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ESTIMATION OF METAL CONTENT AND BACTERIA IN DRINKING WATER

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Abstract: *Metals reach drinking water through various ways, and at certain concentrations they are toxic to the body. In addition to anemia, cancer, kidney problems, these are hepatotoxic. Microorganisms are an indicator for the degree of potability of water. Their presence can lead to gastrointestinal disorders.*
Taking these shortcomings into account, in this paper the bacterial load after 24 hours of incubation on nutrient agar was evaluated and the presence of contaminating bacteria, considered dangerous for the human body, was analyzed. Several special differential media were used to highlight them. Microbiological analysis was performed on water from ten wells. The water that raised microbiological problems was also chemically analyzed. Thus, in addition to the content of sodium (Na) and calcium (Ca), the content of metals in four wells was also monitored. Copper (Cu), cadmium (Cd) and lead (Pb) were absent from the four wells, but the concentration of the other metals varied. Also, the bacterial load varied depending on the pollution sources. In some wells, bacteria with a risk for the consumer have been identified.

• Introduction

In rural areas, drilled wells are a source of drinking water for human and animal consumption, but also for agriculture. Water quality depends on physical, chemical and biological parameters. Their modification is accompanied by the deterioration of quality and the appearance of health problems. Groundwater contamination is the result of chemical treatments from agriculture, abandoned mining areas, industrial activities and improperly stored garbage. Through leaching, the chemical and microbiological composition of the underground water can be changed. Frequent chemical pollutants are metals that accumulate in the food chain, which are difficult to biodegrade and present a high risk to human health and the environment. Polluted water also has a negative effect on animals, plants and the soil. In Romania, drinking water is defined and regulated by Law no. 458 of July 8, 2002 (republished) and Directive Directive (EU) 2020/2184. This study aims to determine the bacteria count in water from ten wells that have been drilled and to identify the types of metals present in some wells that were chosen according to depth. Also, an attempt was made to establish the possible sources of pollution and to inform the owners about the potential health hazards of metals and bacteria.

• Material and method

- **Collection and transport of water samples**

  Water samples were collected from ten households, from the perimeter of Timis county, Romania. The water was collected in clean bottles, hermetically sealed, labeled and transported under appropriate conditions, at low temperatures, to the chemical and microbiological analysis laboratory of the University of Life Sciences "King Mihai I" in Timisoara.

- **Microbiological and chemical analysis**

  The cultural method was used to estimate the bacteria in the water samples. The cultural method is one of the most recommended methods when it comes to a routine evaluation of microorganisms. It is not an expensive method. The bacteria were isolated on nutrient agar, in three repetitions. Undiluted water was inoculated in a quantity of 1 ml/Petri plate. The inoculated Petri dishes were incubated at 37 °C for 24 hours. The results obtained show the number of mesophilic germs and were expressed in CFU •mL-1.

  Analyses of metals and minerals water content was made using ContrAA-300, Analytik-Jena device, as described by Bordean et al, 2010

• Results and discussions

The results indicate an increase in the number of mesophilic bacteria (Fig.1) in some water samples above the limits imposed by the standards in force (table 1). These increases are between 11.4-70% above the values allowed by Law no. 458 of July 8, 2002 (republished) regarding the quality of drinking water .

Table 1 Microbiological parameters according to Law no. 458/2002 (republished)

Parameter	Maximum value allowed
Number of colonies at 22°C	**100/ml**
Number of colonies at 37°C	20/ml
Clostridium perfringens	0/100 ml
Coliform bacteria	0/100 ml
Escherichia coli	0/100 ml
Intestinal enterococci	0/100 ml
Pseudomonas aeruginosa	0/250 ml

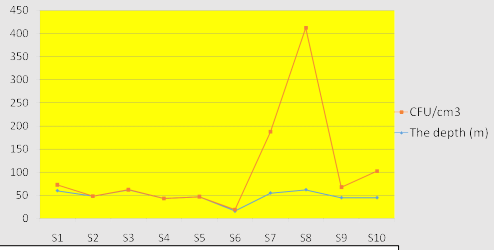

Fig. 1 Estimation of the number of mesophilic bacteria

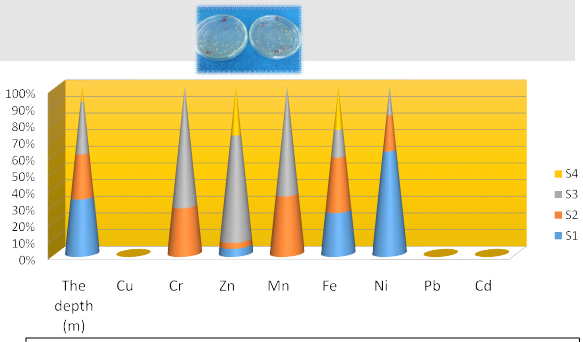

Fig. 2 The concentration of metals (mg/ml) in the water samples

The presence of heavy metals in drinking water may be natural, depending on the geology of the region, but in many cases it is caused by human activity. According to the rules in force, the **Pb** concentration can be 0.01 mg/l, **Cu** 0.1 mg/l and **Cd** 0.005 mg/l. **These three metals were not detected in the analyzed water samples.** The metals that exceeded the legal concentrations are **Cr** (in samples S2, S3), **Ni** (in samples S1-S3), **Mn** (in samples S2 and S3) and **Fe** (fig. 2). The latter is present in all the analyzed samples. Fe and Mn are among the essential elements for humans. To avoid excessive storage of iron in the body, the EU regulated the iron concentration at 5 mg/l. Iron is found naturally in plants and animals. High concentrations of Fe cause cardiovascular problems, diabetes, pulmonary embolism, hemochromatosis, etc. Increased levels of Mn produce emotional and memory disorders, hallucinations, Parkinson's, etc. **Zn** was present in all samples, but below the standard limits. Chromium is another metal that exceeded the legally regulated concentration. Compared to trivalent chromium which is essential for carbohydrate metabolism, hexavalent chromium has a negative impact on the human body in the short and long term, it is mutagenic and carcinogenic.
Calcium **(Ca)** was present in all analyzed water samples. The highest concentration was observed in sample S1. **Sodium** was not highlighted in sample S2 (fig. 3). All concentrations are reduced, compared to those estimated by the norms in force. Both minerals have an effect on the health of the body.

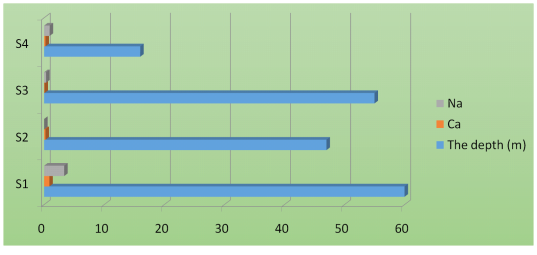

Fig. 3 Analysis of minerals from water samples

Conclusions: The potability of water is crucial to the safety of humans, which is why routine microbiological analyses, by cultural methods, without excessive costs, and metal analysis have become a necessity. Water intended for human consumption, loaded with bacteria and metals above the permitted limits must be treated before consumption.
The presence of some iron, manganese, chromium and nickel in the water from wells drilled above the permitted limit requires monitoring over a longer period of time, long-term observation and establishing the risks associated with them, in order to avoid the negative effects of underground water on the health of residents.