American Journal of Analytical Chemistry, 2024, 15, 135-138
https://www.scirp.org/journal/ajac
ISSN Online: 2156-8278
ISSN Print: 2156-8251

Principles of Technology for Bottling Medicinal Mineral Waters of Sairme Using the Example of Source № 3a

Irina Nikolaishvili, Giorgi Kvartskava

Faculty of Agriculture Sciences and Bio-Systems Engineering, Georgian Technical University, Tbilisi, Georgia
Email: nikolaishvili95@gmail.com, giga.kvartskhava@gmail.com

How to cite this paper: Nikolaishvili, I. and Kvartskava, G. (2024) Principles of Technology for Bottling Medicinal Mineral Waters of Sairme Using the Example of Source № 3a. *American Journal of Analytical Chemistry*, **15**, 135-138.
https://doi.org/10.4236/ajac.2024.154008

Received: March 21, 2024
Accepted: April 27, 2024
Published: April 30, 2024

Abstract

Sairme mineral water, one of the famous mineral waters in Georgia, is renowned for its exceptional healing properties. The distinctiveness and therapeutic benefits of the naturally sourced mineral water, known as "Sairme", stem from its rich array of microelements, notably including iron and manganese. Since 1948, the bottling of Sairme mineral water has been a prominent activity. Named after the Sairme deposit, this mineral water is packaged in various formats to cater to diverse consumer preferences. The bottling process involves transporting the mineral water from wells to the bottling plant through pipelines. Prior to bottling, the mineral water undergoes meticulous processing stages in adherence to current Georgian and international regulations. This process ensures that the concentration of trace elements in the bottled water is minimized, maintaining its purity and quality. Given the importance of preserving the microelements present in bottled mineral water, our research is dedicated to optimizing the technological process. Our objective is to safeguard the valuable microelements while ensuring the highest standards of quality and safety in the final product.

Keywords

Sairme Mineral Water Deposit, Oxidation-Reduction Potential, Trace Elements Chemical Composition, Seasonality

1. Introduction

The Sairme mineral water deposit is located in the highlands of the Lesser Caucasus, on its southern slope, in the middle of Meskheti-Trialeti, at an altitude of 880 - 1000 meters above sea level. The therapeutic benefits of Sairme mineral waters are combined with the geographical and climatic conditions of the deposit and have a positive effect on human health [1]. Utilizing natural constituents, mineral waters, and dietary supplements to enhance and sustain human well-being is a prevalent and extensively employed strategy in contemporary methodologies. We postulate that the bottling of therapeutic mineral water for medicinal purposes will be highly relevant [2]. As part of our doctoral investigation, we thoroughly reviewed the early data regarding the analysis of the Sairme mineral water deposit. The investigation into the therapeutic properties of mineral water commenced in 1932, with subsequent medical and scientific expeditions conducted over several years, as documented in literary sources. Mineral water is extracted from the Sairme deposit via springs and shallow wells [3]. As part of the doctoral program, we investigated various springs within the Sairme mineral water deposit, analyzing the chemical composition of the selected spring waters and assessing their stability. Building upon the research and analysis of our findings, we have been allowed to develop a bottling technology for medicinal mineral water [4]. This development considers the preservation of the chemical parameters of mineral water with minimal alterations, thus imparting additional therapeutic properties to the water.

2. Main Text

The natural mineral waters of Sairme emanate from subterranean depths, undergo formation within the upper strata of the soil, and ascend to the surface as springs enriched with an array of minerals and substances. The chemical composition of mineral water depends on the seasonal changes. The range of the leading chemical indicators of Sairme mineral water changes seasonally, but the composition of the water in the wells of the deposit is stable, and the limits of natural fluctuation do not exceed 20%.

In the initial phase of our investigation, we focused on analyzing the source of Sairme mineral water deposit No.3a. The assessment of the chemical attributes of the research sources was conducted periodically, with due consideration to seasonal variations from 2022 to 2023. The main cations, anions, and microelements of mineral water were studied according to chemical parameters. The studies were conducted in the field, directly at the wells, and in a stationary laboratory. To conserve the inherent chemical composition of mineral water, we have devised a method for preserving the sample for transportation to the laboratory. To achieve this, water samples were saturated with carbon dioxide [5]. Subsequently, the obtained results were juxtaposed with those from experimental investigations conducted earlier, as delineated in **Table 1**.

To ascertain the optimal technological parameters for preserving and bottling trace elements within mineral water, it was deemed pertinent to investigate the correlation between trace elements in mineral water derived from source №3a and the oxidation-reduction potential (ORP) across various temporal intervals [6]. The redox potential denotes the conversion of chemical energy from redox processes into electrical energy and is measured in volts (V) or millivolts (mV) [7]. In laboratory conditions, it was calculated using the potentiometric method.

For this, we used a Hanna Hi988194 multimeter. Research on research samples saturated with carbon dioxide began on 11/09/2023 at 14:45. After a specific time, the ORP of mineral water was measured. The water was filtered, and microelements were determined.

An integral component of the experimental procedure, we quantified the concentrations of calcium and magnesium within the examined water samples to evaluate the constancy of these chemical attributes. The outcomes of the investigation are delineated in **Table 2**.

Table 2 presents the chemical parameters observed for source № 3a across different temporal intervals.

Based on the experiment results, a correlation between ORP and microelements was established. A high ORP value corresponds to low concentrations of iron and manganese. The correlation coefficient is negative and numerically equal to −0.96. According to the data presented in **Table 2**, a noticeable trend emerges wherein the ORP value escalates over time, coinciding with a reduction in the concentration of iron as it precipitates. According to the experiment, the precipitation process of iron reaches completion when the ORP (Oxidation-Reduction Potential) attains a value of 76 mV. At this point, the concentration of iron (Fe) is measured at 1 mg/L. Therefore, this value of the redox potential is critical for determining the technological conditions for bottling mineral water. These conditions will facilitate the maintenance of iron and manganese concentrations in the water, aligning with the primary goal of our research.

Table 1. Chemical characteristics of source № 3a in the period 1957-2023.

Source	Analysis Date	pH	Mineralization g/l	Hydrocarbonate (HCO_3^-) mg/L	Iron (Fe, total) mg/L
Source 3a	16.06.1957	6.40	4.6	2860	12
	19.02.1959	6.50	5.0	3110	15
	26.05.1772	6.45	3.3	2750	10
	14.02.2022	6.32	3.5	3030	8
	26.06.2022	6.49	3.6	2830	11
	20.03.2023	6.37	4.5	3781	12
	08.06.2023	6.45	3.4	2562	9

Table 2. Chemical characteristics of source № 3a in the period 2023.

Sample name	Date of analysis	Analysis time	ORP, mv	Fe (total) mg/L	Mn (total) mg/L	Ca^{2+} mg/L	Mg^{2+} mg/L
Source 3a	09.11.23	14:45	3.2	11.0	0.5	230.0	110.0
	09.11.23	20:00	3.6	9.6	0.48	230	110
	10.11.23	11:00	10.9	3.2	0.47	230	110
	10.11.23	14:00	15.0	1.1	0.47	220	110
	10.11.23	18:00	76.0	1.0	0.45	190.0	100
	13.11.23	18:00	148.1	<0.05	0.35	170.0	80

3. Conclusions

Based on our experimental method, we can conclude:

The chemical characteristics of the springs and wells in the Sairme mineral water deposit remain consistent across all seasons.

In Sairme mineral water, the relationship between the redox potential and microelements demonstrates an inverse proportionality.

At an oxidation-reduction potential of 76 mV, the iron precipitation completes.

During the experiment, iron precipitation, gradual filtration, and a reduction in iron concentration do not impact the concentration of chemical indicators in mineral water.

Considering the correlation between the redox potential and iron concentration, it becomes feasible to devise a technological framework enabling the bottling of mineral water while preserving its natural chemical properties.

Acknowledgements

The article was developed through the meticulous processing of data kindly provided by DG Consulting and Sairme Mineral Waters Ltd. I extend my gratitude to these entities for their invaluable assistance.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Mkheidze, B. and Zautashvili, B. (2011) Hydrology of Georgia. Georgian Technical University, Tbilisi. https://publishhouse.gtu.ge/en/post/391

[2] Eristav, D. (1966) Mineral Waters of Georgia. Soviet Georgia, Tbilisi, 42-43.

[3] Marjanadze, T. and Gagoshvili, A. (1978) Sairme Resort. Soviet Georgia, Tbilisi, 7.

[4] Tarkhan-Mouravi, I., Saakashvili, N. and Kutateladze, N. (2009) Resorts of Georgia. Soviet Georgia, Tbilisi.

[5] Petraccia, L., Liberati, G., Masciullo, S.G., Grassi, M. and Fraioli, A. (2006) Water, Mineral Waters and Health. *Clinical Nutrition*, **25**, 377-385. https://doi.org/10.1016/j.clnu.2005.10.002

[6] James, C.N., Copeland, R.C. and Lytle, D.A. (2004) Relationships between Oxidation-Reduction Potential, Oxidant, and pH in Drinking Water. https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=125092

[7] Lv, Y., Xiao, K., Yang, J., Zhu, Y., Pei, K., Yu, W., *et al.* (2019). Correlation between Oxidation-Reduction Potential Values and Sludge Dewaterability during Pre-Oxidation. *Water Research*, **155**, 96-105. https://doi.org/10.1016/j.watres.2019.02.049