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Microbiological Characteristics of Shkumbin River Waters, Albania[#]

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Abstract: Environmental problems in lakes, rivers and coastal waters are often a result of human pollution of nutrients or toxic substances. Since the nature is very complex it is hard to understand and calculate how these substances will spread in the ecosystem and which effect they will have. This work determined the microbiological characteristics of the waters of river Shkumbin. Samples were taken twice a year, that is, dry and wet seasons of each year. Standard methods were used for bacteriological examinations. The results revealed high faecal pollution, especially during the wet season. This is confirmed by the presence of the coliforms. Isolates include *Pseudomonas spp.*, *Escherichia coli*, *Kleibsiella spp.* etc. Some significant contaminating indicators, namely, total coli form, Fecal coliform, pathogenic parasites have been identified and measured along with the related usual parameters, namely, dissolved oxygen (ppm), pH, temperature (^{o}C), total dissolved solids (ppm), etc.

Key words: *bacteriological examination, water quality indicators, pathogens.*

Introduction

Pollution can be defined as the introduction into the environment of substances or energy that is likely to cause harm or hazards for human health or harm living resources thereby causing ecological damage or interfere with legitimate uses of the environment.

Water quality standards are usually expressed in term of the microbiological, physical and chemical characteristics. Microbiological quality of drinking water is usually expressed in terms of the concentration and frequency of occurrence of particular species of bacteria. According to these authors, polluted water may contain pathogenic bacteria, viruses, protozoa or helminthes eggs and the bacteria that are usually involved are usually referred to as indicator bacteria. They are usually excreted in large number by worm blooded animals. The presence of the indicator bacteria in the water indicates fecal contamination; fecal contaminations are often linked to the presence of pathogens and thus health hazard.

The most commonly-used indicator bacteria are the coliforms. Water is usually tested either for the presence of the total coliform group or for the presence of fecal coliform (Balow *et al*. 1991).

The microorganisms of natural waters are extremely diverse. The numbers and types of bacteria present will depend on the amounts of organic matter present, the presence of toxic substances, its saline content, and environmental factors such as pH, temperature, and aeration. Open water in the center of large bodies of water, free of floating debris, will have small numbers of bacteria. Many species of atrophic types are present, however, that require only the dissolved inorganic salts and minerals that are present. The threat to human welfare by contamination of water supplies with sewage is a prime concern of everyone. The enteric diseases often result in epidemics when waters are not properly protected or treated: Scheidleder *et al*. (1999).

Shkumbini River is one of the longest rivers in Albania. Its length is 181 km and it covers 2444 sq Km at an elevation about 753 m above mean sea level. Elbasani is the largest contributor of pollution to the river (Dahling & Wright 1984; Bordner *et al*. 1978).

Material and methods

Sample Collection

Sample collection is a very important part of river study because conclusions drawn a based only on the testing of collected samples. The purpose of taking samples is to obtain information, which in

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some way typifies the aquatic system from which samples are drawn. Grab Sampling procedure was adopted as recommended by Standard Method for microbiological analysis. Samples were collected during lean and wet season from March 2005 to 2006. Three sets of water samples from each sampling location and for every sampling late were collected for this study.

- Water samples for microbiological examination, other than Helminthes eggs, determination were collected in non reactive borosilicate glass bottles of 500 ml capacity each that had been cleansed and rinsed carefully, given a final rinse with distilled water and sterilized. Samples were taken from the river by holding the bottle near its base in the hand and plunging it, neck downward, below the surface. Then turning the bottle until neck points slightly upward and mouth is directed toward the current. The sampling bottle was not filled up to the brim and 20mm to 30mm space was left for effective shaking of the bottle.
- Water samples for Helminth eggs were collected in non-reactive plastic bottles of 5 l capacity, which had been cleansed and finally rinsed with distilled water.

Sample Preservation and Storage

Microbiological analysis of water samples wag started as soon as possible after collection to avoid unpredictable changes in the microbial population1 as the samples cannot be processed within 1 h after collection, therefore for most accurate results; samples were brought in iced insulated container, during transport from stations of Shkumbini to microbiological laboratory.

Analysis of Samples

The Samples were analyzed in accordance with the standard methods. We have identificated by the tests the bacterial indicators such as: *Total coliform* (TC), *Fecal streptococcus* (FS), *and Fecal coliform* (FC) and *Clostridium perfringens* microorganism.

Total coliform test: The coli form group includes a number of genera and species of bacteria which have common biochemical and morphological attributes that include gram-negative, non-spore forming rods that ferment lactose in 24 to 48 hours at 35^{o}C. These attributes are found in *E. coli* which is the coli form of most sanitary significance as it is very common in the feces of warm blooded animals.

Fecal coli-form test: A subset of the coli form group of bacteria that are able to grow at 44.5^{o}C (thermo-tolerant coli-forms). Monitoring methods that employ elevated temperature incubation give a more specific estimate of the presence the number of *E. coli* and thus the presence of fecal contamination. Fecal streptococci test: The feces of humans and animals contain large number of streptococcal bacteria that can be classified as belonging to the fecal streptococci group.

In addition to determining the presence or absence of coli-forms, we also have used the series of lactose broth tubes to determine the most probable number (MPN) to coli-forms present in 100 ml of water.

Results and Discussion

The variation in water quality parameters determined through the analysis on site and in Microbiological laboratory in Tirana city were reported in Table 1.

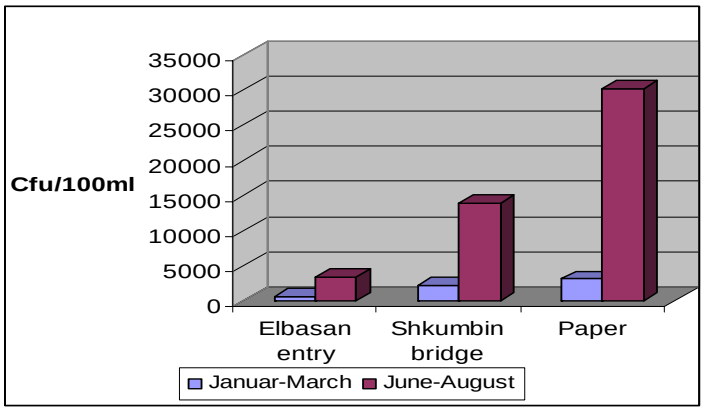

Figure 1. Fecal coliform in our locations

Bridges are normally the first choose for locating a steam sampling station, since they are not only provide ready access but also permit sampling at any point cross the width of stream. Further the bridges are clearly identifiable and the site can be precisely described. We have collected the sample in three sites: in the entrance of Elbasan city, Shkumbin bridge and Paper. The samples are collected during the wet period (January-march) and dry time (June-August).

Table 1. Summary of analytic methods and observes values

Parameters	Principle	Instrument/Technique used	Observed values		
			Minimum	Maximum	Average
Temperature, ^oC	Metric	Thermometer	6.5	22	15
pH	Metric	Digital pH meter	6.22	7.2	8.12
Salinity, g/kg	Volumetric	Digital meter	0.027	0.084	0.06
P tot, mg/l	Volumetric	Digital meter	0.16	0.85	0.5
Dissolve O_2, mg/l	Volumetric	Winkler's method	8.33	9.97	9.15
Suspension mg/ml	Volumetric	Digital suspend meter	91.7	420.6	256
TC, MPN/100ml	MPN index	Lauryl tryptose broth, incubation temperature 35±0,5 ^oC for 24 h to 48 h	1750	28800	15280
FC, MPN/100ml	MPN index	EC medium, incubation temperature 44,5±0,2^oC for 24±2 h	550	31000	15400
FStr, MPN/100ml	MPN index	TSB, blood agar medium, incubation temperature 37,5±0,2 ^oC for 24±2 h	385	26600	13500
Helminth eggs, per ml	Microscopic count	Modified Bailenger method, centrifuge (1000g), compound microscope			

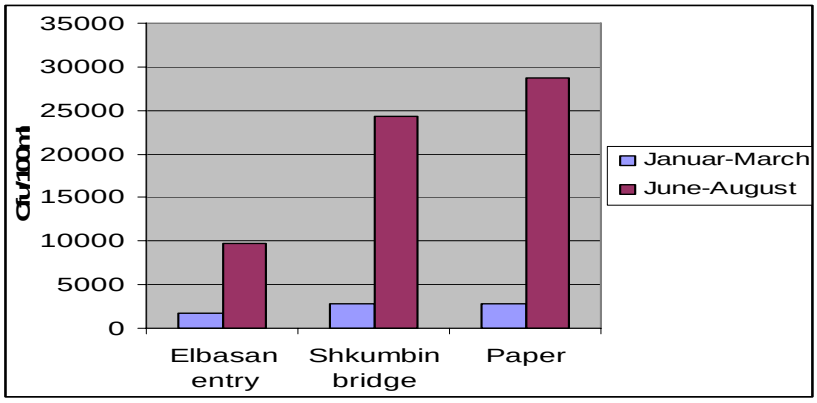

Figure 2. Total coliform in our three sites

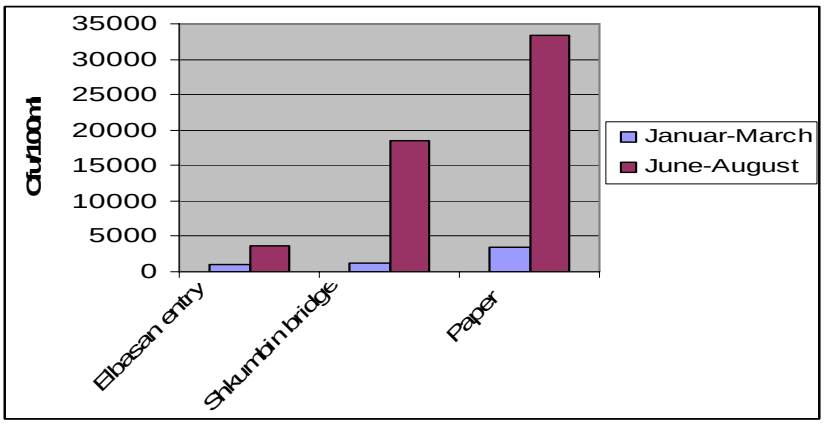

Figure 3. Fecal Streptococcus in our three sites

The most polluted area is near the Paper zone because this region is near the ex Metallurgical Combine and many toxic and harmful discharged in that part of the river. The high value is presented

and near the Shkumbin bridge because many sewage discharge and many garbage are throw away here. If we compare the values of Total Coliform, Fecal Coliform and Streptococcus fecal during the wet and dry periods we can stress that the number of them increasing so munch especially during the dry time because it's impossible to dilute by rain.

The depletion of oxygen was the major impact in the polluted stretch of the river due to excessive presence of organic matter, which disturbed the river ecosystem to a large extend. The biodegradation of organic pollution resulted in release of nutrients, which causes eutrophication of river. The pathogenic parasite Helminths (eggs/l) values found in Shkumbini River is much higher and water is not suitable even for the irrigation purpose. The minimum value was found is 5 eggs/l which exceeds the permissible limit of 1 eggs/l.

Figure 4. Hydrogeologic map of Albania (B_4 represent the basen of Shkumbin River)

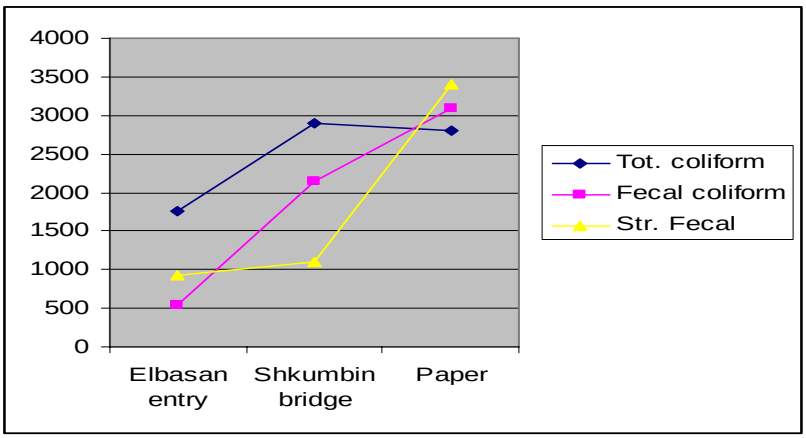

Figure 5. The distribution of microbial indicators during January-March

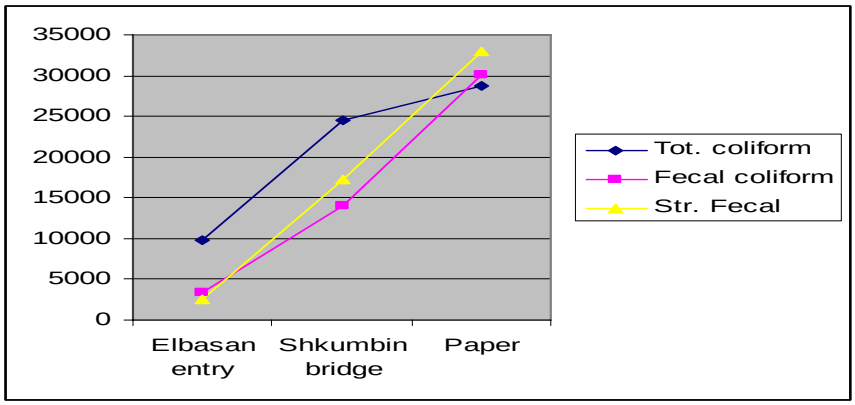

Figure 6. The distribution of microbial indicators during June-August

Fecal pollution was confirmed by the presence of coliforms in the water samples during the rainy seasons which may arise from animal dung carried by run-oil to the rivers during the rainy season. We observed that micro-organisms in air and in the soil can have access to the water bodies and continually or at irregular intervals under certain unusual condition as during or immediately after heavy rains.

The principal coliforms are Escherichia *col, Klebsiella spp and Citrobacter spp*. E. coli is abundant found in the gastro intestinal tracts of humans, birds and animals, but rarely found in water or soil that has not been subjected to fecal pollution. The other bacteria are not also found in the intestine but also elsewhere, therefore their presence in water can indicate fecal contamination. Bacteria composing this indicator group are lactose fermenters and have been recognized as of public health importance for water contamination. The classified indicator for water analysis is *E. coli* and its presence suggests enteric pathogens. There is a direct relationship between the numbers of *E. coli* and the extent of fecal pollution. The higher the number, the more polluted the sample is. This is because *E. coli* cannot multiply in water and therefore, their number slowly declines in river unless new pollution occurs. This can explain the water of river the absence of coliforms in rivers during the dry seasons when no run-off occurs. According to (Chamberlain C, and Mitchell R,1978) bacteriological examination of water is a powerful and foremost tool in order to foreclose the presence of microorganisms that might constitute a health hazard. Microorganisms that are used commonly as indicator of water include coliforms. Naturally, waters contain a large number and variety of microorganisms. In fact, the sanitary quality of potable water is determined primarily by the kinds of microorganisms present rather than by the microbial count (Bisson J, Cabelli V,1998).

Water source used for drinking or cleaning purpose should not contain any organism of faecal origin.In that line The World Health Organization (AOAC International 1995)) suggested that treated water entering the distribution system should contain no coliforrn organisms, and tap water should contain no coliform in 95% of samples taken in any one year and it should not contain more than 3 coliforms per 100 ml or any *E. coli*.

Conclusions

The big number of Coliform E. coli and *Streproccocus fecalis* in water showed the fecal contamination of river water. Traditionally treatment by sedimentation showed very limited effect. The might be a high risk of infectious diseases for animals especially enteric disease of young human and animals.

During these last years the annual average value of microbial indicators is increase. The high values of microbial indicators and pathogens detected revealed that the microbiological quality of water is unsafe and not acceptable.

The rapid method developed for estimation of organic pollution and microbial pollution through interrelationship, namely chemical oxygen demand and *Fecal coliform* can be helpful in routine analysis of river water quality. This method can also be applied for evaluation of water treatment efficiency at the water treatment plant.

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