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INCREASING TREND OF NITRATE CONTAMINATION OF TEHRAN SOUTHWEST GROUNDWATER AQUIFER OF IRAN

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Key words: *Nitrate, groundwater, pollution, Tehran*

Abstract

To assess the pollution trend of southwest ground water aquifer of Tehran by nitrite and nitrate, in February 1999, out of 300 wells within this area, 99 wells were selected according to simple random sampling without replacement, analysed by colorimetric and ultraviolet spectrophotometric screening standard methods, respectively.

The conclution asserted is that with a confidence limit of 95%, standard error of 2, and permissible error of $\pm$ 2.21, the average concentration of nitrate in southwest Tehran ground water aquifer is 48 to 56 mg/l as No^{-}_{3}.

Comparison the results of this survey with the data collected in 1993, it was concluded that the nitrate concentration in aquifer has increased 2.4 fold whereas the nitrite has reduced about 4 fald. One of the reasons for this changes is the process of denitrification occured under the recently made hydrochemical conditions of layers, and finally there was a significant decrease in $No^{-}3$ levels with depth.

Concentration appraisal of the sum of the ratio of the concentration of each parameter (nitrate & nitrite) to its respective guide line value showed that 52.5 percent of wells under the study, exceed the number one recommended guide line and health significance in drinking water by W.H.O.

Introduction

In Iran , like many other parlsof the world, ground water is a vital

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national resource that is used for many purposes including public and domestic water supply systems, for irrigation, livestock watering, industrial, commerical and mining purposes (1).

In many parts of Iran, ground water serves as the only reliable source of drinking, irrigation and idustrial water. Unfortunately, this vital resource is vulnearable to contamination, and groundwater contaminat problems are being reported throughout the country (6,10,11) due to discharge of domestic and industrial waste int sewrage well, use of fertilizer and manure in agriculture more than plants can use and when water can move easily through the soil and underlying rock (3,8).

The excess nitrate is carried through the soil into ground water supplies by irrigation, rain-water and snow melt, due to some plants (soybeans, alfalfa) finally with rain during electrical storms (2,7).

Nitrate concentrations in ground water supplies throughout many areas in Iran, particularly in the North part (Gilan and Mazandaran Provinces), Arak and Mashhad townships have steadily increased well past the guideline established by W.H.O 1997 (11.3mg/L N or 50 mg/L No^{-}_{3}), and are considered to be unsuitable for human consumption for this reason alone (5).

Nitrate perse is not toxic, but is the precursor to nitrite which is produced through microbial reduction of nitrate in the intestine or in food preparation, which can cause a(sometimes fetal) blood disorder called methemoglobinaemia (blue baby syndrome) in reconstitute milk feeding infants under six and especially three months, with a bluish color of the skin particularly around the eyes and mouth, with a chocolate brown color of blood called cyanosis. These children can have slightly retarded bodily growth and slower reflexes (12,13).

Researchers, reuslts indicate that chronic administration of elevated concentration on nitrate in drinking water has capability but unproven risks of inducing cytogentic effects in children, incidence of childhood diabetes, contribute to the risk of Non-Hodgkin's lymphoma, spontaneous abortion, causes hypertrophy of the thyroid, positive significance relationship and mortaliy due to cancer of stomach, bladder, prostate and colon, development of brain tumours and toxic effect to the pancreas(4,9,14,15).

However, the epidemiologic date are not yet sufficient to draw definte conclusions.

Vitamin C is considered to be an effective preventive agent or antidote against the health effects of nitrate or nitrite (4,12,13).

Ruminant animals and infant monogastrics (such as baby pigs and chickens) with the exception of horses, nitrate poisoning affects them the sam way it affects human babies, with other symptoms include a sluggish, staggering gait, rapid heart beat, frequent urination, and labored breathing, convulsion and coma, pregnant animals abortion, followed by collapse (13).

Materials and methods

This study was conducted to assess the amount and alteration of nitrate and niturite in different wells located in southwest zone of Tehran.

For this purpose, from out of 300 wells within this area with depth ranging from 90 to 165 m, 99 wells were selected by simple random sampling for pretest. Samples taken from wells were collected in polyethylen containers (preserved by adding H_2SO_4 to bring pH bellow 2, refrigerated for more than 48 hours storage) and analyzed as soon as possible for nitrite and nitrate by colorimetric and ultraviolet spectrophotometric screening standard methods respectively (1).

The statistical analyses of the results from the pretest calculated (Table 1,2). It was concluded from the pretest that for 95% confidence limit, standard error of 2 and permissible error of 2.21 it is required to study a total of 99 wells. As a result, the work was stopped.

The distribution of nitrate in groundwater aquifer is depicted by the isoconcentration lines shown in Fig. 1. The possible relationship between the distance of wells water and seepage wells of each industry located under the test areas was proposed by a mathematical formula model (Fig. 6,8) and finally the correlation between levels of nitrate and nitrite with depth of wells were obtained (Fig. 7,9).

Results and discussion

This survey showed that there are 300 industrial units in the southwest of Tehran with water consumption of 879.6×10^6 cubicmeter per day and discharge 583.9×10^6 cubicmeter wastewater to seepage wells. Although water table of central part of Tehran during 46 years raised with an average of 28(range 5-46) meter, but

in the southwest we encounter 1.5 meter falling.

The results of analysis of groundwaters in 99 wells show that the concentration of nitrite and nitrate ranging from 5.19 to 85.49 mg/l and 0.29 to 314.22μg/l, with a mean of 51.96 mg/L, 16.18 μg/L and standard diviation of 20.157 mg/L, 1.98 μg/L as No^{-}_{3} and No^{-}_{2}, respectively.

The conclusion obtained is that with a confidence limit of 95%, the average concentration of nitrate in the southwest ground water aquifer was between 48 to 56 mg/l as No^{-}_{3}.

As the isocncentration lines demonstrate the distribution of the nitrate has not followed a particular pattern but it is mostly localized in proximity of industrial centers.

Considering the maximum allowable concentration of nitrate and nitrite to be 50 and 3 as NO^{-}_{3} and NO^{-}_{2} in drinking water (according to WHO) respectively and with respect to this matter that the sum of the ratio of the conentration of each to its respective guideline value should not exceed 1, the concentration of nitrate in 52.5% of the wells in southwest to Tehran exceeds the safe limit.

This implies that necessary measures should be taken before the groundwater is to be consumed for domestic or food industrial purposes.

Comparison the results of this survey with the data of research in 1993, it was concluded that the nitrate concentration in aquifer has increased 2.4 fold, while the nitrite reduced 73 percent which probably may be due to industrial wastewater characteristics, seepage of old waste into aquifer type, groundwater recharge and age also the process of denitrification due changes in the hydrochemical conditions in a layer.

In Iran no documented cases of methaemoglobinemia are avilable. It should be mentioned that many individals using water exceeding the nitrate standared of more than 25 years and still have no obvious effect on their family, such an activity by nitrate hasbeen reported in the literature (13), so revise of nitrate level guideline and standard in drinking water recommended. The probalbe relationship between nitrate in the wells water with their depht were determined and a mathematical formula proposed as below: $C_{NO3^{-}} = 104.01\text{-}0.3\ H$

C = nitrate concentration of wells water in Tehran southwest groundwater aquifer of Iran. mg/L as (N_{o3}^{-})

H= water level as (m)

Table 1- Statistical analyses of nitrate concentration in Tehran southwest groundwater (99 wells)

Parameter	amount (mg/L)
Mean	51.96
Median	48.19
Standard deviation	20.157
Minimum	5.19
Maximum	85.49
Kurtosis coefficent	0.03
Skewness coefficent	-0.36

Table 2- Statistical analyses of nitrite concentration in Tehran southwest groundwater (99 wells)

Parameter	amount (mg/L)
Mean	16.18
Median	1.055
Standard deviation	1.98
Minimum	0.29
Maximum	314.22
Kurtosis coefficent	6.2
Skewness coefficent	41.54

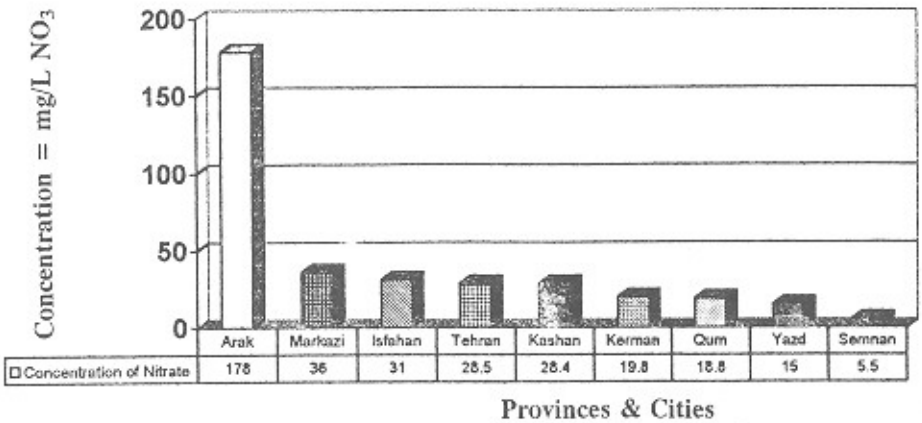


Fig. 1- Average concentration of nitrate in drinking wells waters of Iran-Central regions (1996-98)

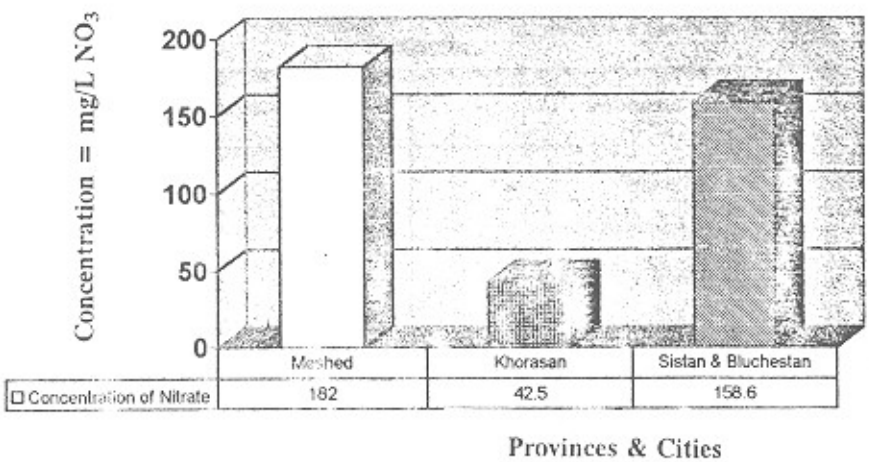


Fig. 2- Average concentration of nitrate in drinking wells waters of Iran-East regions (1996-98)

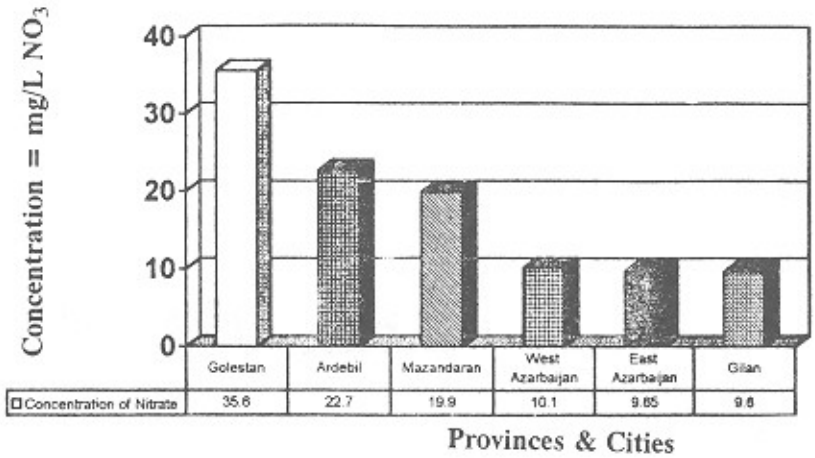


Fig. 3- Average concentration of nitrate in drinking wells waters of Iran-North and North-Western regions (1996-98)

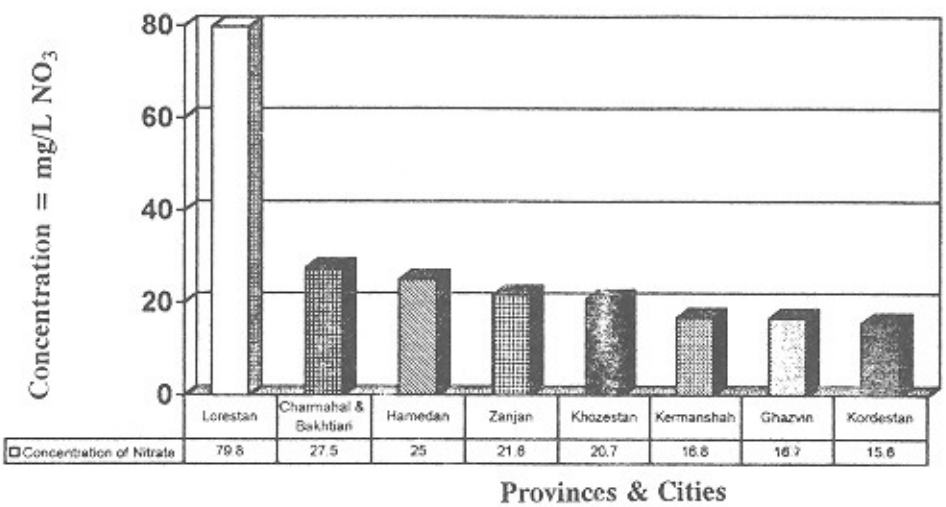


Fig. 4- Average concentration of nitrate in drinking wells waters of Iran-West regions (1996-98)

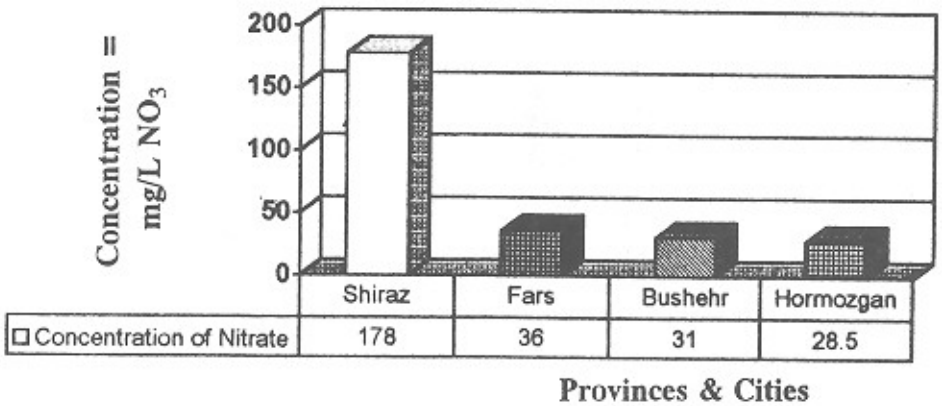


Fig. 5- Average concentration of nitrate in drinking wells water of Iran - South regions

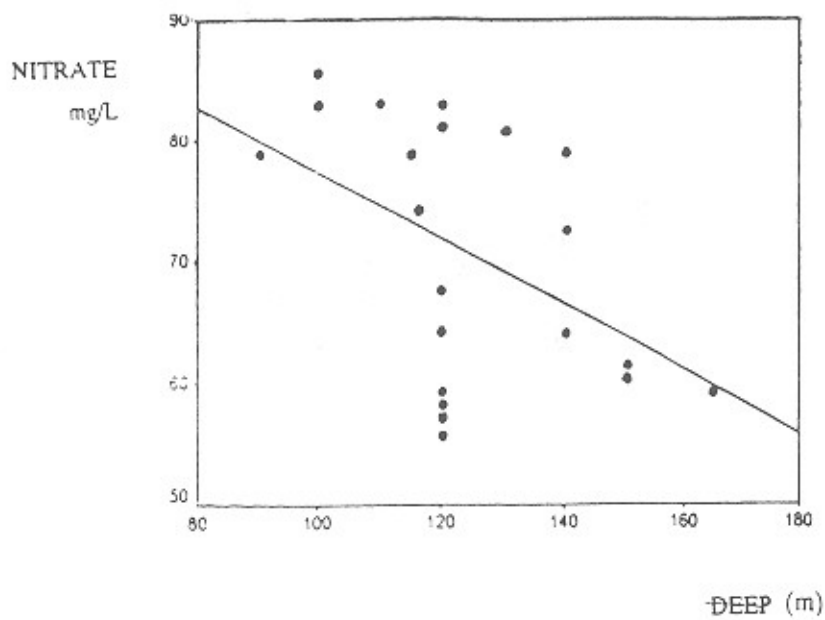


Fig. 6- Correlation between levels of nitrate and depth of wells in southwest of Tehran, Iran, 1999

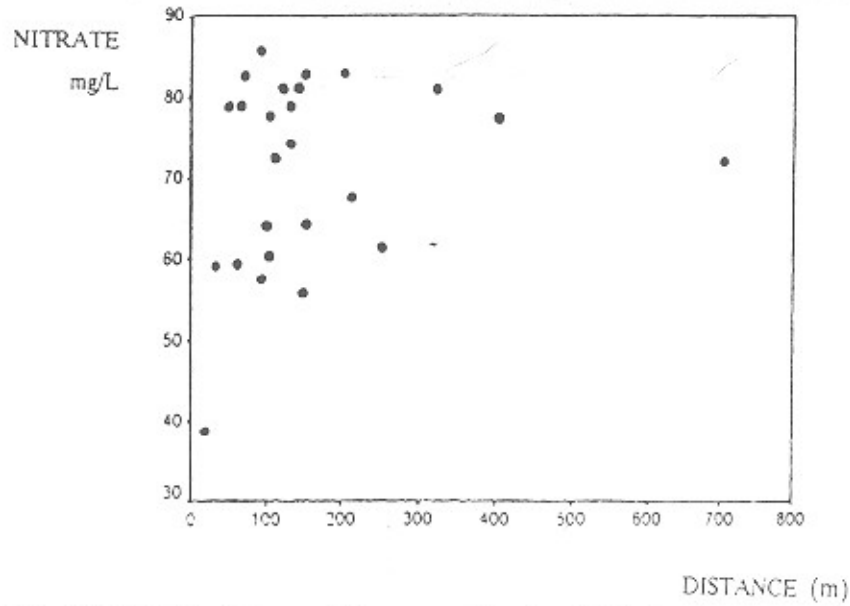


Fig. 7- Relationship between distance and levels of nitrate of water wells in southwest of Tehran, Iran, 1999

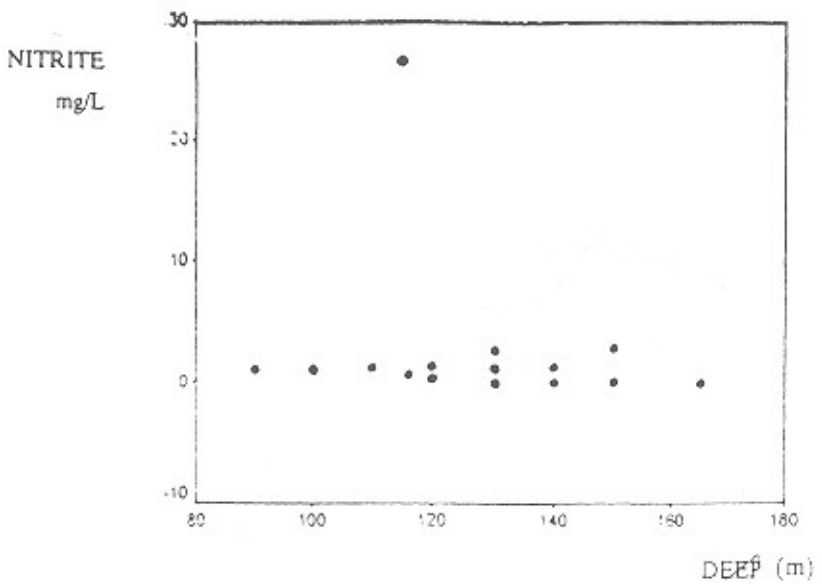


Fig. 8- Correlation between levels of nitrite and depth of wells in southwest of Tehran, Iran, 1999

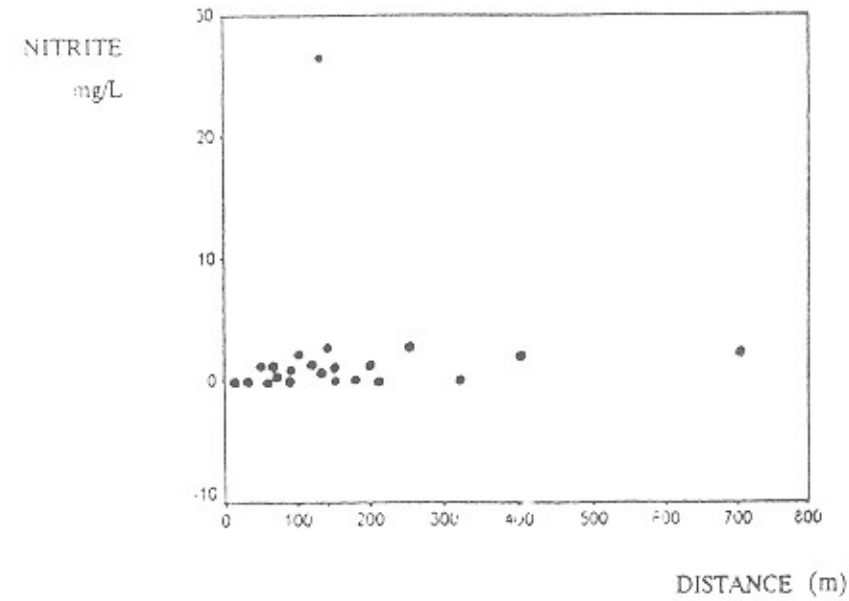
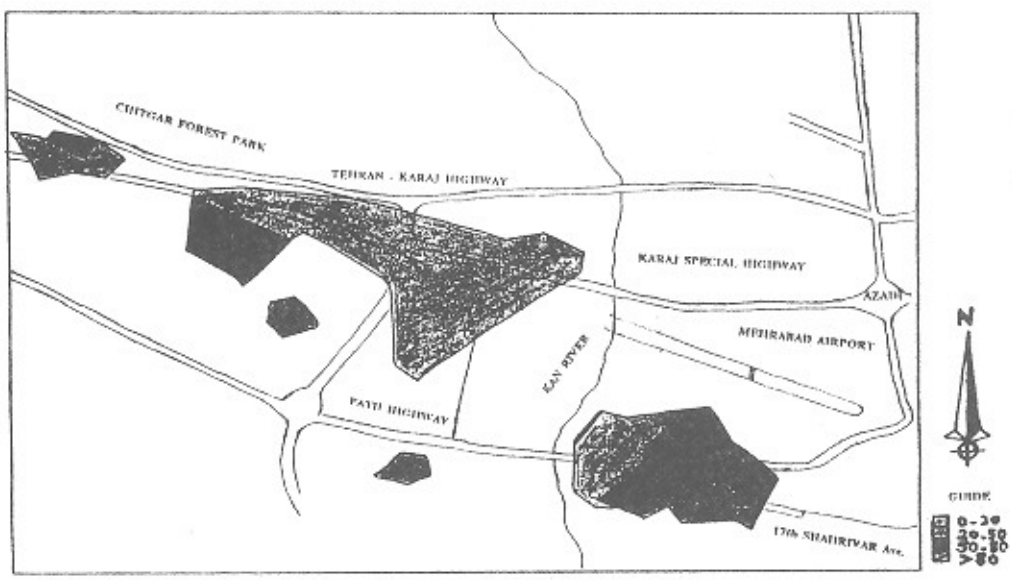


Fig. 9- Relationship between distance and levels of nitrite of water wells in southwest of Tehran, Iran, 1999



Map. 1- The isoconcentration lines of nitrate in Tehran southwest groundwater aquifer of Iran, 1999

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