

Survey on Concentration of Nitrate in the Network Distribution Drinking Water: Jask city, Iran

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Abstract: Nitrate is a chemical contaminants that can enter the surface and groundwater resources of drinking water by various ways. The presence of nitrate in drinking water supplies could endanger human health. In this descriptive-cross-sectional study, the concentration of nitrate in 48 water samples which were collected from 8 regions of Jask city, were measured by spectrophotometer device of model DR2800 and by the method of 8153 of Ferrous sulfate (June to March 2014). The mean and range concentration of nitrate in groundwater is 13.2 ± 6.4 and $ND-23$ mg/l, respectively. The highest and lowest concentration of nitrate is related to the Loranand Yekebeniregion, respectively. The mean concentration of nitrate in distribution network Jask city is significantly lower than the WHO and EPA standard limits.

Keywords: Concentration of Nitrate, Distribution Network, Drinking water, Jask city

I. Introduction

Nitrate ion is an unstable nitrogen composition which can get into the soil and surface and groundwater resources, through the raw wastewater, leakage from sewage and industrial urban wastewater and facilities, the accumulation of urban and industrial waste, excessive consumption of animal and chemical fertilizers in agriculture. [3-1] In the past two decades, the concentration of nitrate in the worldwide water resources is annually on the rise from 1-3 mg/l. [5, 4] Natural concentration of nitrate in groundwater under aerobic conditions is depending on the type of soil and geological conditions; such that in the US the normal level of nitrate have been reported between 4-9 mg/l. [6] Water naturally and without infection have less than 1 mg/l nitrate. [7] Nitrate is a chemical factors that can affect health, drinking water and can cause adverse health effects in consumers [8]. Studies have shown that drinking water with high concentration of nitrate can cause Methemoglobin in infants, children diabetes, stomach, bladder and liver cancer. [11-9] Also water with high concentration of nitrate is more dangerous for children under three years. [12] According to World Health Organization guidelines and America Environmental Protection Agency, maximum concentration of nitrate in drinking water according to nitrate is 50 mg/l. [14, 11] Some studies have shown that the process of nitrification in the water distribution network and reservoirs are often related to amino chlorine disinfection debugger. [14, 13] In most of the studies, concentration of nitrate water distribution network have been measured and have been compared with standard limits. [16, 15] According to the importance of nitrate in drinking water and their effects on disease, so in this study was tried to measure the concentration of nitrate in water distribution network of Jask city and compared it with standard limits.

II. Materials And Methods

1.2 Study of Area

The port city of Jask in southeast of Hormozgan province and at a distance of 220 km to Bandar Abbas (Hormozgan Province Center) is located in geographical coordinates of $25^{\circ}39'11''N$ and $57^{\circ}47'21''E$ (Figure 1) [17]. High of this city from the sea level is 2 meters above and its climate is warm and humid [18]. Drinking water of the city residents is supplied from surrounding wells. Therefore, water without purification acts and just with plain chlorination can enter the urban water distribution network.

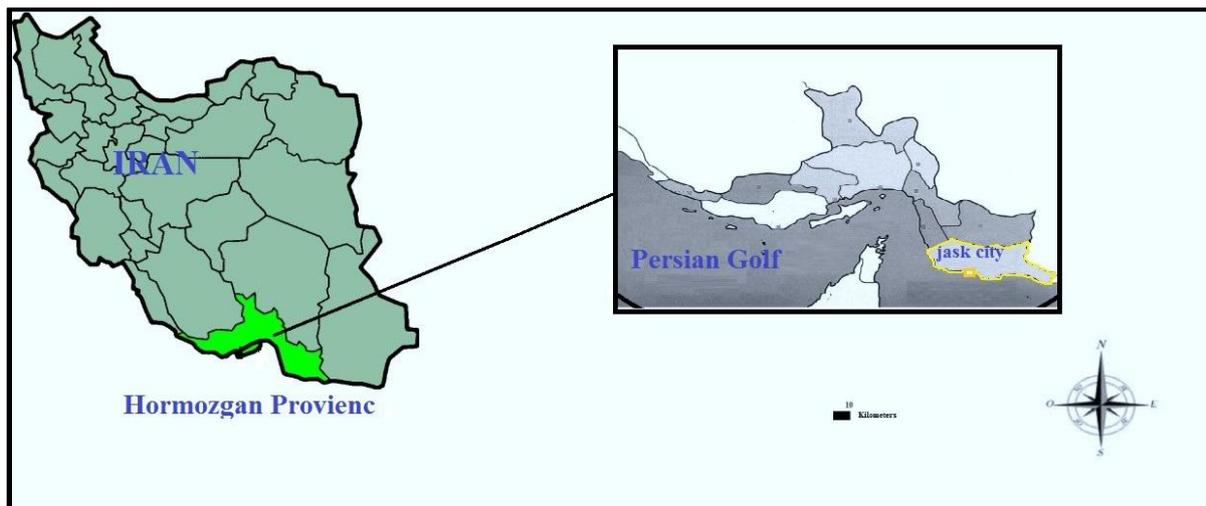


Figure 1. The Jask City in Hormozgan Province of Iran.

2.2 Sample Collection

In this descriptive-cross-sectional study, which was performed in the month of January, February and March (winter) in 2014, in order to obtain a good average of nitrate concentrations in drinking water in Jask, on the basis of size, population density, the city was divided into 8 regions of Yakbany, Laurent, Serreig, Maqsa, Zolmabad, Sarkale and Gharibabad. Samples collection were performed in three time stages (in the middle of the each month). In each month 16 cases and in total 48 water samples (6 water samples from each region during the winter) were collected from the water distribution network in winter. After 10 minutes, the water withdrawal of the pump tube sample was transferred into the 1.5-liter polyethylene container. Samples in the temperature of 4 was transferred to the laboratory School of Public Health in Bandar Abbas [19].

3.2 Measurement concentration of nitrate

Concentration of nitrate in the samples was measured by spectrophotometry DR 28000 (Hack Company). Measurement method of 8153 Ferrous Sulfate Method Powder Pillows was used for determining the concentration of nitrate. The measurement range according to this method was 2-250 mg/l NO_2^- in the 585 nm wavelength [17].

4.2 Statistical Analysis

The difference in the mean concentration standard limits of nitrate were taken by using T test and SPSS16 software with 5% statistical error ($\alpha=5$) as significant level.

III. Results

The mean concentration of nitrate in the months of January, February and March is 13.0 ± 7.3 , 13.2 ± 4 and 14.7 ± 6.4 mg/l, respectively. The mean and range concentration of nitrate is 13.2 ± 6.4 mg/l and ND- 23^1 mg/l, respectively (Table 1). Mean concentration of nitrate in Yekebeni, Louran, Sarrige, Maghsa, Kampa, Zolm abbad, Sarkaleh, Gharib abbad Regions is 4.5, 23, 14, 11, 6, 11.5, 15.5 and 20 mg/l (Table 1).

Table 1. The mean concentration of nitrate water distribution network in 8 regions of Jask (mg /l)

Region	January	February	March	Mean
Yekebeni	23.0	ND	6.0	4.5
Louran	ND	ND	23.0	23.0
Sarrige	12.0	16.0	ND	14.0
Maghsa	ND	11.0	ND	11.0
Kampa	ND	6.0	16.0	6.0
Zolm abbad	ND	14.0	9.0	11.5
Sarkaleh	18.0	16.0	13.0	15.5
Gharib abbad	19.0	16.0	21.0	20.0
Mean	13.0	13.2	14.7	13.2
SD	7.3	4.0	6.7	6.4

¹Not detected (less than 2 mg/l)

IV. Discussion

The order of regions based on mean concentration of nitrate is Louran > Gharib abbad > Sarkaleh > Sarrige > Zolm abbad > Maghsa > Kampa > Yekebeni. All samples (100%) are lower than standard limits. The highest and lowest concentration of nitrate was related to Louran and Yekebeni region (Figure 2).

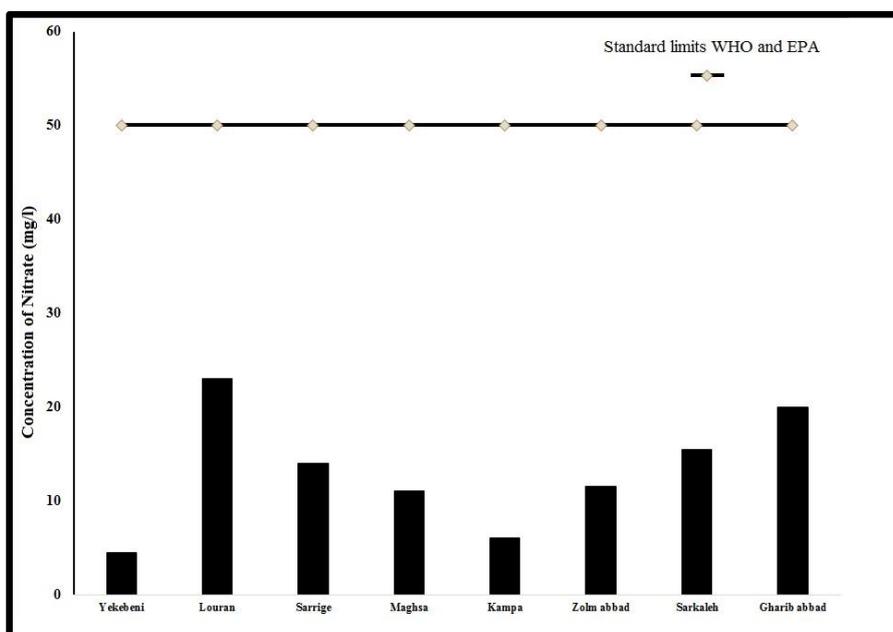


Figure 2. Comparison concentration of nitrate in the water distribution network in 8 regions of Jask city with WHO and EPA standard limits.

Mean nitrate concentration of groundwater is approximately 26.4% of WHO and EPA standard levels [18, 6] (Figure 3). Statistical analysis showed that there is a significant difference between the groundwater nitrate concentrations in our study with WHO and EPA standard limits (p value < 0.05).

Table 2. Comparing the maximum groundwater nitrate concentration in different Regions of Iran with Jask city

	Max	Source	Reference
Isfahan	248.3	Groundwater	[19]
Behshahr	45	Groundwater	[20]
Karaj	85.49	Groundwater	[21]
Malayer	74.4	Groundwater	[22]
Hamedan	17.6	Groundwater	[22]
Kermanshah	84	Groundwater	[23]
Jask	14.6	Groundwater	This study

The maximum concentration of nitrate in this study is less than the maximum concentration of nitrate in Isfahan, Behshahr, Karaj, Malayer, Kermanshah and Hamedan cities (Table 2). The range concentration of nitrate in the study done by Mondal et al. (2008) in water wells of Krishna delta in India is 10-135 mg/l [24]. Mean concentration of nitrate in Amman (Jordan) groundwater in the study done by Obeid et al. (2008) was 33 mg/l [25]. In a study done by Lateef, it was found that the mean concentration of nitrate in groundwater in Tikrit and Samarra, Iraq, was 43.35 mg/l [26]. Mean concentration of nitrate water distribution network at Robat karim city, Tehran in the study done by Panahi et al is much lower than the one in our study [15]. Also, the mean nitrate concentration in the water distribution network in the city of Thebes in the study done by Shams and colleagues (3.5 mg/l in July and 2.5 mg/l in September) is lower than the one in our study [16].

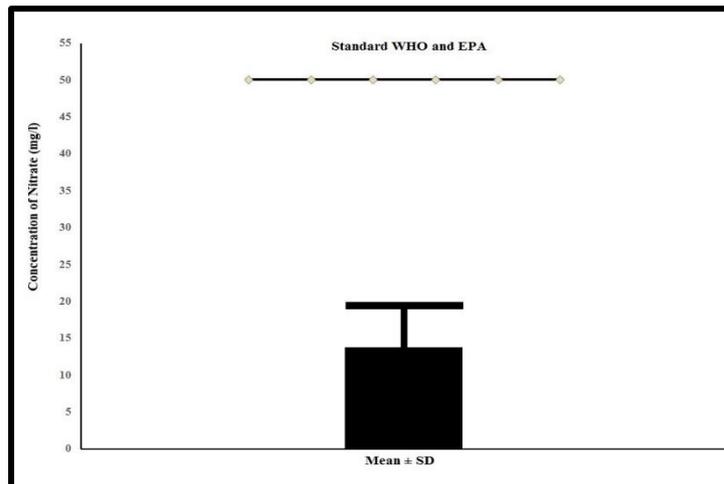


Figure 3. Comparing the mean concentration of nitrate water distribution network of Jask City with EPA and WHO standard limits

V. Conclusion

The highest and lowest concentrations of nitrate was related to Louran (23 mg/l) and Yekebeni (4.5 mg/l). Mean concentration of nitrate distribution network water in Jask city (13.2 ± 6.4 mg/l) is significantly lower than the WHO and EPA standard level.

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