



STUDY OF NITRATE IN GROUND WATER OF JHUNJHUNU DISTRICT OF RAJASTHAN: A CAUSATIVE AGENT OF METHEMOGLOBINEMIA

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ABSTRACT

A survey was conducted in 136 villages during Jan. 2009 to Jan. 2012 in Jhunjhunu district, Rajasthan. It was found that 152 patients (mostly bottle fed infants) were suffering from methemoglobinemia (Blue baby syndrome). Methemoglobinemia is caused by the decreased ability of blood to carry vital oxygen around the body. One of the most common cause is the presence of nitrate in high concentration in drinking water. Children show signs of blueness around the mouth, hands and feet. For the analysis, 269 water samples were collected from 136 villages. Analysis of nitrate was done by spectrophotometric method. The maximum permissible limit of nitrate in drinking water is 45 ppm according to ISI and WHO. The concentration of nitrate was found in the range of 10-180 ppm. Such high concentration of nitrate is responsible for methemoglobinemia.

Key words: Nitrate, Toxicity, Analysis, Methemoglobinemia.

INTRODUCTION

Present study is related with Jhunjhunu district of Rajasthan, where blue baby syndrome or methemoglobinemia is a common occurring disease in local population. One of the most common cause is the presence of nitrate in high concentration in drinking water.

Nitrate (NO_3^-) is a naturally occurring form of nitrogen found in soil. Nitrogen is essential to all life. Most crop plants require large quantities to sustain high yields. The formation of nitrates is an integral part of the nitrogen cycle in our environment. In moderate amounts, nitrate is a harmless constituent of food and water. Plants use nitrates from the soil to satisfy nutrient requirements and may accumulate nitrate in their leaves and stems. Due to its high mobility, nitrate can also leach into groundwater. If human beings or animals drink

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water with high nitrate concentration, it may cause methemoglobinemia, an illness found especially in infants¹.

Nitrates are formed, when microorganisms break down fertilizers, decaying plants, manures or other organic residues. Usually plants take up these nitrates. But sometimes rain or irrigation water can leach them into groundwater. Although nitrate occurs naturally in some groundwater, in most cases, higher levels are thought to result from human activities. Common sources of nitrate include fertilizers and manure, animal feedlots, municipal wastewater and sludge, septic systems, and N-fixation from atmosphere by legumes, bacteria and lightning².

EXPERIMENTAL

A survey was conducted in 136 villages during Jan. 2009 to Jan. 2012 in Jhunjhunu district, Rajasthan. For the analysis, Jhunjhunu district is divided into 38 Gram panchayat of Jhunjhunu block. Samples were collected from tubewell and hand pumps present in this area. In laboratory, nitrate is determined by spectroscopic method as follows :

Nitrate was determined spectrophotometrically by using UV-Visible Spectrophotometer (Model No. 301) at single wavelength of 220 nm. It follows the Lambert-Beer's law up to nitrate concentration of 11 mg/L. Water sample was acidified with 1 N HCl to prevent interferences of hydroxides or carbonate concentration up to 100 mg./l. as CaCO₃.^{3,4}

RESULTS AND DISCUSSION

The maximum permissible limit of nitrate in drinking water is 45 ppm according to ISI and WHO. Investigations show that nitrate level ranges from 10-180 ppm.

Such high nitrate levels in water is responsible for methemoglobinemia or blue baby syndrome, a condition found especially in infants under six months. It was found that 152 patients (mostly bottle fed infants) suffer from blue baby syndrome. Methemoglobinemia is caused by the decreased ability of blood to carry vital oxygen around the body. The stomach acid of an infant is not as strong as in older children and adults. This causes an increase in bacteria that can readily convert nitrate into nitrite⁵.

Nitrite is absorbed in the blood and hemoglobin (the oxygen carrying component of blood) is converted to methemoglobin. Methemoglobin does not carry oxygen efficiently. This results in a reduced oxygen supply to vital tissues such as the brain. Methemoglobin in

blood of infant cannot change back to hemoglobin, which normally occurs in adults. Severe methemoglobinemia can result in brain damage and death⁶.

Nitrate concentration analysis of ground water				
S. No.	Source	Gram Panchayat	Total no. of samples	NO₃
1	Open well	Bishanapura	8	10-70
2	Open well hand pump	Siriyasar Kalan	8	55-95
3	Open well hand pump	Abusar	9	75-180
4	Open well hand pump	Derwala	11	25-100
5	Open well hand pump	Hanumanpura	7	35-115
6	Open well hand pump	Kuhadu	5	50-140
7	Open well hand pump	Wahidpura	6	60-75
8	Open well hand pump	Meharadasi	7	45-170
9	Open well hand pump	Bheemsar	6	55-105
10	Open well hand pump	Nua	7	35-60
11	Open well hand pump	Bahadurwas	8	40-110
12	Open well hand pump	Chatarpura	9	60-85
13	Open well hand pump	Bakra	8	40-65
14	Open well hand pump	Budana	10	55-130
15	Open well hand pump	Ajari Kalan	5	30-65

Cont...

Nitrate concentration analysis of ground water				
S. No.	Source	Gram Panchayat	Total no. of samples	NO₃
16	Open well hand pump	Beebasar	8	30-65
17	Open well hand pump	Bas Nanag	6	40-60
18	Open well hand pump	Sigra	6	40-50
19	Open well hand pump	Bharunda Khurd	10	35-70
20	Open well hand pump	Indali	5	45-65
21	Open well hand pump	Kulod Kalan	14	45-120
22	Open well hand pump	Patusari	8	55-85
23	Open well hand pump	Purohito ki Dhani	7	30-85
24	Open well hand pump	Islampur	5	20-30
25	Open well hand pump	Makhar	6	25-65
26	Open well hand pump	Jai Pahari	4	45-80
27	Open well hand pump	Bhojasar	4	20-35
28	Open well hand pump	Shekhsar	7	55-70
29	Open well hand pump	Bharu	7	35-55
30	Open well hand pump	Nayasar	5	65-120
31	Open well hand pump	Partappura	11	45-55

Cont...

S. No.	Nitrate concentration analysis of ground water			
	Source	Gram Panchayat	Total no. of samples	NO ₃
32	Open well hand pump	Kasimpura	7	50-150
33	Open well hand pump	Lalpur	7	60-70
34	Open well hand pump	Khajpur naya	6	55-95
35	Open well hand pump	Udawas	10	45-160
36	Open well hand pump	Bagar	3	45-80
37	Open well hand pump	Kishorepura	5	40-75
38	Open well hand pump	Solana	4	20-30

Pregnant women, adults with reduced stomach acidity and people deficient in the enzyme that changes methemoglobin back to normal hemoglobin are all susceptible to nitrate induced methemoglobinemia. The most obvious symptom of methemoglobinemia is the bluish colour of the skin, particularly around the eyes and mouth. Other symptoms include headache, dizziness, weakness or difficulty in breathing⁷.

Healthy adults can consume fairly large amounts of nitrate with few known health effects. In fact, most of the nitrate we consume is from our diets, particularly from raw or cooked vegetables. This nitrate is readily absorbed and excreted in the urine. However, prolonged intake of high levels of nitrate are linked to gastric problems due to the formation of nitrosamines. N-nitrosamine compounds have been known to cause cancer.

Exposure to higher levels of nitrate has been associated with increased incidence of cancer in adults and possible increased incidence of brain tumors, leukemia and nasopharyngeal tumor⁸.

CONCLUSION

Methemoglobinemia disease spreading in this area is due to increased uptake of nitrate or nitrite from drinking water. Jhunjhunu block of Jhunjhunu district, Rajasthan has limited uncontaminated water supplies. So water borne diseases is a huge health issue.

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