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QUALITY OF UNDERGROUND WATER IN LUBLIN IN RELATION TO A SUPPLY POINT

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Abstract

The study was conducted on water supplied to inhabitants of Lublin. Samples of water were taken from 8 water supply points every three months of 2005. The content of Fe, Mn, Cr, Zn, Cd, Cu, Pb, Na, Mg, Ca ions and SO_4^{2-}, Cl^-, Cl_2, NH_4^+, NO_2^-, NO_3^- i F^- was determined. It was found out that tap water in Lublin is of very good nutritive quality. Owing to its high concentration of calcium and magnesium ions it can be classified as mineral water.

Key words: water, Lublin, metal ions, anions.

JAKOŚĆ WODY Z ZASOBÓW WÓD PODZIEMNYCH LUBLINA W ZALEŻNOŚCI OD MIEJSCA POBORU

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Abstrakt

Przeprowadzono badania wody, w którą zaopatrywani są mieszkańcy Lublina. W 2005 r. próbki pobierano co kwartał z 8 miejsc złoża podziemnego. Oznaczono w wodzie zawartość jonów: Fe, Mn, Cr, Zn, Cd, Cu, Pb, Na, Mg, Ca oraz SO_4^{2-}, Cl^-, Cl_2, NH_4^+, NO_2^-, NO_3^- i F^-. Stwierdzono, że badana woda charakteryzuje się bardzo dobrą jakością do celów spożywczych. Duża zawartość jonów wapnia i magnezu umożliwia zakwalifikowanie jej do wód mineralnych.

Słowa kluczowe: woda, Lublin, jony metali, aniony.

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INTRODUCTION

Water is not only an essential ingredient of the living matter, but it is also a stimulus of certain processes that condition organic life. When flowing through the ground, water dissolves, oxidates and hydrolizes chemical compounds transforming them into forms more easily absorbable by living organisms. Water, therefore, is an environment for migration of the majority of chemical elements in nature. Elements migrate in water in the form of ions, molecules, chelate compounds and colloidal particles (PASIUK-BRONIKOWSKA 1999, ZABIEGAŁA et al. 1999, ŚWIDERSKA-BRÓŻ 2001).

Both drinking water and water for household purposes must maintain quality standrads in compliance with norms established by corresponding regulations (WHO Regulations 1998, ZERBE 1999, KUŁAKOWSKI 2003, RYBICKI 2003). Water must not contain any toxic or health-harmful substances; neither can it contain any substances that influence its taste and appearance. Water should be translucent, colourless, odourless and it should have a refreshing taste. It should also contain the proper amount of the elements vital to the normal functioning of an organism (e.g. F, Ca, Mg).

The inhabitants of Lublin (c. 360.000 people) use groundwater supplies solely, of the chalk layer mainly. The age of this water, which is about 30 years, guarantees its high mineral content, stable composition and purification of surface and rainwater substances (WILGAT 1998, 1999). The quality of drinking water must comply with the norms stipulated by the Decree by the Minister of Health (JoL. ,Nr 203, pos. 1718). That is why water analysis is necessary, both in supply points and at customers' households (Fe_{total} 0.2, Mg^{2+} 125, F^- 1.5, Mn^{2+}0.05, Cr^{3+}0.05, Pb^{2+} 0.05, Zn^{2+} 5, Cd^{2+} 0.003, Cu^{2+} 2, Na^+ 200, SO_4^{2-} 250, Cl^- 1.5, F^- 1.5, Cl_2 0.3 $mg \cdot dm^{-3}$) This work contains the results of research on groundwater carried out in 8 points of supply and conducted every quarter of the year 2005.

MATERIAL AND METHODS

Water-samples for the analyses were collected in February, June, September and December 2005 in 8 points of water supply: 1 – Centralna pump station, 2 – Felin, 3 – Felin dormitories, 4 – Zemborzycka, 5 – Bursaki, 6 – Dziesiąta, 7 – Sławinek, 8 – Wrotków. The ion content of water was determined using the nuclear absorption spectrometry method; the following ions were found: Fe, Mn, Cr, Zn, Cd, Cu, Pb, Na, Mg, Ca. The remaining ingredients were determined using the following methods: SO_4^{2-} potentiometric method, Cl^- – measurement method, $AgNO_3$, Cl_2 – iodometric method, N-NH_4 – colorimetric indofenol method, $N\text{-}NO_2$ – fotometric method based on the reaction with hydrogensulphanilamide and N-1 – keroseneetylenediamine, $N\text{-}NO_3$ – colorimetric with sodium salicylate, F^- – fotometric based on the reaction with alizarinzirconium lacque. Potentiometric method was employed for testing water pH.

RESULTS AND THEIR ANALYSIS

In all the points of supply, water had more or less the same acidity, with pH around 7.1–7.4. Among the tested ions of metals no Cr, Cd and Pb ions were detected in the water. Mn ions were detected in one point of supply (Centralna) amounting to 0.021–0.025 $mg \cdot dm^{-3}$. Cu ions were detected randomly in 3 points of supply (Centralna, Felin dormitories, Sławinkowska) amounting to 0.05, 0.015 and 0.025 $mg \cdot dm^{-3}$. Na ion content was different in corresponding points of supply – from 8.55 to 21.48 $mg \cdot dm^{-3}$. Yet, in all the points the Na content was on a similar level (Figure 1*a*).

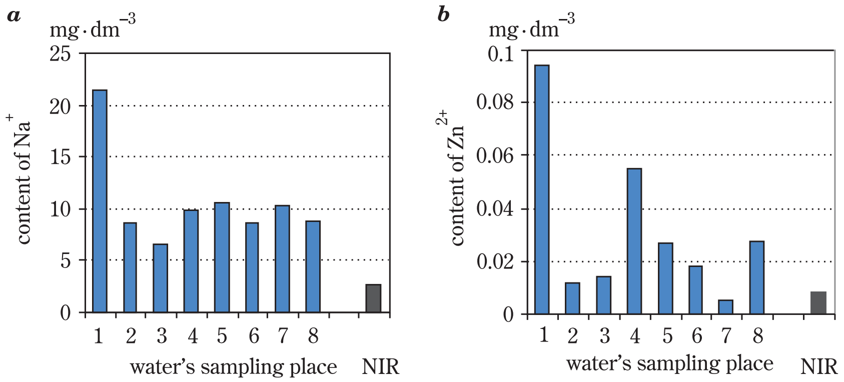

Fig. 1. Averange amounts of Na^+ (*a*) and Zn^{2+} (*b*) ions in water from different places of Lublin: 1– Central pump station, 2 – Felin, 3 – Felin dormitories , 4 – Zemborzycka, 5 – Bursaki, 6 – Dziesiąta, 7 – Sławinek, 8 – Wrotków

The Zn ion content was extremely varied in water from different points of supply, ranging from 0.005 to 0.098 $mg \cdot dm^{-3}$. In the samples from the Bursaki supply point the difference in the Zn ion content was double. Water from the remaining points of supply contained comparable Zn ion content in diverse periods of sampling (Figure 1*b*).

Only in 3 points of supply (Zemborzycka, Bursaki, Sławinek) was the Fe ion content below 0.02 $mg \cdot dm^{-3}$; in all the remaining points of supply it ranged from 0.048 to 0.094 $mg \cdot dm^3$ (Figure 2*a*).

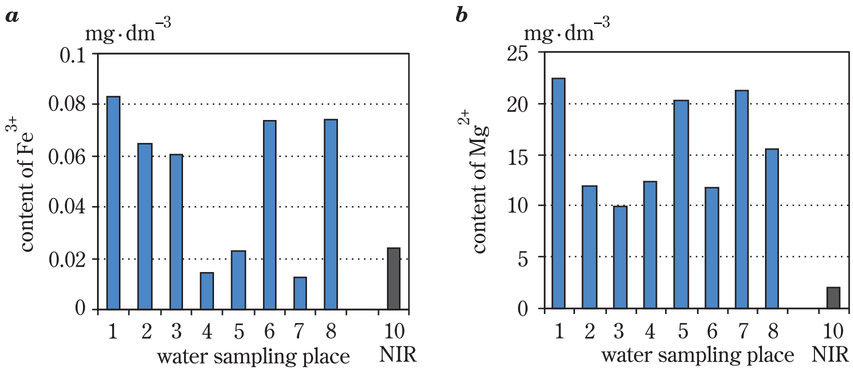

Fig. 2. Averange amounts of Fe^{3+} (*a*) and Mg^{2+} (*b*) ions in water from different places of Lublin: 1– Central pump station, 2 – Felin, 3 – Felin dormitories , 4 – Zemborzycka, 5 – Bursaki, 6 – Dziesiąta, 7 – Sławinek, 8 – Wrotków

Water from various supply points contained from 9.7 to 22.6 mg·dm^{-3} of Mg ions. Nonetheless, all the points of supply were characterized by the Mg ion content on a comparable level (Figure 2b).

Among the water ingredients, attention is drawn to calcium and magnesium ions. In all the points of supply the total content of Ca ions was stable and equalled from 300 to 406 mg·dm^{-3} (Figure 3*a*).

Nitrogen was detected in the tested samples only in the form of N-NH_4 and N-NO_2 in the Centralna supply point in the amounts of 0.10–0.18 and 0.003–0.007 mg·dm^{-3}, respectively. On the other hand, the N-NO_3 content was much more diversified – from 1.14 to 26.4 mg·dm^{-3} .In the water from the Bursaki supply point it amounted from 21.8 to 26.4 mg·dm^{-3}, which was several-fold higher than the N-NO_3 content in the water from the remaining points of

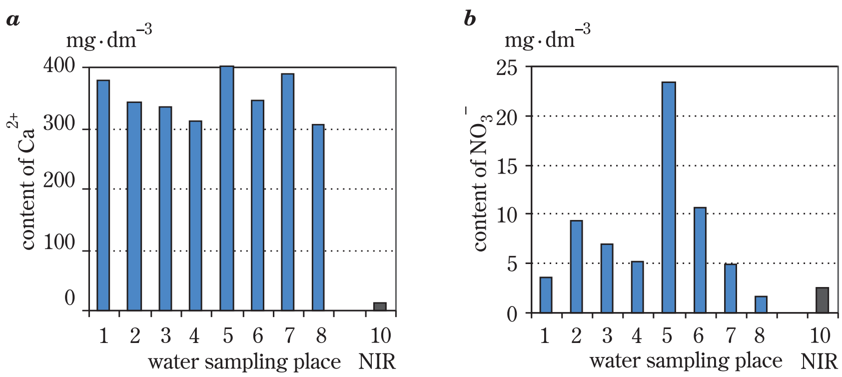

Fig. 3. Averange amounts of Ca^{2+} (*a*) and NO_3^- (*b*) ions in water from different places of Lublin: 1– Central pump station, 2 – Felin, 3 – Felin dormitories , 4 – Zemborzycka, 5 – Bursaki, 6 – Dziesiąta, 7 – Sławinek, 8 – Wrotków

supply. The water from the Wrotków supply point is characterised by its very low N-NO_3 content – below 1.94 mg·dm^{-3} (Figure 3*b*).

The SO_4^{2-} ion content in the samples varied from 22 to 48 mg·dm^{-3} and was the lowest in the Wrotków supply point – from 22 to 26 mg·dm^{-3} (Figure 4*a*).

The amount of F^- ions was comparable in the water from all the supply points in corresponding periods of time. The average F^- ion content varied from 0.26 to 0.42 mg·dm^{-3} (Figure 4*b*).

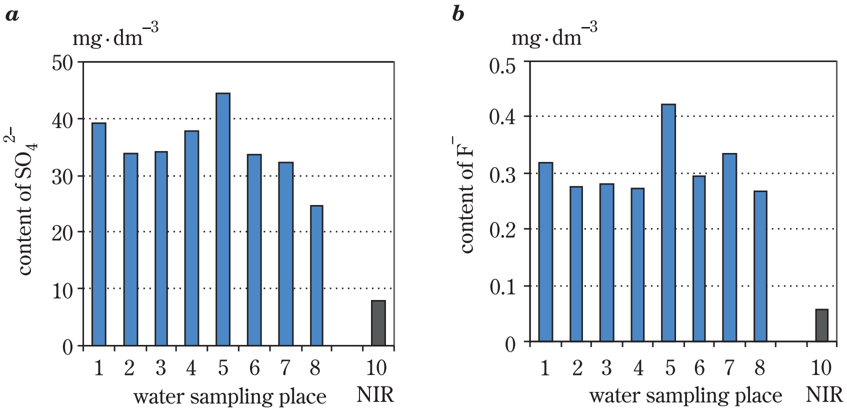

Fig. 4. Averange amounts of SO_4^{2-} (*a*) and F^- (*b*) ions in water from different places of Lublin: 1– Central pump station, 2 – Felin, 3 – Felin dormitories , 4 – Zemborzycka, 5 – Bursaki, 6 – Dziesiąta, 7 – Sławinek, 8 – Wrotków

Chlorine in the form of Cl^- was found in water from only 3 supply points (Sławinek, Zemborzycka, Felin dormitories) and its amount ranged from 20 to 37.1 mg·dm^{-3} (Figure 5*a*).

In 6 supply points chlorine Cl_2 was detected below 0.10 mg·dm^{-3} and only in 2 supply points (Centralna and Felin) it reached 0.10-0.30 mg·dm^{-3} (Figure 5*b*).

Because the water-pipe network in Lublin covers a large area, water supplied to the network is disinfected with chlorine and chlorate(I) and in the Dziesiąta station it is treated with UV rays. Different disinfection methods find their reflection in the free chlorine content.

Being one of the basic components of the environment, water is most prone to pollution and threatened by contamination (Jackowska, Piotrowski 1996, Szpakowska, Karlik 1996, Hoffman, Pieczyński 1998). However, the recently observed improvement of the quality of groundwater proves the efficiency of wide-scale environment protection enterprises. Limiting both the number of sources of pollution and the amount of pollutants emitted decreases both the potential and real danger of the degradation of groundwater supplies (Pawełek 2000, Zabiegała et al., *Report on the condition of the environment of the Lublin region in the year 2002).*

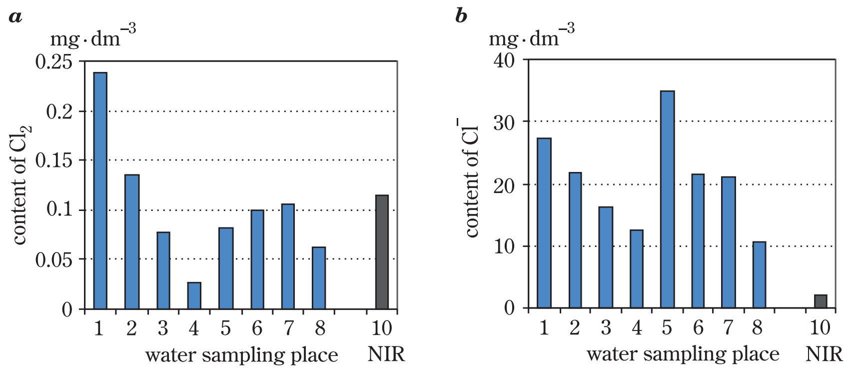

Fig. 5. Averange amounts of Cl_2 (*a*) and Cl^- (*b*) ions in water from different places of Lublin: 1– Central pump station, 2 – Felin, 3 – Felin dormitories , 4 – Zemborzycka, 5 – Bursaki, 6 – Dziesiąta, 7 – Sławinek, 8 – Wrotków

In general, groundwater is of good quality; better than surface water. Rational use of groundwater supplies guarantees their preservation for future generations (CHEŁMICKI 2001, PAWEŁEK 2000). Especially so, when taking into account the fact that the consumption of groundwater by industry is steadily falling. In 2001 the consumption for these purposes was 35% lower than in 1996 (*Report on the condition of the environment of the Lublin region in the year 2002)*.

The research carried out in Lublin proved that the utility water layers of the region have maintained almost intact natural purity. The research also brought evidence that natural waters, being both the source of drinking water and water for domestic purposes, are solutions of mineral salts and dissolved gases, proportions of which depend on the water's origin.

CONCLUSIONS

1. Water in Lublin is characterised by very good quality due to the sources it is obtained from.

2. The composition of water is stable in every point of supply.

3. The content of the tested ingredients does not exceed the amounts allowed for drinking water.

4. High calcium and magnesium content makes it possible to classify water in Lublin among mineral waters.

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