ISSN : 2394-2975 (Online)
ISSN : 2394-6814 (Print)
Vol. 3, Issue 3 (July - Sept. 2016)
International Journal of Advanced Research in Education & Technology (IJARET)

Determination of Nitrates and Sulphates in Water of Barnala (Punjab, India) Region and Their Harmful Effects on Human Lives

[I]Dr.Yogita Sharma, [II]Kamalpreet Kaur
[I]Associate Professor, [II]Research Scholar
[I,II]Dept. of Chemistry, Guru Kashi University, Bathinda, Punjab, India

Abstract

This study was designed keeping in view the negative and harmful effects of high levels of Nitrates and sulphates present in different water sources of Barnala district (Punjab).This paper is focuses on the comparative determination of concentrations of nitrate and sulphate anions and their harmful effects on living beings.Nitrate anion concentration can be determined by using UV-Visible spectrophotometric method, while concentration of sulphate anion can be determined either by Turbidity meter or by spectrophotometer. Samples were collected from three sites (Site A, B and C). Samples from five different water sources were taken under study such as drain water, Surface water, Tap water, Ground water and canal.Maximum value of nitrates and sulphates was found in site C.Due to high values of nitrates and sulphates people may suffer from number of diseases such as methemoglobinemia, gastric and intestinal cancer, Blue-baby Syndrome, vomiting, diarrhea , birth defects, hypertension high blood pressure and catharsis.

Keywords

Health hazards, Human, Physico-chemical parameters, Nitrates and Sulphates, Water samples

Introduction

The determination of nitrate (NO3-) is a difficult task because of the relatively complex procedures involved, the high probability that interfering constituents will be present and the limited concentration ranges of the various techniques.

According to Villa et al. (2010), the modern civilization, industrialization, urbanization and increase in population have led to fast degradation of our groundwater quality. As water is the most important component of eco-system, any imbalance created either in terms of amount, which is presence of impurities added to it can harm the whole eco-system (Hem, 1961).

According to World Health Organization (WHO), the permissible limit of nitrate value is in the range of 40 to 50 mg/L. The Indian Council of Medical Research has recommended desirable limit of 20 mg/L of nitrate for drinking water. Nitrate is a problem as a contaminant in drinking water (primarily from groundwater and wells) due to its harmful biological effects (Hallberg and Keeney, 1993).

A maximum level of 45 mg/L is established as worldwide guidance for nitrate concentration in water.

Sulphates is widely distributed in nature and may be present in natural water in substantial concentration. Sulphates occur naturally in numerous minerals, including barite, epsomite and gypsum(APHA, 2003). According to World Health Organization 2004, typical sulfate levels in fresh spring water are in the vicinity of 20 mg/L and range from 0 to 630 mg/L in rivers. High doses of sulphate particularly magnesium sulphates, cause catharsis or purging of the bowels, andmagnesium sulphate or Epsom salts has been used as a purgative (Cocchetto et al,.1981).The taste thresholds of sulphates are 200-500 mg/L for sodium, 250 mg/L for calcium and 400-600 mg/L for Magnesium (Oeteman, 1980).

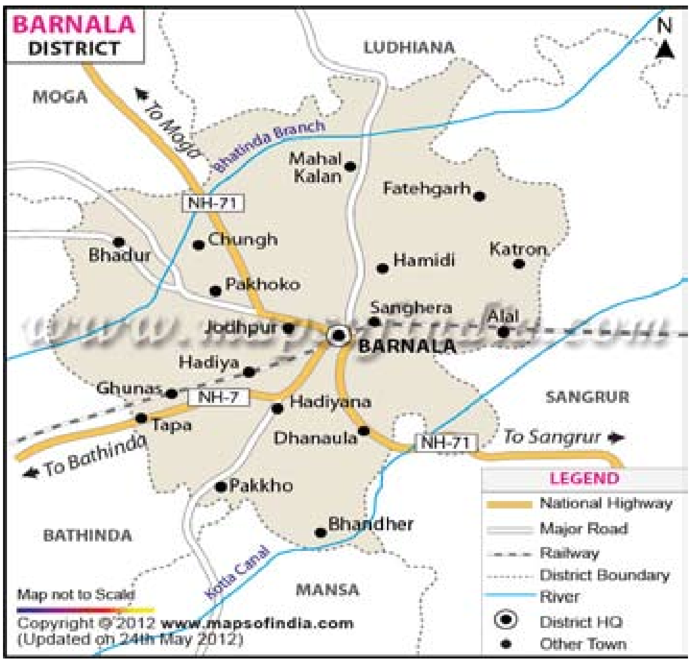
Turbidimetric analysis of sulphates is based on the formation of insoluble barium sulphate. This reaction forms colloids of uniform size and its formation is enhanced in the presence of sodium chloride, hydrochloric acid and glycerol. The sulphate

content in water is important in determining the suitability of water for public and industrial use. Sulphate may also contribute to the corrosion of pipelines in the distribution system (Mariraj et.al,2013). The quality of water is deteriorating due to inorganic anions and cations being released from domestic and industrial effluent.

Materials and Methods

Barnala is situated between 30° 23’ North and 75° 33’ East. It has a mean elevation of 227 metres (745 feet).It is located on the Bathinda-chandigarh highway (no-7) and the Jalander-Rewari national highway (no-71),The Sirsa-Ludhiana state highway (no-13) are passes through it. It is 65 km from Bathinda and 85 km from Ludhiana.According to 2011 census, the total population of Barnala district is 595527.It was 526931 in 2001. Water samples were collected from different water sources (Drain water,surface water,tap water, canal, ground water) from three different sites. .The Sampling time was between 4:30 pm to 5:30 pm on 18 march, 2016.Plastic bottles were used to collect water samples. Testing was done in Environ Tech Laboratories(NABL Accredited laboratory) Department of Science and technology, India S.A.S Nagar (Mohali), Punjab.

Map of Barnala District



ISSN : 2394-2975 (Online)
ISSN : 2394-6814 (Print)

Determination of Nitrate by UV Spectrophotometric Method-

Apparatus- UV Spectrophotometer for use at 220 nm and 275 nm with matched cells of 1cm or longer light path measuring flask, Pipette.

Interference-Dissolved organic matter, Suspended particles Surfactant, NO_2 and Cr^{+6} interfere.

Reagents

1. Nitrate free water- Double distilled deionised water of highest purity was used to prepare all solution and dilutions.
2. Stock nitrate Solution (1000 mg/l)- 0.7218 gram KNO, (dried in an oven at 105˚C for 24 hours) was dissolved in distilled water and dilute to one liter. It was Preserved with 2 ml of chloroform.
3. Working nitrate solution (100 mg/l)- 100ml stock nitrate solution was diluted to 1000 ml with distilled water. It was preserved with 2 ml of chloroform.
4. Hydrochloric acid solution- 1N conc.

Procedure

1.Treatment of sample- To 50 ml clear Sample (filtered if neceesory) one ml of 1N HCl solution was added and mix thoroughly.

2.Preparation of Standard curve- NO□¯N calibration Standards was Prepared in the range of 0-7.0 mg/l NO□¯N by diluting to 50 ml the following volumes of working nitrate solution 0,2,4,---35 ml in 50 ml volumetric flask and 1.0 ml of 1N HCl solution was added to all the Standards and blank made up to mark and mixed thoroughly.

3.Spectrophotometric measurements-(a) wavelength of 220 nm on spectrophotometer was set for reading of nitrate.Set at zero with blank (distilled water+HCl). Absorbance was read with all standard solutions and blank at 220 nm and again at 275 nm to determined interference due to dissolved organic matters. Then a standard curve was constructed by plotting absorbance due to various nitrate concentrations and blank.

(b).Check and set zero with blank standard solution. Absorbance reading of samples was taken at 220 nm wavelength and simultaneously at 275 nm.

Calculation- corrected sample absorbance was used ; sample concentrations was obtained directly from standard curve. For sample and standards subtract two times the absorbance reading at 275 nm from the absrbance at 220 nm was taken to obtained absorbance due to nitrate.

Determination of sulphate by Turbidity method-

Apparatus-

1. Turbidity meter /Spectrophotometer for use at 420 nm
2. Usual laboratory glassware.
3. Stop watch
4. Measuring spoon capacity 0.2 to 0.3 ml
5. Magnetic stirrer with stirring bars

Reagents

1. Barium chloride crystals 20-30 mesh
2. coditioning reagent- 50 ml glycerol was mixed with a solution containing 30 ml conc.HCl ,300 ml distilled water, 100 ml 95% ethyl or isopropyl alcohol and 75 g sodium chloride.
3. Stock Sulphate solution (100mg/l)- 0.147 grams of anhydrous sodium sulphate Na_2SO4 was dissolved in distilled water and dilute to 1 litre.
4. Hydrochloric acid (1:9) one volume of conc. HCl was mixedwith 9 volumes of distilled water.

Preparation of calibration curve- calibration curve was prepared by preparing series of standard solution of sulphate , say 5,10,20,30,40 mg/l by diluting stock solution of sulphate and the blank with distilled water.Reading of each standard was taken on turbidity meter/Spectrophotometer and calibration curve was prepared.

Procedure-The sample was filtered through 0.45 μm if there is any turbidity.20 ml of water sample was taken in 100ml conical flask.Then 1 ml HCl and 1 ml conditioning reagent were added and mix well for 30 seconds.After 10 minutes the turbidity was read on turbidity meter and concentration of sulphate in sample was directly found from the curve.

Results and Discussion

Physico-chemical Parameters

The physico-chemical parameters of different water samples of site A are presented in Table 1.

Table 1 of Site A

Water samples	Conc. Of Nitrate (mg/l)	Conc. Of Sulphate (mg/l)
Drain water	17	794
Surface water	11	786
Tap water	11	783
Ground water	16	792
Canal	10	785
	Mean ±S.D	Mean ±S.D
	13±3.24	788±4.74

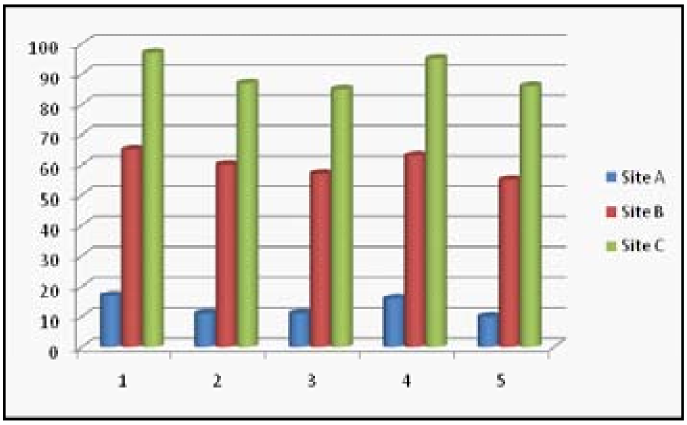
Table 2 of Site B

Water samples	Conc. Of Nitrate (mg/l)	Conc. Of Sulphate (mg/l)
Drain water	65	50
Surface water	60	44
Tap water	57	43
Ground water	63	50
Canal	55	43
	Mean ±S.D	Mean ±S.D
	60±4.12	46±3.67

Table 3 of Site C

Water samples	Conc. Of Nitrate (mg/l)	Conc. Of Sulphate (mg/l)
Drain water	97	990
Surface water	87	985
Tap water	85	982
Ground water	95	989
canal	86	984
	Mean ±S.D	Mean ±S.D
	90±5.56	986±3.39

Graph of nitrate for three sites



In case of site A the values of Nitrate of the water samples ranged from 10 mg/l to 17 mg/l with an average value of 13 mg/l (S.D = 3.24, N=5).The highest value of Nitrate was found in Drain water and lowest value of Nitrate was found in water sample taken from canal. In case of site B the values of Nitrate of the water samples ranged from 55 mg/l to65 mg/l with an average value of 60 mg/l (S.D = 4.12,N=5). In case of site C the values of Nitrate of the water samples ranged from 85 mg/l to 97 mg/l with an average value of 90 mg/l
(S.D = 5.56,N=5).

Harmful effects of high value of nitrate on humans-

Infants

Children under the age of six months are more prone to developing methemoglobinemia, or blue baby syndrome, when consuming high-nitrate water, says Colorado State University. The condition is a form of nitrate poisoning. Nitrates convert to nitrites in the stomach by intestinal bacteria, especially among infants, because their stomach acid is not as strong as adults'. Nitrites alter hemoglobin, which is responsible for carrying oxygen in the blood. Hemoglobin changes to methemoglobin, and oxygen can no longer be transported, leading to oxygen deprivation. According to PubMed Health, infants who eat large amounts of vegetables high in nitrates or who are ill are more susceptible to the illness.

Adults

Adults may also contract nitrate poisoning. If your stomach produces low levels of stomach acid, or you are lacking the normal enzyme that changes methemoglobin back to hemoglobin, you are at higher risk. Still, most adults are able to consume rather large amounts of nitrates without adverse effects, according to Colorado State University. Most nitrates are consumed by eating raw or cooked vegetables and are then removed through urination.

IncreasedCancerRisk-

Nitrosamines that form in cured meats have caused cancer in animals in a number of studies, according to the Agency for Toxic Substances and Disease Registry. Cancers most commonly associated with nitrosamines include bladder, esophageal, nasopharynx and prostate cancers as well as non-Hodgkins lymphoma, the organization states. Nitrosamines may also increase the risk of developing colorectal and stomach cancer. Cancers of the central nervous system, heart, thyroid and kidney have also been produced in animal studies, the International Programme on Chemical Safety reports.Frying bacon well-done creates more nitrosamines, most often nitrosopyrrolidine or, less commonly, dimethylnitrosamine, than not cooking it as well or microwaving it. Fat dripping on hot coals when nitrate-containing meats are broiled can produce benzopyrene, a carcinogenic substance that can be carried on the smoke and deposited back on the meat. While numerous animal studies indicate that nitrosamines have carcinogenic properties, human studies are needed.

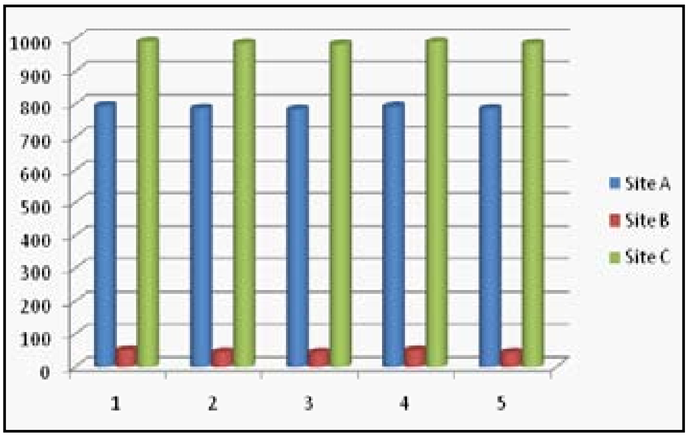
Chromosomal changes.

In animal studies, administration of several types of known carcinogenic nitrosamines in animals produced genetic mutations and chromosomal abnormalities, according to the IPCS. Whether these same changes affect humans has not been adequately studied.

TeratogenicChanges.

In animal studies, some types of nitrosamines have caused birth defects as well as increased pregnancy loss, the IPCS reports. Studies to determine the effects of humans are lacking.

Graph of Sulphate for three sites



In case of site A the values of Sulphate of the water samples ranged from 783 mg/l to 794 mg/l with an average value of 788 mg/l (S.D = 4.74, N=5).The highest value of Sulphate was found in Drain water and lowest value of Sulphate was found in water sample taken from Tap water. In case of site B the values of sulphate of the water samples ranged from 43 mg/l to50 mg/l with an average value of 46 mg/l (S.D = 3.67,N=5). In case of site C the values of Sulphate of the water samples ranged from 982 mg/l to 990 mg/l with an average value of 986 mg/l (S.D = 3.39,N=5).

Harmful effects of high value of sulphate on humans

Due to high value of sulphate in water people can experience diarrhea and dehydration.Infants are often more sensitive to sulphate than adults. Cathartic effects are commonly reported to be experienced by people consuming drinking-water containing sulfate in concentrations exceeding 600 mg/litre (US DHEW, 1962; Chien et al., 1968), although it is also reported that humans can adapt to higher concentrations with time (US EPA, 1985). Dehydration has also been reported as a common side-effect following the ingestion of large amounts of magnesium or sodium sulfate (Fingl, 1980). There are subpopulations that may be more sensitive to the cathartic effects of exposure to high concentrations of sulfate. Children, transients and the elderly are such populations because of the potentially high risk of dehydration from diarrhoea that may be caused by high levels of sulfate in drinking-water (US EPA, 1999a,b).

There have been a number of studies conducted to determine the toxicity of sulfate in humans.People may suffer from

ISSN : 2394-2975 (Online)
ISSN : 2394-6814 (Print)

following-

Renal failure-Increased serum sulphate levelsare a common feature of kidney failure.Increased serum sulphate concentration results in increased complexation with calcium and this may in part be responsible for the parathyroid stimulation that occurs in chronic renal disease. The hypersulfatemia of chronic renal failure may directly affect the trans-sulfuration pathway and contribute to the severityof homocysteinemia typically seen in this condition.

Hyperthyroidism- Hyperthyroidism increases basal metabolic rate which, in turn , increases protein catabolism .

Increased serum sulphate levels have been noted in hyperthyroidism, probably due to increased breakdown of protein and thus sulphur amino acids.

Conclusion

From the above result and discussion it is concluded that values of nitrates and sulphates are higher than standard values in barnala region.Due to higher values of nitrates and sulphates People may suffer from many harmful diseases such as methemoglobinemia, or blue baby syndrome, Chromosomal Changes, Teratogenic Changes,cancer, diarrhea, dehydration, Renal failure, Hyperthyroidism, catharsis.

Acknowledgments

I would like to thank Dr.YogitaSharma , Associate Professor, Guru Kashi University, Bathinda for giving me valuable guidance and suggestions during this study.

Reference

[1]. Magut Hillary and Terer Erick kipngetich "Nitrate anion levels in water from selected wells and points along kimondi River, Nandi" 2012.

[2]. Muhammad tariq Bashir, Salmiaton, Adnan Bashir "Health effects from Exposure to sulphates and chlorides in Drinking Water".2012

[3]. Terer Erick kipngetich , Magut Hillary and T. Anthoney Swamy "Determination of levels of phosphates and sulphates in domestic water from three selected springs in Nandi country , Kenya" 2013

[4]. Fingl E, Laxatives and cathartics. In: Gilman AG et al., eds. Pharmacological basis of therapeutics. New York, NY, MacMillan Publishing.1980

[5]. US DHEW Drinking water standards — 1962. Washington, DC, US Department of Health, Education and Welfare, Public Health Service; US Government Printing Office (Publication No. 956). 1962

[6]. US EPA, National primary drinking water regulations; synthetic organic chemicals, inorganic chemicals and microorganisms; proposed rule. US Environmental Protection Agency. Federal Register, 50(219):46936.1985

[7]. US EPA(a) Health effects from exposure to high levels of sulfate in drinking water study. Washington, DC, US Environmental Protection Agency, Office of Water (EPA 815-R-99-001). 1999

[8]. US EPA(b) Health effects from exposure to high levels of sulfate in drinking water workshop. Washington, DC, US Environmental Protection Agency, Office of Water (EPA 815-R-99-002).1999

[9]. Hallberg GR, Keeney DR Nitrate, Alley, William A., ed., Regional Groundwater Quality, Van Nostrand Reinhold, New York. Pp. 297-322. 1993.

[10]. Hem JD Some aspects of Chemical Equilibrium in ground water contamination, Public Health Service Symposium, A. Report Taft Sanitary Engr. Centre, Report WEI-5.1961.

[11]. Cocchetto, D.M&Levy, G. Absorption of orally administered Sodium Sulphate in Human.J.Pharmaceutical Sciences. (70). 331.1981.

[12]. Mariraj Mohan S L and Vanalakshmi P. Assessment of water quality in Noyyal River through water quality index, International Journal of Water Resources and Environmental Engineering Vol. 5(1) :pp. 35- 48, January 2013.

[13]. Oeteman, B.C.J. Sensory Assessment of Water Quality. Pergamon Press, New York. 1980.