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Research Article

QUANTITATION OF NITRATE IN GROUNDWATER TO ASSESS THE WATER QUALITY OF BUNDELKHAND

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A R T I C L E I N F O

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A B S T R A C T

Water plays an important role in the development of healthy society. Quality of water depends on various constituents present in it. Nitrate is one of the components responsible for the quality of water and associate with various health problems if present in excess. In some areas of multiple countries the nitrate concentration is very high due to runoff and discharge of sewage, effluents of agriculture and industries. To monitor the quality of water of Bundelkh and we analyse 54 groundwater samples of four districts belonging to Uttar Pradesh. Among them only one sample contains high nitrate concentration. The remaining samples contain nitrate within permissible range.

INTRODUCTION

Water is essential natural resources for sustaining life and environment. At present nearly one fifth of all water used in the world is obtained from groundwater resources. Ground water is the major source of drinking water in urban as well as in rural areas. Nitrate is a common surface water and groundwater contamination. In atmosphere about 80% N_2 which is most abundant element (Berner 1987). Nitrate is highly oxidised form of nitrogen. The other forms of nitrogen are ammonia, ammonium, nitrous oxide, hydrazine, nitric oxide, nitrogendioxide. These forms are interconvertible depends on the atmosphere condition, geochemical condition, pH of soil and water. All living system needs nitrogen for their survival. The nitrate is taken up by plants during their growth and used to build Protein, DNA, RNA, Hormones and Vitamins. Permissible value for nitrate in drinking water is 50 mg/l as nitrate ion (equivalent to 11mg/ml of nitrogen) to be protective of the health of human (WHO 2007). Drinking water containing high water of nitrate is becoming public health concern due to endogenous reduction to highly toxic compound such as nitrite and nitrosamine (Ward *et al*., 2010). High concentration of nitrates in water can cause various health problem for human and animals. Ingested nitrate is readily and completely absorbed from the upper small intestine. About one fourth ingested nitrate transported into saliva where one fifth converted into nitrite. Bacterial reduction of nitrate may also take place in gastrointestinal tract. This nitrite in the blood binds and converts haemoglobin to the methaemoglobin.

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This Fe^{+++} form does not allowing oxygen transport when methaemoglobin concentration reach 10% of normal haemoglobin concentration the condition called methaemoglobinaemia (Speizers *et al*. 1989, Comly 1987). Because of blue colour of skin and nail in infants is known as blue baby syndrome. Recent epidemiologic study revealed that excess nitration ingested may be linked to gastric cancer**,** miscarriage, thyroid disorder birth defects, meningitis, and cancer (Eskandari *et al* 1997, Sleight &Atallah 1968, Hirose *et al* 1993, Mirvish 1995, Van *et al*., 2000).

The main source of nitrate in drinking water is nitrogenous fertiliser, excreta, dung, urine produced by animals and coal gasification. They can enter into groundwater by various channels. Landfill leachates have high concentration of nitrogenous waste, which is in the form of ammoniacal nitrogen due to anaerobic condition. The predominant nitrogen compound like ammonia, nitric acid, urea, ammonium nitrate is also used in various industries. Some of them are plastic, metal, raw material for textile, colouring material, pharmaceutical, boards, plywood and explosive. In surface water nitrate concentration changes from day to day, usually low concentration in rainy season due to dilution. Nitrate contaminants again increase due to inappropriate handling and disposal of the effluents into the stream. Several developed countries re-obtained these nitrogenous compounds from waste materials thus decrease the use of fertiliser in agricultural.

According to the annual report of different environmental protection authorities in developed and developing countries such as United States, India, Australia and New Zealand and. in some areas of China nitrate concentration exceeding the 50 mg/l (Burrow, 2010, USEPA, 1987, Zhao Zhou, 2015). In Denmark and Netherland nitrate concentration increasing at

the rate of 0.2-1.3 mg/l per year (WHO, 2007). In several parts of Middle East country like Iran, southern part of Tehran, Mashhad, and Shiraz high nitrate concentration in groundwater is estimated (Dordelmann, 2006). The high nitrate concentration in Indian location between 50mg/l and 100 mg/l, or even higher than 100 mg/l. A study conducted by Reddy *et al*. 2013 revealed that 12% of area in Anantpurar in Andhra Pradesh, India are unfit for drinking purpose due to excess nitrate (>45mg/l). The maximum nitrate concentration was found to be 250.224 mg/l in Begaria in Lucknow (U.P.) (Verma *et al*., 2014). High nitrate concentration in the river bank filteration well in shrinagar srikot of Uttrakhand, area was reported by Gupta *et al*. 2015. Groundwater systems are dynamic so there is a need of continuous monitoring of water.

***Study area*:** Out of seven district of Bundelkhand area we selected four district namely Jhansi, Banda, Lalitpur, Mahoba to monitor the nitrate concentration in drinking water during the month of May, June, July in 2018. The climate of bundelkhand area is arid and semiarid with average rain is 700 mm. The temperature of this area varies from 6^0C to 45^0C.

Sample site: We select total 54 samples at least 11 from each district in present study to assess the nitrate concentration to evaluate the water quality. Shown in figure from 1 to 5 and Table-1.

Table 1

District	Selected area
Jhansi	Jhansi, Bijauli, Babina, Ambabai, Garhmau, Chirgaon, Amargarh, Punchh, Samthar, Garhwai, Gusarai, Baghaira, Tahrauli, Durwai, Raksa
Lalitpur	Lalitpur, Bansi, Talbahat, Birdha, Gona, Paron, Bar, Chararau, Mahroni, Banpur, Jakhaura, Kelwara, Jakhlau, Pali
Mahoba	Mahoba, Kohnia, Panwari, Rebai, Kulpahar, Ajnar, Srinagar, Supa, Charkhari, Kabrai, Jaipur
Banda	Banda, Khairar, Khurhand, Atarra, Badausa, Oran, Kamasin, Ingua, Marka, Murwal, Tindwari, Paprenda, Palra, Jaspura

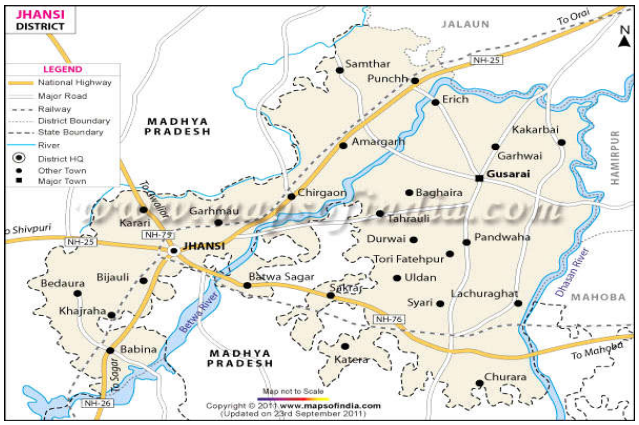
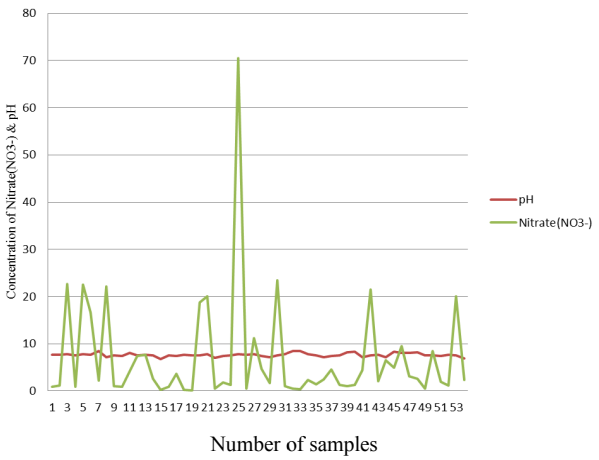


Table 2

Nitrate concentration (mg/l)	Classified	Percentage of contamination	Indication of value
Between 0-10 mg/l	Good (desirable)	79.63	
Between 10-20 mg/l	Permissible	5.56	
Between 20-45 mg/l	Slightly contaminated	12.96	
Above 45mg/l	Highly contaminated	1.85	



METHODOLOGY

pH: The pH is measured by using systronic pH model 135 pH meter.

Nitrate (NO_3^-)**:**The nitrate concentration in the groundwater is determined by Phenol Disulphonic Acid (PDA) method. All chemicals for nitrate analysis were analytical reagent grade, using, a SHADZU (Model No. UV-2550) UV-Visible spectrophotometer with 1 cm matching quartz cell was used for the absorbance measurements.

RESULT AND DISCUSSION

The pH of water is a very important indication of its quality and provides important information in many types of geochemical equilibrium or solubility calculation (AL-Shaibani 2008). According to WHO standards pH of water should be 6.5 to 8.5. In this study all the ground water samples found within the limits as prescribed by WHO. The highest pH value 8.5 observed at Raksa whereas the lowest value i.e. 6.7 found at Ambabai. Although there is no direct co-relation was observed between Ph and nitrate concentration but in natural denitification by biological microbes the most important factor are dissolved oxygen, pH and temperature (Meyer et. al. 2010). Kapoor and vira sagnavan (1997) also found pH adjustment is very necessary to maintain nitrate concentration in treatment plant. Some denitrifying bacteria also affected by pH.

According to WHO standards nitrate concentration in the water should be 45mg/l. The lowest value of nitrate concentration in groundwater is 0.2 mg/l observed at Ambabai and maximum nitrate concentration is 70.5 mg/l observed at Samthar. Except one, all the samples are within the permissible limit.

CONCLUSION

Groundwater contamination by nitrate is a severe health problem in various part of world. To manage quality of water and to minimise the nitrate concentration in groundwater system, there is a need of monitoring nitrate concentration time to time. In our results Samthar of Jhansi district the concentration is very high so there is a need of further investigation of this area both in terms of nitrate concentration and methaemoglobinaemia case, all other areas showing good water quality.

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