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PHYSICOCHEMICAL AND BIOLOGICAL ANALYSIS OF DRINKING WATER OF THE SHIVNA RIVER

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ABSTRACT
The Shivna the holy river passes from district Mandsaur (M.P.) but it is greatly unfortunate that it is highly polluted due to the addition of dirty drainages which mingle into it at different places for a long time. The Shivna river water samples were collected from five different stations that are situated at different places situated on the bank of river at Mandsaur. Drinking water of the Shivna river quality was determined with different parameters such as pH, chloride, nitrate etc. and all parameters were compared with standard WHO, ICMR and CPCB. Out of them at five stations the water samples of two stations' S-1 and S-2 were under specific parameters while other three stations S-3, S-4 and S-5 were not suitable for drinking and even bathing due to the pollution with discharge of sewage water into the river.

KEYWORDS: Physicochemical and Biological Parameters, MSW, Toxicity, Shivna River.

INTRODUCTION
Water is the most essential necessity for human and even other creatures. Life without water is impossible to imagine. It is considered that less than 1% water can be used for drinking purpose. Approximately 75% part of the earth is covered by water in which approximately 97% water is salty (Agrawal, 2008). The pure drinking mineral water is safe for all human and creatures (Anderson *et. al.* 2002, Fewtrell *et al.*, 2005, Ross *et. al.* 1988, Vidyasagar 2007). Now a days, Water pollution is a burning problem all over the world. Different types of waste materials including domestic waste, industrial waste are thrown into rivers as well oceans. These waste materials pollute rivers with the results the water can not be used for drinking. Today, more than ten thousand dyes are used for commercial purposes and about seven lakh tones of dyes are produced per year (Zolinger, 1987). The dyes contain toxic character and some have carcinogenic characteristic. When the waste material is mingled into the river, the river water contaminated. When this polluted water is drunk by human and animals, they suffer terrible diseases ultimately causing death. Keeping in view 'Namo Ganga project' has been launched in India. Mains rivers likes Yamuna, Chambal, and Kaveri etc. are highly polluted due to above reasons.

The Shivna river originates from Raipuri hills four kilometers away from Salamgarh in district Chittorgarh Rajasthan.It is also known as Shavna. It passes through district Mandsaur, Madhya Pradesh. About three to four lakh populations depend for drinking water. The famous temple of Lord Shiva named Pashupati Nath is situated at the bank of holy river Shivna. It is a great misery that this holy river is highly polluted by toxic contents and city drainages of dirty water. Some factories and industries are working near the river, draining waste liquid material into river without treatment by ETP. Wells near the river are also contaminated with poisonous water. Polluted water of the river and the wells irrigates the fields producing vegetables and other crops resulting in various diseases. Formerly, the study of municipal sewage water was done. The concluding results of the study showed the effects on the growth of onion roots. The growth of onion roots was too much disappointing (Bhatt S. *et. al.*, 2013).

MATERIAL AND METHODS
Collection of Samples
The District Mandsaur (figure-1) is situated at the northern projection of Madhya Pradesh between the parallels of latitude 23^0 45' 50" North and 25^0 2' 55" North, between the meridians of longitude $74^0$42'30" East and $75^0$50'20" East (Bhatt S. *et.al.* 2013). The Shivna river flows across district Mandsaur. The water samples were collected from five different places at Mandsaur district Mandsaur (M.P.) to check physicochemical and biological analysis (figure-2). These places were respectively KalaBhata Dam,

RamGhat Water Filtration Plant, Pasupathinath- Ghat area, Near to Starch Factory and Municipal Sewage Water that is mixed in the river. The physicochemical and biological analysis of all water samples were analysed according to standard analytical procedures of water analysis and BIS (BIS, 2012).

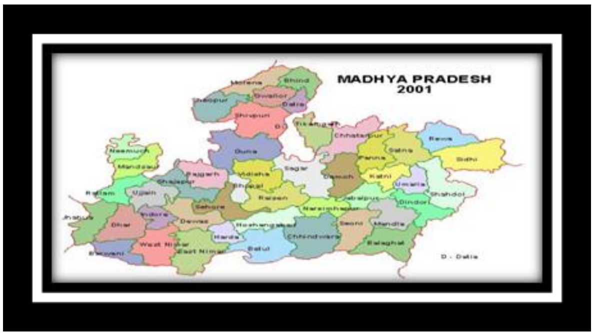

Figure 1: Map of Madhya Pradesh.

Figure 2: Five Different Sampling Stations.

pH

The electrode of pH meter was dipped into samples and observed the pH value.

Conductivity

The electrode of conductivity meter was dipped into the samples and the value was observed.

Chloride Test

50ml. sample in each conical flask was taken and added with 2-3 drops of potassium chromate solution. Water sample turned into yellow colour then titrated with 0.0141N silver nitrate solution. The yellow colour solution converted into brick red colour.

$$Cl\ (mg/L) = \frac{N.\ of\ AgNO_3\ x\ ml.\ of\ AgNO_3\ x\ 35.45x\ 1000}{ml.\ of\ Sample}$$

Iron Test

In another test, 50ml. water sample was taken in each conical flask and 2ml. HCl with 2ml of hydroxylamine hydrochloride solution was added. Then, added 2-3 glass beads and boiled until the samples remained approximately half. The solution was cooled and added 10ml sodium acetate, 2ml. phenanthroline solution and made up the volume upto 100ml. The coloured solution intensity was measured on spectrophotometer at 510nm and was calculated with standard curve.

$$Iron\ (mg/L) = \frac{Standard\ match\ x\ 0.01\ x\ 1000}{Sample\ taken}$$

Total Dissolve Solids

50 ml sample was taken in each conical flask and added 2-4 drops of ammonium buffer then mixed Eriochrome Black T into it. The sample’s colour converted into pink

colour which was titrated against EDTA Solution (0.01M) and pink colour changed into blue colour.

$$\text{TDS (mg/L)} = \frac{C^1 \times 1000}{\text{Water Sample}}$$

Residual Chlorine

10ml sample was taken into a test tube and added 2-4 drops of Orthotolidine reagent. The yellow colour appeared.

Fluoride

100ml sample was taken into a Nessler tube, added 5ml algerian red solution with 5ml of zirconyl acid. These solutions were kept for half an hour at room temperature then observed absorbance on spectrophotometer.

Hardness Test

5ml sample was taken into a test tube and 5 drops of reagent-A and reagent-B were added then mixed properly. The sample's colour was wine red. It indicated hardness of water while blue colour showed water's softness. The reagent C was added until blue color appeared.

Drop of hardness reagent C x 50=………mg/liter.

Nitrate

5ml sample was taken into a test tube and added 2 drops of HCl. After it, 50 ml nitrate reagent-A was added and mixed well. After 10 minutes, four drops of nitrate reagent-B were added into it. The water colour converted into light red after 15 minutes.

Calcium

50ml sample was taken into a conical flask and added 1ml of sodium hydroxide with 1ml of isopropyl alcohol. Then, a pinch of murexide indicator was added and mixed well. It was titrated against EDTA until the pink color turned purple.

$$\text{Calcium (mg/L)} = \frac{T \times 400.5 \times 1.05}{\text{Sample taken (ml)}}$$

Where, T=Volume of Titrant (ml)

Magnesium

Total hardness and calcium hardness were determined by EDTA and then calculated magnesium.

$$\text{Magnesium (mg/L)} = (T\text{-}C) \times 0.243$$

Where, T= Total hardness mg/L (as $CaCO_3$)

C= Calcium hardness mg/L (as $CaCO_3$).

Sulphates

100ml water sample was taken and filtrated into a Nessler's tube containing 5ml of conditioning reagent and added 0.2g of barium chloride crystals. The volume was made-up upto 100ml and stirred. After sometime, turbidity was developed into solution, which was measured in nephlometer.

Sulphate (mg/L) = Nephlometer reading x (0.4) x Dilution Factor.

RESULTS AND DISCUSSION

Water is the most important necessity of life but its purity is also important because polluted water generates different types of diseases like diarrhea, itching etc. by bacteria that develop into water. Many rivers and recharging wells with rivers are polluted due to municipal sewage water that mixed into rivers directly. The Shivna river is one of the rivers which flow across Mandsaur (M.P.) where many drainages of municipal sewage water and the waste polluted of starch factory water is also poured into the Shivna river without treatment. Therefore, different water samples were collected from different areas respectively KalaBhata Dam (S-1), RamGhat Filtration Plant (S-2), Pashupatinath-Ghat area (S-3), near Starch Factory Mandsaur (S-4) and Municipal Sewage Water (S-5) and analysed with BIS protocol. The results were compared with standard limits of Indian council of Medical Research (ICMR, 1975), Central Pollution Control Board (CPCB, 2000) and World Health Organization (WHO, 2006).

pH

The pH value the most important part provides the information about the acidic or alkaline quality of water. The pH values of different water samples were determined that were collected from different stations. The pH values of different sampling points were S-1 8.5, S-2 8.5, S-3 9.0, S-4 8.7 and S-5 9.0 respectively (fig. 3). These values were compared with WHO, ICMR and CPCB and evaluated that 8.5 was the upper limit while 9.0 was not acceptable according to the limits of WHO and CPCB. The water quality of sampling stations S-3, S-4 and S-5 were not suitable for drinking purpose and also health hazardous. The pH level increased during summer season due to the low water level and concentration of nutrients (Narayana J. *et al.* 2008) whiles the pH level minimum at the time of monsoon due to the dilution of water by rainy water (Reddy VK. *et. al.* 2009). In pH range 3.5-4.5 of water system, aquatic life also affects (Adarsh and Mahantesh, 2006; Leo and Dekkar, 2000).

Turbidity (NTU)

Various light particles are floating in water that make turbid to water. It was determined by turbidometer. The station points S-4 and S-5 samples were out of limit as compared to WHO while other station points water was suitable and under limit to all three standard limits. The limit of WHO is 05 NTU while ICMR has 25 NTU and 10 NTU for CPCB. In the monsoon season, soil particles and sewage contents, which present on river basin, mixed into river. Thus turbidity of water increases at the time of monsoon. It also affects the growth of aquatic organism (Verma *et. al.* 1984).

Conductivity

The conductivity values depend on the dissolved solids, turbidity, colloidal matters & other reverse osmosis is one of the best technique that removes all contents by which conductivity values comes under limit (Rahmanian N. *et. al.* 2015). At this time, the electrical conductivity of tap water is not known (Azrina *et. al.* 2011) similarly minerals also affect a conductivity. Water quality effects human health but only conductivity does not directly impact.

In the Shivna river, the water samples were collected from different station and determined the conductivity the S-1 showed 71.4 mg/L, S-2 69.0mg/L, S-3 284.0mg/L S-4 314.0 mg/L and S-5 230. mg/L respectively (fig. 4). The results were compared to WHO, ICMR, CPCB and were found under limits at this time but may be damaging in future. The conductivity of S-2 had 69.0mg/L while 314mg/L and 0 mg/L S-3 where a lot of drainages are mixed. In the industrial and agriculture purposes, the conductivity is more valuable.

Chloride

The chloride quantity was determined of different stations (S-1 to S-5) and found S-1 had 100mg/L, S-2 136 mg/L, S-3 650 mg/L, S-4 450 mg/L, and S-5 640 mg/L, respectively (fig. 5). The all datas were under limitations as compared to the limit of WHO, ICMR and CPCB. Residual chloride was also studied. S-1, S-2 and S-3 values were 0.0 mg/L while S-4 had 0.2 mg/L and S-5 3.2 mg/L respectively. The chloride concentration increases at the time of summer season due to evaporation of water while the lowest values of chloride during monsoon season due to the dilution of water with rainy water (Shastry CA *et. al.* 1970).

Nitrate

The nitrate values found, had variability at different stations. The S-1 showed 14.0 mg/L, S-2 8.0 mg/L, S-3 38.2 mg/L, S-4 45.0 mg/L and S-5 52.8 mg/L (fig. 6). All stations' values were compared with standards and found under limits. The nitrate concentration increases in water through discharge of sewage and industrial wastes and also different agricultural activities (Solanki HA, 2012). These activities cause increase of nitrate concentration in ground and surface water (Nas and Berktay, 2006). After increasing the concentration of nitrate-nitrogen in surface water cause level of oxygen decreased results in effects on the aquatic organisms (Davie, 2003).

Total Hardness

The water taste depends on the soluble contents in water. In the Shivna river, total hardness of water of S-1 was 220 mg/L, S-2 160 mg/L, S-3 400 mg/L were under limit as per standard values of WHO, ICMR, CPCB while S-4 1000 mg/L and S-5 1000 mg/L, were out of limit (fig. 7). Water hardness depends on calcium and magnesium with sulphate which increases at the time of monsoon while the lowest concentration was recorded at the time of winter (Pawar SK 2005, Salve V.B., Hiware CJ, 2008).

Calcium

The presence of calcium contents can increase the hardness of water and it is also harmful effect for human being. A stone disease problem is caused by calcium contents. On the study of the Shivna river, S-1 showed 132mg/L, S-2 98.4 mg/L, S-3 240 mg/L, S-4 360 mg/L and S-5 600 mg/L (fig. 8). As per comparative study with ICMR and CPCB standards, only S-1 and S-2 were under limit while S-3, S-4 and S-5 were out of limit. The calcium quantities increase in rainy season by the addition of sewage waste with rain water (Verma *et. al.* 2010). Calcium contents are useful source for construction of shell bone building in organisms (Solanki HA, 2012).

Magnesium

Magnesium is involved into the heavy metals category which is effective on human body. Its limited quantity does not affect according to the WHO, ICMR and CPCB limits. Magnesium quantity was determined in different stations' water of the Shivna river. S-1 had 88 mg/L, S-2 65.6 mg/L, S-3 160 mg/L, S-4 240 mg/L and S-5 400 mg/L (fig. 9). According to the limits of CPCB, S-1 and S-2 were under limit while S-3, S-4 and S-5 were out of limit. As per WHO all the samples data were out of limit which is highly damaging because magnesium involved in heavy metals. Magnesium is an essential factor for the growth of chlorophyll pigments and phytoplankton (Solanki HA, 2012).

Iron

Iron is also involved in heavy metals category and its quantity effects on human and animal health. Iron like contents are more valuable in blood of human and animals. In the Shivna river, quantity of iron was vary at different stations, S-1 had 0.10 mg/L, S-2 0.11 mg/L, S-3 0.30 mg/L, S-4 0.24 mg/L and S-5 0.16 mg/L respectively(fig. 10). The datas were compared with ICMR and CPCB and found all stations had under limit while S-1 and S-2 datas were under limit as per WHO standards.

Fluoride

Fluoride is highly toxic content for human health. The quantities of fluoride were present at all stations but only S-3 and S-4 samples quantity was out of limit according to WHO, ICMR and CPCB (fig. 11).

Sulphate

Sulphate quantity was calculated with ICMR and CPCB limits and found under control. S-1 showed 10.0 mg/L S-2 25.1 mg/L, S-3 12.0 mg/L, S-4 14.0 mg/L, and S-5 28.0 mg/L respectively (fig. 12).

Bacterial Colony

Bacterial colonies present in water cause different diseases in which the most common diseases are diarrhea and jaundice. *E.coli* is responsible bacteria for generate above mentioned diseases (fig. 13). As per CPCB standard, bacterial quantity was no relaxation.

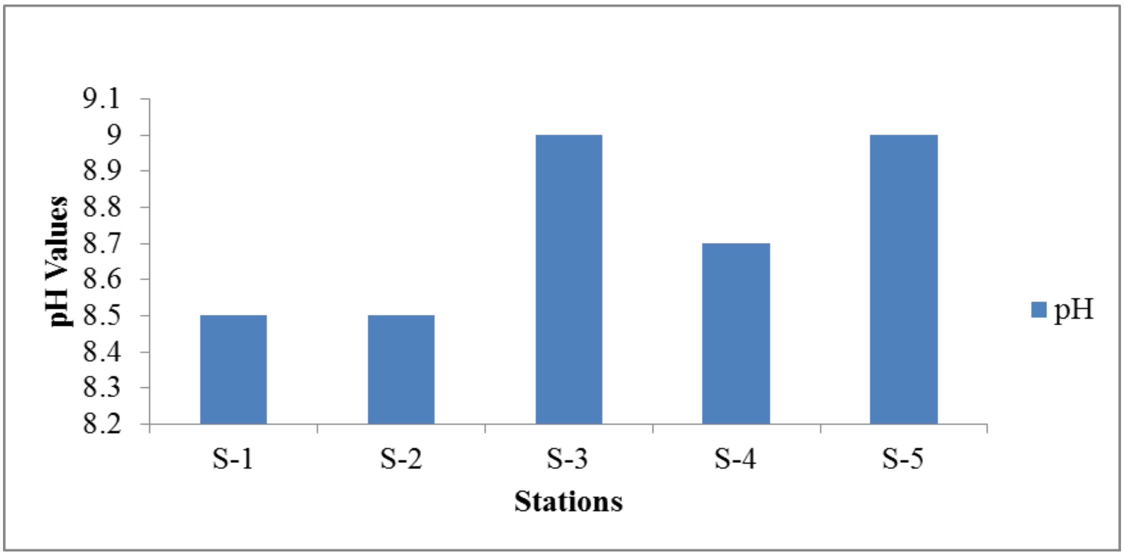

Figure-3: Comparative Values of pH with Different Stations.

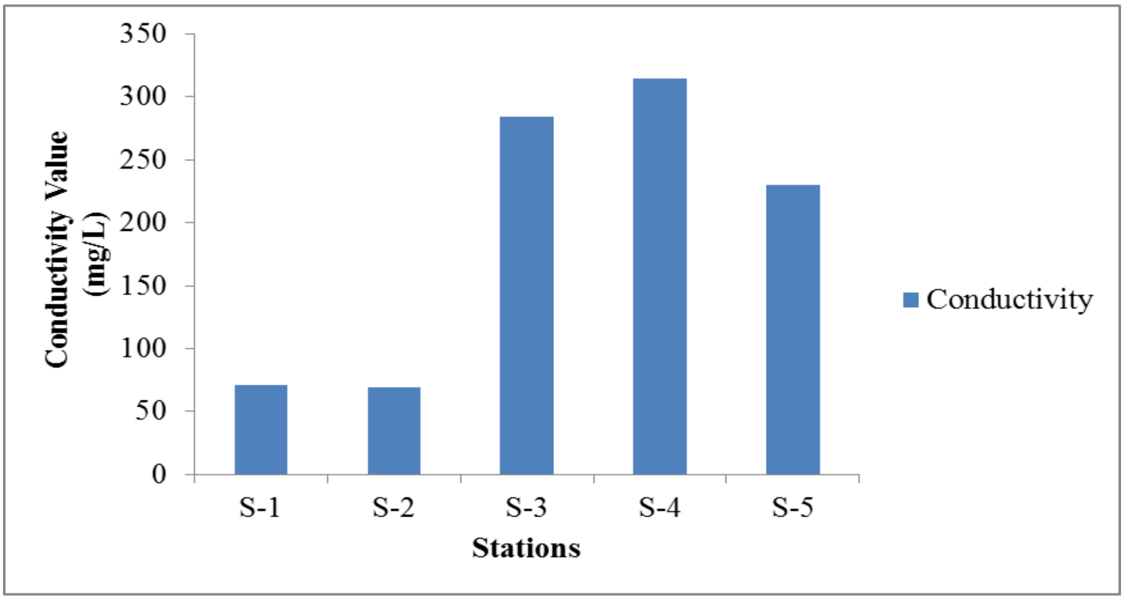

Figure-4: Comparative Study of Conductivity between Different Stations.

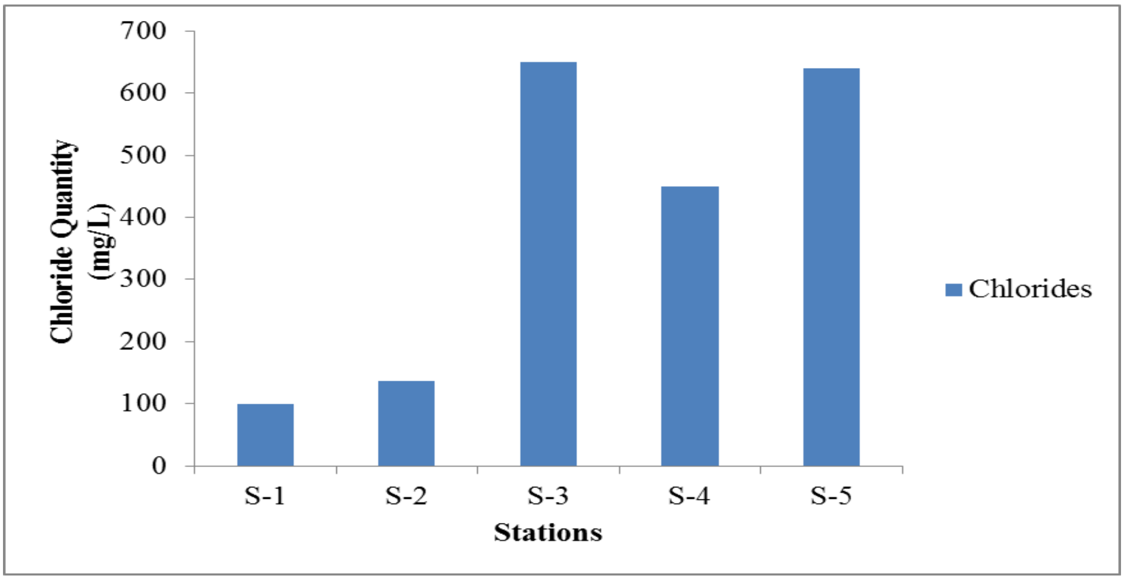

Figure-5: Comparative Study of Chlorides between Different Stations.

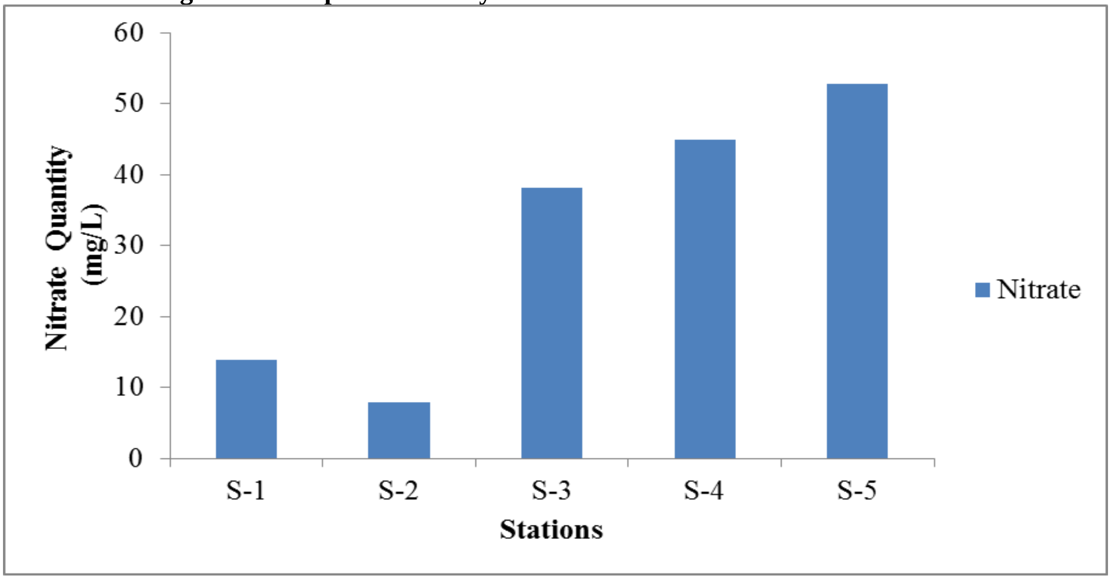

Figure-6: Comparative Study of Nitrate between Different Stations.

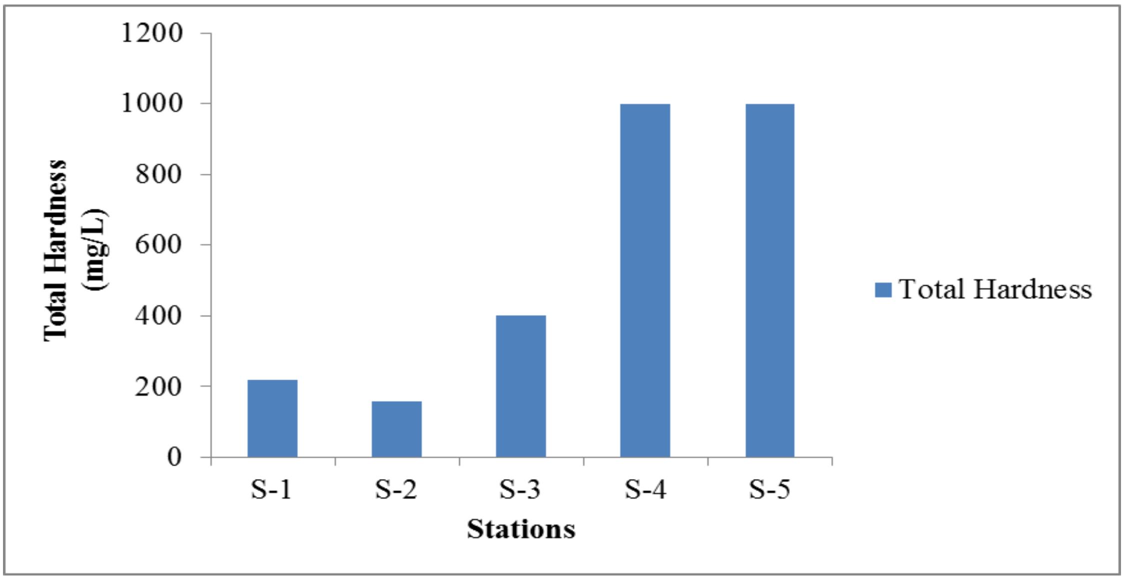

Figure-7: Comparative Study of Total Hardness between Different Stations.

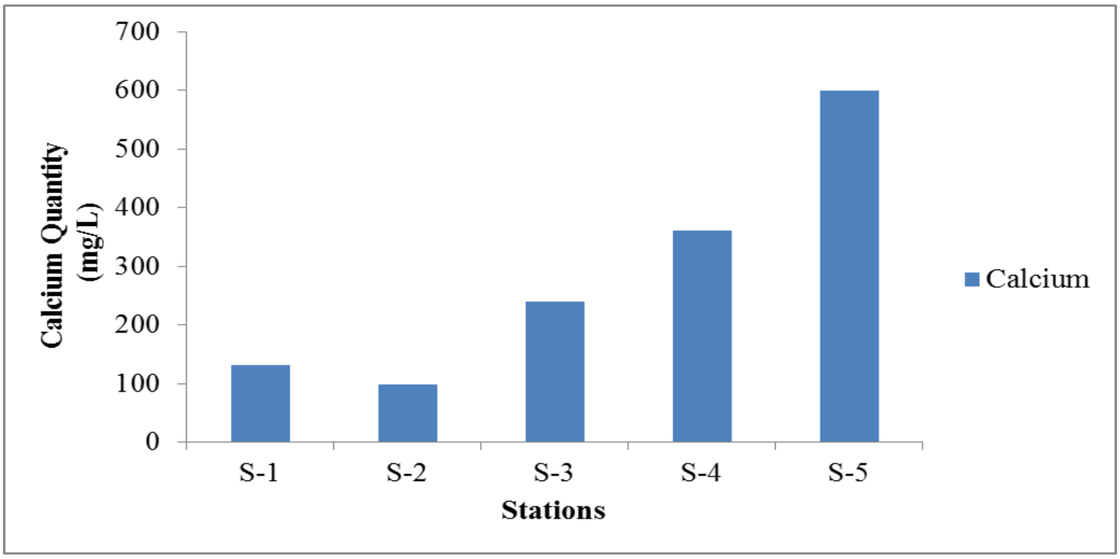

Figure-8: Comparative Study of Calcium between Different Stations.

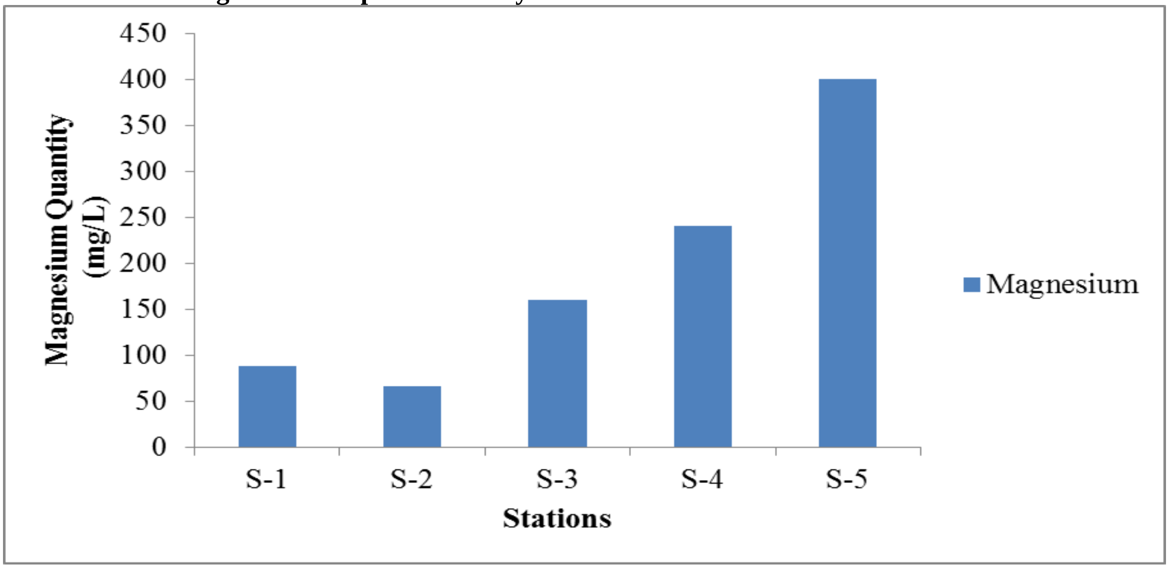

Figure-9: Comparative Study of Magnesium between Different Stations.

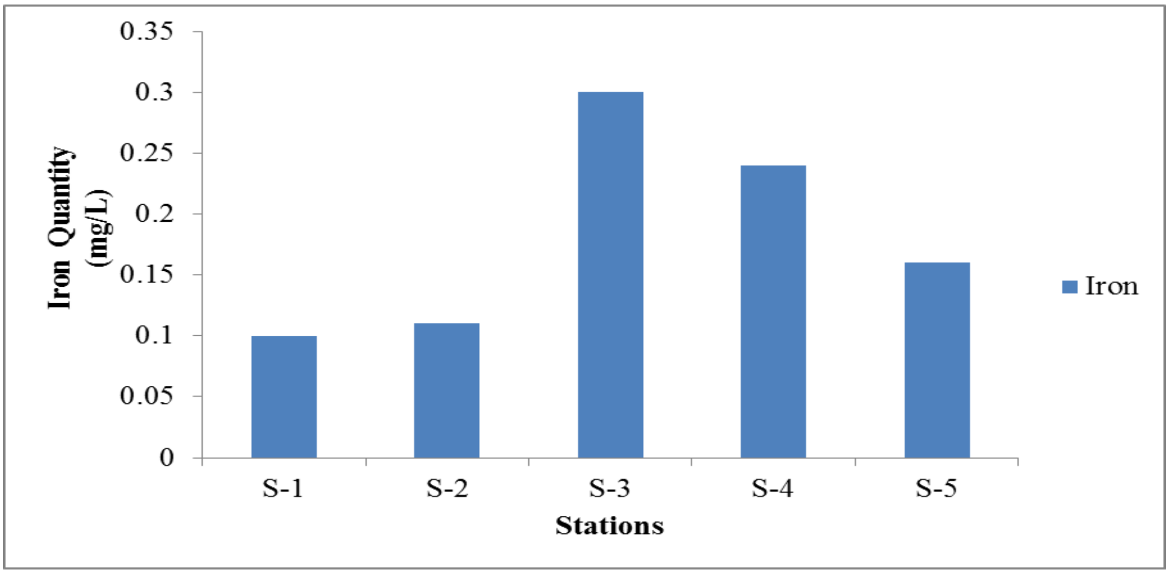

Figure-10: Comparative Study of Iron between Different Stations.

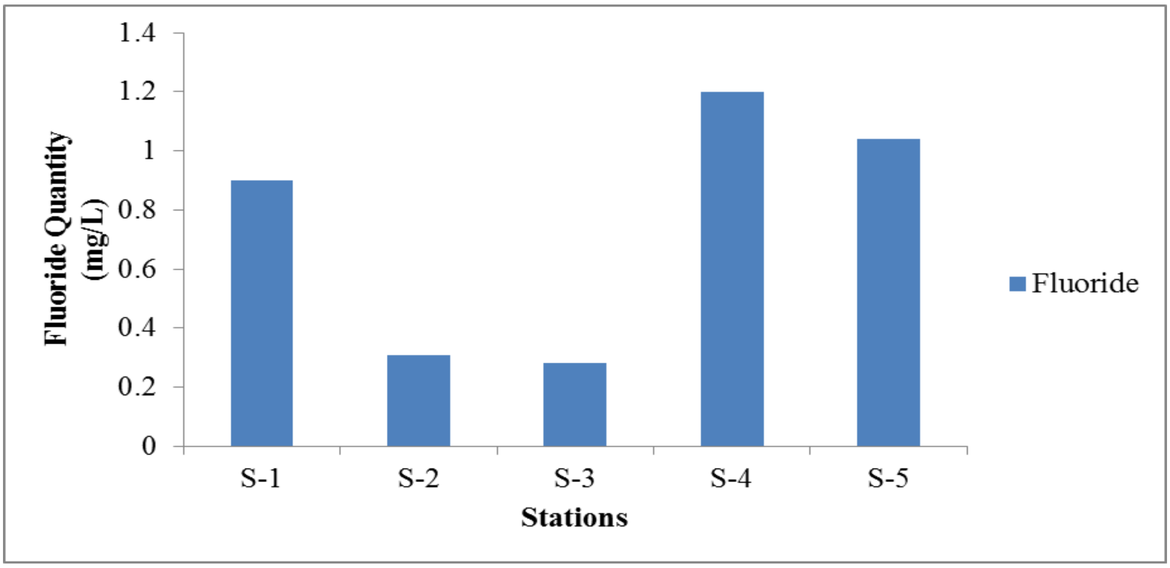

Figure-11: Comparative Study of Fluoride between Different Stations.

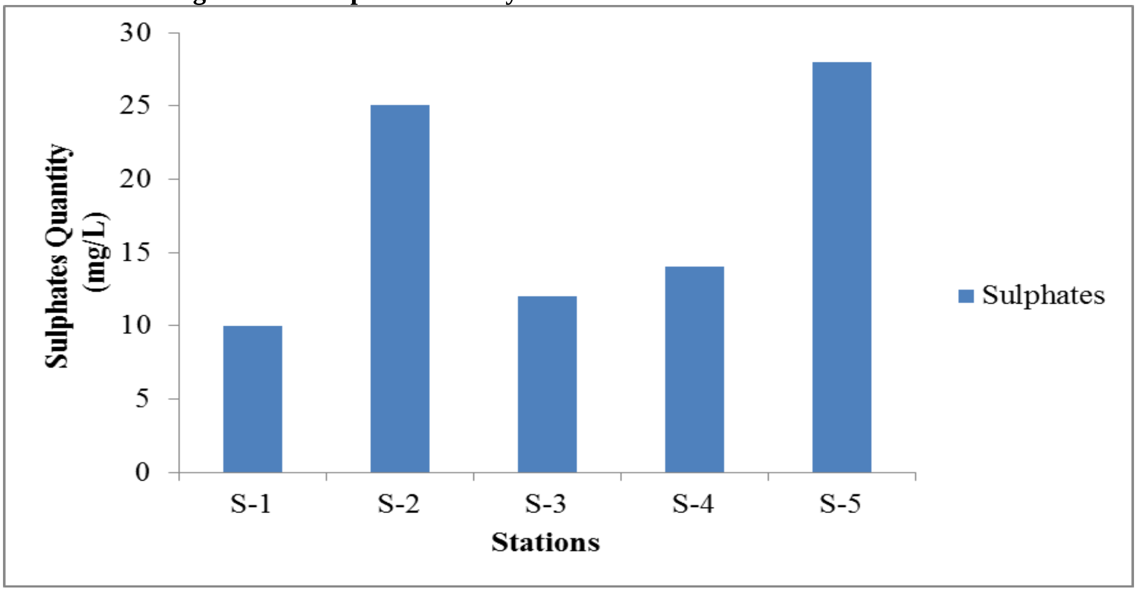

Figure-12: Comparative Study of Sulphates between Different Stations.

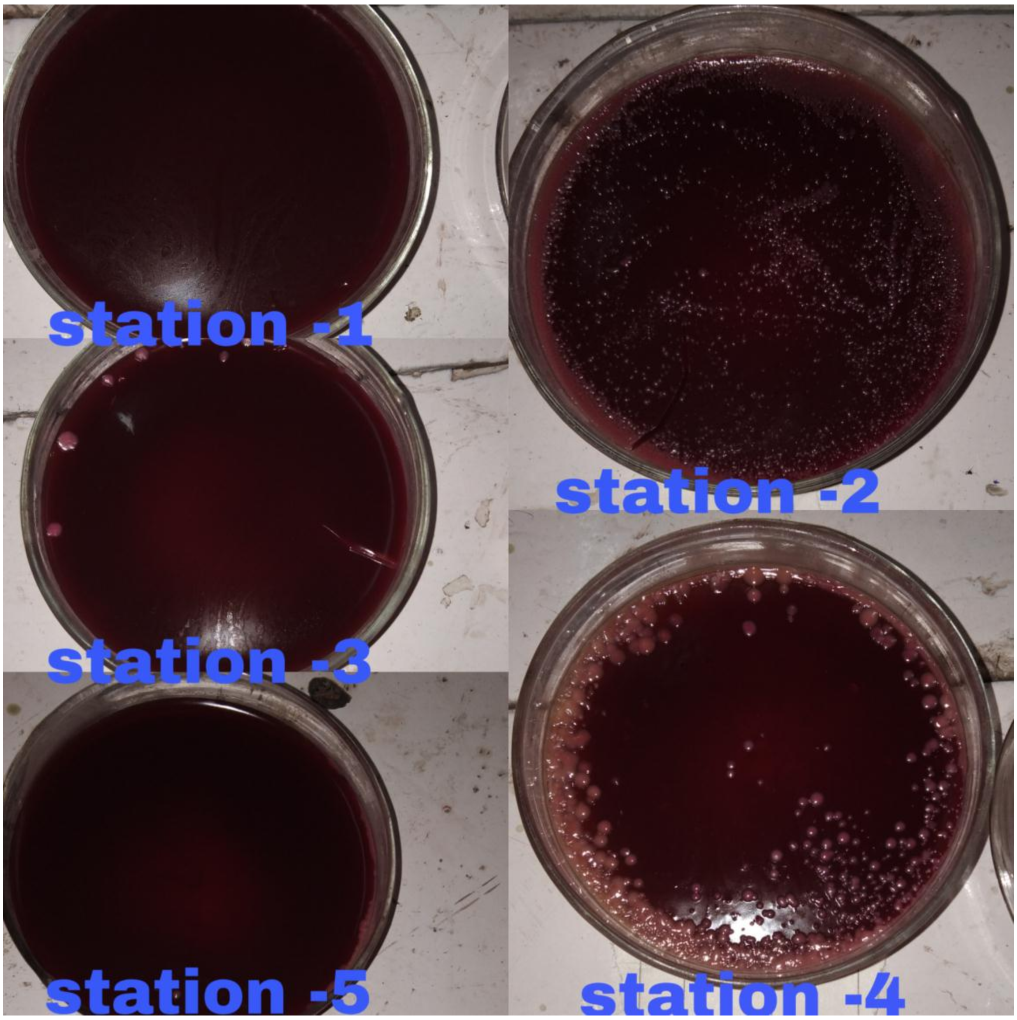

Figure-13: Presence of MPN (*E.coli* bacteria) in different station's sample on MacConkey agar.

Analysis	Kalabhata Dam (S-1)	Ramghat Dam Filtration Plant (S-2)	Pashupatinath Area (S-3)	Big Bridge (S-4)	MSW (S-5)	ICMR	CPCB	WHO
Color	Colorless	Colorless	Light Yellow	Light Yellow	Green	-	-	-
Test & Odour	Unargumental	Unargumental	Objectionable	Objectionable	Objectionable	-	-	-
Turbidity (NTU)	1.2	1.0	4.5	6.5	5.0	25	10	-
pH (mg/L)	8.5	8.5	9.0	8.7	9.0	6.5-9.2	6.5-8.5	6.5-8.5
Chlorides (mg/L)	100	136	650	450	640	1000	1000	200
Residual Chlorine (mg/L)	0.0	0.0	0.0	0.2	3.2	-	-	-
Nitrate (mg/L)	14.0	8.0	38.2	45.0	52.8	100	100	-
Total Hardness (mg/L)	220	160	400	1000	1000	600	600	500
Calcium (mg/L)	132	98.4	240	360	600	200	200	75
Magnesium (mg/L)	88	65.6	160	240	400	-	100	50
Iron (mg/L)	0.10	0.11	0.30	0.24	0.16	1.0	1.0	0.1
Fluoride (mg/L)	0.90	0.31	0.28	1.20	1.04	1.5	1.5	1.5
Sulphates (mg/L)	10.0	25.1	12.0	14.0	28.0	400	400	-
Conductivity (mg/L)	71.4	69.0	284.0	314.0	230.0	-	2000	-
***E.coli* (MPN/ 100ml)**	Present	Present	Present	Present	Present	-	No relaxation	-

CONCLUSION

The water of Shivna river quality, as per drinking water category parameters such as pH, conductivity, chloride, nitrate, total hardness etc. were determined of five samples. The parameters were compared with standard WHO, ICMR and CPCB and found station-1 (S-1) and S-2 water samples were under limit while most of the parameters of S-3, S-4 and S-5 were out of limit according to the three limit. Therefore, only S-1 and S-2 can be used in drinking purpose while other station's water was not suitable for drinking and even bathing.

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REFERENCES

1. Adarsh, S., Mahantesh, B. Personal Communication. Resident Doctors of Medicine. Hanagal Shree Kumareshwara Hospital, Bagalkot, Karnataka, India, 2006.
2. Agrawal KC. Environmental biology. Nidhi Publishers, Bikaner, India. Second edition, 2008.
3. Anderson, B.A., Romani, J.H., Phillips, H.E., and Van Zyl, J.A. Environment access to health care and other factors affecting infant and child survival among the African and coloured populations of South Africa, 1989-94. *Population and Environment*, 23: 349-364.
4. A. Azrina, H.E. Khoo, M.A. Idris, I. Amin, and M.R. Razman, Major inorganic elements in tap water samples in Peninsular Malaysia. *Malaysian Journal of Nutrition*, 2011; 17(2): 271-276.
5. Bhatt Shashank and Dhyani Suresh. Toxicity effects of municipal sewage effluent on onion roots. *J. Environ. Res. Develop*, 2013; 7(4A): 1547-1551.
6. BIS (Bureau of Indian Standards) 10500 Specification for Drinking Water 2012 Indian Standards Institution New Delhi, 15.
7. CPCB (Central Pollution Control Board) Water Quality Status of Yamuna River. Assessment and Development of River Basin. CPCB Report, 2000.
8. Davie, T. Fundamental of Hydrology. *Routledge, Taylor and Francis Group*, London. New York, 2003.
9. Fewtrell, Lorna, Kaufmann, Rachel B., Kay, David, Enanoria, Wayne, Haller, Laurence, and Colford, John M., Jr.'' Water, sanitation, and hygiene interventions to reduce diarrhea in less developed countries: a systematic review and meta-analysis.'' *The Lancet Infectious Diseases*, 2005; 5: 42-52.
10. Ross, J.A., Rich, M., Molzen, J., and Pensak, M. Family planning and child survival in one hundred developing countries. New York: *Center for Population and Family Health*, Columbia University, 1988.
11. ICMR (Indian Council of Medical Research) Manual of Standards of Quality for Drinking Water Supplies, Indian. Special Reports No. 44197527.
12. M.L. Leo, M. Dekkar. Handbook of Water Analysis. Marcel Dekker, New York, 2000; 1-25,115-117, 143,175, 223-226, 261, 273, 767.

13. Narayana J., Puttaiah ET, Basavaraja D. Water quality characteristics of Anjanapura reservoir near Shikaripur, District Shimoga, Karnataka. *Journal of Aquatic Biology*, 2008; 23: 59-63.
14. Nas, B, Berktay, A. Ground water contamination by nitrates in the city of Konya (Turkey): A GIS Perspective, *J. Environ. Manag*, 2006; 79: 30-37.
15. Reddy VK Prasad KL, shamy M, Reddy R. Physico-chemical Parameters of Pakhal Lake of Warangal District Andhra Pradesh, India. *Journal of Aquatic Biology*, 2009; 24: 77-80.
16. Rahmanian N., Siti Hajar Bt Ali, Homayoonfard, Ali N.J., Rehan M., Sadaf Y. & Nizami A.S. Analysis of physiochemical Parameters of evaluate the drinking water quality in the state of perak, Malaysia. *Journal of chemistry, Hindawi publishing corporation*. Vol. 2015 article id 716125.
17. S.R. Verma, P. Sharma, A. Tyagi, S. Rani, A.K. Gupta, R.C. Dalela. Pollution and Saprobic Status of Eastern Kalinadi, Limnologia, 1984; 15: 69-133.
18. Solanki HA. Status of soils and water reservoirs near industrial areas of Baroda: pollution and soil –water chemistry. *Lap Lambert Academic Publishing*, Germany, 2012; ISBN 376.
19. Shastry CA, Aboo KM, Bhatia HL, Rao AV. Pollution of upper lake and its effects on Bhopal water supply. *Journal of Environmental Health*, 1970; 12: 218-238.
20. Salve V.B., Hiware C.J. Studies on water quality of Wanparakalpa Reservoir, Nagpur, Near Parli Vaijnath, District Beed, Marathwada Region. *Journal of Aqua. Biol.*, 2008; 21(2): 113-117.
21. Pawar SK, Pulle JS. Studies on physicochemical parameters in Pethwadaj Dam, Nanded District in Maharashtra, India. *Journal of Aquatic Biology*, 2005; 20: 123-128.
22. Verma PU, Chandawat D. Solanki HA. Study of Water quality of Hamirsar Lake-Bhuj. *International Journal of Bioscience Reporter*, 2010; 8: 145-153.
23. Vidyasagar, D. Global minute: water and health-walking for water and water wars. *Journals of Perinatology*, 2007; 27: 56-58.
24. WHO (World Health Organization) 3rd ed. Guidelines for Drinking Water Quality. (1). Recommendations Vol. 12006491493.
25. Zolinger, H. Colour chemistry- Synthesis, Properties of organic dyes and pigments, *VCH publishers*, New York, 1987; 92.