

## **Concentrations of Nitrate Groundwater in the 17 Wells at the Region of Hasht Bandi of Minab, Iran**

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**Abstract:** Consumption of drinking water containing high concentrations of nitrate can be cause Methemoglobin in infants, diabetes children and types of cancer. In this cross-sectional study, the concentration of nitrate in 102 water samples collected from 17 wells in Hasht Bandi of Minab was measured by a spectrophotometer Model DR2800 (May to July, 2014). The mean concentrations of nitrate in groundwater is  $17.5 \pm 6.6$  mg/l and ND-41 mg/l, respectively. The lowest and highest concentration of nitrate is related to well 8 and well 14, respectively. Mean nitrate concentrations of groundwater is lower than WHO and EPA standard limits.

**Keywords:** Nitrate, Groundwater, Wells, Hasht Bandi of Minab

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### **I. Introduction**

In recent years, surface water and groundwater concentration of nitrate has been increased due to the expansion of agricultural and industrial activities [3-1]. Nitrate ion is one of the mineral nitrogen ingredients that is produced in the last step of ammonia oxidation. [5, 4] Organic substances, municipal and industrial wastewater, natural and chemical fertilizer can cause resources of nitrate inclusion in groundwater and surface water. [7, 6] Studies have shown that consumption of drinking water with high concentrations of nitrates cause methemoglobin in infants, diabetes among children, stomach cancer, bladder and liver [10-8]. When hemoglobin concentration is reached 1.5 g per deciliter of blood, or at least to 10% of adult hemoglobin concentration, the anemia complications and cyanosis will be produced in person. The main symptoms of cyanosis is blue color of the skin, especially around the eyes and mouth. [6] Water has a high concentration of nitrate is potentially harmful for babies and children. Because the bacteria in the digestive tract can revive food and water nitrate to nitrite. Then nitrate will be absorbed into the bloodstream and transforms hemoglobin to Methemoglobin. Although Methemoglobin is not potentially toxic, it reduces the capacity oxygen carrying by the hemoglobin. Also, nitrite resulted from Nitrate revival by bacteria in the digestive tract is combined with the second and third amines and forms nitrous and produces carcinogenic amines [13-11]. According to World Health Organization guidelines and America Environmental Protection Agency, Maximum permissible nitrate (MPC) in drinking water by nitrogen is equal to 10 mg/l and by nitrate is 50 mg/l [14, 11]. In many of the studies, concentration of nitrate in groundwater has been measured, such as the study conducted by Wjchoi et al who evaluated the impact of land use on groundwater concentration of nitrate in rural areas of South Korea. [15] The more the use of chemical nitrogen fertilizers on agricultural land, the higher the groundwater concentration of nitrate increases [17, 16]. Due to agricultural activities, the use of chemical fertilizers, especially nitrogen fertilizers in Hasht Bandi of Minab city is high. Hence, this study tries to measure concentration of nitrate groundwater in 17 wells in this area and compare with standard limits.

## II. Materials And Methods

### 1.2 Study of Area

Hashtbandiregion, populated with 5 thousand people and 20 km<sup>2</sup> area is located in northeast of Minab city and in 163 km at Bandar Abbas (the center of Hormozgan Province) and in 27°07'19"N and 57°27'23" Geographical coordinates (Figure 1)[18]. The region's climate is hot and dry and the original activities of inhabitants of the area is agriculture. The depth of water wells in this area is between 60 to 160 m.

### 2.2 Sample collection

In this cross-sectional descriptive study, sample collection was performed in three stages from May to the July 2014 (one stage per month). In each stage, two water samples were collected from each well. Hence, 102 water samples were collected from 17 wells in total of three stages (Figure 1). After 10 minutes of existing water out of the pump tube, the sample was transferred into the 1.5 liter polyethylene bottle. The samples were transferred at the temperature of 4°C to the Chemical Laboratory Faculty of Health in the Bandar Abbas[19].

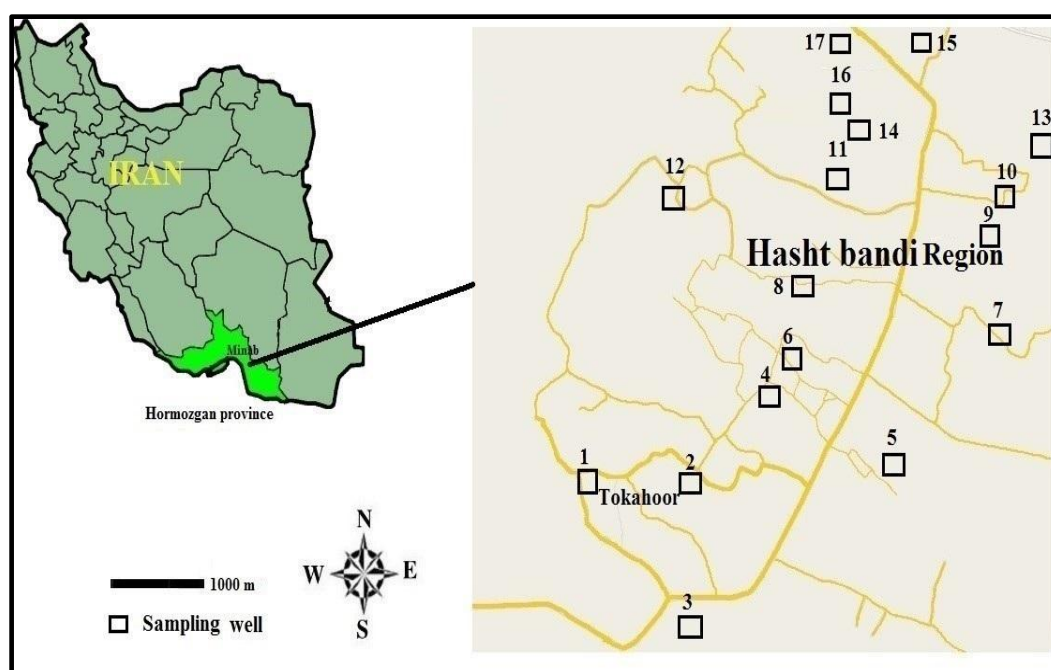


Figure 1. 17 wells in the Hashtbandiregion at Minab in northeastern part of Minab city, Iran.

### 2.3 Measurement concentration of nitrate

Concentration of Nitrate in the samples was measured by spectrophotometry device model DR28000 (Hach Company). 8153 Ferrous Sulfate Method Powder Pillows for determining the concentration of nitrate was used. According to this method, the measurement range is 2-250 mg/l NO<sub>2</sub><sup>-</sup> in the 585 nm wavelength [20].

### 2.4 Statistical Analysis

The difference in mean concentration of nitrate by standard limit is done using T test by SPSS16 software with 5% statistical error ( $\alpha=5$ ) as significant level.

## III. Results

The mean concentration of nitrates in the months of May, June and July 2014 is 17.9±10.1, 16. ± 310.6 and 16.2 ± 9.4 mg/l. respectively. Mean and range concentration of nitrate is 17.5±6.6 mg/l and ND<sup>1</sup>-41 mg/l (Table 1). Mean concentration of nitrate in the well 1, Well 2, Well 3, Well 4, Well 5, Well 6, Well 7, Well 8, Well 9, Well 10, Well 11, Well 12, Well 13, Well 14, Well 15, Well 16, Well 17 is 13.5, 15.3, 23.5, 15.0, 14.0, 13.5, 33.5, 17.0, 10.3, 25.0, 22.3, 13.6, 0, 15.7, 19.3 and 17.5 mg/l, respectively.

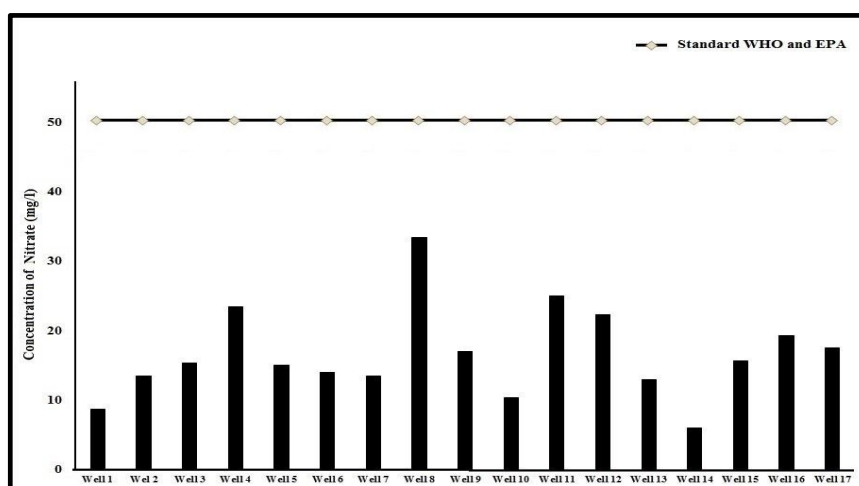
<sup>1</sup>Not detected (less than 2 mg/l)

**Table 1. Mean concentrations of nitrate in groundwater in 17 wells Hasht Bandi of Minab (mg/l)**

	May	Mean June	July	Mean
Well 1	11 <sup>2</sup>	6	9	8.7
Well 2	ND	8	19	13.5
Well 3	16	11	19	15.3
Well 4	32	15	ND	23.5
Well 5	11	19	ND	15.0
Well 6	ND	16	12	14.0
Well 7	21	ND	6	13.55
Well 8	26	ND	41	33.5
Well 9	15	ND	19	17.0
Well 10	5	9	17	10.3
Well 11	19	31	ND	25.0
Well 12	35	12	20	22.3
Well 13	ND	ND	13	13
Well 14	6	ND	ND	6.0
Well 15	14	28	5	15.7
Well 16	7	37	14	19.3
Well 17	32	3	ND	17.5
Mean	17.9	16.3	16.2	16.3
SD <sup>3</sup>	10.1	10.6	9.4	6.6

#### IV. Discussion

The order of wells based on mean concentration of nitrate is well8> well11> well4> well12>Well16> well17> well9> well15> well3> well6> well13> well7>well2> well10> well1> well14. All samples (100%) are lower than WHO and EPA standard levels. The highest and lowest concentrations of nitrate relates to well8andwell14, respectively (Figure 2). The higher concentration of nitrate in groundwater in well8 can result from contamination of soil to chemical nitrogenous fertilizers or higher soil permeability [23-21].



**Figure 2. Comparing the concentration of nitrate in 17 water wells at Hasht Bandi with WHO and EPA standard limits**

<sup>2</sup> Mean of 2 samples

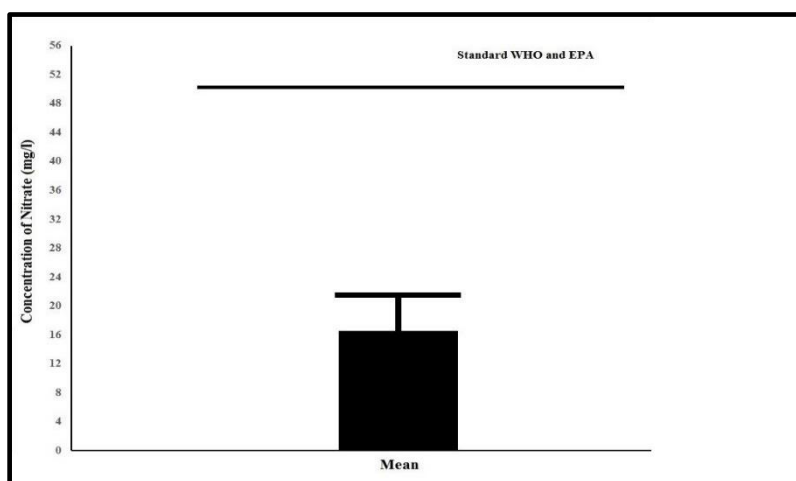
<sup>3</sup>Standard Deviation

Concentration of nitrate groundwater is 35% of standard limits of WHO and EPA [14, 11] (Figure 3). Statistical analysis showed that there is a significant difference between the groundwater concentration of nitrate in this study by WHO and EPA standard limits ( $p$  value  $< 0.05$ ).

**Table 2. Comparing the mean concentration of nitrate of groundwater in different regions of Iran with Hasht Bandi Minab**

	Max	Source	Reference
Isfahan	248.3	Groundwater	[24]
Behshahr	45	Groundwater	[25]
Karaj	85.49	Groundwater	[26]
Malayer	74.4	Groundwater	[27]
Hamedan	17.6	Groundwater	[27]
Kermanshah	84	Groundwater	[28]
Minab (Hashtbandi)	41	Groundwater	This study

The maximum concentration of nitrate in this study is less than the maximum concentration of nitrate in Isfahan, Behshahr, Karaj, Malayer, Hamedan and Kermanshah (Table 2). The range concentrations of nitrate in the study conducted by Mondalet al (2008) in well waters of Krishna delta in India is 10-135 mg/l [29]. Mean concentration of nitrate in Amman (Jordan) groundwater in the study of Obeidat et al (2008) is 33 mg/l [30]. Mean groundwater concentration of nitrate in Tikrit and Samarra, Iraq in the study of Hameed Lateef (2010) is 43.35 mg/l [31].



**Figure 3. Comparing the mean and standard deviation concentration of nitrate in the groundwater at Hashtbandi with EPA and WHO standard limits**

## V. Conclusion

The highest and lowest concentrations of nitrate are related to well 8 (33.5 mg/l) and well 14 (6). Mean groundwater concentration of nitrate in 17 wells in the study area of Minab Hasht Bandi is significantly lower than the WHO and EPA standard levels.

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