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EVALUATION OF DRINKING WATER QUALITY CLUJ COUNTY FROM ROMANIA REGARDING NITRATE CONCENTRATION

Silvia Claudia MOŞNEAG[1], Daniela VELE[1] & Călin NEAMŢU[1]
[1]*Someş Water Company, Water Analysis Laboratory of the WTP Gilău, 407310, Cluj-Napoca, ROMANIA, e-mail: claudiamosneag@yahoo.com*

Abstract: The main sources of drinking water in Cluj county include private wells or drillings, rivers, and less lake. In many Cluj county rural areas, the drinking water from private wells is highly polluted with nitrate, as a result of agricultural activity (including excess application of inorganic nitrogenous fertilizers and manures) or seepage of human sewage from private septic systems. This study presents quality assessment of drinking water from Cluj county, regarding nitrate concentration. Drinking water parameter like conductivity, pH, turbidity, nitrite, ammonium, nitrates were investigated. The study was carried out in the January - December, 2015. The nitrate concentrations were low in drinking water samples from surface source in the ranged between 1.68-3.34 mg/L. On the other hand in groundwater samples high nitrate concentration was obtained 4.78-47.81 mg/L, but not exceed the limits indicated by the legislation (50mg/L).

Key words: nitrate, drinking water, groundwater, quality

1. INTRODUCTION

The ensuring of good quality drinking water is a necessary feature for preventing diseases and improving quality of life. Water is critical for the development of every nation and access to clean water is important for human growth. The quality of drinking water is a basic factor in guaranteeing public health, the protection of the environment and sustainable development (Asamoah et al., 2015).

Safe drinking water is generally obtained by complying with specific water quality standards such as European Union Drinking Water Directive (Council Directive 98/83/EC, 1998).

The Directive 2000/60/EC for water resources and its Romania version Law 458/2002 republished in 2011 and 311/2004 (Romanian Law 458, 2011; Romanian Law 311, 2004), impose the organization of monitoring networks for a variety of quality and quantity parameters of potable water.

In recent years, there has been increasing awareness and concern about the surface water pollution all over the world, and new approaches toward the sources of pollutants and achieving sustainable exploitation of water resources have been developed (Venkatramanan et al., 2014).

Groundwater is the most reliable source of water that requires little or no treatment due to its quality for various uses compared to surface water (Akoteyon, 2015; Hoaghia et al., 2015b).

Nitrate concentration is one of the most important drinking water quality parameters. The European Union Directive on drinking water quality (98/83/EC) established the maximum contaminant level (MCL) of 50 mg/L. On the other hand, the US Environmental Protection Agency (EPA) has set a Maximum Contaminant Level (MCL) goal (MCLG) for nitrates at 10 mg/L, because EPA believes this level of protection would not cause any of the potential health problems described above (Moşneag et al., 2015; EU Council Directive, 1998; US Environmental Protection Agency, 1995). The presence of nitrates can pose serious health risks, especially for infants and pregnant women. The removal of nitrate from drinking water has gained renewed attention due to the potential harm by nitrate to human health (Moşneag et al., 2014; Senila et al., 2014; Wanga et al., 2006).

Nitrogen is inextricable part of the organic compounds, such as amino acids, proteins and nucleic acids. Approximately 98% of nitrogen in soil is organic nitrogen that is not taken by the plants. The rest of the nitrogen (2-3%) that may be used by plants is formed

by nitrate (NO_3^-) and ammonium (NH_4^+). Nearly 50-70% of the artificial nitrogen, which is supplied from the fertilizers, is consumed by plants, 2-20% of it evaporates and mixes into the atmosphere, 15-25% form compounds with organic materials in soil, and the remaining 2-10% is transported to surface and ground water (Kurt et al.,2012).

Tap water from the municipal supply system is the source of drinking water for majority of consumers in Romania.

In Cluj region, rural areas the main sources of drinking water are groundwater, therefore excessive nitrate concentrations in groundwater may be a health hazard for consumers.

Cluj - Napoca is a populous city located in the northwestern part of the country and represent Cluj County municipality residence. The source of surface water is used Tarnita, Somes Cald, Gilau Lakes and groundwater from Floresti source.

The objective of this study was to assess the quality of drinking water from Cluj county regarding nitrate concentration. Hence, the monitoring and assessment program of drinking water was executed by evaluating physico-chemical parameters (turbidity, conductivity, pH, nitrates, nitrites and ammonium) of drinking water of Cluj county.

2. MATERIALS AND METHODS

2.1. Sample collection

Drinking water quality is routinely monitored in the distribution network and inside households at the point of consumption according to the national and european relevant legislation about the quality of water used for human consumption.

The collection of samples was carried out by the members of water analysis laboratory of the WTP Gilau from Somes Water Company. Samples were carefully transported to laboratory following precise instructions and detailed protocols in order to avoid any contamination during sampling and transportation.

In the present study, water samples were collected during the January - December 2015 in morning period from the each selected sampling zones. The parameters that belonged to the routine analysis were analyzed, according to the Ministry of Health about the frequency of the sampling and the quality of drinking water regulations.

Water samples were collected in polyethylene (PE) bottles for physical and chemical analysis. The bottles used for sampling were cleaned thoroughly in according to the SR EN ISO 5667-3/2013 (SR EN ISO 5667-3, 2013).

The number of samples and sampling frequency during the study period is in proportion to the water consumption.

Drinking waters from different areas of the Cluj Napoca town (Manastur, Marasti, Grigorescu); Huedin town, Capusu Mare, Dangau Mare, Baisoara, Alunis villages and from the entrance to the distribution system (R1) were evaluated and compared.

2.2. Sample preparation and analysis

All chemicals and reagents used were of analytical reagent grade (Merck). Deionized water was used throughout the study.

The laboratory uses standard method, reference materials and certified reference materials. The uncertainty of all the physicochemical methods were calculated and ranged in the relevant standard methods acceptable limits.

The samples of drinking water were analyzed using standard methods.

Nitrates were determined using a Lambda Bio 40 UV-VIS spectrophotometer from Perkin Elmer according to the SR ISO 7890-3 (SR ISO 7890-3, 2000).

Nitrites and ammonium were analyzed using standard methods (SR EN 26777/C91, 2006; SR ISO 7150-1, 2001)

The turbidity was determined using a Hach 2100N turbidimeter, according to the European Standard EN ISO 7027 (EN ISO 7027, 2001). The pH and conductivity measurements were carried out using a WTW multimeter Inolab 740 and determination was performed according to the SR EN ISO 10523 and SR EN 27888 (SR EN ISO 10523, 2012; SR EN 27888, 1997).

3. RESULTS AND DISCUSSION

Table 1 give comparative physico-chemical analysis (the average of annual sample) of the laboratory results from the drinking water samples collected. The turbidity is low in all types of drinking water and do not esceed the limits indicated by the legislation 5 NTU.

The pH of drinking water indicates degree of deterioration of the water quality (Singh & Bharti et al., 2015). In this case range of pH for the use of drinking water is 6.26 - 7.78, are within the acceptable limit (6.5 - 9.5 pH), except Baisoara samples were is below the legislation (6.26 pH). pH is the indicator of acidic and alkaline condition of drikingwater, a small change in pH is a considerable change in hydrogen (H^+) ion concentration. Our results are in accordance with those reported by Moşneag et al., 2013).

Table 1. The concentrated results of the physico-chemical analysis, from drinkingwater

Sampling points	Turbidity NTU	pH	Conductivity µS/cm	Ammonium mg/L	Nitrites mg/L
R1	0.66	7.41	87.49	0.01	0.01
Manastur	0.68	7.31	93.65	0.01	0.01
RTG	0.32	7.02	521.61	0.01	0.01
Marasti	0.69	7.26	93.79	0.01	0.01
Baisoara	0.76	6.26	34.61	0.01	0.01
Capus	0.34	7.28	670.36	0.02	0.01
Dangau	0.91	6.93	162.15	0.01	0.01
Huedin	1.47	7.66	135.75	0.01	0.01
Alunis	0.44	7.78	437.42	0.01	0.01

From the observation of the results summarized in table 1, it can be seen that the value of electrical conductivity for all types of drinking water do not exceed the limits indicated by the legislation (2500 µS/cm). Conductivity is often used as another indicator of the abundance of dissolved inorganic compounds or total concentration of cations and anions (Neskovic et al., 2015).

The concentration of ammonium and nitrites was very low at all drinking water samples (Table 1).

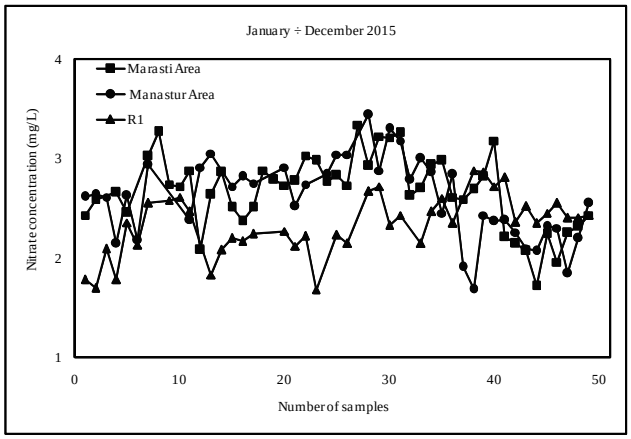

Figure 1. The variation of nitrate concentration of drinking water from Cluj Napoca city and R1- the entrance to the distribution system.

The figure 1 shows that the variation of nitrate concentration of drinking water from the different areas of the Cluj Napoca city (Manastur, Marasti) and R1 - the entrance to the distribution system. The nitrate concentration of the drinking water samples is low, varied from 1.68 and 3.44 mg/L which is an indication that the water is from surface source.

Drinking water from Grigorescu Area is surface water and groundwater in combination, were confirmed by the presence of high nitrate concentration comparative with surface water (Fig. 2). However, is in accordance with Legislation (50mg/L). On the other hand, the US Environmental Protection Agency (EPA) has set a maximum contaminant level (MCL) for nitrates at 10 mg/L.

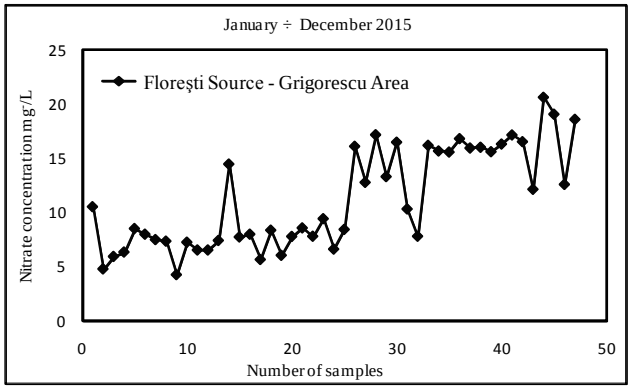

Figure 2. The variation of nitrate concentration of drinking water from Cluj Napoca city –Grigorescu Area.

It was observed that the nitrate concentration from Capusu Mare and Dangau Mare samples is high comparative with Baisoara samples (Fig. 3), besides all are groundwater source. Baisoara is a village located in forestry areas with an estimated population of about 1940 inhabitants.

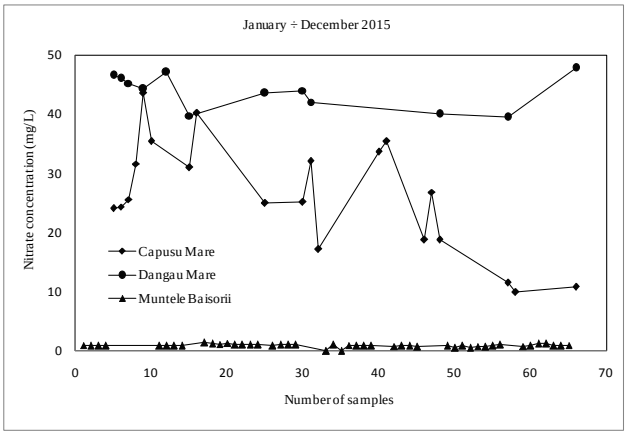

Figure 3. The variation of nitrate concentration of drinking water from localities: Capusu Mare, Dangau Mare, Baisoara.

The absolute values given here are specific for

the groundwater and have significant relationship and directly indicate organic pollutant load in groundwater system.

High nitrate concentration it is correlated with high electrical conductivity (670.36µS/cm for Capus). Nitrat concentration from Dangau Mare and Capusu Mare samples not exceed the limits indicated by the legislation (50mg/L), but are greater than the maximum contaminant level (MCL) 10 mg/L recommended of EPA (US Environmental Protection Agency). The presence of nitrates can pose serious health risks, especially for infants and pregnant women (Moşneag et al., 2013; Wanga et al., 2006).

Dangau Mare and Capusu Mare are localities with influence of agricultural, cropping systems, application of nitrogenous fertilizer, the pesticides and habitational activities.

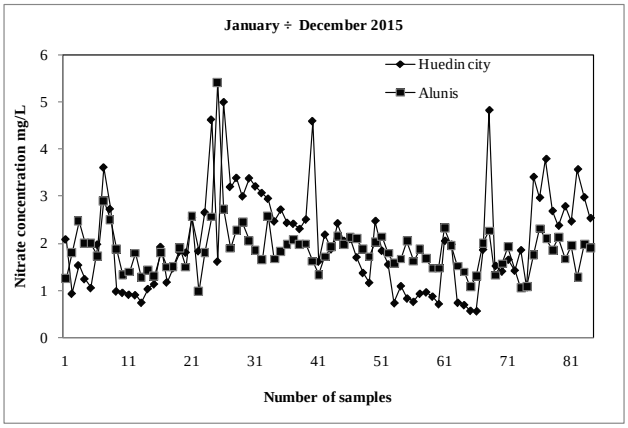

Figure 4. The variation of nitrate concentration of drinking water from Huedin city and Alunis.

Intensification of agriculture is believed to be one of the major causes of NO_3^- contamination of groundwater, especially in the regions where large quantities of inorganic nitrogenous fertilizers are used (Kundu et al., (2009). Similar positive correlation between the concentration of NO_3-N in groundwater and the rate of fertilizer application was reported by Thorburn et al., (2003) in Australia and Almasri (2007) in Palestine.

Huedin is a small city from Cluj county, were the drinking water is surface water with low concentration of nitrat, range values are 0.57-4.99 mg/L (Fig. 4). Drinking water from Alunis is source of groundwater and the samples had values between 0.99-5.42 mg/L (Fig.4).

4. CONCLUSIONS

Nitrate is an important water quality parameter and was measured in the drinking water samples.

The high variability of nitrate concentration is observed, especially in the drinking water from groundwater (Capusu Mare, Dangau Mare, Grigorescu Area) in comparison to the drinking water from surface water (R1, Manasur Area and Marasti Area). The nitrate concentration from Capusu Mare and Dangau Mare samples are greater than the maximum contaminant level (MCL) 10 mg/L recommended of EPA, but not were greater than the maximum level (50mg/L). Nitrate concentration was observed in the ranged between 1.68 - 3.34 in the drinking water from surface water and 4.78-47.81 in the drinking water from groundwater. On the other hand, the drinking water from Muntele Baisorii and Alunis contain very low concentrations of nitrate, although are groundwater source.

It can be concluded that is an essentially differences between drinking water from surface source comparison with groundwater source.

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