

Concentration of Nitrate in drinking water of the distribution network of Minab city, Iran

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Abstract

In the past two decades, concentration of nitrate in the water resources is rising. The presence of nitrates in water resources can cause health and ecological risks. In this cross-sectional study, concentration of nitrate in 90 samples collected from 10 regions in Minab city was measured by spectrophotometer model DR2800 and the method of ferrous sulfate 8153 (July to September 2014). The mean and range concentration of nitrate in groundwater was 14.6 ± 7.8 mg/l and ND-43 mg/l, respectively. The lowest and highest concentration of nitrate were related to the Zohki and Ahmad abbad region, respectively. The mean concentration of nitrate distribution network at Minab city is lower than the WHO and EPA standard limits.

Keywords: Nitrate concentration, distribution networks, drinking water, Minab city

1. Introduction

Nitrification is a two-step process, first, ammonia is oxidized to nitrite by ammonia-oxidizing bacteria (AOB) and then nitrite is oxidized to nitrate by nitrite-oxidizing bacteria (NOB) [2, 1]. In the past two decades, the concentration of nitrate in water resources of the world is rising annually 1.3 mg/l [3]. Since nitrate has a high solubility in water, hence it can be widely extended into the water [4]. Water pollution to nitrates can be entered into water sources by water pollution of industrial and municipal waste, animal and chemical manure or industrial and municipal wastewater [6, 5]. The influx of nitrate in water resources causes ecological and health risks [7, 4]. Studies have shown that consumption of drinking water with high concentrations of nitrates cause Methemoglobin in infants, diabetes in children, stomach, bladder and liver cancer [9, 8]. Water has a high concentration of nitrate is dangerous for children under three years of age [10]. Because the bacteria in the digestive tract can revive food and water nitrate to nitrite. Then nitrate is absorbed into the bloodstream hemoglobin is changed into Methemoglobin. Although Methemoglobin is not potentially toxic, but reduces the oxygen carrying capacity by the hemoglobin. Also, the nitrite revived by nitrate by bacteria in the digestive tract is combined with the second and third amines to form nitrous and produce carcinogenic amines [12, 11]. According to World Health Organization guidelines and America Environmental Protection Agency, the maximum nitrate allowed in drinking water in terms of nitrate is 50 mg/l [14, 11]. In many studies, the concentration of nitrate in the water distribution network is measured and compared with standard limits [14, 13]. Some studies have shown that the process of nitrification in the water distribution network and reservoirs are often related to amine chlorine disinfections [16, 15]. Hence, this study was an attempt to measure the concentration of nitrate distribution network at Minab city and compare it with standard limits.

2. Materials and methods

1.2. Study of Area

Minab city has been located in the southeastern Hormozgan province and at a distance of 100 km from the city of Bandar Abbas (center of Hormozgan province) in the geographical coordinates of 27° 11'53" N and 54° 22'7" E (Figure 1). Height of this city is 27 meters above sea level and has a warm and humid climate . [17] Residents of the city's drinking water is supplied from groundwater sources (three 300 meter wells).

2.2 Samples Collection

In this cross-sectional study, samples were collected at three stages of July, August and September 2014 (one step per month). At each stage from the region 3 water samples were collected. Hence, in the total of three stages, 90 water samples were collected from 10 study areas (Figure 1). After 10 minutes of water discharge from Pump pipes, the sample was transferred into 1.5 liter polyethylene container. The samples was transferred to the chemical library at Health Faculty of Bandar Abbas at 4°C temperature . [18]

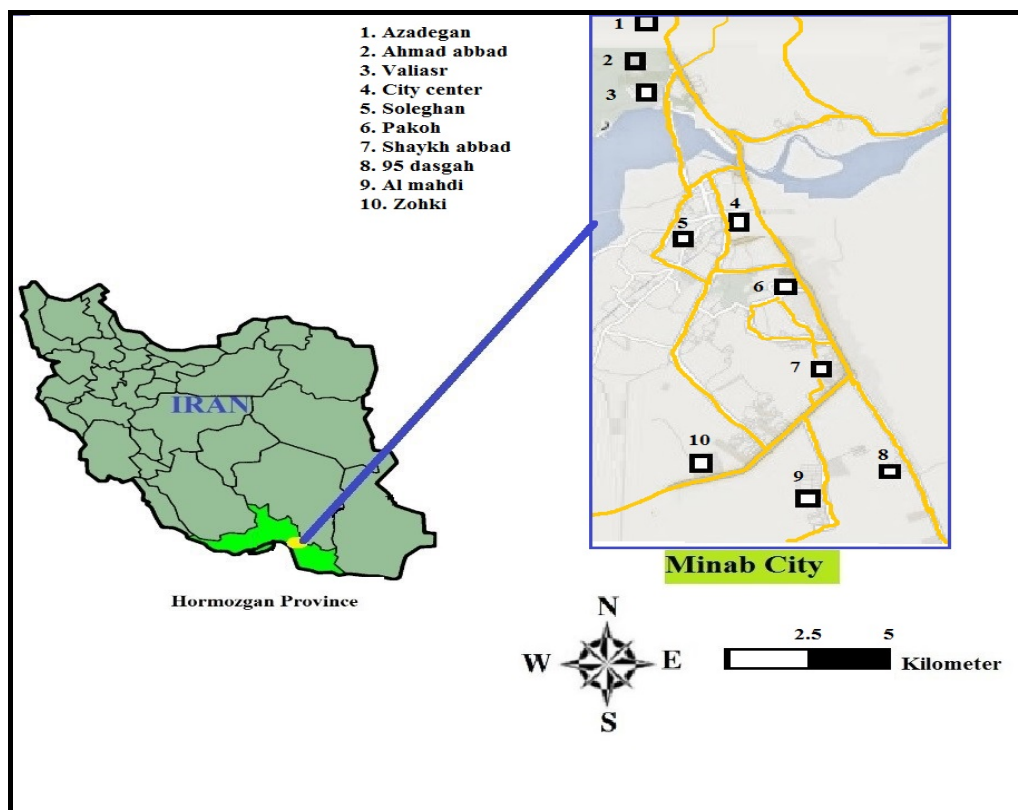


Figure 1. 10 areas of water samples collection in Minab city, Iran

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 [19].

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.

3. Results

The mean concentration of nitrates in the months of July, August and September are 12.9 ± 6.6 , 15.7 ± 5.9 and 18.9 ± 14.5 mg/l, respectively. The mean and concentrations range of nitrate is 14.6 ± 7.8 mg/l and ND-43¹ mg/l, respectively (Table 1). Mean concentration of nitrate in Azadegan, Ahmad abbad, Valiasr, City center, Pakoh, Shaykh abbad, 95 Dastgah, Al Mahdi and Soleghan areas is 10.5, 5, 16.7, 19.5, 21, 15, 5.5, 11.5, 27.5 and 25.3 mg/l (Table 1).

Table 1. The mean nitrate concentration of water distribution network in 10 regions of Minab (mg /l)

Area	July	August	September	Mean
Azadegan	5.0	ND	16.0	10.5
Ahmad abbad	ND	7.0	3.0	5.0
Valiasr	19.0	10.0	21.0	16.7
City center	21.0	18.0	ND	19.5
Pakoh	ND	21.0	ND	21.0
Shaykh abbad	ND	17.0	13.0	15.0
95-Dasgah	5	ND	6.0	5.5
Al Mahdi	12.0	ND	11.0	11.5
Zohki	17.0	ND	38.0	27.5
Soleghan	12.0	21.0	43.0	25.3
Mean	12.9	15.7	18.9	14.6
SD	6.6	5.9	14.5	7.8

4. Discussion

The order of wells based on mean concentration of nitrate is Zohki>Soleghan>Pakoh>City center>Valiasr>Soleghan>Al Mahdi>Azadegan> 95-Dasgah>Ahmad abbad. All samples (100%) are lower than standard level. The lowest and highest nitrate concentrations were related to Zohki and Ahmad abbad areas (Figure 2).

¹ Not detected (less than 2 mg/l)

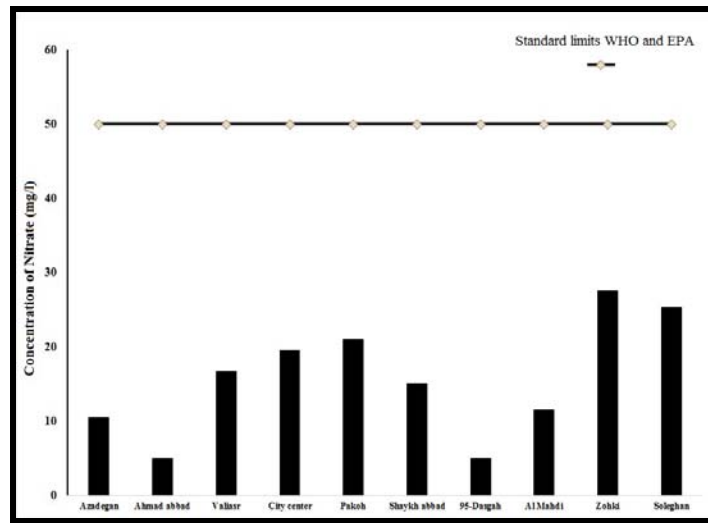


Figure 2. Comparison of nitrate concentrations in the water distribution network in 10 regions of Minab city with WHO and EPA standards

Mean nitrate concentration of groundwater is approximately 29.2% of WHO and EPA standard levels [20, 11](Figure 3). Statistical analysis showed that there is a significant difference between the groundwater nitrate concentrations in our study with WHO and EPA standards (p value <0.05).

Table 2. Comparing the maximum groundwater nitrate concentrations in different areas of Iran with Minab city

	Max	Source	Reference
Isfahan	248.3	Groundwater	[21]
Behshahr	45	Groundwater	[22]
Karaj	85.49	Groundwater	[23]
Malayer	74.4	Groundwater	[24]
Hamedan	17.6	Groundwater	[24]
Kermanshah	84	Groundwater	[25]
Minab	43	Groundwater	This study

The maximum nitrate concentration in this study is less than the maximum nitrate concentration in Isfahan, Behshahr, Karaj, Malayer and Kermanshah cities and more than Hamedan (Table 2). The range of nitrate concentration in the study done by Mondal et al. (2008) in water wells of Krishna delta in India is 10-135 mg/l . [26] Mean nitrate concentrations in Amman (Jordan) groundwater in the study done by Obeid et al (2008) was 33 mg/l . [27] In a study done by Lateef, it was found that the mean nitrate concentrations in groundwater in Tikrit and Samarra, Iraq, was 43.35 mg/l . [28] Mean nitrate concentration of 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 . [13] 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 in mg/l in September) is lower than the one in our study . [14]

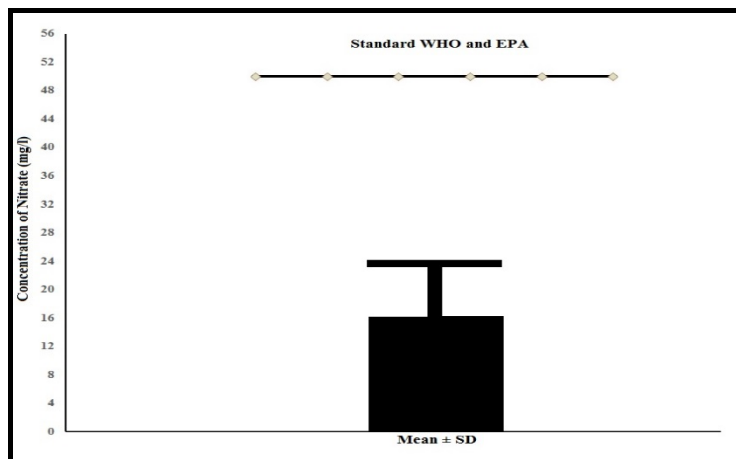


Figure 3. Comparing the mean concentration of nitrate water distribution network of Minab city with EPA and WHO standard limits

6. Conclusion

The highest and lowest concentrations of nitrate was related to zohki (27.5 mg/l) and Ahmad abbad (5 mg/l). Mean concentration of nitrate distribution network water in Minab city (14.6 ± 7.8 mg/l) is significantly lower than the WHO and EPA standard level.

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8. References

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