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EVALUATE THE QUALITY OF MINERAL WATERS FROM VALCEA COUNTY AREA USING STATISTICAL INDICES FOR HEAVY METALS

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Introduction

Romania has a lot of spas internationally recognized, thermal and mineral springs ranking third in Europe. In Valcea county there are mineral water springs located in the spa resorts Călimăneşti - Caciulata, Băile Olăneşti, Ocnele Mari and Băile Govora.

For the present study we used the quality index to determine the level of water pollution with heavy metals. Therefore, the water quality index aims at assessing the quality of water through a single numerical value, calculated on the basis of one system which convert all the individual parameters and their concentrations, present in a sample into a single value. This is an effective method that allows to compare the quality of various water samples based on a single numerical value and not only the parameters values of each sample. Any result of water quality measurements can serve as indicator of water quality.

During the years have been formulated several water quality indices by some national or international organization, which were applied for evaluation of water quality in different particular cases. At global level is not a single index that can describe overall water quality for any water body.

The aim of this study was to determine the content of metals in the mineral waters taken and to interpret the results obtained by comparing them with current legislation and by applying the metal distribution coefficient (kd) and the total environmental risk coefficient (I_{ER}).

Materials and methods

The results of the analysis of spring water samples are obtained by: gravimetric method for suspended solids, by electrochemical method for pH and by induction coupled plasma optical emission spectroscopy (ICP-EOS) method for cadmium, chromium, copper, iron, manganese, nickel, lead and zinc. All solutions used were of analytical quality. The solutions used to determine the metals were standard solutions of Cd, Cr, Fe, Mn, Ni, Pb and Zn, which were prepared in 5% HNO3 solution dissolved in ultrapure water. All reagents used in the experimental studies are purchased from Sigma Aldrich (USA).

Results and conclusions

The present study aimed to determine the degree of impurity with heavy metals of the mineral water samples studied by using environmental statistical indices.

Due to the chemical composition (iodinated, brominated, sodium, calcium, sulfurous, chlorinated, hypotonic or isotonic) and therapeutic benefits, the mineral springs studied in the spa resorts in Valcea County are internationally recognized, which is why we chose to evaluate the water quality.

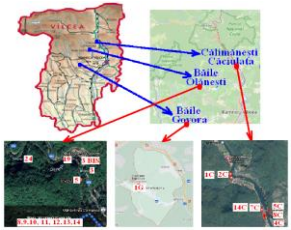

Figure 1. Location of the resorts where the mineral water samples were taken from Valcea County

In order to assess the quality of mineral waters in Valcea County in terms of the concentration of heavy metals, mineral water samples were taken from 22 springs located in the resorts of Baile Olanesti, Calimanesti Caciulata and Baile Govora in October 2020. Figure 1 shows the resorts where the mineral water samples were taken from this study.

The quality indicators determined from the mineral waters in the present study were: cadmium, chromium, copper, iron, manganese, nickel, lead, zinc, pH and suspensions. In order to capitalize on the obtained results, the experimental data were interpreted by calculating some statistical quality indicators (the metal distribution coefficient and the total environmental risk index).

The values obtained for the total environmental risk indices (I_{ER}) calculated for each metal were below 0 ($I_{ER} \leq 0$), which indicates that all water samples studied do not present a risk for the environment.

For all the studied mineral water samples, it is observed that their pH is within the neutral or weakly basic range (pH = 7.3 and pH = 8.2), which recommends the use of these waters for therapeutic purposes.

The variations of the distribution coefficient kd for each metal studied from all mineral water samples taken from the three investigated resorts indicate that, at low values of the distribution coefficient kd, the binding capacity of the metal in particles is small and the toxicity is insignificant. The data were interpreted by applying statistical indices (distribution coefficient and risk index), and the results obtained were compared with the legislation in force. Thus, we notice that the values of the analyzed quality indicators, metals, fall within the maximum allowed limit.

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