Original Research Article Website : www.ijbasr.org ISSN : 2349-1965
International Journal of Basic & Applied Science Research
[2014; 1 (1): pp 40-47]

MUNICIPAL SUPPLY DRINKING WATER QUALITY ANALYSIS OF SAMASTIPUR TOWN AREA, BIHAR, INDIA

Singh J. K[1]., Priyanka[2]., Kumari P[3]., Prasad S[4]., and Jha A. M[4].
[1]P. G. Department of Biotechnology, T. M. Bhagalpur University, Bhagalpur.
[2]Department of Biotechnology, Samastipur College, Samastipur.
[3]National Applied Research Institute, Patna.
[4]Ram Nirikshan Atma Ram College, Samastipur.

ABSTRACT :

Water borne diseases are most common in urban regions of developing countries. Urban people depend upon municipal water supply for drinking purpose. At certain time intervals, municipal supply water quality should be evaluated. Under this study, water samples were collected randomly from 20 different locations of Samastipur municipal area. Different physio-chemical test, chemical test and microbial test were tested for knowing the municipal supplied water quality. It was observed that most of the physiolochemical, chemical and microbial contamination were excess from BIS standard limit (Table 1, Table 2 & Table 3). On the basis of this study, it was confirmed that municipal supply water of samastipur area were not suitable for drinking purpose.

KEY WORDS : *Total dissolved solid (TDS), Chlorides, Aerobic microbial count (AMC), Yeast & Mold (Y/M)*

INTRODUCTION:

Municipal supply water is major source for drinking water in town areas. Due to increasing industrialization, urbanization and growth of population, water demand is increasing day by day. Source of municipal supply water is ground water. It is stored in water tank through deep boaring and than supplied for public use (Mohapatra and Singh, 1999). The ground water quality depends not only on natural factors such as the lithology of the aquifer but also upon human activities, which may polluting or by changing the hydrological cycle (Helena, *et al.*, 2000).

Urbanization has direct impact on water source and water consumption is drastically increasing. House hold pollution spread in lake or river nearby town and people have tendency to encroach upon the lake and river (Khan, *et al.*, 1988).

In context of quality and quantity, groundwater fluctuates invariably in its own which reflects the time to time status of groundwater. Irrigated agriculture is responsible for 93% of the total water demand in

Corresponding Author :
Jiv Kant Singh
E-mail : jivkant@gmail.com
Date of Acceptance : 12. 03. 2014
Date of Publication : 20. 04. 2014

Gorganrud basin. Irrigated agricultural in Morocco is also reported to have negative impacts on groundwater quality (Khoshravesh, *et al.*, 2011). For instance observed high nitrate contamination of groundwater in the central Gorganrud basin and explained this contamination by an intensifying agricultural activity. Agricultural practices can result in non-point source pollution of ground water (Hall, *et al.*, 2001). With non-point sources, ground water quality may be depleted over time due to the cumulative effects of several years of practice (Addiscott, *et al.*, 1992). The extensive use of fertilizers on crops is considered as a main source of nitrate leaching to ground water particularly in sandy soils (Hubbard and Sheridan, 1994). Elevated nitrate concentrations in ground water are common around dairy and poultry operations, barnyards, and feedlots (Hii, *et al.*, 1999).

In the town area of Samastipur, there is few large industries like Sugar mill, Jute mill and Railway repairing factory. Municipal supply water is only sourse of drinking water in samastipur town area, so quality of suppy water should be tested. therefore, quality of municipal supply water may be improved.

MATERIALS AND METHODS:

Study Areas:

Samastipur city is situated in Bihar, India located at latitude 25°54' North, longitude 86°05' East at Budhi Gandak river. This spread over an area of 2904 sq. km. Samastipur is bounded on the north by the Bagmati River which separates from Darbhanga district. On the west it is bordered by Vaishali and some part of Muzaffarpur district, on the south by the Ganges, while on its east it has Begusarai and some part of Khagaria district. The district headquarters is located at Samastipur. According to the Census 2011, total population of Samastipur District is 4,254,782 and population density is 1,465 per sq.km. The district comprises of 4 sub-divisions, and 20 community development blocks. It has 5 towns and 1248 villages. Infrastructure wise Samastipur is very strong. It is the Divisional Headquarters of the North Eastern railway. The district has direct train links with Patna, Kolkata, Delhi, Dhanbad, Jamshedpur and other places of importance. National Highway No. 28 passes through the district.

Sampling Site:

In order to select the suitable sampling sites, a preliminary survey was conducted to determine the various water collection sites for municipal supply water quality test of Samastipur area. On the basis of survey, 20 different sampling sites were random selected are as in Table 1. The water samples were collected in such a manner that neck of collection bottle is below the hand pump so as to avoid the inclusion of atmospheric oxygen and brought in well-equipped laboratory for various chemical analyses.

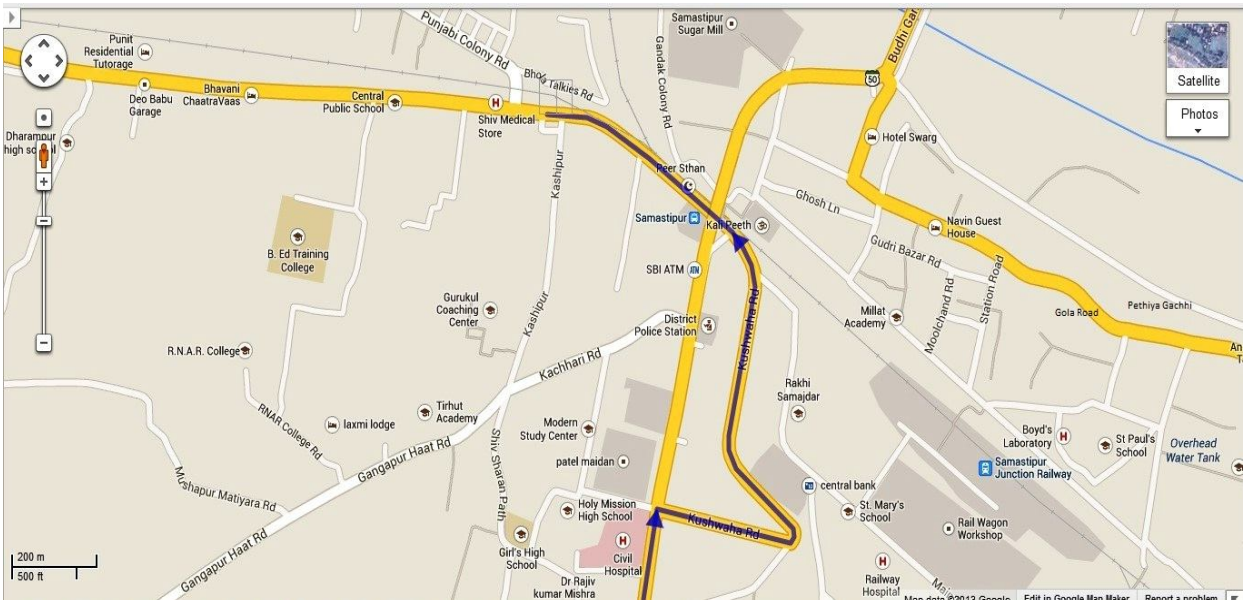
Table 1: List of sampling sites of water in Samastipur municipal area.

Sl. No	Name of water collection site	Sl. No	Name of water Collection site
1.	Water Harvesting Pump	11.	Ganesh Chowk
2.	Azad chowk	12.	Gola Road
3.	Professor colony	13.	Munchand road
4.	Panjabi colony	14.	Marwaribajar,
5.	Mahadev chowk	15.	Shekh toil
6.	Kashipur	16.	Bangali tola
7.	Kacharai	17.	Bahadurpur
8.	Barapathar	18.	Railway colony Bahadurpur
9.	Railway colony	19.	Madhurichowk
10.	Rambabu Chowk	20.	Pethiyagachhi.

concentration of standard colors solution. Standard color solution was prepared by using potassium chloroplatinnate and cobalt chloride.

CHEMICAL TEST:

Calcium was determined by EDTA - Titrimetric method, Alkalinity was determined by titrimetric method, Chloride was determined by Silver nitrate method, Iron (Fe) was determined by Thiocyanate method, Nitrate was determined by Phenol disufonic acid method and Fluoride was tested by Scott-



PHYSIO-CHEMICAL TEST :

Physiochemical investigation was carried out according to standard methods (APHA 1985; NEERI 1991). The pH of the samples were determined using digital pH meter. Turbidity was determined by Nephelo - turbidity meter. Total dissolved solids (TDS) was determined by gravimetery method. Colour was determined by visual comparison of the sample with known Sanchis Calorimetric Method as per Standard Method (APHA 1985).

MICROBIOLOGICAL TEST:

For bacterial culture of municipal supply water of each sample,100ml of water from each sample was filtered through 0.45µm membrane filter paper and was placed up on the surface of different agar and broth culture media plate and incubated at 22°C and

37°C for 72 and 48hrs respectively. Total colony of bacteria was counted by the help of fluorescent lamp colony counter.

RESULTS AND DISCUSSION:

Twenty samples of municipal supply drinking water from different areas of Samastipur town have been analyzed statically. Results shown were differ from site to site (Table 2, Table 3 and Table 4). Results of different parameters of municipal supply water are as follow:

pH: The maximum pH of the municipal water sampleof Samastipur was recorded as 8.6 in sample number 4 and the minimum pH was recorded as 6.8 in sample number 7 (Table - 2). For drinking water, pH limit range of 6.0 - 8.5 is recommended (De 2002). Therefore, pH was within normal limits.

Turbidity: In this study, it was found that maximum turbidity 2.4 NTU in sample number 8 and minimum 1.4 NTU in sample number 3 (Tables-2). According to WHO (1984) highest desirable limit is maximum 2.0 NTU.

TDS : In the present study, it was found that maximum TDS 680ppm in sample number 20 and minimum 505 in sample number 6 & 7 (Tables 2). According to WHO (1984) maximum limit of TDS is 500ppm. Therefore TDS is not in limit.

Color: The present study shows Color maximum < 4 of sample number 4 and minimum < 1 of sample number 6 (Table - 2). WHO (1984) prescribed highest desirable limit Max < 2.

Table 2: Shown results of different physio-chemical tests of different sites of municipal supply water (data represent mean value of duplicate). Values are exposed as the mean ± SEM and P < 0.05.

S. No/ Sample No.	pH 6.5 to 8.5	Turbidity Max 2 NTU	TDS Max 500ppm	Color Max < 2
1.	7.8	1.6	510	< 1
2.	7.7	1.5	587	< 2
3.	7.5	1.4	546	< 2
4.	8.6	2.1	639	< 4
5.	7.3	1.5	588	< 3
6.	6.9	1.7	515	< 1
7.	6.8	1.9	515	< 1
8.	7.5	2.4	579	< 3
9.	7.3	2.3	595	< 3
10.	7.2	1.5	587	< 3
11.	7.5	1.6	577	< 3
12.	7.8	2.4	602	< 4
13.	7.6	2.3	586	< 3
14.	7.5	2.3	546	< 3
15.	7.1	2	580	< 4
16.	7.4	2.1	535	< 3
17.	7.6	2.1	586	< 3
18.	7.8	2.2	604	< 4
19.	7.4	2.2	535	< 3
20.	7.3	2.1	680	< 4

The different physical parameters suggest variations in different samples collected from different sites. This is due to the pipeline transportation of municipal water. The change in pH suggests incorporation of either acidic or alkaline sources during transportation.

Change in Turbidity and TDS in different samples suggests either growth of micro-flora or the incorporation of solid compounds during transportation. Change in colour of different water samples was mainly due to the change in Turbidity and TDS contributing factors.

Calcium: The maximum Calcium was recorded as 90 ppm in sample number 20 and the minimum value was recorded as 52 ppm in sample number 14

(Table-3). According to BIS, maximum limit of Calcium in drinking water to be 75 ppm.

Alkalinity: The maximum alkalinity was recorded as 210 ppm in sample number 4 and the minimum value was recorded as 144 ppm in sample 3 (Table-3). According to BIS, maximum limit of alkalinity in drinking water to be 200 ppm.

Chloride: Chloride was found in all natural waters in widely varying concentrations. The chloride contents normally increases as the mineral contents increases (Dubey, *et al.*, 2003). In the present study the chloride concentration was found maximum 89 ppm in sample number 4 (Mahadeb chawk) and minimum 61ppm in sample number 19 (Table-3). This was due to the addition of natural contaminants and pollutants in to the iron pipe.

Nitrate: The nitrate in municipal supply water was found maximum 45ppm in sample 20 and minimum 23ppm in sample 1 (Table 3). According to ISI 1991; 45 ppm Nitrate is accepted for drinking water.

Magnesium: The magnesium in manucipal supply water was found maximum 28ppm in sample number 4 and minimum 21ppm in sample 14 (Tables 3). According to ISI 1991; 30ppm magnesium is accepted for drinking water.

Iron (Fe): Fe in manucipal supply water was found maximum 0.2ppm in sample number 12 and minimum 0.5ppm in sample 7 (Table 3). According to standards ICMR 1975; 0.1 ppm Iron was accepted for drinking water.

Fluorine (F): F in manucipal supply water was found maximum 0.5ppm in sample number 4 and minimum 0.3ppm in sample 12 (Table - 3). According to standards ICMR 1975; 1.0 ppm florin was accepted for drinking water.

The different chemical tests result were varies due to incorporation of different chemicals discarded from household, hospitals and small scale industries garbage into the drainage system which is shared by the water supply pipelines. The different pesticides like endosulfan, profenofos, rodenticides and insecticides are introduced by local people. These toxic compounds were washed and unknowingly discarded in the municipal drainage system. It might be possible that different chemicals contamination through brakage pipe line interered and supply water got contaminated.

MICROBIAL CONTAMINATION :

In this study, microbial contamination like Aerobic microbial count (AMC), *E. coli*, Yeast & Mold, Peudomonas aeruginosa, Sulphite reducing anaerobes and Coliform was measured in municipal supply water. Microorganism were cultured in different microbial culture media at different cultured conditions. Number of colonies of different bacteria was counted in different culture plates. Aerobic microbial count (AMC) at 37^0C for 24 hrs cultured and it was observed that maximum 49 colonies were found in sample number 4. *E. coli* were observed in sample number 2, 4, 5, 6, 7, 8, 9, 14, 15, 16, 19 and 20, Yeast & Mold were observed

in all sample, *Psuedomonas aeruginosa* was absent from all samples, Sulphite reducing anaerobes and Coliform were observed in few sample (Table 4).

From microbial test result, it was observed that Panjabi colony, Mahadev chowk, Kashipur and Pethiya gachhi municipal supply water samples were highly microbial contamination. The result of Coliform bacteria is considered as "Indicator Organism" and their presence in water strongly suggested the presence of other pathogenic organisms is present there. According to BIS and WHO the presence of *E. coli* in water samples is unacceptable conditions for drinking, due to outbreak of certain water borne diseases.

Table 3: Different Physio-chemical test result of Municipal supply water of Samastipur town area (Data represents mean value of triplicates), P< 0.005.

S. No/ Sample No.	pH	Turbidity	TDS	Color
	6.5 to 8.5	Max 2 NTU	Max 500ppm	Max < 2
1.	7.8	1.6	510	< 1
2.	7.7	1.5	587	< 2
3.	7.5	1.4	546	< 2
4.	8.6	2.1	659	< 4
5.	7.3	1.5	588	< 3
6.	6.9	1.7	515	< 1
7.	6.8	1.9	515	< 1
8.	7.5	2.4	579	< 3
9.	7.3	2.3	595	< 3
10.	7.2	1.5	587	< 3
11.	7.5	1.6	577	< 3
12.	7.8	2.4	602	< 4
13.	7.6	2.3	586	< 3
14.	7.5	2.3	546	< 3
15.	7.1	2	580	< 4
16.	7.4	2.1	535	< 3
17.	7.6	2.1	586	< 3
18.	7.8	2.2	604	< 4
19.	7.4	2.2	535	< 3
20.	7.3	2.1	680	< 4

Table 4: Different microbial test result of municipal supply water of Samastipur town area.

Sl. N0	Aerobic Microbial count	*E. coli*	Y/M	Pseudo-monas aeruginosa	Sulphite reducing anaerobes	Coliform
ISO/IS Limit	37^0 / 24hr 20 Colony	Absent / 24	Absent / 5 day	Absent / 48	Absent	Absent
1.	Absent	Absent	Absent	Absent	Absent	Absent
2.	38	Present	Present	Absent	Absent	13
3.	42	Absent	Present	Absent	Absent	7
4.	49	Present	Present	Absent	Absent	14
5.	25	Absent	Present	Absent	Absent	5
6.	27	Absent	Present	Absent	Absent	4
7.	30	Present	Present	Absent	Present	7
8.	24	Present	Present	Absent	Absent	9
9.	26	Present	Present	Absent	Absent	1
10.	35	Absent	Present	Absent	Absent	Absent
11.	35	Absent	Present	Absent	Absent	Absent
12.	27	Absent	Absent	Absent	Absent	5
13.	45	Present	Present	Absent	Absent	6
14.	34	Present	Present	Absent	Absent	2
15.	38	Present	Present	Absent	Absent	4
16.	24	Present	Present	Absent	Absent	7
17.	29	Absent	Present	Absent	Absent	8
18.	34	Absent	Present	Absent	Present	9
19.	35	Present	Present	Absent	Absent	10
20.	45	Present	Present	Absent	Present	14

CONCLUSION:

For analysis of municipal supply water quality of Samastipur district town, 20 sites of water samples were collected from different areas. Different test for physico-chemical, chemical and microbial contamination were examined. From above results Table - 2, 3 & 4, it was analyzed that municipal supply drinking water of Samastipur district town have poor quality. In general, not any parameters are within the range of standard values prescribed by various agencies. Microbial analysis (Table - 4) shown clearly that municipal supply water has highly contamination. Physio- chemical analysis (Table - 2 & 3) showed clearly that not any parameters are in normal range. Analysis also indicates that the test results of water fluctuate sample to sample. Question is if source of municipal water supply is same then

why water quality is differ from area to area? On the basis of above study, most probable answer will be municipal supply water delivered door to door by iron pipe and this pipe is spread through drainage but due to lack of maintenance this iron pipe may get damage at different places. It may be possible that drainage water enters into water supply iron pipe and supply water is contaminated. It is fact that status of Samastipur townmunicipal supply water is not fit for drinking in any circumstance. This needs the attention towards the improvement of municipal supply water system so that people may protect from water born disease. To maintain the quality of municipal supply water study will be performed at certain interval so that municipal supply water quality may be maintained.

ACKNOWLEDGEMENT:

The authors are thankful to Principal, Ram Nirikshan Atma Ram College, Samastipur and Secretary, National Applied Research Institute, Patna for providing infrastructure and laboratory facilities.

REFERENCES:

1. Addiscott T. M., Whitmore A. P. and Powlson D. S., Farming, Fertilizers and the Nitrate Problem, *CAB International, Wallingford*, 1992.
2. American Public Health Association Standard methods for the examination of water and waste water (10th edn.). *Washington, DC: American Public Health association*, 1985.
3. APHA, Standard methods for the examination of water and wastewater, 19th edition American Public Health Association, Washington, 1985: 1- 467.
4. Bureau Indian Standards (BIS), Specification for drinking water, *Bureau of Indian Standards, New Delhi,* 1991; 18: 10500.
5. De A. K., Environmental chemistry (4th edn.). New Delhi, India: *New Age International Publishers*, 2002: 232.
6. Dubey N., A comparative status of quality of drinking water of Bhopal city filtration plants and ground water with special reference to heavy metals and organo chemical. Ph.D. Thesis, Barkatullah University, Bhopal, 2003.
7. Hall M. D., Shaffer M. J., Waskom R. M. and Delgado J. A., Regional nitrate leaching variability: what makes a difference in Northeastern Colorado. *Journal of the American Water Resources Association*. 2001; 37(1): 139 - 408.
8. Helena B., Pardo B., Vega M., Barrado., Fernandez J. M. and Fernandez L., Temporal evolution of groundwater composition in an alluvial aquifer (Pisuerga River, Spain) by principal component analysis. *Water Research* 2000; 32: 19 - 30.
9. Hii B., Liebscher H., Mazalek M. and Tuominen T., Ground Water Quality and Flow

Rates in the Abbotsford Aquifer, British Columbia, *Environment Canada, Vancouver,* BC 1999.

10. Hubbard R. K and Sheridan J. M., In: Adriano, D.C., Iskandar, A.K., Murarka, I.P. (Eds.), Contamination of Ground Waters, *Science Reviews, North wood* 1994.
11. ISI. Indian Standard Specification for drinking water, IS: 10500, New Delhi 1991.
12. ICMR Manual of standard quality for drinking water supplies. Special report series No. 44, 2nd edition, 1975.
13. Khan A. A., Bhatnagar A., and Saxena R., An introduction of Bhopal Lakes. In S. K. Kulshreshtha (Ed.), *Proc. nat. symp. present, past & future of Bhopal lakes,* 1988: 7 - 10.
14. Khoshravesh M., Shirazi P., Heydarpour M., Divband L. and Mazidi M,. Prospection of nitrate amount in the Ziarat river by sagacious techniques, 2011.
15. Mohapatra U. K. and Singh B. C., Trace metals in drinking water from different sources in old capital city of Cuttak. *Indian Journal of Environmental Health,* 1999; 41(2): 115 - 120.
16. NEERI Manual on water and waste water analysis. *National Environmental Engineering Research Institute, Nagpur,* 1991.
17. World Health Organization. Guidelines for drinking water quality. Geneva: WHO (2nd edition) 1984.
18. WHO, Guidelines for drinking water recommendations, *World Health Organization, Geneva,* 1996; 2.

***