Buletinul USAMV-CN, 63/2006 (223-227)
ISSN 1454-2382

CHEMICAL CHARACTERIZATION OF CARBONATED AND UNCARBONATED MINERAL WATER FROM STÂNA DE VALE SOURCES

Lujerdean, Augusta Andrea Bunea, Camelia Fogorosi

University of Agricultural Science and Veterinary Medicine
titilujerdean@hotmail.com

Key words: mineral water, chemical composition, volumetric and photometric methods

Abstract. It was determined calcium, magnesium, nitrites, nitrates, ammonium, chloride, dicarbonates, pH, hardness, total dissolved solids (TDS) and chemical oxygen demand (COD_{Mn}) of carbonated and uncarbonated mineral waters from Stâna de Vale sources (Bihor county). The experiments have been carried out during six months (november 2005 – april 2006) using both volumetric and photometric techniques. Some of results (Ca^{2+}, Mg^{2+}, Cl^-, NO_2^-, NO_3^-, hydrogen carbonate, TDS) were compared with mean values of EU mineral water.

INTRODUCTION

Natural mineral water is clearly distinguishable from ordinary drinking water because: it is characterized by its content of certain mineral salts and their relative proportion and the presence of trace elements or of other constituents; of the constancy of its composition and the stability of its discharge and its temperature, due account being taken of the cycles of minor natural fluctuation: it is packaged closed to the point of emergence of the source with particular hygienic precautions; it is not subjected to any treatment other than those permitted by the standard.

Water colorless, odorless, tasteless is the “universal solvent” dissolving more substances than any other liquid. This means that wherever water goes it takes ions with it. Ions (ranging from nutrients such as calcium, magnesium to contaminants such as nitrite, nitrate, and ammonium) are present in mineral waters but their concentration is often limited by the adsorption to mineral surfaces in soil. Mineral water contains inorganic salts like calcium and magnesium dicarbonates, the extent to which these minerals are dissolved, indicates the hardness of water. The higher the value, the heavier the taste. Mineral water must have at least 250 ppm in total dissolved solids. If the TDS content is bellow 500 ppm, or it is greater than 1500 ppm, water has low mineral content or high mineral content respectively. Consuming naturally hard water provides health benefits, like reduced rates of heart disease or osteoporosis.

MATERIAL AND METHOD

Samples were collected from Stâna de Vale mineral water sources in the period: November 2005 – April 2006. Like any other product for human consumption mineral water need to be periodically tested for chemical composition. The sample was collected under conditions which guarantee the original microbiological purity and chemical composition of essential components and derived from geologically protected underground water source. It has not been processed physically or chemically except by sedimentation or filtering.

Sources have being tapped at one or more boreholes or spring. The analyzed mineral water was collected from an underground formation from which water flows naturally to the surface.

All the samples were placed in a cooler and transported to the laboratory of Chemistry and Biochemistry department of Animal Breeding and Biotechnology (USAMV Cluj-Napoca) and chemical analysis laboratory from Rieni (Bihor county).

They were analyzed ionic composition of mineral water including Ca^{2+}, Mg^{2+}, Cl^{-}, HCO_3^{-}, ions, the contaminants $NO2^{-}$, NO_3^{-}, NH_4^{+}, pH, hardness, total dissolved solids and chemical oxygen demand.

Ca^{2+} and Mg^{2+} were determined by complexometric titration using EDTA at a pH of 12 (Ca^{2+}), pH = 10 (Mg^{2+}). Hardness was calculated from Ca^{2+} and Mg^{2+} concentration. The chloride content was measured by argentometric titration and chemical oxygen demand by permanganometric titration.

Inorganic nitrogen compounds were determined photometrically using Merk-Aquaquent 144408 equipment and TDS gravimetrically at 180 ° C. Water pH was measured directly using a combinated hydrogen ion selective electrode.

Hydrogen carbonate ions were determined by titration with dilute H_2SO_4.

RESULTS AND DISCUSSIONS

The aim of this study was to give a concise overview of chemical characteristics mineral water from Stâna de Vale sources and to evaluate the concentration fluctuations during a period of time (six month).

In order to identify the main characteristics of mineral water it was compared two groups of water: carbonated and noncarbonated.

Results show that there is a spread of concentrations between the analyzed chemical components.

Chemical parameters [mg/l]	Test method	November	December	January	February	March	April	Maximum limit admitted
TDS	Gravimetrically at 180 °C	145.9	148.4	147.1	144.3	146.7	144.7	500
Ca^{2+}	Volumetry (EDTA)	45.69	47.6	48.3	45.7	46.2	45.7	100
Mg^{2+}	Volumetry (EDTA)	9.72	8.63	8.7	9.62	8.2	9.6	15
Cl^-	Volumetry (Mohr)	4.60	5.0	4.9	4.5	4.9	4.5	250
NO_3^-	Spectrophotometry/salicylic acid	0.08	0.06	0.05	0.07	0.01	0.07	50
NO_2^-	Spectrophotometry/ sulphanylamide in acidic medium	0.02	0.01	0.02	0.02	0.02	0.01	2
NH_4^+	Spectrophotometry/ Nessler	0.1	0.2	0.2	0.1	0.3	0.1	0.5
COD-Mn	Volumetry ($KMnO_4$)	0.74	0.76	0.69	0.73	0.8	0.73	3
HCO_3^-	Volumetry (NaOH excess titrated with H_2SO_4	85	86.2	84.3	84	83.1	84	300

Table 1

Chemical parameters of naturally carbonated water

Table 2

Chemical parameters of mineral uncarbonated water

Hardness (german degrees)	Volumetry (EDTA)	8.63	9.1	8.2	8.4	8.6	8.4	15
pH	Potentiometry	4.75	4.2	5.0	4.2	4.0	4.6	6.5-9.5

Chemical parameters [mg/l]	Test method	November	December	January	February	March	April	Maximum limit admitted
TDS	Gravimetrically at 180 °C	133.99	137.2	128.08	131.89	139.73	135.65	500
Ca^{2+}	Volumetry (EDTA)	27.25	28.2	27.3	27.3	28.4	27.3	100
Mg^{2+}	Volumetry (EDTA)	4.86	5.0	4.2	4.84	6.0	4.61	15
Cl^-	Volumetry (Mohr)	7.80	8.12	7.21	7.7	8.4	7.6	250
NO_3^-	Spectrophotometry/salicylic acid	1.18	1.0	1.5	1.2	1.0	1.1	50
NO_2^-	Spectrophotometry/ sulphanylamide in acidic medium	0.012	0.01	0.02	0.02	0.02	0.02	2
NH_4^+	Spectrophotometry/ Nessler	0.05	0.03	0.03	0.05	0.03	0.03	0.5
COD-Mn	Volumetry ($KMnO_4$)	0.83	0.91	0.94	0.8	0.9	0.81	3
HCO_3^-	Volumetry (NaOH excess titrated with H_2SO_4	92	94	86.9	90	95	90	300
Hardness (german degrees)	Volumetry (EDTA)	4.15	5.2	6.1	4.2	5.6	4.2	15
pH	Potentiometry	8.1	7.3	8.0	7.1	6.5	8	6.5-9.5

Based on studied ionic constituents, carbonated and noncarbonated mineral water from Stâna de Vale sources is placed in the group of low mineral content. By the mineral type and composition both of them belong to calcium dicarbonated waters.

Testing chemical components it was found the substantial participation of dicarbonates to it's mineral contents. That's why consuming both kind of water is having favorable effect on digestive trackt, decreasing the amount of gastric acid ; dicarbonated water intake affects too the liver bial and bial ducts functioning.

Acidic carbonated mineral water containing 46.69 mg/l calcium has a good buffering effect. Concentration fluctuation during six month of this study don't significantly affect the amount of total dissolved solids of these water.

All the contaminants (NO_2^-, NO_3^-, NH_4^+) are bellow admitted limit (0.02 mg/l NO_2^-, 50 mg/l NO_3^-, 0.5 mg/l NH_4^+).

Due to its low mineral content it can be recommended for unlimited every day use.

In order to appreciate the main chemical parameters of Stâna de Vale sources the results were compared to the mean values of EU mineral water (concentrations are expressed in mg/l). Data are summarized in Table 3.

Table 3

Comparison of mean values between EU and Stâna de Vale mineral water

	Ca^{2+}	Mg^{2+}	Cl^-	NO_2^-	NO_3^-	HCO_3^-	TDS
EU	55.8	50.0	344	0.02	0.1	2511	3178
Stâna de Vale (carbonated)	46.69	9.07	4.73	0.016	0.056	84.43	146.18
Stâna de Vale (uncarbonated)	27.62	4.91	7.80	0.016	1.16	91.3	134.54
EU/Stâna de Vale (carbonated)	1.19	5.51	72.72	1.25	1.78	29.74	21.74
EU/Stâna de Vale (uncarbonated)	2.02	10.18	44.10	1.25	0.08	27.50	23.62

A brief comparison of carbonated and uncarbonated water from Stâna de vale and UE show a significantly different concentration concerning major components as : magnesium, chloride, and total dissolved solids.

In contrast with European mineral water, Stâna de Vale water show lower concentrations of mentioned constituents first of all magnesium, a cation of wider interest.

CONCLUSIONS

1. Bottle label is only a source of basic information concerning chemical composition of mineral water.
2. It has to know precisely the chemical characteristics of mineral water because they determine the use of water and potential economical benefits.
3. There is a natural fluctuation in concentration of tested components but we know little about it.
4. This study was concerced with showing (for the first time) a brief comparison between mean value pf EU chemical parameters of mineral water and Stâna de Vale carbonated and uncarbonated water.

BIBLIOGRAPHY

1. Eschlemann M. N. (1991) – Water and mineral elements – Ed. I.B. Lippincott Company, New Jersey
2. Augusta Lujerdean, Andrea Bunea (2005) – Chimia apei si solului – Ed. Academic Press, Cluj-Napoca.
3. Augusta Lujerdean, Andrea Bunea (2002) –Biochimie desciptiva– Ed. Napoca Star Cluj-Napoca.
4. Augusta Lujerdean, Andrea Bunea (2002) – Metode si tehnici de laborator in biochimie Ed. Academic Press, Cluj-Napoca.
5. www. biochem/edu/uk.com
6. www.greenagenda.org/eco-ogna/potabil.htm