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Physico-chemical and Microbiological Water Quality Assessment of Perisuyu River, Tunceli, Turkey

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Generally, the water quality depends on its chemical and microbiological conditions. So, in this study, the chemical and microbiological characteristics of the Perisuyu River through 4 year long surveillance in Tunceli, Turkey were studied. Sampling was carried out four times during the year. Nitrate, nitrite, ammonium concentrations, total dissolved solid, total coliform counts were determined and the presence of *Escherichia coli*, important water quality indicator, was tested. Generally in water samples *E. coli* and total coliform were found very high and nitrate, nitrite and ammonium concentrations were low. In 2008 August and 2009 February water pH was higher than the World Health Organization limit value. Electrical conductivity was higher in 2004 May, December and 2008 February.

Key Words: Perisuyu river water quality, Physico-chemical characteristic, Microbiological characteristic.

INTRODUCTION

Water is an essential compnent for life. Water quality can have a major impact on both individuals and communities health. Water is an essential component for life on Earth, which contains minerals extremely important in human nutrition[1]. So the quality of water is significant. Drinking contaminated water or using it in food preparation may lead to new cases of infection. Water pollution originated from human or other activities cause serious health problems and some economic costs related to water treatment, remediation and locating a new water supply[2]. An adequate quantity of water is of primary importance in public health, since diseases are more easily transferred directly from person to person or *via* contaminated food. Water could be chemically, physically or microbiologically contaminated. The main source of microbiological contamination is microorganisms from human or animal excreta, which reaches humans through contaminated water from wastewater, landfills or wastewater treatment stations, causing serious health problems such as typhoid and cholera in adults and diarrhea in children[3-5]. The most commonly used indicators for microbiological contamination are the coliforms: total and fecal coliforms. *E. coli* is a subgroup of total coliform group[6]. The provided of good quality water is a basic factor in guaranteeing public health, the protection of the environment and sustainable development.

Chemical contaminants such as nitrate and nitrite levels in water are other important indicators of water quality. The presence of high ammonium content in drinking water, which is readily transformed into nitrate. Ammonium is adsorbed in the intestine and can be excreted directly though the kidneys in small quantities[7]. The increasing levels of nitrate and nitrite concentrations are becoming an important problem for public health. Large amounts of these species may be toxic and induce eutrophication. Nitrates are of great toxicological concern as they are involved in the origin of nitrites and nitrosamines and the development of methaemoglobinaemia. The toxicity of nitrite is primarily due to its interaction with blood pigment to produce methemoglobinaemia[8]. Moreover, nitrite can be used as an important indicator for the organic pollution of water, since it could be formed during the biodegradation of nitrogenous organic matter[9]. The increasing levels of these compounds result mainly from organic matter in the soil, the use of nitrogenous fertilizers and herbicides in industrial agriculture, livestock and human excrement and other organic wastes from chemical industries, domestic wastes and septic tank effluents[10-14].

According to the World Health Organization (WHO), the maximum allowable levels of nitrate and nitrite concentration in drinking water are 50.0 and 0.1 mg/L, respectively[15].

Determination of the water quality is important for public health. Therefore, the objective of the current study is to present

the quality of the Perisuyu River in the country of Tunceli, as well as the comparative evaluation of the chemical and microbiological analysis results for four years (2008-2009 and 2004-2005).

EXPERIMENTAL

Water samples were taken in Perisuyu River around Akpazar Bridge for four years. The water quality data obtained from Tunceli-DSI (State Hydraulic Works) between years 2004-2005 and 2008-2009 were analyzed in order to evaluate the characteristics of the Perisuyu River. Anion and cation analyses were done by ion chromatography, total dissolved solids were analyzed multiparameter water quality monitor. pH was measured by pH-meter and temperature was measured by thermometer.

RESULTS AND DISCUSSION

The water quality depends on its chemical and microbiological condition. The variation of the chemical parameters of a water system used as potable water, especially when it is underground, depends on many parameters like the solubility of pollutants, their adsorption and halflife, from the climatic and hydrogeological conditions.

Physico-chemical and microbiological analyses were done the samples which were taken for 4 years. Temperature varied in the range of 0-7 ºC during 4 years on February, 11-16 ºC on May, 18.5-21.0 ºC on August, 7.9-14.0 ºC on December. pH varied in the range of 7.5-8.8 (Table-1). Loukas[16] found the mean value of temperature, conductivity and pH 12.09 ºC, 601.26 µs/cm, 7.87, respectively. As seen in Fig. 1 nitrite the lowest values were obtained for December and February months in 2009 and the highest level (0.04 mg L^{-1}) was obtained for May in 2004. The levels of nitrate were ranked in the decreasing order of May > February > December > August in 2004, May > February > December > August in 2005, May > February > December > August in 2008, February > May > December > August in 2009 (Fig. 2). In a study River water nitrate concentration were found in the range of 9.35-27.23 mg L^{-1} [17]. Ammonium concentrations were < DL-0.058 mg L^{-1} during four years on February, < DL-0.172 mg L^{-1} during 4 years 4 years on May, 0.018-0.020 mg L^{-1} during 4 years on August, 0.007-0.560 mg L^{-1} during four years on December (Fig. 3). Paredes *et al.*[17] determined ammonia concentrations (1.85-50.11 mg L^{-1}) in Manzanares River higher than our results. *E. coli* and total coliform levels were the highest in 2004 December and 2009 August, respectively. In a study samples were taken in Buyukmelen River basin biannual during 2005-2006 years. According to this study finding pH was varied in the range of 8.07-8.37 in winter season, 6.5-7.3 in summer season. Conductivity was found in the range of 287-428 µs cm^{-1} in winter and 310-436 µs cm^{-1} in summer season. Total dissolved solid concentration was the highest at Asarsu River in summer and winter season[18]. Generally, *E. coli* and total coliform concentrations alterations were found similar during all years. In Perisuyu River water *E. coli* level was found in the range of 15-10600 MPN/100 mL (Fig. 4). In Normandy (France) five small River waters were taken and *E. coli* was investigated. Minimum value of *E. coli* was determined 2.4×10^2 MPN/100 mL and maximum *E. coli* was determined 5.5×10^4 MPN/100 mL[19]. In Raccoon River annual *E. coli* concentrations were investigated. Maximum *E. coli* concentration (65100 MPN/100 mL) was detected in April[20]. There were significant variations in total coliform levels in River water throughout the period (Fig. 5). The highest total dissolved solid concentration (TDS) was determined in February 2008 and the lowest in February 2005. Except 2008, during the other years TDS concentrations were varied similarly (Fig. 5).

TABLE-1
PHYSICO-CHEMICAL VALUES OF PERISUYU RIVER

Year	Month	T (ºC)	pH	EC (µS/cm)
2004	February	1.6	8.4	394
	May	11.0	8.3	411
	August	18.5	8.4	309
	December	9.2	7.9	422
2005	February	5.2	7.5	249
	May	14.5	7.8	308
	August	19.8	7.8	289
	December	7.9	7.6	349
2008	February	ND	8.0	438
	May	16.0	8.4	311
	August	21.0	8.6	356
	December	14.0	8.2	360
2009	February	7.0	8.8	261
	May	13.0	8.4	289
	August	21.0	8.1	257
	December	11.0	8.3	346

ND: Not detected.

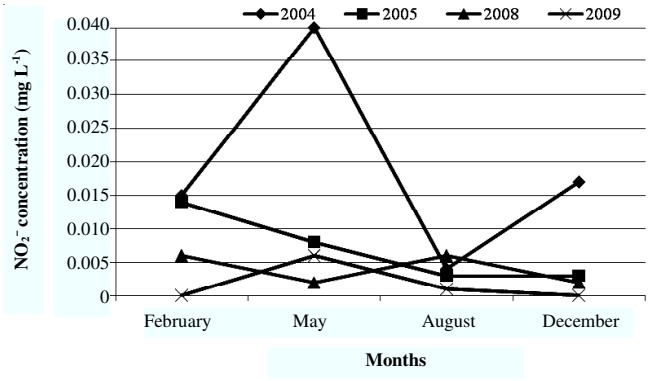

Fig. 1. Variation of NO_2^- concentration of Perisuyu River

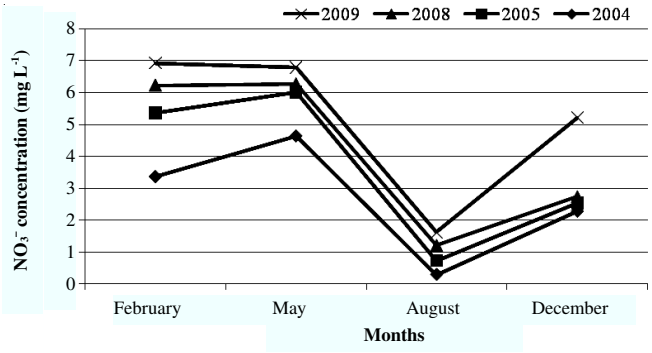

Fig. 2. Variation of NO_3^- concentration of Perisuyu River

Conclusion

This study was carried out to provide information on chemical and microbiological quality of Perisuyu River. In 2008 August and 2009 February water pH was higher than the

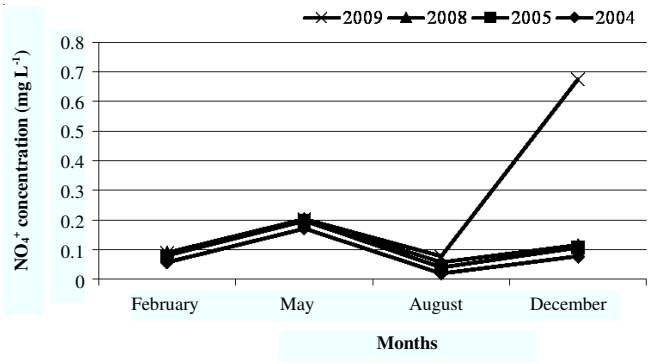

Fig. 3. Variation of NH_4^+ concentration of Perisuyu River

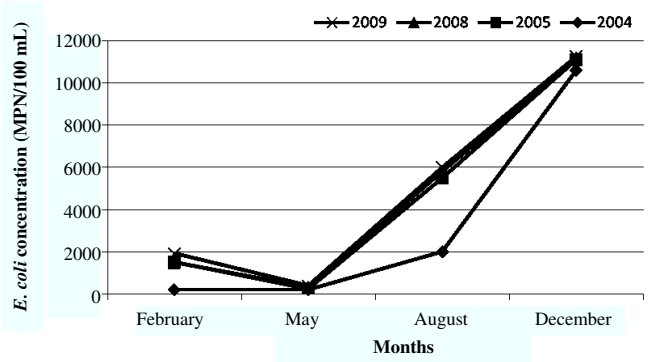

Fig. 4. Variation of *E. coli* concentration of Perisuyu River

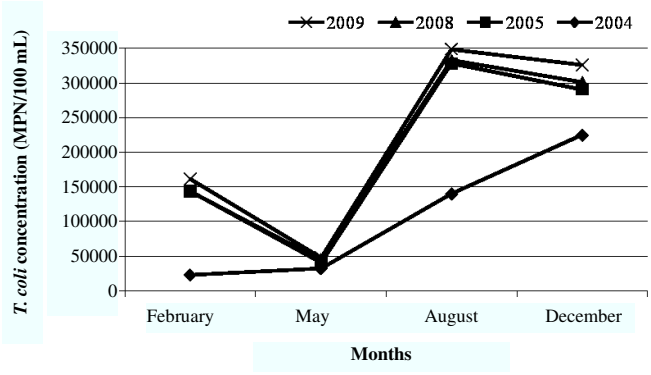

Fig. 5. Variation of total coliform concentration of Perisuyu River

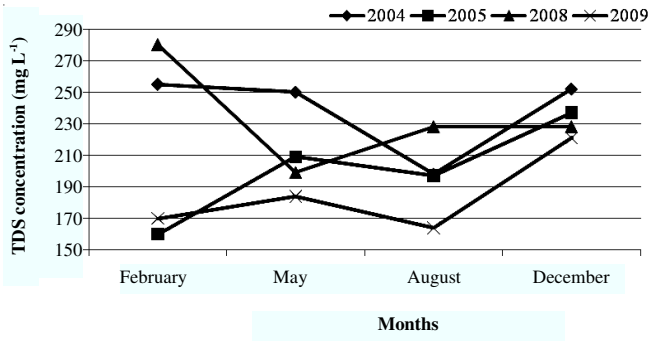

Fig. 6. Variation of TDS concentration of Perisuyu River

World Health Organization limit value. WHO[21] was determined the value of electrical conductivity 400 μs cm^{-1}, in studied samples in 2004 May (411 μs cm^{-1}), 2004 December (422 μs cm^{-1}) and 2008 February (438 μs cm^{-1}) exceeded this value. Generally nitrate, nitrite and ammonium concentration was low. In water samples *E. coli* and total coliform must not be detectable in 100 mL of sample, but generally in water samples *E. coli* and total coliform was found very high.

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