Poll Res. 43 (3-4) : 314-318 (2024)

ISSN 0257–8050

DOI No.: http://doi.org/10.53550/PR.2024.v43i03-04.019

A STUDY ON THE ZINC CONCENTRATION IN SELECTED WATER BODIES OF UDAIPUR, RAJASTHAN, CITY OF LAKES

PREMLATA VIKAL[1], PRAGYA DADHICH[2] AND PREETI[3]

[1]*Department of Botany, S.M.B. Govt. P.G. College, Nathdwara, Rajasthan, India*
[2]*Department of Botany, University College of Science, Udaipur, Rajasthan, India*
[3]*Department of Botany, University College of Science, Udaipur, Rajasthan, India.*

(Received 19 June, 2024; Accepted 10 August, 2024)

ABSTRACT

Picture a calm lake framed by peaceful surroundings, creating a stunning and serene natural view with its surface reflecting sunlight. Below, a prosperous underwater world is enriched with lively flora and fauna. However, this tranquil setting hides a danger: zinc contamination! This metal can disturb the fragile harmony of aquatic ecosystems, posing a silent threat to their health and balance if not watched. The assessment of zinc concentration in water bodies is crucial as zinc pollution can affect aquatic ecosystems and pose risks to public health if water quality is compromised. Despite the significance, there is a notable lack of detailed studies on zinc pollution in the water bodies of the Udaipur district. The objective of this study is to investigate the concentration of zinc in various water bodies within the Udaipur district of Rajasthan, India, to assess the extent of zinc pollution and its potential environmental and health impacts on living beings. Water samples were collected seasonally from five locations: Lake Pichola, Lake Fateh Sagar, Ayad River, Sukha Naka and Dabok Pond, during the period of 2023-2024. The analysis revealed that zinc levels in Lake Pichola and Lake Fateh Sagar were consistently below detection limits (BDL < 0.01 mg/l) during all seasons, indicating minimal contamination. Ayad River and Sukha Naka exhibited slightly higher concentrations of zinc during summer whereas Dabok Pond showed consistently measurable zinc concentrations, suggesting a persistent contamination source. The study highlights the need for continuous monitoring and management of water quality in Udaipur, emphasizing the importance of mitigating zinc pollution to protect the ecosystem and public health. The findings underscore the critical role of sustainable land and water management practices in preserving the water bodies of Udaipur.

KEY WORDS: Water, Water bodies, Zinc, Human health, Aquatic ecosystem, City of lakes.

INTRODUCTION

Udaipur is a historic city located in the Indian state of Rajasthan, also known as the "City of Lakes" due to its picturesque lakes. The city resides in between the serene waters of its renowned lakes and the ancient Aravali hills stand-in as a natural boundary that separates the Thar Desert from the plains and plateaus of eastern Rajasthan. The lakes of Udaipur not only attract tourism but also contribute significantly to the surface water supply of the city and has been supporting ecosystem, greatly. Lakes are of utmost importance yet unfortunately, water quality management of the city has suffered due to the pressures of urbanization and a growing population density. Furthermore, the watersheds of these lakes, crucial for maintaining the hydrological cycle and ecosystem balance, are witnessing a decline. This diminishment is a direct consequence of widespread deforestation and inadequate land management practices in recent years in the city (Choudhary *et al*., 2022 and Auddy *et al*., 2022). Lakes sustain a wide variety of plant and animal species and supply freshwater for industry, agriculture and drinking purposes. They provide amusing activities, minimize floods, and control the water cycle. The contribution of lakes to biodiversity, cultural legacy and economic development highlights maintenance of life and ecosystem. Are you beginning to crave a glass of water? No, I mean, the frequent mention of the word lakes above must have sparked a thirst within you! Let it be not just for water, but also for respecting and protecting the precious resources that keep us alive.

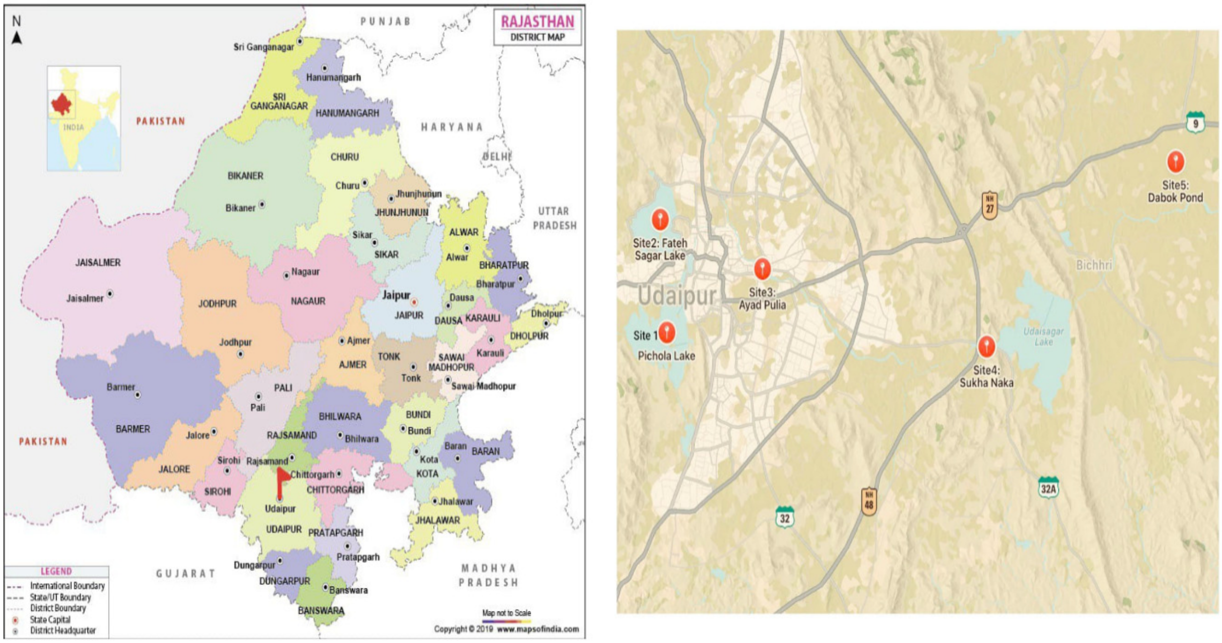
Water is essential for life on Earth. It flows through rivers, fills oceans and nourishes plants and animals. We depend on it for drinking, cooking, cleaning and multiple purposes. Our bodies composed of 70-80% water (Kumar and Puri, 2012). Every person on the planet inherently understands that water is the fundamental essence of all existence, irreplaceable for survival, given to us as a divine blessing, and serving as the very soul of our planet and so, our primary duty is to ensure the conservation of water and cherish it for generations to come. Despite of being aware of the importance of water in our lives, anthropogenic activities continue to degrade its quality. Around 14000 people die by drinking contaminated water every day according to a paper by Choudhary *et al.*, (2017). Contamination (by metals, organic toxins and radionuclides), acidification and eutrophication are considered as threat to aquatic ecosystem by Hakanson and Byrhn in 1999. Industries, use water from water reserves for cooling in factories and power stations. Human wastes, sewage, untreated factory waste and garbage dump into water bodies, agricultural, commercial, liquid medical wastes from hospitals, excessive use of pesticides and fertilizers are some notable sources of water pollution. Dumping of untreated sewage and industrial waste, which often contain solids and organic matter, into water bodies result in the release of toxic chemicals and metals, make aquatic environment polluted. In recent years, heavy metals have been reported as destructive for the water bodies. Metals that have atomic density above $5gcm^{-3}$ and an atomic number greater than 20 are defined as heavy metals (Raychaudhuri *et al.*, 2021) and are toxic even in trace amount. Through the investigation of zinc metal concentration in the water of some lakes, a non-perennial river and a pond in Udaipur, this paper draws attention towards zinc pollution. Even after being essential to life, zinc in the dose that makes a poison, harms life. Zinc, a metal found naturally in small amounts, is widely used across industries and can be released into the environment through mining and smelting. In habitants near zinc-related facilities may experience increased exposure through water, air, and soil. Continued exposure to high zinc levels may have adverse health effects. Human activities like mining, smelting, steel production and coal burning, are major sources of environmental zinc pollution (IDPH, 2024). It has been observed by the researchers that zinc toxicity in plants results in chlorosis in younger leaves, manganese and copper deficiencies and a noticeable loss of germination (Ebbs and Kochian, 1997; Lee *et al.*, 1996 and Manivasagaperumal *et al.*, 2011). A paper by Plum *et al.*, (2010) highlights some of the symptoms which appear due to zinc toxicity in humans as well such as lethargy, regional brain deficits, metal fume fever, respiratory illnesses caused by zinc smoke inhalation, nausea and vomiting, epigastric pain, diarrhoea, and an elevated risk of prostate cancer.

MATERIALS AND METHODS

The study was conducted in summer, post monsoon and winter seasons of year 2023-2024.

A. Study Area

Water samples for the analysis of zinc metal concentration were collected from 5 different water bodies of Udaipur region including 2 popular lakes namely Lake Pichola and Lake Fateh Sagar. Lake Picholacovers an area of 6.96 square kilometres, lies at 24°34′48"N 73°40′54"E. Its history dates back to 1362, making it one of the city's oldest lakes. Notably, the lake interconnects with the second study site that is Lake Fateh Sagar. It is situated at 24°36′17"N 73°40′43"E and is an eye-catching tourism spot. The overflow of lake Fateh Sagar flows into the river Ayad through Gumania Nallah. It's a non-perennial river and water from the western and central Aravali hills that surround the inner Girwa plains of Udaipur drains into this river. Ayadriver is a tributary of Barech River which is a tributary of Chambal River. As this river passes across the city and falls into the Lake Udai Sagar forms a great natural drainage system. The third and fourth sampling sites were Ayad River (24°35′12"N 73°42′40"E) and Sukha Naka (24°34′00"N 73°47′37"E). Through Sukha Naka the river Ayad enters into Lake Udai Sagar. The fifth site of sample collection was Dabok pond (24°36′53"N 73°51′48"E). This water body is situated in the village Dabok which is 20 Km towards East from Udaipur district head quarter. Figure 1 illustrates the sampling sites on map.



A B

Fig. 1. (A) Map of Rajasthan, India showing study area- Udaipur. (B)Map showing selected sampling sites in Udaipur region

B) Data Collection

To investigate the zinc metal concentration in water bodies of Udaipur region, 5 sites were selected. Water samples from the same locations of the same sites were collected during all the three seasons i.e. summer, post-monsoon and winter. Samples were collected from 30 cm below the water surface in the pre cleaned 1 L PET bottles and brought immediately to the laboratory for further analysis. The bottles were rinsed thrice from the same water that is to be taken for analysis before filling them up (Trivedy and Goel, 1986). While collecting the samples from flowing river Ayad it was taken into account that the mouth of the bottle should be directed towards the current. Temperature and pH of the water samples were noted for each sites at the time of water sample collection (Table 2). A proper experimental procedure was followed in the Apex Enviro Laboratory, Udaipur to determine the concentration of zincmetal in all the collected water samples (Table 1).

RESULTS AND DISCUSSION

Table 1 presents the concentrations of zinc (mg/l) in different water bodies during three seasons i.e., summer, Post-Monsoon and winter. The result points out that in lake Pichola the concentration of zinc is below detection limit (BDL< 0.01 mg/l), indicating very low levels of zinc in the water during all the seasons. Similar to Lake Pichola, Lake Fateh Sagar also shows very low concentrations of zinc, with values below the detection limit (BDL < 0.01 mg/l) in all three seasons. Water samples collected from Ayad River exhibits slightly higher

Table 1. Concentrations of zinc (mg/l) in selected study sites during summer, Post-Monsoon, and Winter Seasons

S. No.	Site	Season	Concentration of zinc (mg/l)
1.	Lake Pichola	Summer	0.002
		Post-monsoon	BDL<0.01
		Winter	BDL<0.01
2.	Lake Fateh Sagar	Summer	0.006
		Post-monsoon	BDL<0.01
		Winter	BDL<0.01
3.	Ayad River	Summer	0.02
		Post-monsoon	BDL<0.01
		Winter	0.01
4.	Sukhanaka	Summer	0.02
		Post-monsoon	BDL<0.01
		Winter	BDL<0.01
5.	Dabok pond	Summer	0.02
		Post-monsoon	0.02
		Winter	0.02

BDL indicates 'Below Detection Limit' (<0.01 mg/l).

concentrations of zinc compared to the previous two locations. In summer, the concentration was 0.02 mg/l, indicating a slight increase compared to the detection limit. In Post-Monsoon, the concentration decreases to below detection limit (BDL < 0.01 mg/l), suggesting a reduction in zinc levels after monsoon due to increasing dilution. In Winter, the concentration remains relatively low at 0.01 mg/l. Similar to Ayad River, Sukha Naka also showedvery low concentrations of zinc, with values below detection limit (BDL < 0.01 mg/l) during Post-Monsoon and Winter seasons. In summer, the concentration was found to be 0.02 mg/l. Dabok Pond stands out with consistently measurable concentrations of zinc across all seasons.

The low concentrations of zinc in Lake Pichola and Lake Fateh Sagar suggest minimal contamination or natural sources of zinc in these water bodies. Water samples of Ayad River and Sukha Naka showed slightly higher values but still relatively low zinc concentrations, possibly due to local industrial activities or runoff from nearby areas. Dabok Pond consistently showed measurable zinc levels, indicating a potential contamination source that demands further investigation. The fluctuation in zinc levels throughout the year emphasizes the impact of seasonal factors like rainfall, temperature and water flow on metal transport and distribution in water ecosystems. Although the permissible limit of zinc (mg/l) in drinking water is 5.0 according to WHO and ISI, 15.0 according to CPCB (Kumar and Puri, 2012) and an acceptable limit of 5.0 is given by Bureau of Indian Standards, IS 10500- 2012. The above data still highlights the need for continuous monitoring and management efforts to evaluate water quality and address potential risks associated with metal contamination in these water bodies.The pH and temperature of water samples were also noted at each site during different seasons (Table 2). pH levels across all sites ranged from acidic to slightly alkaline, with values between 4 and 6. These pH levels are within the acceptable range for freshwater bodies but may indicate localized variations in water quality. Water temperatures varied across sites and seasons, ranging from 14 °C to 35 °C. The consistently low levels of zinc in Lake Pichola and Lake Fateh Sagar suggest good water quality in terms of zinc contamination. Variable zinc concentrations in the water of Ayad River and Sukha Naka indicated potential sources of contamination that need further investigation. Dabok Pond exhibits stable zinc levels, suggesting a continuous source of contamination that requires mitigation measures. Overall, the study provides valuable insights into the spatial and temporal variations of zinc contamination in water bodies of Udaipur region, highlighting areas of concern and the need for ongoing monitoring and management efforts.

Table 2. pH and water temperature at different sampling sites of Udaipur region during summer, post-monsoon and winter season.

S. No.	Site	Season	pH	Temperature (°C)
		Summer	4-5	35
1.	Lake pichola	Post-monsoon	4.5	27
		Winter	4	17
		Summer	4-5	28
2.	Lake Fateh Sagar	Post-monsoon	4-5	27
		Winter	4.5	19
		Summer	4-5	30
3.	Ayad River	Post-monsoon	5	28
		Winter	4.5	22
		Summer	5-6	31
4.	Sukhanaka	Post-monsoon	6	27
		Winter	4.5	18
		Summer	5	32
5.	Dabok pond	Post-monsoon	5	28
		Winter	4.5	14

CONCLUSION

The concentration of zinc in water bodies represents a persistent environmental issue with thoughtful ecological and societal implications. By elucidating the distribution, sources and impacts of zinc contamination in aquatic environments, researchers can provide evidence-based strategies for water resource management, pollution control and ecosystem restoration. There is a high requirement for the mitigation of ill effects of zinc, monitoring and regulation of zinc emission, implementation of pollution control measures and promotion of sustainable practices. We need to prioritize the protection and preservation of freshwater ecosystems for the benefit of current and future generations.

ACKNOWLEDGEMENT

The authors would like to thank Apex Enviro Laboratory, Udaipur for helping in the study.

Conflict of Interest- None

REFERENCES

Auddy, N., Rai, A. K., Shrimali, A., Pobi, K.K., Dutta, S. and Nayek, S. 2022. Assessing influence of anthropogenic and environmental factors on surface water quality for sustainable management of urban lakes: A case study from Udaipur, India. *Water Practice and Technology*. 17(8): 1615-1634.

Chaudhry, F.N. and Malik, M.F. 2017. Factors affecting water pollution: a review. *Journal of Ecosystem and Ecography*. 7(1): 225-231.

Choudhary, S., Jangeed, D., Rankawat, P.R., Tank, S. and Sen, N. 2022, October. GIS mapping for distribution of ground water quality in Udaipur. In *IOP Conference Series: Earth and Environmental Science*. 1084 (1): 012043. IOP Publishing.

Ebbs, S.D. and Kochian, L.V. 1997. Toxicity of zinc and copper to Brassica species: implications for phytoremediation. American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America. *Journal of Environmental Quality*. 26 (3): 776-781.

Håkanson, L. and Bryhn, A. 1999. *Water Pollution.* Backhuys Publication, Leiden.

Kumar, M. and Puri, A. 2012. A review of permissible limits of drinking water. *Indian Journal of Occupational and Environmental Medicine*. 16(1): 40-44. .

Lee, C.W., Choi, J.M. and Pak, C.H. 1996. Micronutrient toxicity in seed geranium (Pelargonium × hortorum Bailey). *Journal of the American Society for Horticultural Science*. 121(1): 77-82.

Manivasagaperumal, R., Balamurugan, S., Thiyagarajan, G. and Sekar, J. 2011. Effect of zinc on germination, seedling growth and biochemical content of cluster bean (*Cyamopsis tetragonoloba* (L.)Taub).*Current Botany*. 2(5): 11-15.

Mirza, F. 2018. Udaipur's Lake System: The Interconnection of Lakes, You Must Know!

Plum, L.M., Rink, L. and Haase, H. 2010. The essential toxin: impact of zinc on human health. *International Journal of Environmental Research and Public Health*. 7(4): 1342-1365.

Raychaudhuri, S.S., Pramanick, P., Talukder, P. and Basak, A. 2021. Polyamines, metallothioneins, and phytochelatins-Natural defense of plants to mitigate heavy metals. *Studies in Natural Products Chemistry*. 69: 227-261.

The Understanding Water Flows in Udaipur- A report, 2018. Heinrich Boll Foundation, Berlin, Germany and Development Alternatives, New Delhi, India.

Toxicology-zinc, IDPH 2024. Division of Environmental Health, Springfield

Trivedy, R.K. and Goel, P.K. 1986. *Chemical And Biological Methods for Water Pollution Studies*. Environmental Publications, Karad. Pp. 248.

Uniform Drinking Water Quality Monitoring Protocol, 2013. Government of India, Ministry of Drinking Water and Sanitation, New Delhi.