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Variations Of Physical, Chemical And Microbiological Parameters Of Water In Prishtevka River

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***Abstract*—Prishtevka River is left flow of Sitnica River basin. It is located between 21° 03' and 21° 19' longitude and 42° 44' and 42 ° 36' of latitude. It is situated in the northeast and southwest of Prishtina city. Its area is of 97. 3 km^2, catchment area on the left side is 62.1 km^2, while the area to the right side is 35. 20 km^2 and asymmetry coefficient of 0.27. Height average across the catchment of Prishtevka river is 756 m. Prishtevka River Basin in the upper part is characterized by hilly - mountain terrain, while the side stretched towards the city of Prishtina to the estuary of Sitnica river is characterized by fieald terrain. 1.5% of the catchment area is situated at an altitude above 1000 m, 33.9% from 1000 m to 800 m, 20.1% from 800 m to 700 m, 25.2% from 700 m to 600 m, and 19, 2% at an altitude below 600 m [1]. Prishtevka River forms a partly deep ravine in the upper flow. The middle part of the Prishtavka River (down Makovc settlement) to Emshir is covered (into a concrete canal). The lower part of the river from Emshiri to its discharge into the Sitnica River delineates the field area.**

In this part, the river bed has a slight expansion and mild drop downward (approximately 1%). Part of the area from Fushë Kosova up on Prishtina city is not covered by plants. While the part obove Pristina city starting from Makovc and Zllatar village, its basin is covered with vegetation. The climate is continental, annual rainfall average range from 550 mm (the field part) to over 750 mm (the mountain part), the annual temperature average ranges from -1.1°C (January) to 23 °C (August) [2]. Prishtevka River water is facing relatively high contamination by wastewater discharged without prior treatment. Water in the river upstream is mainly good quality, while the pollution in its middle and lower flow sometimes exceeds the permitted requirements.

***Keywords*—Eutrophication, catchment, river, variation, pollution, parameter etc.**

I. INTRODUCTION

Prishtevka River is left flow of Sitnica River basin. It is located between 21 ° 03' and 21° 19' longitude and 42 ° 44' and 42 ° 36' of latitude (Figure 1.).

Surface water pollution is causing a serious problem not only in national level but also beyond. The increasing demand for the use of water for drinking, food preparation, irrigation, industry, etc., on one hand, the lack of infrastructure for collection and treatment of used water on the other hand is highly increasing the water pollution. Prishtevka River flows throughout the Prishtina city. The city of Pristina and some settlements located close to Prishtevka River basin, discharge all wastewater into the river exceedingly contaminating water quality in the river. Increased pollution level of the river water is also enabled by small amount of annual flow average which ranges from 2.53 m^3/s (Maximum) to 0.57 m^3/s (minimum), which principally in summer seasons disables the natural self-cleansing of the water.

Prishtevka River is a water body with very bad ecological condition [3].

Prishtevka River is the main receiver of all wastewater discharged from sewage of the city of Prishtina and as such results in high levels of Chemical oxygen demand (COD) (168 mg /l) and other organic pollution indicators [3].

Figure 1. *Physical - geographical position of Prishtevka River*

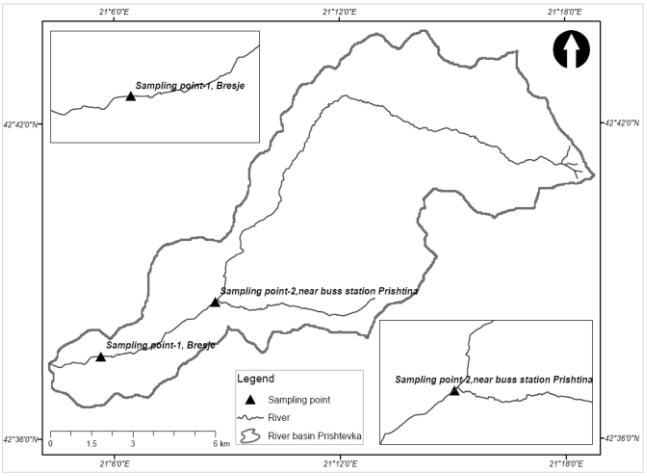


Figure 2. *Water sampling points in Prishtevka River*

This paper aims to show the variety of physical, chemical and biological parameters, specifically determination of the level of pollution respectively, load of the river, eutrophication and water improvement situation at a distance approxiamtely 10 km to the Prishtevka River measured and analyzed at different time periods in 2010. The aim of this paper is also to advance the level of information about water quality in the Prishtevka River which in recent years is in great pressure from wastewater discharges (household, industry, transport, etc.) Tests of physical, chemical and biological parameters were conducted in two stations in achieving the purposes of this paper (Fig .2.), near the bus station in Prishtina (mid flow) and in Bresje village (downstream). The achievement of this goal was preceded by:

- Knowledge of the physical - geographic characteristics of Prishtevka River basin;
- Possession of knowledge in the field of Chemistry and Biology;
- Knowledge of the principles of work in the laboratory;
- Knowledge of computer programs and their use for data processing;
- Integration of the results and their systematization herein.

II. MATERIAL AND METHODS

Working method used in this paper is a development method based on professional research and practical experience coupled with outreach activities, laboratory analysis, data processing and interpertation. The working method was also served by analog works carried out years ago in other areas of the country. The working method followed the following steps (Figure 3.)
The material used for performing the reasearch:

- Water/water samples;
- Laboratory equipment;
- Growth medium or culture medium /planting area;
- Incubating;
- The process of counting.

Physico-chemical tests were analyzed at the Laboratory of Kosovo Hydrometeorological Institute. Determining the concentration of hydrogen ions (pH) was tested by apparatus called pH-meter - Hanna.
Dissolved oxygen - was specified by Winkler method.
Turbidity - was defined by a device called Turbidimeter Hach 2100 Psio.
Electrical conductivity - was specified by Conducty-Meter Hanna hi8633.
Chemical oxygen demand (COD) and Biochemical Oxygen Demand (BOD_5) - were defined by Spectrophotometer Secomam Pastel UV Prim Light.
Nitrates and nitrites - were specified by the spectrophotometric method through the type of spectrophotometer called Spectrophotometer Secomam Pastel UV Prim Light.
Sulphates - were specified by the Complexometric method.
Indirect methods have been applied for microbiological examination such as agar method (according to Koch) through membrane filter method. Initially the samples were diluted with the dilution series of 10^1-10^6, in that case all dilutions were planted in order to determine which dilutions provide the required number of colonies, so in the case of Peter plate 10 cm diameter after planting and incubation as successful are considered dilutions in

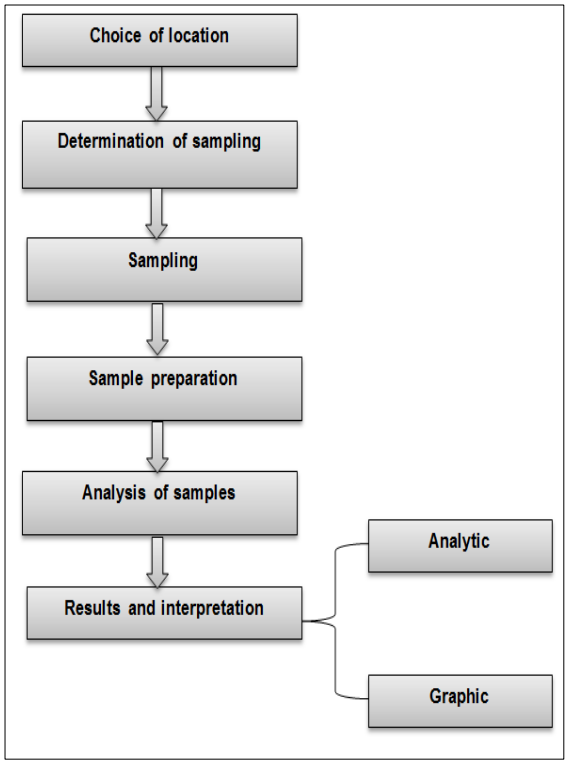


Figure 3. *Work method scheme*

which there were 30 to 300 colonies and in the case of membrane filters after specific planting and incubation in Peter boxes, 6 cm are considered those plates or dilutions 10-60 respectively 20-80 colonies [5].

Specification of the number of cells is to ascertain the number of colonies, so because it starts from the premise that a cell has made a colony and specification of cells in certain amount of sample is done according to the formula [5].

$$\text{No of cells}/100 = \frac{\text{CFU}_{\times \text{SD} \times 100}}{\text{VS (volume of sample)}} \qquad (1)$$

Where:

No of cells/100 - total number in 100 ml.
CFU - colony forming unit.
SD - serial of dilution.
100 - volume (mass) in which the number of microorganisms is required.
VS - volume of sample

Water microbiological analysis aimed at specifying the total number of bacteria: Heterotrophic bacteria, Total Coliforms, Enterococci, Salmonella and Shigella, and Yeast and Molds. Preparation of food, their planting- incubation, manipulation through device and all action in the Laboratory of Microbiology in University of Prishtina has been conducted in standard conditions. The incubation time for Heterotrophic Bacteria, Total Coliforms, Enterococci, Salmonella and Shigella bacteria lasted 48 hours at a temperature of 37 °C. On the other hand molds and yeasts have been incubated at the time interval from 5 days course up to 8 days at room temperature (20-22 °C) [5].

At the end, each dilution was planted three (3) times parallelly and was supposed to obtain more accurate results.

III. RESULTS AND DISCUSSION

The parameters analyzed (Table 1.) in Samplings points 1 (SP-1) and Samplings points 2 (SP-2), have shown these variations.

The concentration of hydrogen ions (pH) - the pH value was calculated as the average value of monthly measurements for sampling points and ranges from 7.3 SP-1 to 7.7 SP-2. This shows that the water of Prishtevka River has neutral pH up to basic pH. Compared to standard values - Norwegian Institute for Water Research (NIVA), the values of this parameter indicate that the water quality at the point SP-1 and SP-2 belongs to I-st class (very good) in terms of water quality in rivers [4]. Increasing the pH value of 7.3 SP-1 to 7.7 SP-2, it shows that between these two points we have collection of basic components which are a function of time and space.

Electrical conductivity (χ) - the value of electric conductivity ranges from 2090 μS/cm SP-1 to 785 μS/cm SP-2. Increased electrical conductivity at sampling point SP-1 is the result of mineralization of water from wastewater discharge. Reduction of Electrical conductivity SP- 2 is the result of dilution and dissolve of mineralization and other components.

Table 1*. The variety of physical - chemical parameters*

Simple point	pH	Turbidity (NTU)	Electrical Conductivity (µS/cm)	mg/L					
				O_2	BOD_5	COD	NO_2^-	NO_3^-	SO_4^{2-}
SP-1	7.3	130	2090	1.5	140	140	2.6	0.2	300
SP-2	7.77	122.4	785	3.68	97	187.3	1.2	0.42	62.9

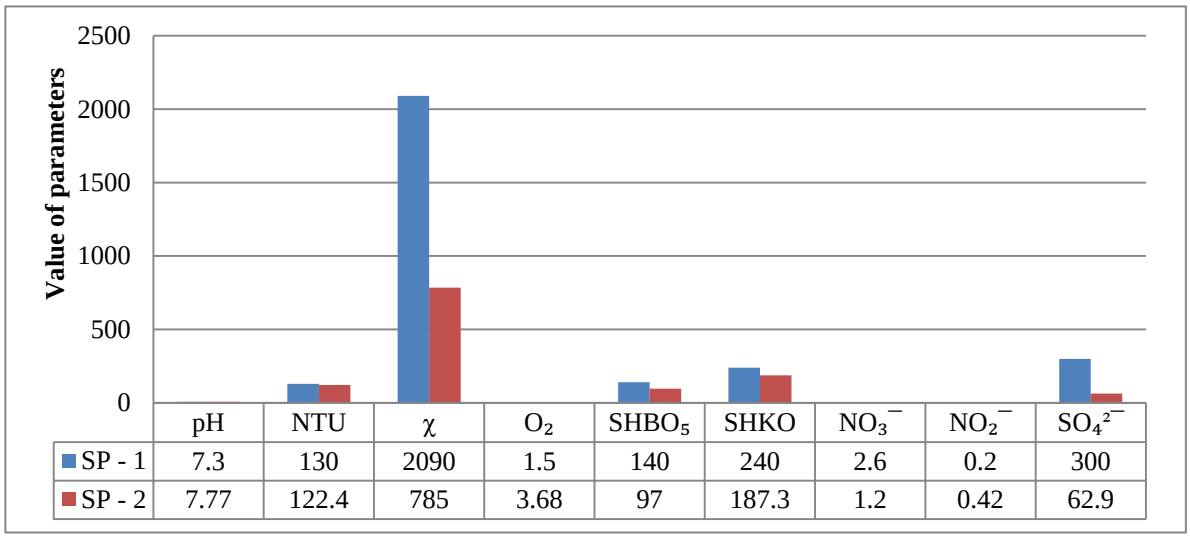


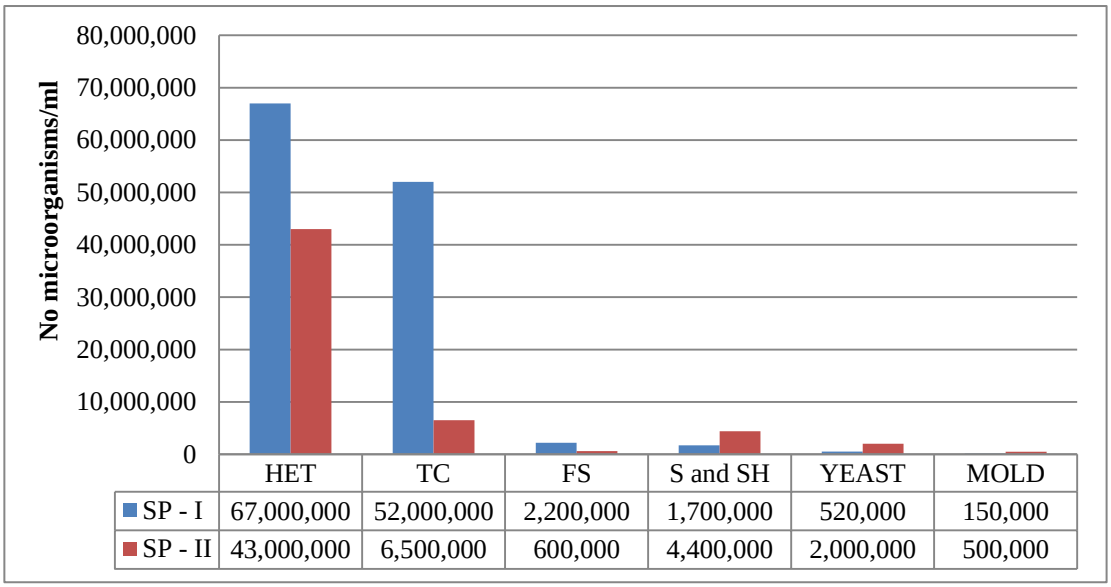
Figure 4. *The variety of physical - chemical parameters*

Free oxygen (dissolved) - is one of the most important parameters. Its correlation to water body provides direct and indirect information eg in bacterial activity, photosynthesis, the availability of nutrients, stratification [7]. The value of free oxygen ranging from 1.5 mg/L at the point SP-1., while the point SP-2 has had a notable increase 3.68 mg/L. Compared to standard values Norwegian Institute for Water Research (NIVA), the values of this parameter indicate that the water quality at the point SP-1 belongs to the V (fifth) class (very bad) and the point SP-2 water belongs to the IV (fourth) class (bad), in terms of water quality in rivers [4].

Turbidity - varies from 130 units at SP-1 to 122.4 units at SP-2. This parameter shows no significant difference and it turns out that water thereafter passing about 10 km distance is turbid.

Biochemical Oxygen Demand and Chemical Oxygen Demand (BOD_5 *and COD)* - are very important parameters of the load with pollutants. BOD_5 is a measure of the presence of organic materials in water, which alsosupports the development of microorganisms, BOD_5 is known as test for water pollution control [6]. BOD_5 and COD at the point SP-1 had a value of 140 mg/l respectively 240 and at the point SP-2 was recorded a reduction of these values which shows a significant cleaning water during the flow at a distance of 10 km through non-urbanized and quiet area.

Nitrates, nitrites and sulphates - have had changes, nitrates have been reduced by 2.6 mg/l to 1.2 mg/l, and nitrites have been increased from 0.2 mg/l to 0.4 mg/l, while theSulphates have been reduced from 300 mg/lat 62.9 mg/l.Thus microbiological perameters (Figure. 5) have resulted as follows: The tests resulted that Heterotrophic bacteria at the sampling point SP-1 are of high quantity about 67 million or 54.22% in 100 ml of water. This indicated that Prishtevka River water at the sampling point SP-1 is loaded by pollution resulting from organic pollutants
(proteins,carbohydrates, fats, etc.) [8]. Type of Coliform bacteria at the sampling point SP-1 marks the second palce of 52,000,000 or 42.08% of the cells in 100 ml of water, compared to the total number of microflora tested in the river water. Enterococci coliforms (Fecal streptococci) in 100 ml of water they participate with 2.2 million or 1.78%. Pathogenic Coliform bacteria: Salmonella and Shigella participate with 1,700,000 cells per 100 ml of water, and fungus, mold, and yeast respectively indicated little participation; 520,000 respectively 150,000 per 100 ml of water. The number of yeasts and molds turns out to be normal for the fact that they attack mainly fruits, vegetables, foods of organic nature, mainly in aerobic conditions. This statement was argued by the fact that Prishtevka River from the segment called Fusha e Pajtimeve up to the sampling point SP-1 flows through the closed concrete canal that enables the transfer of yeasts and molds to the sampling point SP-1.



	HET	TC	FS	S and SH	YEAST	MOLD
SP - I	67,000,000	52,000,000	2,200,000	1,700,000	520,000	150,000
SP - II	43,000,000	6,500,000	600,000	4,400,000	2,000,000	500,000

Figure 5*. Variety of microbiological parameters*

The process of planting and incubation of Heterotrophic bacteria, Total coliform bacteria, as well as Fecal streptococci have been tested at a temperature of 37 ° C. This process is conducted in the conditions of suchtemperature, and has given colonies of: different size, shape, color, consistency, anabundance. Yeasts and molds after planting and incubation at room temperature 18-22 °C provided colonies of: different size, shape, color, consistency, and abund

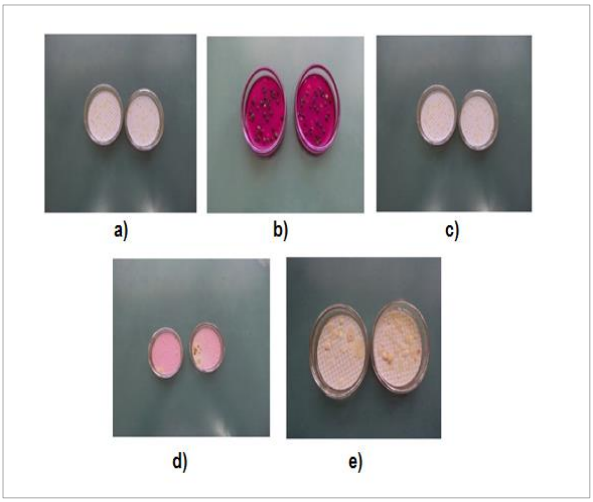


Figure 6. *Microorganisms colonies: a) Heterotrophic bacteria culture colonies, b) Total coliform bacteria cultures colonies, c) Fecal streptococci (enterococci), bacteria cultures colonies, d) Salmonella and Shigella bacteria culture colonies, e) Yeasts and Molds cultures colonies.*

Heterotrophic bacteria at the sampling point SP-2 have proved to be 43,000,000 or 75.44% in 100 ml of water. This shows that the water of Prishtevka River at this point is loaded with pollutants, especially with organic ones which create conditions for growth and development of heterotrophic bacteria (proteins, carbohydrates, fats, water, temperature, etc.).

Total coliforms as indicator of fecal contaminated water [9, 10]. These bacteria take the second place for the number of bacteria at the sampling point SP-2 with: 6,500,000 cells or 11.41%. At this point, Fecal streptococci take the first place (600,000 cells or 1,05%) within enterococci coliforms is applied to determine whether fecal pollution is originating from human or animal based on the ratio FC / FS [11].

Pathogenic Coliform bacteria represented by Salmonella and Shigella participate with 4,400,000 cells per 100 ml water of analyzed sample. Fungi represented by molds and yeasts show a relatively high participation from 2,000,000 to 500,000 in 100 ml water of tested sample. This large number of participation of molds and yeasts is within normal conditions because they attack mainly fruits, vegetables, foods of organic nature.

In general, the results indicate that the microbiological parameters are higher at the sampling point SP-1, and such growth is reduced in the course of waterflow, respectively at the sampling point SP-2. Since the purpose of the research was to define the level of pollution, the river load respectively, eutrophication and self-improvement of the water situation at a distance 10 km near the river, the results have shown that the microbiological parameters from the sampling point SP-1 taowards the samplinpoint SP-2 ranged as follows:

Comparing the results obtained by two sampling point SP-1 and SP-2 have shown that Heterotrophic bacteria have a significant difference between the

first point SP-1 to the point SP-2, which turns out to be 24 million Heterotrophic bacteria more at the sampling point SP-1. In terms of Total coliform bacteria also at the point SP-1, the number is higher than the point SP-2 with a difference between them of 45.5 million cells in 100 ml of water.
Fecal streptococci at the sampling point SP-1 indicated growth about 3.5 times more than at the sampling point SP-2. Salmonella and Shigella bacteria proved to be about twice higher at the smapling point SP-2 when compared to sampling point SP-1. By this rule of decreasing bacterial microflora from sampling point SP-1 to sampling point SP-2, yeasts make an exception which at the sampling point SP-1 were lower compared with the sampling point SP-2 around 1.5 times, while the molds at the point SP-1 showed the highest value at the point SP-2 to 350, 000 cells per 100 ml of water sample.

IV. CONCLUSIONS

Based on the results obtained in this research can be concluded as follows:

- Urban waste water of Prishtevka River estuary from underground canal near the bus station sampling point 1 (SP-1) is highly loaded with organic and inorganic pollutants.
- Heterotrophic bacteria as a typical indicator of the level of pollutants load were present to 67 million cells per 100 ml or participate in the entire explored microflora with 74.8%.
- Total coliforms are present with 18 million cells in measurement units and participation in percentage is 20.1%.
- Less represented are specifically coliforms Fecal streptococci (enterococci) with 2.2 million in 100 ml with percentage participation of 2.46%.
- Salmonella and Shigella were represented by 1.7 million, namely 1.9% of all explored microflora.
- The yeasts were less present. In 100 ml of the sample are recorded at 520 thousand cells or 0.58% for the entire microflora.
- Finally mold, at the sampling point SP-1, were 150 thousand cells with 0.1% participation.
- With the exception of Salmonella, Shigella, and yeasts which marked growth at the sampling points 2 (SP-2), most other microbiological and physico-chemical parameters at the sampling point 2 (SP-2) have shown significant reduction.

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