



ORIGINAL ARTICLE

Study the Chemical Equilibrium Properties of Compounds listed on the labels of Packaged bottled Water brands available in Ahwaz city

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ABSTRACT

There has been a significant increase in consumption of packaged drinking water in recent years so that the bottled water producing companies have increased from 2 companies to 70 companies over nearly 40 years. However, the production and supply of packaged bottled water supply suffers from a lack of control and supervision as many food products, as it is not quite clear that whether some of these bottled mineral water are produced at home or in factory; given that the most contradiction has been seen in labeling of these products and there are no specific standards for such labeling, they are very difficult to detect. Therefore, in this study, by collecting 25 of bottled mineral water brands available in the city of Ahwaz, one of the most important chemical parameters of compounds in water, the chemical equilibrium between positive and negative ions in water composition, has been evaluated. Studies on assessment based on chemical parameters listed on the labels of these bottled water brands suggest that the 18 bottled water brands lack the required chemical equilibrium; accordingly, we can say that 72% of packaged bottled water available in Ahwaz does not meet the required standards. The survey results also revealed that 52% of the water of such bottles contain hard water; 44% of contain semi-hard water and 4% have soft light water. Also, 2 percent of such bottled water has a fluoride content exceeding the allowed level of 4 mg/liter. Finally, improvement of the quality of these bottled waters depends on the increased supervision and control of relevant responsible organizations on production of these types of waters.

Keywords: Natural mineral water, Chemical equilibrium of compositions

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INTRODUCTION

Water represents the world sustainability and is of the main and survival elements on the planet. This vital matter has become much more important with the rising trend and growing agricultural, domestic and industrial consumption and uses in the contemporary world and its shortage has caused some problems, especially in the arid and semi-arid countries. Now, there is no doubt that the world will face with serious crisis due to lack of water and its incorrect usage in the years ahead, and optima land appropriate utilization of groundwater resources and surface waters is a challenging issue, which is considered with sensitivity and accuracy by all the world [1]. Meanwhile, the use of bottled water for drinking is taken into account as a serious solution in this regard [4]. Currently, the consumption of bottled water is rising in the world, and despite its relatively high price compared to the piping network water, its annual consumption is increasing by an average of 12% [2]. Also, in our country, Iran, the consumption of packaged drinking water, especially bottled mineral water, has increased dramatically due to the inadequacy of old supplies of drinking water and issues related to its health and safety in recent years; especially, with regard to that currently, the quality of tapped drinking water is not in an ideal situation in Ahwaz, and the bottled mineral water is considered as a major source for drinking water. Given the importance of the issue, mineral water companies in Iran have been increased in number over nearly 40 years from 2 companies to 70 companies.

By definition, mineral water is extracted from natural sources such as springs and drilled locations on underground aquifers that all kinds of precautions should be performed to avoid any contamination or foreign influences on its quality [5]. All mineral water manufacturing companies

require equipped with advanced laboratories to be able to examine and check the quality of factory's water products output daily. However, some manufacturers of mineral water have insufficient knowledge of the industry and use inappropriate methods in their work, and using methods such as filtration through chlorination and use of other chemicals, they unsuccessfully try to reduce the microbes present in such waters. However, the production and supply of packaged bottled water supply suffers from a lack of control and supervision as many food products, as it is not quite clear that whether some of these bottled mineral water are produced at home or in factory; and the most contradiction seen in labeling of these products can indicate inappropriateness of the used groundwater sources regarding hydrological and geological properties and lack of knowledge to understand the difference between drinking water and mineral water. Due to lack of specific standards for such labeling, they are very difficult to detect. Therefore, in this study, by collecting the bottled mineral water brands available and distributed in the city of Ahvaz, one of the most important chemical parameters of compounds in water, i.e. the chemical equilibrium between positive and negative ions in water composition, has been evaluated. Among the research work in this field, ZandVakili *et al.* study can be mentioned, which aimed at evaluating the microbiological and physicochemical quality of mineral waters. The study results indicated the improvement of microbial quality of mineral water brands and declined chemical and physical quality of mineral water brands from 2003 to 2005 that was the greatest discrepancy in labeling of these products [2]. Also, in a research entitled as "Investigate the microbial and chemical conditions of bottled mineral water brands marketed in the city of Birjand by Khodadadi *et al.*, the results indicated a significant difference between the specifications on the bottled mineral water labeling and the average experimental results [3].

MATERIALS AND METHODS

This was an explanatory study. To perform the research, the bottled mineral water brands available in the city of Ahvaz were purchased. A water source to be chemically balanced needs to have equal positive and negative ions in its combinations; simply explained, such compounds should be equal to one another according to a particular parameter. Then, to examine the presence of chemical equilibrium in the water of these bottled water, parameters of calcium, magnesium, sodium and potassium as cations and parameters of bicarbonate, sulfate, chloride, fluoride and nitrate as anions listed on labels of these bottles were tested and checked. Based on Iran's national standards, the maximum optimal water hardness value and the allowed maximum value are as 150 mg/lit CaCo₃ and 500 mg/lit CaCo₃, respectively [6].

Table 1: Classification of water hardness

Water hardness in terms of Mg/lit CaCo ₃	Water classification
Less than 50	Soft light
50-150	Semi-hard
150-300	Hard water
More than 300	Super-hard water

Table 2: Classification of water TDS

TDS levels based on Mg/lit CaCo ₃	Water classification
10000-40000	Sea
1000-10000	Saltwater
500-1000	Allowed drinking water
100-500	desirable water
5-100	Industrial optimal water

(1)

$$\text{Meq/Lit} = \frac{\text{mg/lit}}{\text{Eqw}}$$

$$\text{Mg/Lit CaCo}_3 = \text{Meq/Lit} \times 50 \quad (2)$$

Where, Meq/ Lit measure is the water composition measurement unit and Mg/Lit CaCo₃ is the unit to measure the hardness and TDS of water.

Table 3: Parameters of obtained results from different types of mineral water brands available in the city of Ahwaz according to the labels on them

Fluoride content Mg/lit	Water type based on TDS Mg/lit CaCo ₃	TDS value	hardness	Hardness rate Mg/lit CaCo ₃	Chemical equilibrium control	Mineral water brand name	Row
0	desirable water	214	Semi-hard	106	No	Arvand	1
0.23	desirable water	236	Hard water	153	No	Peykan	2
0.45	desirable water	321	Semi-hard	140	No	Gahar	3
28	desirable water	318	Semi-hard	128	No	Pasaj	4
0.3	desirable water	249	Semi-hard	59	No	Sivan	5
0.36	desirable water	253	Hard water	176	Yes	Shiraz	6
0	Allowed drinking water	611	Hard water	159	Yes	Anahita	7
0.5	desirable water	267	Hard water	197	No	Dalaho	8
0.172	desirable water	163	Semi-hard	117	No	Bika	9
0.2	desirable water	352	Hard water	192	No	Mineral	10
0.26	desirable water	173	Hard water	151	No	Rojin	11
0.5	desirable water	182	Semi-hard	139	No	Laliya	12
11	desirable water	401	Hard water	203	No	Makhmal	13
0.24	desirable water	341	Hard water	170	Yes	Espirooz	14
0.2	Allowed drinking water	538	Hard water	272	Yes	Damavan	15
0.07	Allowed drinking water	532	Hard water	232	Yes	Bishe	16
0.07	desirable water	209	Semi-hard	94	No	Eshmak	17
0.22	desirable water	367	Hard water	164	No	Hidra	18
0.48	desirable water	204	Hard water	189	No	Pars	19
0	desirable water	182	Semi-hard	112	No	Zamzam	20
0	desirable water	208	Semi-hard	106	Yes	KohSefid	21
0	desirable water	189	Hard water	189	No	Ayda	22
0.3	desirable water	257	Semi-hard	133	No	Saman	23
0.2	desirable water	169	Semi-hard	140	No	Persika	24
0.003	desirable water	166	Soft light	46	Yes	Desani	25

RESULTS & DISCUSSION

Studies on assessment based on chemical parameters listed on the labels of these bottled water brands suggest that the 18 bottled water brands lack the required chemical balance; accordingly, we can say that 72% of packaged bottled water available in Ahwaz does not meet the required standards. The survey results also revealed that 52% of the water of such bottles contain hard water; 44% of contain semi-hard water and 4% have soft light water. Also, the TDS values indicate that 88% of these bottled waters can be classified in the optimal category based on listed compounds on their labels, and 12% are in the allowed drinking water. Also, 2 percent of such bottled water brands have a fluoride content exceeding the allowed level of 4 mg/liter, Iran's standards.

Conclusion

Given that the currently tapped drinking water quality in Ahwaz does not meet an optimal condition and mineral water bottles are considered as an important source alternative, production and supply of such packaged bottled water brands suffer from the lack of supervision and control, there is no standard procedure for their labeling. Such a control weakness has led to the production and supply of some bottled water brands with low quality that can even endanger the public health. The quality improvement of these bottled waters depends on the increased control and supervision by relevant responsible organizations and authorities on production of these bottled water brands. Further studies on available bottled water brands regarding their biological properties can be suggested in future research.

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