

Assessment of Essential Elements and Heavy Metal Contents in Unrefined and Refined Rock Salts Consumed in Turkey*

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ABSTRACT

While certain amounts of metals known as heavy metals are useful for organisms, excessive amounts can be detrimental. Some of the heavy metals elements found in sea water are Cu, Fe, Zn, Pb, Hg, Co, Mn, Cr, S, Ni, V and Cd. Although these metals cause pollution, many of them are necessary for the life of creatures and contribute in the molecular and protein structures of the organisms. In Çankırı City, particularly in Yenidoğan, Ballıbağı village Doğan köy and kayatuzu, samples were taken and examined. Results revealed that basic elements and heavy metals found in refined rock salt have been observed to be below the world average. Elements and heavy metals were not found at a rate that could be detrimental to human health.

Keywords: Unrefined rock salts, refined rock salt, radionuclide, heavy metal, Çankırı/Turkey

I. INTRODUCTION

In this study, the researchers worked essential elements contents of refined and unrefined salt rock samples in Çankırı city (Yenidoğan village, Ballıbağı village, Doğan village). Examples of salts are sodium (Na), magnesium (Mg), phosphorus (P), sulfur (S), chlorine (Cl), potassium (K), calcium (Ca), vanadium (V), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), selenium (Se), molybdenum (Mo), bromine (Br), cadmium (Cd), tin (Sn), iodine (The level of I), mercury (Hg), and lead (Pb); which were analyzed using energy-distributed X-ray fluorescence spectrometry. Heavy metals are naturally occurring chemical elements that have a relatively high density compared to water. If found in excess quantity, heavy metals can be considered systemic toxicants, which could induce multiple organ damage, even at lower levels of exposure if they can directly or indirectly come in contact with the human body.

Recently there has been an increasing ecological and global public health concern associated with environmental contamination with heavy metals. Although certain amounts

of metals are useful for organisms, excess amounts beyond the tolerable concentration can be detrimental. Some common main heavy metals include Cu, Fe, Zn, Pb, Hg, Co, Mn, Cr, S, Ni, V and Cd. While many of these metals cause pollution, they are necessary for the life of the creatures and participate in the molecular and protein structures of the organisms. Radionuclides and radioactive potassium (⁴⁰K) of the Earth-borne Uranium-Radium (²³⁸U-²²⁶Ra) and thorium (²³²Th) radioactivity levels are present in varying amounts in all environments. Rock Salt, which is known as Sodium Chloride (NaCl), is one of the naturally-occurring Earth minerals, which could be affected by natural radioactive sources. Because people consume rock salt, it is possible that the effects of radioactive emission (*alpha*, *beta*, and *gamma*) on rock salt could also affect people.

II. METHODS AND MATERIALS

In this study, which was conducted between July 2017 and July 2018, in Çankırı province Yenidoğan, Ballıbağı village and Doğan köy, a total of 45 samples of salt rocks were collected. The collected samples were dried and then analyzed under the laboratory at the Kastamonu University central advanced research laboratory. The chemical compositions of rock salts samples were examined to determine concentration of

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radioactive components in rock salts. In this research, XRF analysis model Spectro Xepos was used. It uses 50 watt end window x-ray tube to excite the samples. XRF is frequently used for the verification of the quality and the physical characteristics of industrial mineral processes.

III. RESULTS AND DISCUSSION

The Çankırı rock salt reserves showed that the gamma dose ratios of G-M radiometers of the Yenidoğan, Ballıbağı and Doğantepe fields were 31.5 nG/h, 25.3 nG/h and 23.1 nG/h, respectively. These results are below the world average. In other words, rock salt is not a source of human exposure to radiation, but rather cosmogenic and earth-based radionuclides, which some studies estimated at about 90% of the average annual effective radiation.

The average values of the main (essential) elements found were: 566751.2 mg/kg Na; 292.2 mg/kg K; 114.3 mg/kg P; 6162.0 mg/kg S; 5531.2 mg/kg Ca; 1340.0 mg/kg Mg; 219764.3 mg/kg Cl; 2.0 mg/kg Zn; 505.4 mg/kg Fe; 13.1 mg/kg Mn; 2.0 mg/kg Cu; 4.0 mg/kg Ni; 1.0 mg/kg Co; 3.0 mg/kg V; 4.1 mg/kg I; 2.1 mg/kg Cr; 0.01 mg/kg Mo; 2.1 mg/kg Br; and 0.01 mg/kg Se. Average concentrations of non-essential heavy metals were: 1.4 mg/kg Pb; 1.1 mg/kg Cd; and 0.3 mg/kg Hg; and 1.0 mg/kg Bi.

Figure 1 shows the comparison of some minerals in Çankırı rock salt and Himalayan salt, which showed variations in concentration of sodium, chloride, sulfur, and calcium.

IV. CONCLUSIONS

Although some human diseases, such as cancer, are induced by exposure to radioactive materials and food intake, such as salt, results of this study to a certain extent offer assurance that the Rock Salts from Çankırı, whether refined or unrefined, have negligible

Table 1. Çankırı rock salt (NaCl) reserves

Reserve area	visible (million ton)	possible (million ton)	% tenor	depth (m)
Yenidoğan 1	122.1	263.2	99.94	658
Yenidoğan 2	122.2	366.3	93.82	490
Balıbağı	74.5	147.7	97.82	920
Center	7.9	63.8	97.44	680

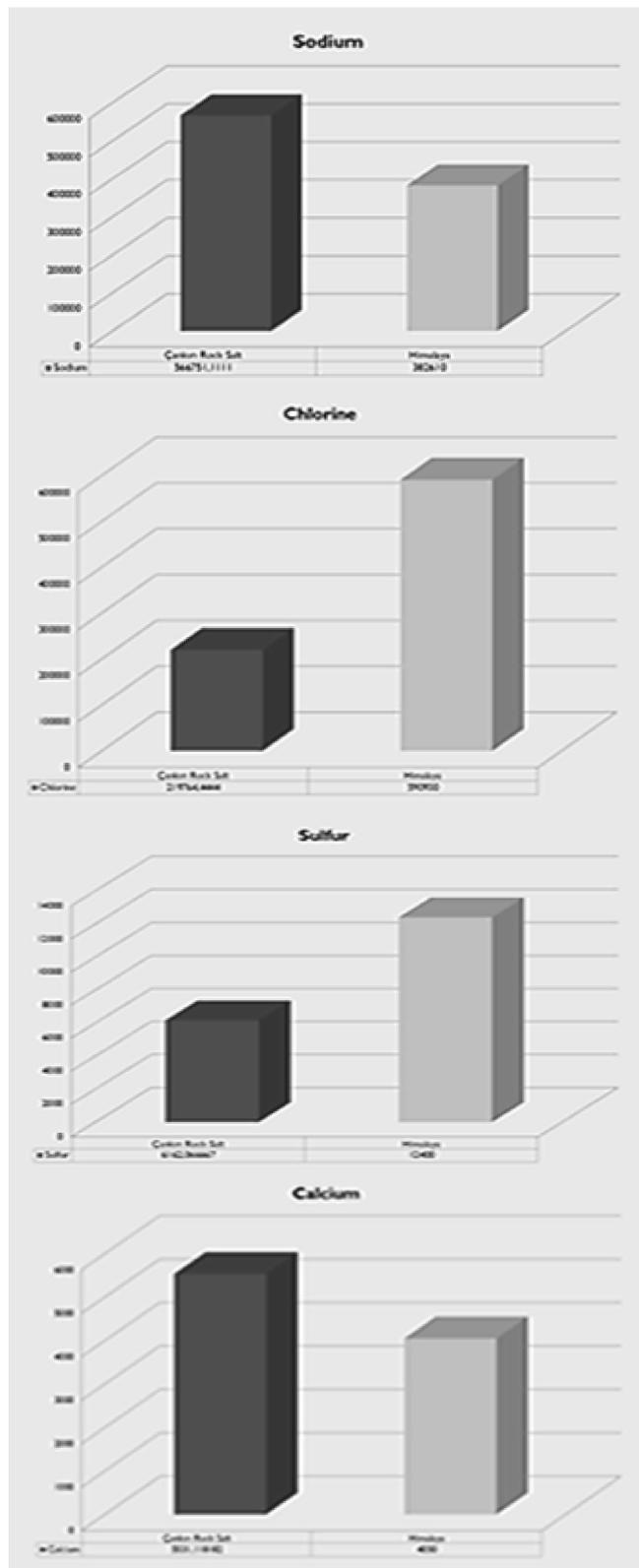


Figure 1. Çankırı rock salt and Himalayan rock salt comparison.

concentration of radioactive materials, and therefore, are safe to consume. The relevance and significance of this information finds in health and food regulations and policies in Turkey can hardly be overstated.

REFERENCES

- [1] A. Kurnaz et al, "Radionuclides content in grape molasses soil samples from Central Black Sea region of Turkey". *Human And Ecological Risk Assessment*, 22(6), 1375-1385, 2016.
- [2] M. Alkan, Ö. Demirbas, and M. Dogan, *Fresenius Environmental Bulletin*, 13(11a), 1112-1121, 2004 .
- [3] G. U. Chibuike, and S. C. Obiora, Heavy "Metal Polluted Soils: Effect on Plants and Bioremediation Methods". *Hindawi Publishing Corporation Applied and Environmental Soil Science*, Article ID 752708, Doi.org/10.1155/2014 /752708, 2014.
- [4] R. B. De Souza, T. G. Maziviero, C. A. Christofoletti, T. G. Pinheiro, C. S. Fontanetti, "Soil Contamination with Heavy Metals and Petroleum Derivates: Impact on Edaphic Fauna and Remediation Strategies". *Soil Processes and Current Trends in Quality Assessment*, chapter 6, <http://dx.doi.org/10.5772/52868>, 2013.
- [5] A. S. Alaamer, "Assessment of Human Exposures to Natural Sources of Radiation in Soil of Riyadh, Saudi Arabia", *Turkish J. Eng. Env. Sci.*, 32, 229-234, 2008.
- [6] J. Al-Juundi, "Population Doses from Terrestrial Gamma Exposure in Areas Near to Old Phosphate Min Russafia, Jordan", *Radiation Measurements*, 35(1), 23-28.
- [7] L. Bruzzi, M. Baroni, G. Mazzotti, R. Mele, and R. Serena, "Radioactivity in Raw Material and End Products in the Italian Ceramics Industry", *J. Environm. Radioact.*, 47, 157-170, 2000.