IJMPR 2024, 8(5), 65-68

International Journal of Modern Pharmaceutical Research
www.ijmpronline.com

ISSN: 2319-5878
IJMPR
Research Article

SJIF Impact Factor: 5.273

DETERMINATION OF CONCENTRATION OF TOTAL SODIUM AND POTASSIUM IN SURFACE AND GROUNDWATER USING A FLAME PHOTOMETERY

Amit S. Sontakke, Karan S. Jadhav*, Amol R. Khandare, Ananta R. Dhabale, PrajwalM. Hingole, Shubham R. Kandekar, Rishikesh P. Khondil, R. H. Kale and K. R. Biyani

Prms's Anuradha Collage of Pharmacy, Anuradha Nagar, SakegaonStreet, Dist. Buldhana, India 443201.

Article Received on: 11/03/2024
Article Revised on: 01/04/2024
Article Accepted on: 21/04/2024

***Corresponding Author**
Karan S. Jadhav
Prms's Anuradha Collage of Pharmacy, Anuradha Nagar, SakegaonStreet, Dist. Buldhana, India 443201.

ABSTRACT

This study investigates the sodium and potassium ion content in Nine water samples sourced from various locations around Chikhli (Buldhana), India, including surface, underground, and river water. Utilizing flame photometry, the research maps out the spatial distribution of these ions to discern the impact of human activity and natural processes on water quality. Additionally, a water quality index (WQI) is calculated to assess the suitability of the collected samples for human consumption. Results reveal that water from Kali temple pond exhibits the lowest sodium and potassium concentrations, making it most suitable for consumption, while water from Bhima river has the highest concentrations. Importantly, all samples exhibit WQI values below 50, indicating their safety for human consumption. Recommendations are made to mitigate potential risks to water quality, including reducing the use of pesticides, potassium permanganate, and water softeners to maintain a safe WQI in Chikhli.

KEYWORDS: Flame photometer, Sodium, Potassium, Water Quality index.

INTRODUCTION

The use of characteristic emission from excited atoms for quantitative analysis in analytical chemistry was pioneered by Bunsen and Kirchhof. Their work laid the groundwork for the development of instruments like the flame photometer, which revolutionized quantitative analysis, particularly for alkali metal ions such as potassium and sodium. Atomic emission has since been recognized globally as an effective tool for detecting trace metals.Creating a robust and quantitative atomic emission-based method requires careful consideration of various factors, including the selection of atomization and excitation sources, proper wavelength and slit width selection, and the minimization of chemical and spectral interferences. The development of the flame photometer was accelerated with the introduction of the nebulizer, enabling the aerosol introduction of samples into the air/acetylene flame. This innovation, coupled with quartz prism spectrograph dispersion and photographic emission recording, led to the creation of a low-cost, highly sensitive instrument for the precise determination of alkali metal ion content in samples.While other precise techniques like atomic absorption spectroscopy (AAS) and inductively coupled plasma atomic emission spectroscopy (ICP-AES) were developed alongside flame photometry to enhance resolution in detecting other metal ions, flame photometers exhibit high resolution specifically for alkali metal ions like sodium (Na^+) and potassium (K^+). The technique's efficiency in detecting sodium and potassium surpasses that of ICP-AES, making it a preferable choice, particularly for cost-effective analysis.

Flame photometry operates by atomizing a sample solution into a flame, separating the characteristic spectra of elements, and measuring emissions. With flame temperatures ranging from 1000 to 3000 °C, it is particularly suitable for alkali and alkaline earth metals such as calcium and barium. Each alkali metal and alkaline earth metal emits characteristic wavelengths when excited, facilitating their detection.

Beyond analytical chemistry, the study of sodium and potassium levels in drinking water holds significant importance for human health. Chikhli (Buldhana), as one of India' Agricultural area with a large population, relies heavily on water bodies in and around the city for drinking water. Investigating sodium and potassium levels in these water sources is crucial for identifying potential health hazards, particularly for vulnerable populations such as school-going children and the elderly with kidney-related issues.In this study, we analyze various drinking water samples from Agricultural areas around Chikhli(Buldhana) to assess their sodium and potassium content. By employing a flame spectrophotometer, we aim to determine the presence of sodium and potassium ions in these samples. Additionally, we calculate the Water Quality Index (WQI) to understand the overall water quality, considering the influence of dissolved solutes like sodium and potassium on human consumption suitability.

Through this research, we strive to contribute valuable insights into the quality of drinking water in Chikhli and its surrounding areas, aiding in public health management and policy decisions.

MATERIAL AND METHOD

Material

- Various ground water sample
- Various surface water sample
- Distilled water

Apparatus

- Beakers
- Measuring cylinder
- StirrerInstruments
- Flame photometer

Study areas

Surface water samples were collected from the various sources as shown in which are situated in and around Chikhli city of Maharashtra India. These are hold the agricultural areas and large population of Chikhli city along with villages around Chikhli city. So these area were chosen for the study. The surface water were collected from sources, Namely Rana gate tube well, Anuradha pharmacy college bore well, Housing colony tube well Chikhali, Samtha colony bore well and Kali Mandir bore well Chikhli these are the fresh ground water situated in Chikhli. Rani talav Amdapur, Ghatpuri river Khamgav city, Bhima river Mehkar, Beside hill talav Chikhli are the surface water situated in Chikhli. All the above mentioned collected water sample were examined using a Flame photometer for the detection of sodium and potassium ions contained in the water samples.

Experimental procedure

Table 1: Characteristic emission color from alkali metals under the flame.

Alkali metal	Characteristic wavelength	Flame color
1.Sodium	589nm	Yellow color
2.Potassium	766nm	Fent orange color

Fig: Map showing the locations of collected water sample In and Around chikhli city.

Nine water samples were collected from various water bodies in and around Chikhli city, of which Five were surface water, while four were underground water comprising of four shallow and Two deep aquifers, wells, bore, tube wells along with one water sample collected from BHIMA Dam built on the banks of Bhima River (biggest reservoir of Buldhana Municipal Corporation). For spectroscopic analysis of these water samples, a flame photometer was employed (Anuradha college of pharmacy). The flame photometer was calibrated using the standard stock solution of sodium and potassium having 30 ppm concentration. Various other instrumental parameters were adjusted to fine-tune the flame. After instrumental calibration, it was run to examine the collected water samples. For examination, 100 ml of water from each collected sample was taken in standard laboratory plastic bottles and then the water samples were poured inside the flame photometer. All the samples were collected during the dry summer season in the month of April when the average temperature was 33 °C. All the samples were collected once for analysis from the water sources.

Table 2: Quality of water classification Range and Water type based on WQI value.

Range	Type of water
< 50	Excellent water
50–99.99	Good water
100–199.99	Poor water
200–299.99	Very Poor water
≥ 300	Unsuitable for drinking

RESULT AND DISCUSSION

Analysis results as obtained from the flame photometer data are summarized below in Tables 1, 3: The results indicate that the sodium and potassium contents in all the water samples are well within the permissible limit as per guideline laid down by World Health Organization (WHO 1984) But there are observed fluctuations in the sodium and potassium contents between different sources

of water, i.e., surface water and underground water.The cause of the presence of sodium in the surface water can be attributed to time-dependent wear-out of mineral rock that contains sodium salt.

The relative weight (W_i) of the chemical parameter was computedusing the following equation:

$$\sum \frac{W_i}{\sum_{i=1}^{n} W} \quad \text{.....eq-1}$$

where,
W_i is the relative weight,
wi is the weight of each parameter, And n is the no. of parameter

Calculeted relative weight (W_i) values of each parameter are given in table-2. In the third step, a quality rating scale (Q_i) for each parameter is assigned by dividing its concentration in each water sample by its respective standerds according to guidelines (BIS,1991) and the result is multiplied by 100:

$$q_i = \left(\frac{c_i}{s_i}\right) \times 100 \quad \text{.....eq-2}$$

Where,
Q_i is the quality rating,
C_i is the concentration of each parameter in each water sample in mg/ml,and S_i is the indian drinking water standard for each chemical parameter mg/ml.

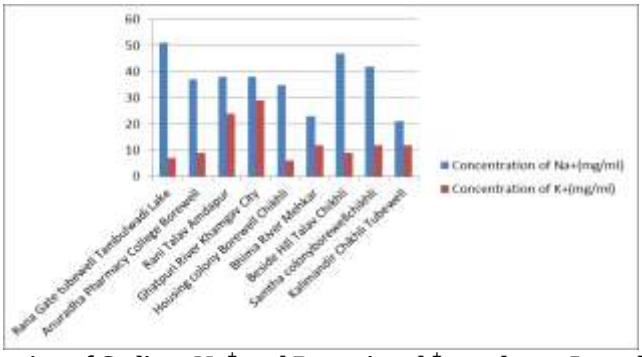
For computing WQI, the sub index (SI) is first determined for each chemical parameter, as given below:

$$SI_i = W_i \times q_i \qquad WQI = \sum_{i=1}^{n} SI_i$$

where,
SL_i is the sub index of i^{th}parameter,
W_i is the relative weight of i^{th}parameter,
Q_i is the rating based on concentration of i^{th}parameter, and
N is the number of chemicalparameter

Table 3: Concentration of Sodium and Potassium ions in the analyzed water sample.

Sample details	Sample locations (coordinates)	Concentration of Na^+ (mg/ml)	Concentration of K^+ (mg/ml)
1. Rana Gate tube well tambulwadilake	20.34175^0 N, 76.274337^0 E	51	7
2. Anuradha pharmacy collegebore well	20.357916^0 N, 76.222162^0 E	37	09
3. Rani talavamdapur	20.417916^0 N, 76.462976^0 E	38	24
4. Ghatpuri river khamgav city	20.711751^0 N, 76.56541^0 E	38	29
5. Housing colony bore well chikhli	20.347484^0 N, 76.234901^0 E	35	06
6. Bhima rivermehkar	20.14832^0 N, 76.568747^0 E	23	12
7. Beside hill talav chikhli	20.675334^0 N, 76.575007^0 E	47	9
8. Samtha colony bore well chikhli	20.378596^0 N, 76.234232^0 E	42	12
9. Kali mandir chikhli tube well	20.349662^0 N, 76.253281^0 E	21	12



Graph: Concentration of Sodium Na^+ and Potassium k^+ are shown In and Around chikhli.

Table 4: Water quality classification based on WQI values of the study area.

Sr. no.	Sample detail	Na (mg/l)	K(mg/l)	WQI	Waterqualiy
1.	Rana Gate tube welltambulwadi lake	51	7	37.618	Excellent
2.	Anuradha pharmacycollege bore well	37	09	29.80	Excellent
3.	Rani talav amdapur	38	24	40.234	Excellent
4.	Ghatpuri river	38	19	26.973	Excellent
5.	Housing colony borewell chikhli	35	06	26.539	Excellent
6.	Bhima rivermehkar	23	12	29.147	Excellent
7.	Beside hill talav chikhli	47	9	36.32	Excellent
8.	Samtha colony borewell chikhli	42	12	35.017	Excellent
9.	Kali mandir chikhli tube well	21	12	21.32	Excellent

CONCLUSIONS

The analysis of sodium and potassium ions present in Nine water samples collected from three types of water sources, e.g. surface, ponds and underground, in and around the Chikhli city showed variable concentrations. The concentrations of water bodies of the Chikhli city are within the safe limits and are safe for drinking, agricultural and industrial purposes. The water of Kali Temple Pond is found to have the least concentration of sodium and Housing colony bore well Chikhli have the least concentration of potassium so we can say that because of being away from city areas, the water of the rivers flowing in this region is much safer and not saline. The presence of a good concentration of sodium in underground waters taken from tube wells depicts that the aquifers are attached to the mineral bed of strata which contains a large amount of dissolved sodium. Although flame photometry is not a very reliable analytical technique for metal cations analysis, it has a high efficiency of sodium and potassium ions detection. Human activities in and around the chikhli city must also be kept under control to keep potassium ions content under control. Bhima River Water may be concluded to be the best fit for daily consumption based on sodium and potassium ions content. In a general sense, the water of all the water bodies is safe for human consumption and use from the point of view of sodium and potassium concentration. So the human beings should be careful before dumping toxins in the barren landscape, in water bodies such as rivers and ponds. We should minimize synthetic inputs to the entire food chain and optimize the management of waste disposal so that we leave a world that can sustain future generations to come.

REFERENCES

1. Banerjee, P., & Bably, P.(Determination of Concentration of Total Sodium and Potassium in Surface and Ground Water Using a Flame Photometer.) Applied Water Science, 2020; 10: 104-113.
2. Asit Kumar Batabyal1*, Surajit Chakraborty2. (Hydrogeochemistry and water Quality Index in the Assessment of Groundwater Quality for drinking uses.) Water Environment Research, 2015; 10: 607-617.
3. Hemant U. Chikhale1, Pratibha U. Chikhale2 (Flame Photometric Estimation of Sodium and Potassium Ion Present In Water Sample of Darna and Godavari River.) Scientific & Engineering Research, 2017; 8(1): 131-136.
4. Girdhari Lal Meen. (Determination of Sodium and Potassium in groundwater) IJRTI, 2020; 5(3): 179-182.
5. 1Rupali S. Joshi*, 2Vaishnavi U.Rajpoot, 3Chaitali L Raccha, 4 Sejal S Renavikar. (Three Simple Methods for Quantitative Estimation of Sodium and Potassium in ORS by Flame Photometry.) International Journal of Pharmaceutical Research and Applications, 2023; 8(3): 472-475.
6. Rakesh kumar gupta. (Analytical Chemistry Reasearch: Flame Photometry.) International Journal of Multidisciplinary Educational Research, 2021; 3(4): 15-21.