over the standard limits (2100-4300 faecal coliforms/100ml, and 930-2400 faecal streptococci/100ml), because discharge of rural wastewaters, meanwhile in Beshiri bridge after urban wastewaters discharge, the pollution is very high (level 104-105cfu/100ml for faecal coliforms and 103-105 for faecal streptococci).

Waters in Shkumbini river, Krasta the faecal coliforms are within standards for good bathing quality, except the August, meanwhile in Toplias and Paper after discharge of wastewater of city Elbasan the level of microbiological pollution is much higher than recommended limits (Fig. 2, 2/1). Nearly the same situation is for faecal streptococci except the June (Fig. 4, 4/1).

In conclusion, referring the standards of UNEP/WHO, Directive 76/160/EEC, and Directive 2006/7/EC concerning the management of bathing water quality, waters of rivers of Albania that run off into the Adriatic Sea before wastewater discharge are generally pure from point of view of microbiological pollution, while after urban wastewater discharge are high or very high polluted, except of Drini and Kiri rivers in November.

Referring the seasons (months), with some exceptions, higher pollution is detected in July-August, while lower pollution is detected in October-

November. This is explained by large fluxes during these months as a result of precipitations.
The data of this work show clearly, that urban wastewaters are not treated before discharge.

It is strong recommended to begin as soon as possible the disposal and treatment of urban wastewater before discharging to the rivers, lakes, sea etc.

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