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Assessing the Chemical Components of some Iranian Brands of Bottled Water

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ABSTRACT

Aims Bottled water is widely used in many countries and more than 100 different brands of bottled water are produced in Iran. The aim of the present research was to assess the chemical compound of some Iranian brands of bottled water and compare them with the mention information on their labels.

Instrument & Methods This descriptive study was performed during March to December 2012 on the 16 brands of bottled water produced in Iran. Random sampling (10 samples for each brand) was done by buying 1.5liter bottled water with different brands from the supermarkets in Kashan City, Iran. The concentration of Na+, K+, F-, NO3-, SO4-2 and Cl- and the pH of bottled water samples were measured. Data were analyzed by SPSS 16 software using independent T test.

Findings The mean concentration of NO3- was 1.70±2.52mg/l, Na+ was 8.44±8.76mg/l, K+ was 0.11±0.53mg/l, SO4-2 was 15.15±12.49mg/l, Cl- was 42.30±33.84mg/l and F- was 1.02±1.88mg/l in all samples of 16 brands of bottled water. The highest concentration of NO3- was seen in brand 12 (9.55±2.76mg/l), Na+ in brand 6 (32.18±12.60mg/l), K+ in brand 13 and 4 (1.86±0.76mg/l), SO4-2 in brand 6 (40.53±8.90mg/l),Cl- in brand 16 (88.73±13.80mg/l), F- in brand 13 (0.63±0.12mg/l). The pH of brand 12 (7.9±0.1) was the highest among the samples.

Conclusion The concentrations of Na+, K+, F-, NO3-, SO4-2 and Cl- of the studied Iranian brands of bottled water are not higher than the national and international standards and the pH is in the acceptable range.

Keywords Bottled Water; Drinking Water; Water Quality; Public Health

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Introduction

Consumption of the bottled water started in 1970s especially in France, the main producer of the bottled water in the world [1]. In spite of its high prices regarding to public water supply, its consumption increases about 12% annually in world [2]. In addition, the use of bottled water is considered a reliable source of water supply in an emergency situation [3]. Because of the increased concentration of soluble salts, such as high salinity, in the public water supply of Iran, the tendency of consumers to use bottled water is increased [4, 5].

The bottled water is the drinking water that packaged in the bottle with or without addition of minerals [6, 7]. In general, minerals were not added to bottled water [8]. The mineral water is the water contains at least 1000mg of salt or 250mg free carbon dioxide per liter [9]. The mineral water flows from the natural springs where it is filled in the special container and sent for consumption. Important issue in this regard is water quality that is critical for the health of consumers [10, 11].

The pollution of bottled water can cause some diseases especially in children, aged and people with weak immune system. So, the chemical quality is very important for those consuming the bottled water instead of the usual tap drinking water. The rate of water pollution due to the chemical factors can be determined by the laboratory methods [2, 4, 12].

The studies have shown that the pollution of the bottled water can be caused by the pollutions of the water supply resources or leakage from the packaging materials [10, 13, 14]. In addition, there is the probability of the poisonous metal and organic ingredients leakage from the bottles made of polyethylene terephthalate (PET) into the water [4, 6, 7, 15]. Therefore, every manufacturer of bottled water must be equipped with a full laboratory for water quality analysis. In general, in terms of health regulations, the chemical components of water must be mentioned on the label of every container of bottled water. In some cases, due to the benefits of the producers, it is possible that the actual quality of the water is differed from the quality mentioned on the label and is hidden from the consumers which is in conflict with the rights of consumers. Therefore, the actual quality of bottled water that produced in each country should to be routinely controlled by the authorities [1, 11, 16-18].

The aim of the present research was to assess the chemical compound of some Iranian brands of bottled water and compare them with the mention information on their labels.

Instrument & Methods

This descriptive study was performed during March to December 2012 on the 16 brands of bottled water produced in Iran (Names of the brands are preserved to the journal). Random sampling (10 samples for each brand) was done by buying 1.5liter bottled water with different brands from the supermarkets in Kashan City, Iran.

Experimental analysis was performed according to the methods described in the last edition of the standard methods for the examination of water and waste water [19] to determine the concentration of Na^+, K^+, F^-, NO_3^-, SO_4^{-2} and Cl^- and the pH of bottled water samples in the chemistry laboratory of Health College of Kashan University of Medical Sciences, Iran. All analyses were done in triplicates.

Data were analyzed by SPSS 16 software using independent T test and compared with the values mentioned on the bottle labels and then with the national standard of Iran and the guidelines of the World Health Organization for drinking water [17, 18, 20].

Findings

The mean concentration of NO_3^- was 1.70±2.52mg/l, Na^+ was 8.44±8.76mg/l, K^+ was 0.11±0.53mg/l, SO_4^{-2} was 15.15±12.49mg/l, Cl^- was 42.30±33.84mg/l and F^- was 1.02±1.88mg/l and the mean pH was 7.31±0.07 in all samples of 16 brands of bottled water. The actual values of all studied parameters were significantly lower than the Iranian and WHO drinking water standards ($p<0.05$) except for F^- which was lower.

The highest concentration of NO_3^- was seen in brand 12 (9.55±2.76mg/l), Na^+ in brand 6 (32.18±12.60mg/l), K^+ in brand 13 and 4 (1.86±0.76mg/l), SO_4^{-2} in brand 6 (40.53±8.90mg/l), Cl^- in brand 16 (88.73±13.80mg/l), F^- in brand 13 (0.63±0.12mg/l). The pH of brand 12

(7.9±0.1) was the highest among the samples (Figure 1). Statistically significant differences were seen between label and actual values for F^-, CL^-, K^+ and $NO3^-$ ($p<0.05$) there were no significant differences in other studied parameters ($p>0.05$).

The actual concentrations of NO_3^-, Na^+ and SO_4^{-2} in 4 brands were more and in 12 brands were less than the value mentioned on the bottles' label. The actual concentrations of F^- in 12 brands were more and in 4 brands were less than the value mentioned on the bottles' label. The actual concentration of K^+ was more than the value mentioned on the bottles' label in only one case and the actual concentration of Cl^- was less than the value mentioned on the bottles' label in only one case. The actual pH in 6 brands were more and in 9 brands were less than the value mentioned on the bottles' label and only equal in one case.

Figure 1) The mean concentration of the chemicals and the values inscribed on the labels of the 16 brands of bottled water produced in Iran during 2012 (mg/l)

Brand No.		NO_3^- (50mg/l)	Na^+ (200mg/l)	K^+ (12mg/l)	SO_4^{-2} (250mg/l)	Cl^- (250mg/l)	F^- (0.7-1.2mg/l)	pH (6.4-8.5)
1	Actual	0.8±0.5	2.3±1.1	0	15.2±6.6	20.6±11.7	0.3±0.2	7.4±1.3
	Label	5.5	21	1.2	34	12	0.1	7.6
2	Actual	2.6±1.0	1.3±0.4	0	32.4±12.5	15.4±8.9	0.4±0.1	7.3±2.3
	Label	2	4	0.6	85	9	0.2	7.29
3	Actual	0	0	0	14.2±2.8	5.2±2.5	0.2±0.1	7.7±1.7
	Label	0.7	6	1	0	1	0	7.3
4	Actual	2.9±0.8	14.7±7.4	1.9±0.9	6.2±3.1	10.3±7.4	0.3±0.2	7.1±2.5
	Label	2-4	15-20	2-5	10-20	10-20	0	6.8-7.2
5	Actual	3.1±1.3	1.3±0.2	0	10.8±3.6	82.3±32.9	0.4±0.9	7.4±1.1
	Label	5	6	0.5	0	8	0.48	7.7
6	Actual	0.9±0.1	32.2±12.6	0	40.5±8.9	102.9±17.9	0.4±0.2	6.9±2.8
	Label	3	15	0.1	11	14	1.11	7.76
7	Actual	0	1.3±0.2	0	18.8±5.5	5.2±2.3	0.4±0.2	7.1±1.8
	Label	2.3	4.7	1.9	19	0.7	0.11	7
8	Actual	1.3±0.1	6.4±2.1	0	2.2±0.4	66.9±17.8	0.2±0.1	7.1±1.2
	Label	0.61	22	0.34	24	45	0.07	7.06
9	Actual	0.7±0.1	0.2±0.1	0	14.3±3.6	10.3±4.8	0.1±0.1	7.7±1.7
	Label	3.5	1	0.4	4	1.5	0.07	7.2
10	Actual	0.7±0.2	0.2±0.1	0	14.3±3.6	10.3±4.8	0.1±0.1	7.7±2.3
	Label	<10	0	0	0	0	0	7.4
11	Actual	4.8±1.1	0	0	0.1±0.1	25.7±5.8	0.5±0.2	7.5±2.9
	Label	14	20	1	39	6	0	7.84
12	Actual	9.6±2.8	15.7±5.3	0	2.2±0.8	46.3±5.7	0.6±0.2	7.9±1.6
	Label	3	10	1.5	40	38	0.53	7.4
13	Actual	0.1±0.1	18.2±3.4	1.9±0.8	20.1±5.6	31.3±7.4	0.6±0.1	7.7±1.2
	Label	8	9.6	0.4	15	23	0.5	7.4
14	Actual	0.1±0.1	10.5±2.9	0	18.2±2.4	57.4±1.2	0.3±0.1	7.2±2.3
	Label	1.8	6.2	0.8	20	0	0.2	7.2
15	Actual	0.1±0.1	4.7±1.4	0	25.1±4.6	20.9±6.2	0.26±0.1	7.1±2.9
	Label	1	10	0	0	17	0.5	7.5
16	Actual	0	1.8±0.1	0	13.9±3.2	88.7±13.8	0.3±0.1	7.1±2.9
	Label	3.7	2	0.2	6	4	0.23	7.8

Discussion

The results of our research showed that the chemical concentrations mentioned on the bottle labels were different from the actual measured values in some samples. So, it is recommended to the producers and supervisor organizations to be more careful in quality control of the bottled water. Although, the mean concentration of chemicals were not higher than the standard limits of the drinking water of bottled water but some brands' chemical concentrations were not acceptable due to the different water supply resources and different water treatment processes [12].

Samadi *et al.* has shown that there is a significant difference between label and actual values for some chemicals in some bottled water brands that it is to extent compatible with our study findings [8].

Misund *et al.* have reported that in 51 cases out of 56 analyzed samples of 44 different brands of bottled water, the suitable quality of drinking water standards are met [10]. Eslami *et al.* [20] and Yekdeli Kermanshahi *et al.* [21]

have reported that all the parameters measured in bottled water were below the Iranian standard levels. In addition, study of conformity of the variables to the label has indicated that there is a significant difference between the values measured and the values listed on the labels which is compatible with our study results. It was reported that 33.3% of pH values, 99.3% of acidity, 53.5% of nitrite, 73.3% of fluoride, 100% of sodium and potassium concentrations of the assessed bottled water samples are not in the standard level. In addition, there is a significant difference between the values on the labels of the bottled water and the mean values of the laboratory analyzing results partly due to the differences among the laboratory methods [21]. We were not faced with any limitations in performing this study. The authors suggest that the similar study to be carried on heavy metals and microbial quality of other Iranian bottled water in future.

Conclusion

The concentrations of Na^+, K^+, F^-, NO_3^-, SO_4^{-2} and Cl^- of the studied Iranian brands of bottled water are not higher than the national and international standards and the pH is in the acceptable range.

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Ethical Permission: The Ethics Committee of Kashan University of Medical Sciences has approved the study.

Conflict of Interests: None declared by authors.

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