

Concentration of Nitrate in Bottled Drinking Water in Qom, Iran

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Background & Aims of the Study: Consumption of bottled water in the world is increasing. The highest growth rates are occurring in Asia and South America. Biological and chemical monitoring of these waters is necessary. The aim of current study was determination of nitrate concentration in bottled drinking water in Qom, Iran in 2012.

Materials & Methods: A cross-sectional study carried out in Qom, Iran. First of all, 18 most frequent brands of bottled drinking waters were purchased in June 2012 randomly. Then concentration of nitrate was measured according to the spectrophotometric method. In next step, experiment data were analyzed by Excel Software and P_{value} was obtained by statistical calculations. Finally data were comprised with written nitrate concentration on labels and recommended permissible values.

Results: The median nitrate concentration was 2.1 mg/L with the minimum 0.8 mg/L and maximum 8.1 mg/L. In 66.7 % of the samples, the measured nitrate concentrations were less than the written nitrate concentrations and in 33.3% of samples, the nitrate concentration was higher. The statistical calculation proved the significant difference between the median of written nitrate concentration on the label and investigated nitrate concentration ($P_{\text{value}} > 0.05$).

Conclusions: It be concluded that the measured nitrate concentration in all of the water samples is below the recommended permissible level.

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Background

Consumption of bottled drinking waters as one of the safe water sources has been grown throughout the world recently (1). In the area without any safe or available potable water resources, bottled drinking waters are used. The main reasons to use of this kind of waters are including the low quality of water supplies, attractive appearance, availability and

portability of them (2). According to the published statistical in 1999 had been estimated that 89 billion liters of bottled water had consumed and reached to 154 billion liters in 2004 that trend to growing (3, 4). People believe that bottled drinking waters are safe to drink, although we must pay attention to this fact that dangerous chemical and biological agents can contaminate bottled drinking water, so without biological and chemical monitoring,

many health problems will be caused. One of the chemical parameters that can effect on health, is nitrate compounds (5). Diseases that are caused by high concentrations of nitrate are include methemoglobinemia (MetHb), children diabetes, gastrointestinal cancer, bladder cancer, abortion and liver cancer (6).

Nitrogen compounds can accumulate in soils and water sources due to the use of fertilizers, industrial emissions and other human activities and can enter to surface water and groundwater in different ways. The nitrate standard level of drinking water and bottled water is considered 45 mg/L in Iran (6). United States Food and Drug Administration (U.S. FDA) and the United States Environmental Protection Agency (U.S. EPA) have announced the permissible values of nitrate in drinking water about 44 mg/L (7, 8). Many studies have been conducted with this topic. Jahed *et al.* surveyed the nitrate levels of 6 available water brands in Tehran (9). A study about nitrate levels in bottled mineral water was investigated by Lolayi *et al.* in Kerman (10). In another project, the concentrations of bottled drinking water's nitrite and nitrate was assessed in Babol (11).

Aims of the study: The aim of current study was determination of nitrate concentration in bottled drinking waters in Qom in 2012 and comparison with written nitrate levels on labels and recommended permissible values.

Materials & Methods

A cross-sectional study carried out in Qom, Iran. First, 18 most common brands of bottle drinking waters were purchased from market in June 2012 randomly. Then the concentration of nitrate was measured according to the spectrophotometric method by using a spectrophotometer DR/4000 (HACH Company). In next step, 10 ml of each water sample was poured into a quartz cell and 10 ml of the same sample plus a nitrate reagent was poured into another cell. The samples measured at 500 nm.

All of the experiments for each sample were done three times. Excel Software drew the experiment data and P_{value} was obtained by statistical calculations. Finally, data were comprised with written nitrate concentration on labels and recommended permissible values.

Results

The obtained results of samples and information on the labels are shown in table 1.

Table 1) results of analysis of samples of bottled drinking water

Brand of bottled water	Number of test	Measured nitrate, first time (mg/l NO_3^-)	Measured nitrate, Second time (mg/l NO_3^-)	Measured nitrate, third time (mg/l NO_3^-)
Vata		1.1	0.9	0.7
Saman		1.5	1.6	1.4
Nava		1.5	1.3	0.9
Nina		2.3	1.8	2.2
Rusta		0.9	0.9	1.2
Bishe		1.3	0.9	1.1
Hobab		3.7	4.1	3.9
Vivant		1.9	1.7	1.5
Hayat		4.3	4.5	4.7
Damash		1.1	1.6	1.5
Rabi		1.5	2	1.6
Kolak		2.3	2.6	2.6
Vatso		7.8	8.5	8
Damavand		1.3	1.7	1.8
Spiroze		1.4	1.8	1.6
Alys		0.9	1.1	1.6
Akvafyna		0.6	0.8	1
Zamzam		0.8	1.1	1.4

The median nitrate concentrations obtained 1.2 mg/L (NO_3^-). The highest measured median level was allocated to Vatso brand 8.1 mg/L, the lowest measured median level was allocated to Akvafyna brand 0.8 mg/L. The highest nitrate concentration on bottle with a median difference between measured nitrate related to the Rabi brand and the lowest differences related to the Damavand brand. Fig. 1 shows the median measured nitrate level versus written nitrate level on label. In 66.7% of the samples, measured nitrate level was less than written nitrate level on label and in 33.3% of samples was more than the amounts on labels. Fig. 2 comprises measured nitrate

concentrations and written nitrate concentration on the label. Based on statistical calculations, there is no significant difference between the

median nitrate concentrations on label and median measured nitrate ($P_{\text{value}} > 0.05$)

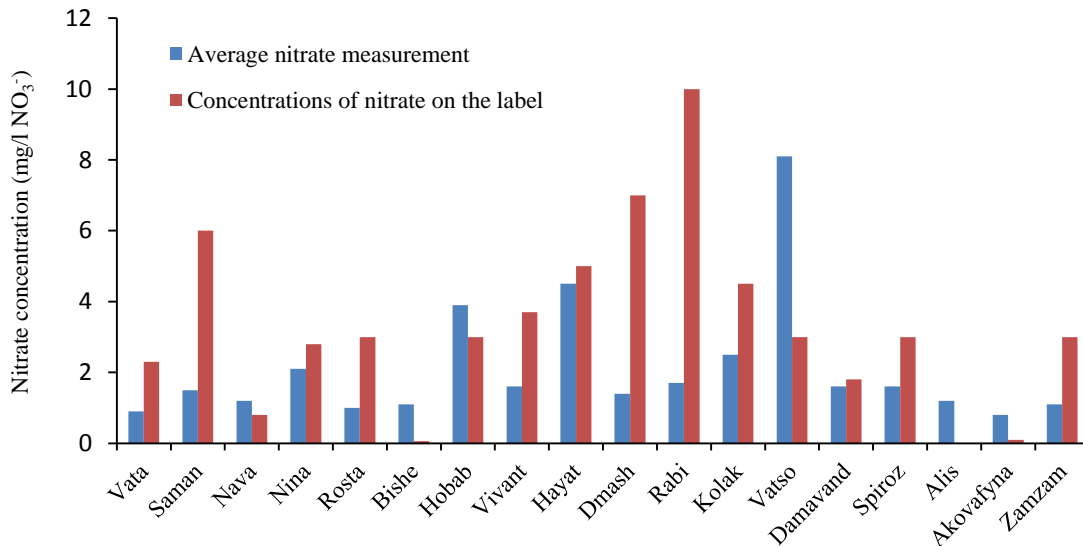


Figure 1) Comparison between measured nitrate concentrations and written nitrate on the label (mg/L NO₃⁻)

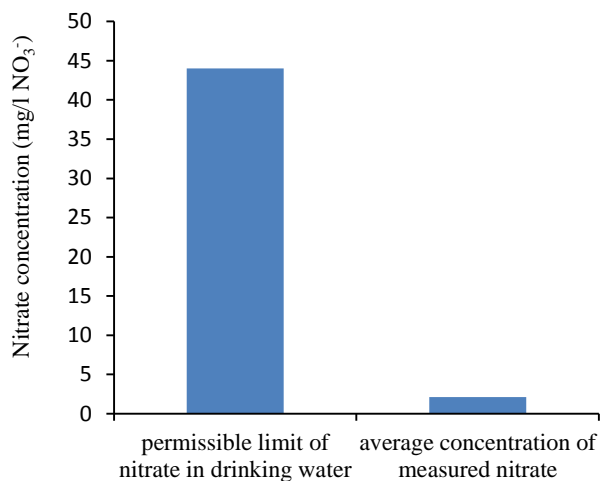


Figure 2) Comparison between the median measured nitrates with permissible nitrate level in drinking water (mg/L NO₃⁻)

Discussion

The aim of current study was determination of nitrate concentration in bottled drinking waters. As was expressed some factors can be effective on adverse quality of bottled water such as lack of continuous monitoring of product quality by manufacturers, inaccuracies in the measurement standard of chemical factors such as nitrate end etc.

The statistical calculation of this study proved that there are significant difference between the median of written nitrate levels on the label and investigated nitrate levels ($P_{\text{value}} > 0.05$). The results of this study have compared with other studies; in a conducted study with six brands of mineral water in Tehran, total median nitrate concentration was obtained 9.02 mg/L (NO₃⁻) which was less than the permissible (9). In another survey in Kerman

which was done on 13 brands of bottled mineral water experiments showed in %7 of samples nitrate level was more than the standard level (10). Nitrite and nitrate concentrations studied in 14 different brands of bottled water in Babol. The highest concentration of nitrate was 8.38 mg/L, fortunately it means that national and international standard were considered (11).

In project with title, "Quality of Bottled Water Brands in Egypt" showed which all of brands had nitrate concentrations according to Egyptian standard. Maximum nitrate concentration was 4.05 mg/L. World Health Organization has recommended 50 mg/L for nitrate level and 10 mg/L for nitrite level in drinking water as standard (12). Result of another study show that Nitrate concentration in six brands of bottled drinking waters was 0.1 - 1.7 mg/L with mean 0.5 mg/L. This level provides no margin of safety for infants (13). According to EPA, infants less than six months that drink water containing nitrate in excess of the potable water standard could become seriously ill and, if untreated may die (13).

In the United Arab Emirates, the nitrate and nitrite level in the tested bottled water were below the permissible standards set by U.S. and international organizations. Nitrite as well as nitrate may cause serious problems (14).

In Spain, the average of nitrate concentration was 4.2 mg/L (range 1-29.0). Nitrate concentration in rural and urban area was similar ($p_{\text{value}} = 0.86$). Differences between areas were significant for nitrate ($p_{\text{value}} < 0.001$). Only nitrate was quantifiable in bottled water (range 2.3-15.6 mg/L). Nitrate concentration in municipal water and bottled water were below the recommended limit in all samples (15). Increased nitrate intake could also affect the thyroid function. The reason is that the nitrate ion alone or in mixture with thiocyanate (SCN^-) and perchlorate (ClO_4^-) shares the same transport mechanism at the sodium iodide symporter of thyroid gland and competitively inhibits the iodide uptake. In

many countries, Nitrate in potable water has been recognized as a factor for progress goiter incidence (16). In current study, median nitrate level was 2.1 mg/L that was less than permissible level. Continuous monitoring of water quality and effectiveness of the treatment processes and obeying recommended levels are required. Fortunately in this investigation the concentration of nitrate in all of the samples were below the recommended permissible values. These indicate on regarding the national and international standards to investigation these chemical parameters in bottled drinking water in Qom.

Conclusion

It be concluded that the measured nitrate concentration in all of the water samples is below the recommended permissible level.

Footnotes

Conflict of Interest:

The authors declare no conflict of interest.

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