ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN-POLONIA
VOL. LXI, N1, 20 SECTIO D 2006

Department of Hygiene, Medical University of Lublin
Clinic of Internal and Occupational Diseases and Toxicology, Institute of Rural Medicine

ALICJA WÓJCIK, SYLWIA SEMPOCH, ZDZISŁAW BRZESKI, ANDRZEJ BORZĘCKI

Monitoring of the drinking water quality on the selected area of the Lublin macroregion

Water is one of the most important elements of the environment in which man lives. It belongs to those biosphere resources that are characterised by considerable lability. Lability of water and its chemical qualities that make easier dissolving of numerous substances in water causes that it is a very important means of transport and exchange of mass in the biosphere. Thanks to that, it is part of the majority of biogeochemical cycles of mass circulation. Water plays an important part as a factor creating climate and it is a basic component of organisms and their environment. Thanks to its special physical-chemical qualities it acts as a dissolvent and environment in which chemical reactions take place. These reactions are the foundation for life processes. Changes in water content in the organism and its distribution in particular organs lead to disturbance of internal environment stability, disturbances in the course of reactions and disorders in cell functioning.

Water is essential for keeping up life and hygiene and it must be available in satisfactory amount and proper quality. Water resources should be protected against all kinds of chemical pollution and against pollutants that may contain pathogenic bacteria, viruses, protozoa and intestinal parasites. Hygienic and sanitary neglect during water delivery to the consumer, ways of water conditioning and improper control may contribute to the development of many diseases among people. The threat concerns both toxic substances with the ability to accumulate in the organism and microbiological pollution. Maintenance of proper rules of hygienic water delivery, the used way of disinfection and control of its quality at water conditioning stations should make an important element of prevention.

Assuring sufficient amount of water of proper quality is an essential condition of civilisation progress both in the city and in the country. In the city the economic and health importance of water is particularly high. Environmental conditions and the character of work on land create big demand for water. Emission of pollution coming from industry, transport and chemicalization of agriculture causes large contamination of natural waters in rural areas. Because of their high noxiousness and durability in the environment, pesticides, fertilisers, heavy metals, detergents and also nitrates – precursors of mutagenic nitrosoamines are dangerous for human health. (1, 4, 6, 7, 10).

The aim of the undertaken research was monitoring of the quality of drinking water and water for household needs of a selected agricultural region in the macroregion of Lublin.

MATERIAL AND METHODS

The research into water quality was conducted on water from water lines situated in towns on the Vistula belonging to the commune of Wilków (Lubomirka, Rogów, Wilków). The research was conducted in the Laboratory of Physical, Chemical and Microbiological Study of Water of the Sanitary-Epidemiological Station in Opole Lubelskie in the area of review and control monitoring (15). The results of the research concern the analyses in the years 2000–2003 and in quarter I of 2004. Within physical and chemical studies there were evaluated: water colour, opacity, reaction, con-

ductivity, smell, ammonia, nitrites, nitrates, manganese, iron, fluorine, lead, cadmium, chromium, arsenic, hardness and oxidation. Notation was made in accordance with obligatory methods of Polish Standards. Microbiological study concerned determination of general contents of living organisms, bacteria of *Escherichia Coli* group and of *enterococcus* by method of membrane filters (FM) and tube method according to generally recognised rules of Polish Standards.

RESULTS

From the analyses conducted in 2000–2004 concerning water from water lines situated in the commune of Wilków (Lubomirka, Rogów, Wilków) it appears that water delivered to the inhabitants meets the requirements of water intended for consumption by people. Periodically, there occurred slight deviation from the norm of some physical, chemical or bacteriological parameters that did not have any influence on people's health. Periodical exceeding of bacteriological parameters was removed by using disinfection of the network done on the spot. The study of water from private wells, especially dug ones, indicates poor health quality of water. In the case of lack of water network on a given area, it is recommended to use water only from drilled (deep) wells and not from dug wells of small depth.

The sanitary and technical state of the water line Lubomirka from 2000 to 2004 does not arouse any reservations. Apart from few examples (increased iron content in 2000 and 2001), physical, chemical and bacteriological parameters did not reveal any exceeding of obligatory standards. In November 2002 there occurred twice microbiological parameters not in accordance with the norm (bacteria of *Coli* group and general number of bacteria at 22 °C after 72 hours). The observed contamination appeared in connection with the expansion of a water line, to which new towns were connected (Zastów Karczmiski and Zarudki) (Fig.1, 4).

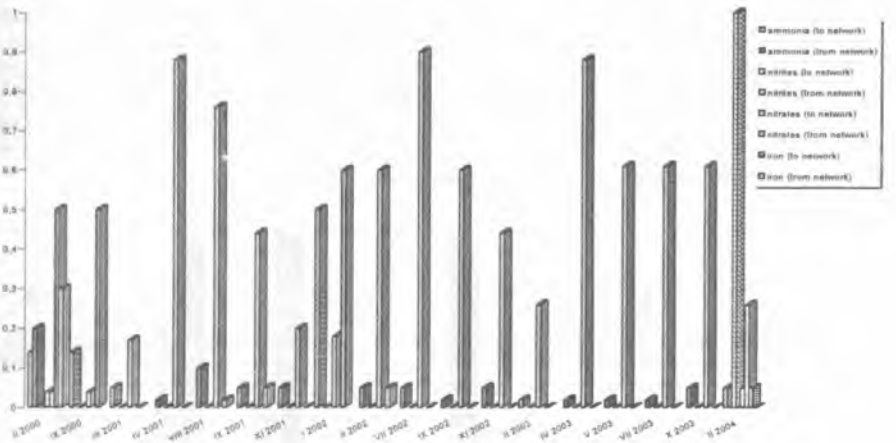

Fig.1. Values of selected chemical features determined in water from the water line of Lubomirka in 2000–2004

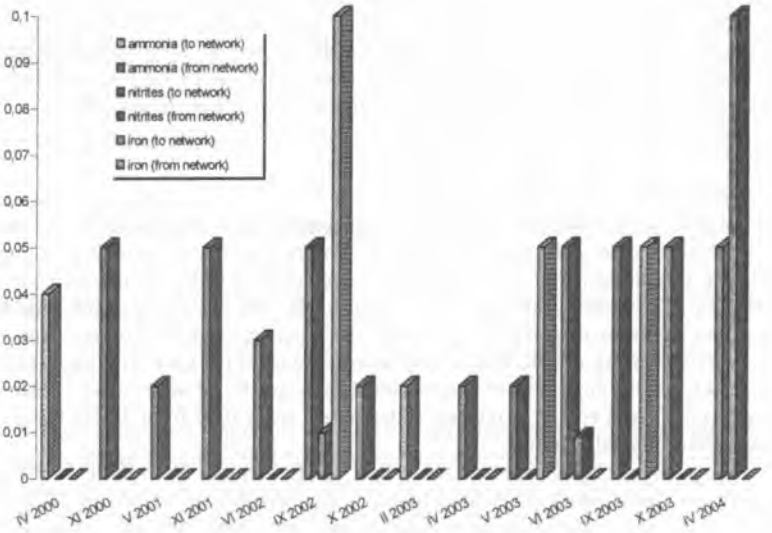

Fig. 2. Values of selected chemical features determined in water from the water line of Rogów in 2000–2004

The sanitary and technical state of the water line Rogów from 2000 to 2004 was without any reservations. The studied physical, chemical and bacteriological parameters did not reveal any exceeding of obligatory standards (Fig. 2, 4). In Wilków the results of physical and chemical study of water line in 2000 did not reveal any exceeding of permissible values. In June this year the bacteriological study showed the exceeding of obligatory standard of the general number of bacteria at 22°C after 72 hours. In 2001 there were found biological parameters not compatible with the norm. In view of the flood in 2001 and the localisation of the public water line in Wilków on the area endangered by the flood, the water line was closed (Fig. 3, 4).

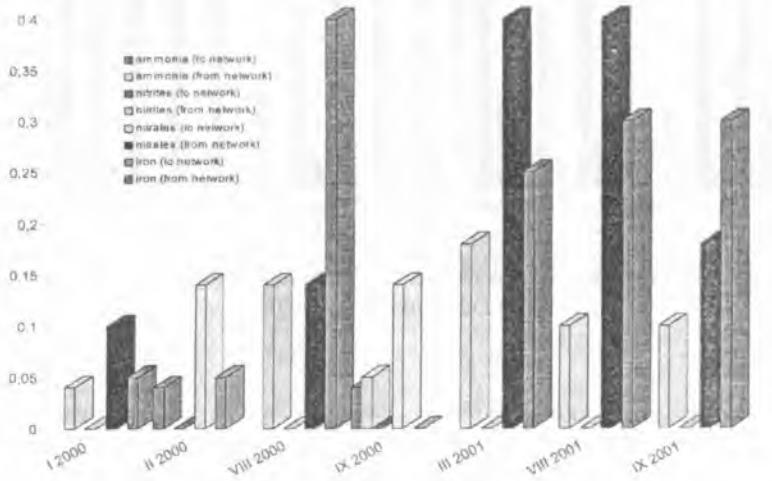

Fig. 3. Values of selected chemical features determined in water from the water line of Wilków in 2000–2001

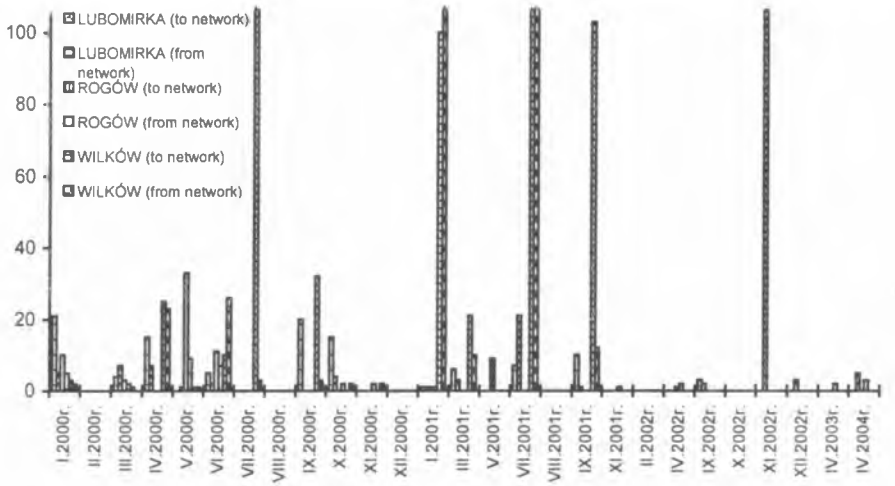

Fig. 4. General number of bacteria at 22°c after 72 h determined in water from water lines in Lubomirka, Rogów and Wilków in 2000 – 2004

Because of the flood in 2001, additional physical, chemical and bacteriological studies were conducted, concerning the water taken from private wells situated near the Vistula. Above water–bearing layers in this region there are deposits of permeable sands and thus it appears that the flood could have an influence on the worsening of the quality of underground water, especially in dug wells. It was found that there was exceeding of permissible ranges of values with the following parameters: opacity, ammonia, iron, water hardness, thermotolerant bacteria of *Coli* group (stercorous type) and the general number of bacteria at 37°C after 72 hours. The remaining parameters were within the standards. It was found that dug wells had improper results, especially bacteriological and that there was exceeding of the iron value in 4 wells (Fig. 5, 6).

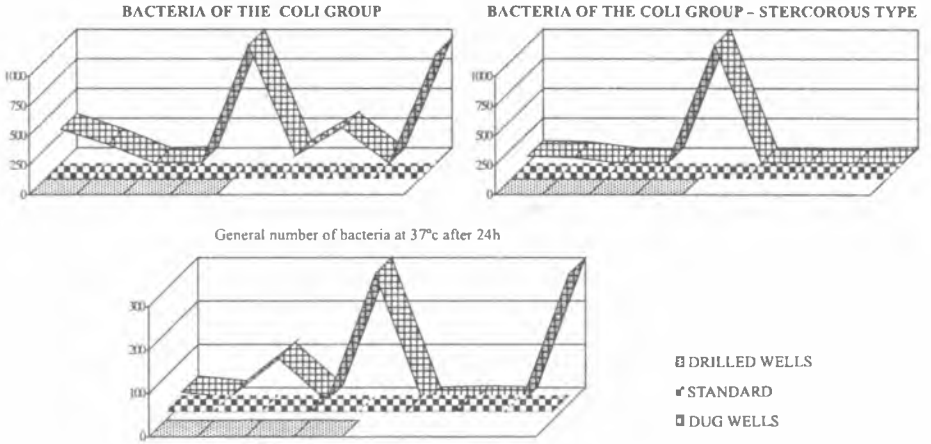

Fig. 5. Comparison of bacteriological parameters determined in water from private drilled and dug wells during flood in 2001 within the commune of Wilków

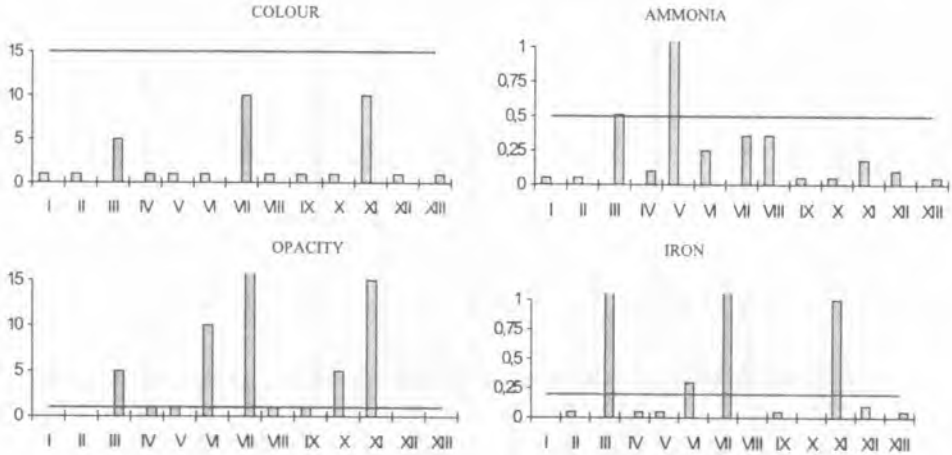

Fig. 6. Values of selected physical-chemical features determined in drinking water from private wells during flood in 2001 within the commune Wilków

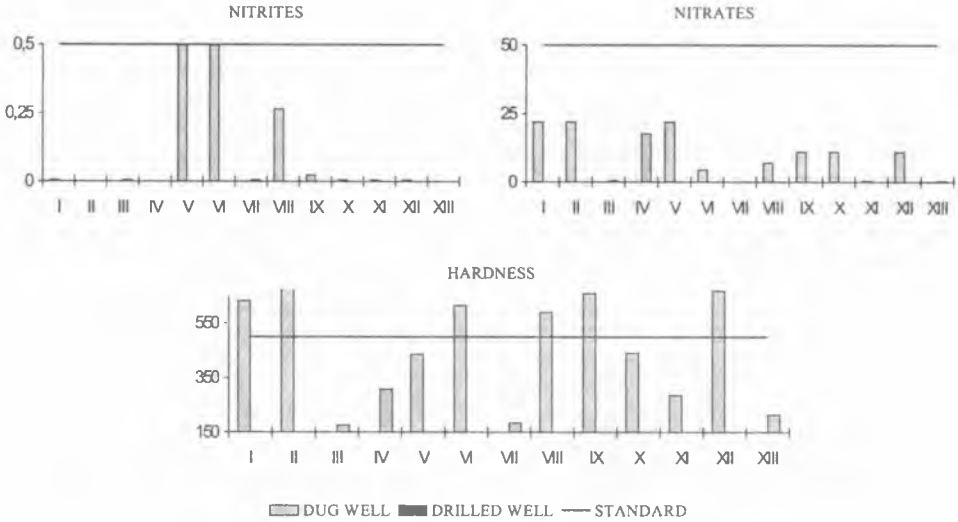

Fig. 6 c.d. Values of selected physical-chemical features determined in drinking water from private wells during flood within the commune of Wilków

DISCUSSION

The main factor shaping life on land is water, for all biological processes demand its presence. The basic aim of hydrosphere protection is setting up rules of rational administering of resources, preventing or counteracting the disturbance of environmental balance and all the changes in water environment, that may result in limitation of utility of resources for people, biotic communities and economy. Insufficient protection of water resources and ineffective water conditioning expose

society to the risk of epidemics of the alimentary tract diseases and other infectious diseases. What is of great importance is a regular control of water quality through the monitoring of hydrosphere and sanitary control of the systems delivering water. In rural environment water is very important for economy and health. Village supply with water is natural to a great extent. In Poland there are regions, especially in the provinces of Lublin, Mazowsze and Kujawy, where the availability of both underground and superficial water is limited due to unfavourable hydrographic conditions (2, 3, 5, 8, 9, 11). Maziarka and co-authors studied water intakes in villages from different regions of the country. They showed very big needs in the area for improvement of water delivery to the villages. In rural areas, where because of industry activities and urbanisation came to disappearance of underground waters or to their considerable contamination, it is not possible to use these waters for the need of people and agriculture. From the study of wells situated near homes conducted by Provincial Sanitary and Epidemiological Station it appears that a lot of water samples show bacterial impurity. The content of heavy metals and some other harmful substances in the studied water is within safe limits. Frequent cases of exceeding of standard values concerned mainly nitrates and organoleptic water indices (12). Tymczyna and co-authors conducted a sanitary-hygienic evaluation of well waters within the action area of Nitrogen Plant "Puławy" in comparison to wells situated on the territory of the health resort of Nałęczów. The studies were being conducted for 5 years. Water for study was taken from 12 wells. Physical and chemical study of water did not reveal big deviations from the norms set up for drinking water both in wells situated in the surroundings of the Nitrogen Plant and Nałęczów. The exception to this were nitrites, nitrates, the content of iron, manganese and opacity. Concentration values of the above mentioned values were higher in the surroundings of the Nitrogen Plant in comparison to waters coming from the surroundings of Nałęczów. The general content of nitric compounds in the studied wells from the region of Puławy is decreasing year by year thanks to investments done for the sake of environment protection in the Nitrogen Plant "Puławy", which to a great extent reduced emission of pollution to atmosphere (14). Szelągowski draws attention to a particularly dangerous phenomenon of large and constantly growing contamination of small rivers, streams and drainage and melioration ditches. These phenomena result from quite dense building development of the outskirts of the cities, in which municipal sewage systems do not function. In recent years individual and joint efforts have been made directed towards improvement in the water delivery to villages and improvement in sanitary conditions of inhabitants of small towns and village settlements. As a result, the consumption of water has increased and in consequence there was an increase in the wastewater. These changes are often accompanied by the lack of the sewage system and a water treatment plant. Thus of great importance is protection from pollution of waters from small rivers, streams and drainage ditches that are sources of big rivers, and being source areas they may cause a direct threat to agricultural areas (13). From the results of analysis conducted in the years 2000–2004 concerning water from water lines situated within the commune of Wilków (Lubomirka, Rogów, Wilków) it appears that the water delivered to the inhabitants meets the standards of water which is intended for consumption. Few deviations from the norm of some physical, chemical or bacteriological parameters that were observed periodically were removed immediately and did not influence people's health. However, the study of water from private wells, especially dug ones, show bad quality, therefore in the case of lack of water-pipe network on a given area, it is recommended to use water only from drilled (deep) wells.

Shaping healthy and proper environment through spatial planning of agricultural areas, water-sewage economy and forest management helps to protect the environment and to protect the health of human population. The role of water factor in the protection and formation of ecosystems is of multifunctional character. In climatic and soil conditions, water is one of the basic and at the same time very important elements of the natural environment.

CONCLUSIONS

1. The sanitary-technical state of water lines from the studied area did not arouse major reservations. A decisive majority of the values of physical, chemical and microbiological features did not show any exceeding of obligatory standards.

2. Slight deviations of iron values, occurring periodically in the studied samples do not have an influence on water quality and health. They only change organoleptic features (colour).

3. Periodical exceeding of microbiological parameters was removed by effective network disinfection done on the spot.

4. Proper frequency of water line control and water study allows keeping good quality of drinking water.

REFERENCES

1. Alloway B.J., Ayres D.C.: Chemiczne podstawy zanieczyszczenia środowisk. PWN, Warszawa 1999.
2. Biblioteka Monitoringu Środowiska .: Raport o stanie środowiska województwa lubelskiego w 2002 r. Lublin 2003.
3. Burzyńska I.: Zanieczyszczenia wód gruntowych i ich wpływ na zdrowie ludzi. Wiad. Zielar., 42, 5, 3, 2000.
4. Chełmicki W.: Woda – zasoby, degradacja, ochrona. PWN, Warszawa 2002.
5. Hermanowicz W., et al.: Fizyczno-chemiczne badania wody do picia i potrzeb gospodarczych. PZWL, Warszawa 1995.
6. Horst A.: Ekologia człowieka. PZWL, Warszawa 1995.
7. Jethon Z.: Medycyna zapobiegawcza i środowiskowa. PZWL, Warszawa 1997.
8. Just J., Hermanowicz W.: Fizyczne i chemiczne badania wody do picia i potrzeb gospodarczych. PZWL, Warszawa 1995.
9. Kowal D. et al.: Ochrona środowiska. UMCS, Lublin 1999.
10. Kurnatowska A.: Ekologia, jej związki z różnymi dziedzinami wiedzy. PWN, Warszawa-Łódź 1997.
11. Lipkowska-Grabowska K., Faron-Lewandowska E.: Pracownia chemiczna : analiza wody i ścieków. WSiP, Warszawa 1998.
12. Maziarka S., Kongiel-Chabło I.: Jakość wody do picia i na potrzeby gospodarcze wsi. Mat. Naukowe Konf. nt. „ Ekosystemy żywicielskie i żywność – zagrożenia i problemy ochrony", Warszawa 9 IV 1991.
13. Szelągowski Z.: Mechanizmy prawno-administracyjne oraz ekonomiczne ochrony wód przed zanieczyszczeniem. Mat. Nauk. Konf. nt. „Ekosystemy żywicielskie i żywność – zagrożenia i problemy ochrony". Warszawa 9 IV 1991.
14. Tymczyna L. et al.: Stan sanitarny wód studziennych w rejonach Puław, Roczn. PZH. 53, (2),17, 2002.
15. Zarząd Gminy Wilków: Studium uwarunkowań i kierunków zagospodarowania przestrzennego gminy Wilków – dokumentacja, stan istniejący. Pracownia Urbanistyczno-Architektoniczna „Widok", Lublin 1999.

SUMMARY

During the period 2000–2004, the studies were conducted of the quality of drinking water and water for household needs in the selected agricultural area in the Lublin Macroregion. The monitoring of physical, chemical and microbiological parameters was carried out according to the Polish Standards in operation. The results of the analyses of water from water supply systems

located in the villages of the Wilków Commune on the Vistula River showed that it fulfilled the requirements for drinking water designed for humans. Slight deviations from the standard concerning some physical and chemical parameters, which were periodically observed, did not affect the quality of water and human health. Bacteriological parameters were temporarily exceeded, however, instantly controlled by the disinfection of the water supply system. Studies of water from private wells, especially dug wells, indicated poor quality of drinking water. In the case of the water supply system in a given area it is recommended that only the water from drilled wells of high depth should be used.

Monitoring jakości wody pitnej wybranego terenu makroregionu lubelskiego

Przeprowadzono badania jakości wody do picia i potrzeb gospodarczych wybranego terenu rolniczego makroregionu lubelskiego w zakresie monitoringu przeglądowego i kontrolnego w latach 2000–2004. Badania parametrów fizykochemicznych i mikrobiologicznych wykonano według obowiązujących Polskich Norm. Z przeprowadzonych analiz wyników badania wody z wodociągów zlokalizowanych w miejscowościach nadwiślańskich gminy Wilków wynika, że odpowiada ona wymaganiom wody przeznaczonej do spożycia przez ludzi. Obserwowane występujące okresowo niewielkie odchylenia od normy niektórych parametrów fizykochemicznych nie miały wpływu na jakość wody i zdrowie ludzi. Czasowe przekroczenia parametrów bakteriologicznych usuwano stosując dezynfekcję sieci w trybie natychmiastowym. Badania wody ze studni prywatnych, a w szczególności kopanych, wskazują na złą jakość zdrowotną wody. W przypadku braku sieci wodociągowej na danym terenie wskazane jest używanie wody tylko ze studni wierconych o dużej głębokości.