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THE PRESENCE OF DISSOLVED ANIONS IN SEVERAL WELL WATER SAMPLES FROM NADĂŞ VILLAGE (CLUJ COUNTY)

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ABSTRACT. The main objective of the present study was to determinate the quality of well water by analyzing the presence of dissolved anions from several well water samples from a rural area. The samples were taken from Nadăş village, located in Crisul Repede village, Cluj County. At the beginning of the study there were 17 wells selected, but only 10 private wells have been chosen (W1, W3, W4, W5, W6, W7, W12, W13, W15, W16) for the analysis of dissolved anions content: F^-, Cl^-, NO_3^-, NO_2^- , PO_4^{-3}, SO_4^{-2}. The wells were selected according to the electrical conductivity (EC) values that ranged between 409 µS/cm (W12) and 1251 µS/cm (W4). EC was within the MPL (maximum permissible limit) set by national legislation which is 2500 µS/cm. In the water samples taken from W1, W5, W6, W7 nitrate exceeded the MPL (50 mg/ L according to the national legislation). In the water sample from W6 nitrite exceeded the MPL (0.5 mg/ L according to the national legislation). In the water sample from W1 sulphate exceeded the MPL (250 mg/ L according to the national legislation). The present study indicated that some of the investigated water sources may pose some health problems if the waters are used as drinking water, especially due to the high content of nitrate and nitrite.

Key words: *well water quality, drinking water, electrical conductivity, dissolved anions, rural area*

INTRODUCTION

For the rural population in order to develop a reliable water source or keep it functional, some problems are raised up. This is because the old wells were not decontaminated and restored over time and the introduction of a network source of drinking water needs time.

Nadăş village (46°51 '22.27 '', 23°9'5.53'') is located in Cluj County and it is crossed by the Nadăş River (www.turactiv.ro). The area has a topography that consists in a valley surrounded by hills, having a high of 500-700 meters. Cluj-Napoca (53.5km), Huedin (12 km) and Zalău (73.5 km) are neighbouring towns (Niculescu-Varone, 1935).

MATERIALS AND METHODS

The fieldwork consisted in collecting water samples from wells in sterile polyethylene containers. In the laboratory, after the filtration and dilutions of the samples with millipore water until EC < 100 µS/cm, the dissolved anions were analysed by ion chromatography (DIONEX 1500 IC).

The network sampling is shown in figure1.

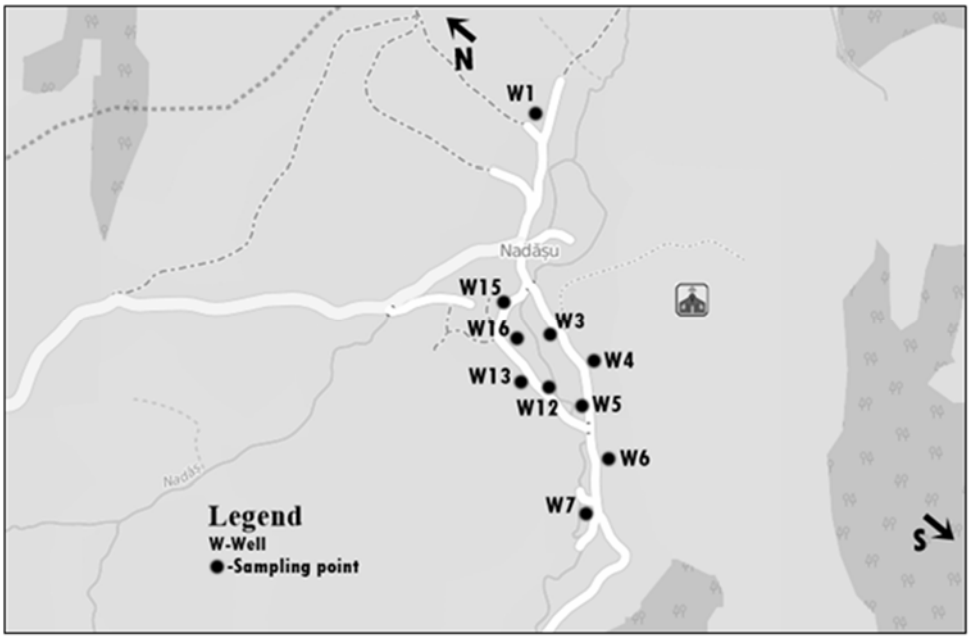

Fig. 1. *Study area (Nadăş Village) with sampling points (modified after www.turactiv.ro)*

RESULTS AND DISCUSSIONS

Electrical conductivity is the property of material to allow the passage of electric current and according to Law 458/08.07.2002 the MPL (maximum permissible limit) is 2500 µS/cm. The lowest value (409 µS/cm) was observed in sample W12, while the highest value (1251 µS/ cm) was detected in W4 sample. As it can be seen in figure 2 the other samples had values that ranged significantly. All analysed water samples proved to have a low EC level, below the MPL according to national legislation.

It is known that collected groundwater samples from wells had a different ionic composition than the samples collected from springs, also that there are many natural factors that can affect groundwater quality.

Fluorine was found in all natural groundwater sources at different concentrations, depending on type of soil and minerals. Fluorine is a chemical that has a significant effect in drinking water, because affects humans in different ways. At a low concentration in the drinking water has a beneficial effect for teeth, but if the concentration is higher than maximum allowable concentration (1.2 mg/L according to Law 458/2002) combined with other substances it may cause seriously health problems (Fawell et al., 2006).

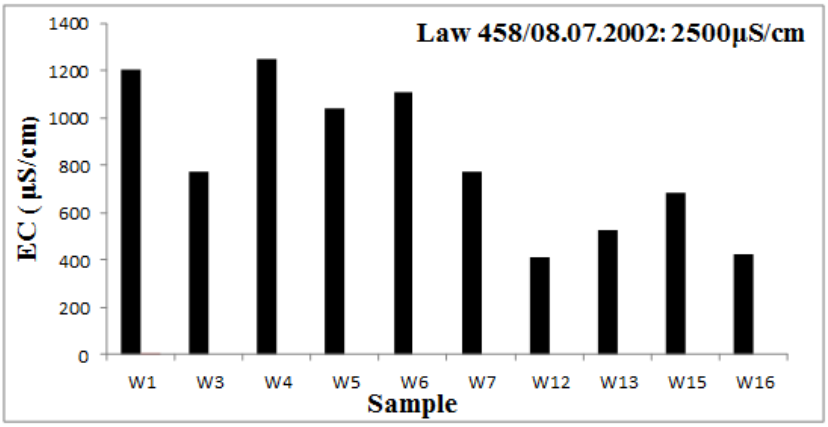

Fig. 2. *Electrical conductivity values depending on the sampling points*

In the present study the fluorine values were within the MAC according to the national legislation as it can be seen in figure 3.

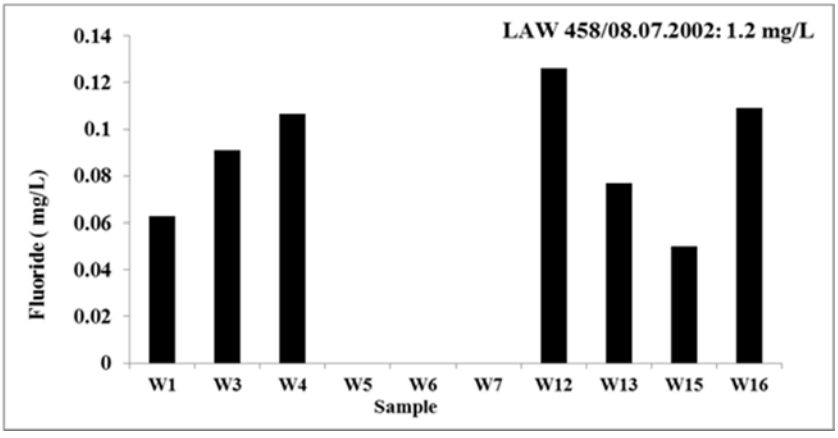

Fig. 3. *Fluorine values depending on the sampling points*

The chlorine concentration in nature is based on sodium salts (NaCl), potassium (KCl) or calcium ($CaCl_2$). A high concentration of chloride can affect the water taste. The pollution of groundwater sources with chlorine can be both natural and anthropic. There is only little information about the impact of chloride on human health (Fawell et al., 1996). In the present study the chlorine concentration was within the MPL, the sample W12 had the lowest value 13.9 mg/ L and the sample W4 had the highest value 190.03 mg/L (figure 4).

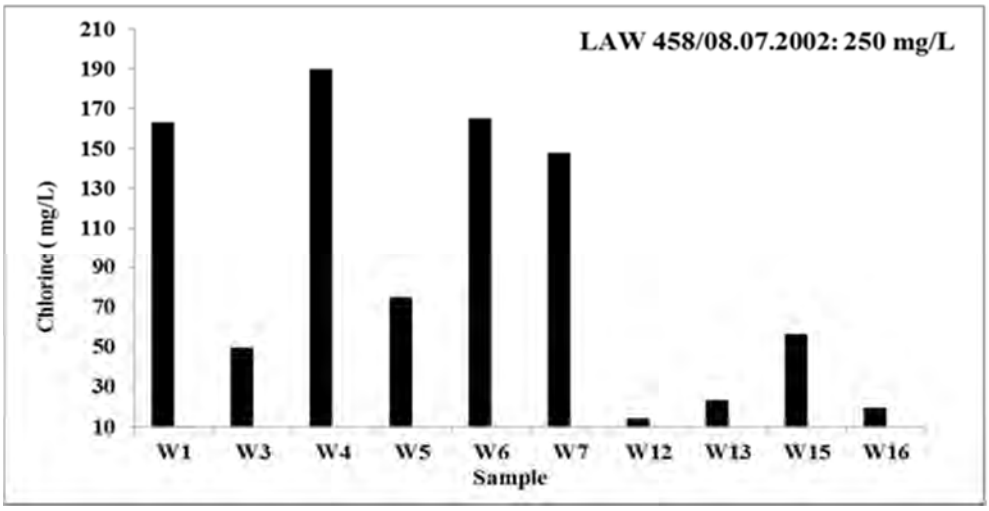

Fig. 4. *Chlorine values depending on the sampling points*

Nitrogen is a chemical element whose presence in groundwater at low level does not cause health problems. Nitrate and nitrite are two chemicals, two different forms of nitrogen that at high concentrations can cause health problems.

A high level of nitrate in drinking water is often caused by contamination from animal waste excessive use of fertilizers, or because of the human sewage systems.

Microorganisms from water change the nitrate to nitrite. Nitrite is also dangerous and harms the human health because it causes methemoglobinemia, the body is deprived by oxygen and it will not function in a proper way (Lewis, 2000).

In the present study nitrate had the lowest value (6.03 mg/ L) in the sample W16 and highest value (249.67 mg/L) in the sample W1. In the samples W1, W5, W6, W7 nitrate exceeded the MPL (50 mg/L). Nitrite was detected in only one sample (W6) which had a level of 1.616 mg/L that exceeded the MPL (figure 5).

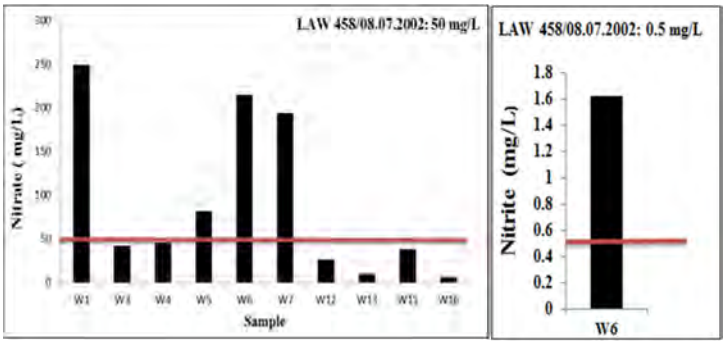

Fig. 5. *Nitrate and nitrite values depending on the sampling points*

Phosphates are formed from phosphorus element, which is an essential nutrient for all life forms and it is the most abundant mineral from the Earth's crust. For people and animals phosphate is not toxic, but may cause digestive problems if it is found in a extremely high concentration in drinking water (Kotoski, 1997).

In the national legislation is still not specified a maximum allowable concentration value for phosphate.

In only one sample (W5) phosphate was discovered above 1 mg/L, as it can be seen in figure 6.

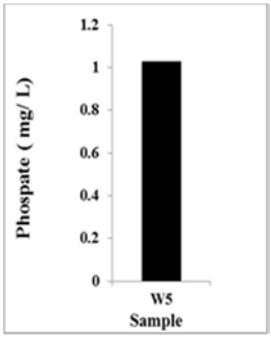

Fig. 6. *Phosphate value*

Sulphates exist naturally in numerous dissolved minerals that are found in drinking water sources. The studies show that in case of a short exposure to high sulphate concentrations from drinking water, there are no adverse effects other than diarrhoea. However, a long exposure to high sulphate concentration can cause adverse human health effects and it is very dangerous for children because of the dehydration from the diarrhoea may do much harm for the human body (Fawell and Mascarenhas, 2003).

In the present study the sample W16 had the lowest value 67.69 mg/ L and the sample W1 had the highest value 272.54 mg/ L. W1 exceeded the MPL (250 mg/ L) according to the national legislation as it can be seen in figure 7.

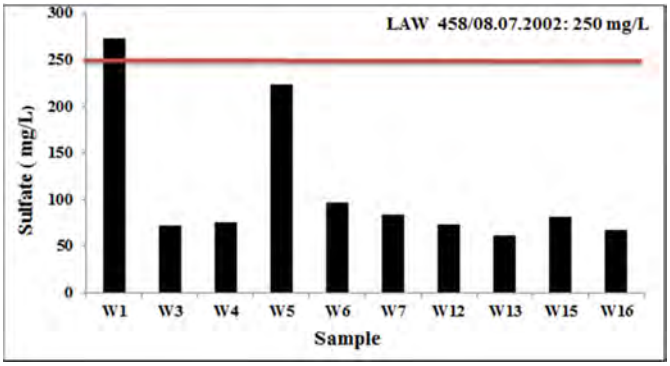

Fig. 7. *Sulphate values depending on the sampling points*

CONCLUSIONS

The laboratory analysis showed that the electrical conductivity values were lower than the MPL (2500µS/ cm) for all the analysed groundwater, according to national legislation (Law 458, from 08.07.2002). EC ranged between 409 µS/ cm (W12) and 1251 µS/ cm (W4).

The samples W1, W5, W6, W7 exceeded the MPL for nitrate (50 mg/L according to the national legislation. The nitrite concentration exceeded the MPL in case of groundwater collected from well W6. Only one sample (W1) exceeded the MPL for sulphate (250 mg/L according to the national legislation). In only one sample (W5) phosphate was discovered above 1 mg/ L.

The present study indicated that some of the investigated water sources may pose some health problems for the people who use the investigated water as drinking water.

People should be announced about the results, the groundwater sources should be monitored in order to observe some changes in chemical composition.

In the nearby future people should use water filters special made for well if they use the groundwater as drinking water, restructuring the wells and their wooden walls, using concrete, cement, brick or stone, using caps or roof construction to protect well water from polluted atmospheric precipitations.

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