# ION CHROMATOGRAPHIC STUDY OF DRINKING WATER OF SELECTED VILLAGES IN BHUJ TALUKA OF KACHCHH REGION

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*Abstract:* **Drinking water quality is a universal health concern with global impact. Objectives of this work were to study concentrations of anions namely fluoride, chloride, bromide, nitrate, phosphate and sulphate is drinking water sample collected from selected area in Bhuj Taluka of Kachchh region and determine the physiochemical characteristic of those samples. Different twelve water samples were collected for the study and the anions were measured in ion chromatography instrument. The results showed that there are variations in anion in present in water samples of different locations. Other physiochemical parameter like EC, pH, TDS etc. were also measured from those samples.**

*Keywords:* **Global Impact, Heavy metal, ion chromatography, Drinking water, Physiochemical parameter.**

## I. INTRODUCTION

Physical and chemical analysis of the samples was done according to Standard Methods as per APHA, [1] and Trivedi and Goel [2]. Ion chromatography (IC) is the high performance form of ion exchange chromatography. Ion chromatography differs from HPLC in that ion exchange is the primary separation mode and conductivity is the principal method of detection (Jackson and Chassaniol, 2002)[3]. In ion chromatography with suppressed conductivity detection, the separator column effluent passes through a suppressor column which chemically reduces the eluent background conductance, while at the same time increasing the electrical conductance of the analyze ions (Small, 2004)[4]. This method results in both improved reproducibility and sensitivity when compared to most electrophoresis method of analysis (Connolly and Paull, 2001)[5]. The commonly used are NaOH, $NaHCO_3$ and $Na_2CO_3$ at various proportions. Ion chromatography offers an easy, fast, small sample volume demanding, and fit for purpose methodology for the determination of routine ions in surface, ground and potable water samples. Jackson, P. E[6] Many regulatory and standard organizations, such as APHA, ASTM, AOAC, ISO, AWWA, and US EPA have validated ion chromatographic methods for the analysis of inorganic anion in drinking water. The excess sodium and chloride in drinking water may induce congestive heart failure (Brooker and Johnson, 1984);[13] Sivagurunathan and Dhinakaran, (2005).[14], Since our independence, India has achieved considerable progress in industrialization and today it is among the first ten industrialized nation of the world. However, there is always some amount of environmental degradation because many toxic chemicals are released into different compartments of the environment either by industries or by agriculture and public operations or through the automobile exhaust.( Balusamy K, Indrani T 2018) [15]

## II. METHODOLOGY

**Instrumentation and Conditions-** A Metrohm 883 Basic IC plus with chemically suppressed module, equipped with a Metrosep A Supp 4-250/4.0 column, was used for the ion chromatographic determination of chloride, fluoride, bromide, nitrate, sulphate and phosphate. The instrument was operated with the MagIC Net Basic software and detection was carried out by microprocessor-controlled Digital Signal Processing conductivity detector. Elute used for the anion is 340gm sodium carbonate and 84 mg sodium bicarbonate.

**Chemicals and Reagents:-** Multi-element standard contains all six anions ($F^-$, $C^-$, $Br^-$, $NO_3^-$, $PO_4^{3-}$, $SO_4^{2-}$) each at equal concentrations of 10 ppm procured as a sample from Metrohm India Ltd., Baroda. AR grades (Merck India Ltd.) sodium carbonate, sodium hydrogen carbonate and sulphuric acid were used and millipure water used for the analysis.

**Preparation of Solutions:-** Mobile Phase Preparation for anions;- An accurately weighed of 84 mg $NaHCO_3$ and 340mg $Na_2CO_3$ were transferred into 1000 ml volumetric flask and dissolving by adding 1L of millipure water. Volume was made up to mark with millipure water. Preparation of Regeneration Solution:- In 1000 ml volumetric flask, 2.7 ml H2SO4 was transferred and volume was made up to mark with millipure water.

**Preparation of Working Standard Solutions:-** From the anion standard stock solution working standards having concentration of 10 ppm each of ($F^-$, $Cl^-$, $Br^-$, $NO_3^{3-}$, $PO_4^{3-}$ and $SO_4^{2-}$) and for the caution ($Li^+$, $Na^+$, $K^+$, $Mg^+$, $Ca^+$).

**Sampling and Pretreatment:-** Physical and chemical analysis of the samples was done according to Standard Methods as per APHA, [1] and Trivedi and Goel [2]. The values obtained were compared with standards prescribed by WHO [7] and BIS [8]. Few parameters such as temperature, pH and Electric Conductivity were recorded on the site by their respective probes. Drinking water samples were obtained from different areas of Bhuj Taluka of Kachchh region. Water samples were injected directly with no pretreatment other than filtration through a 0.45 μm filter.

## III. RESULT AND DISCUSSION

For calibration purpose working standard solution of anions were injected (Suhas vyas) [9]. The overlay IC chromatograph of mixed anions standard Busch, K. W [10] are shown in Fig. 1.
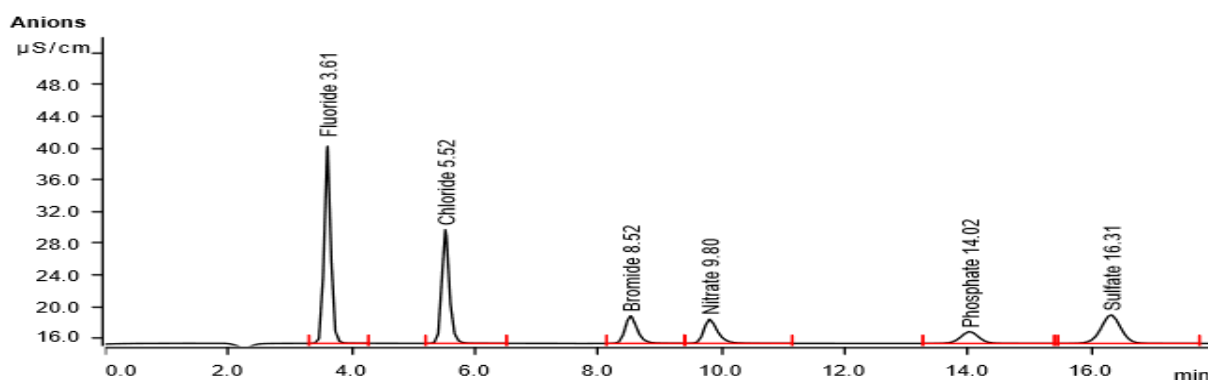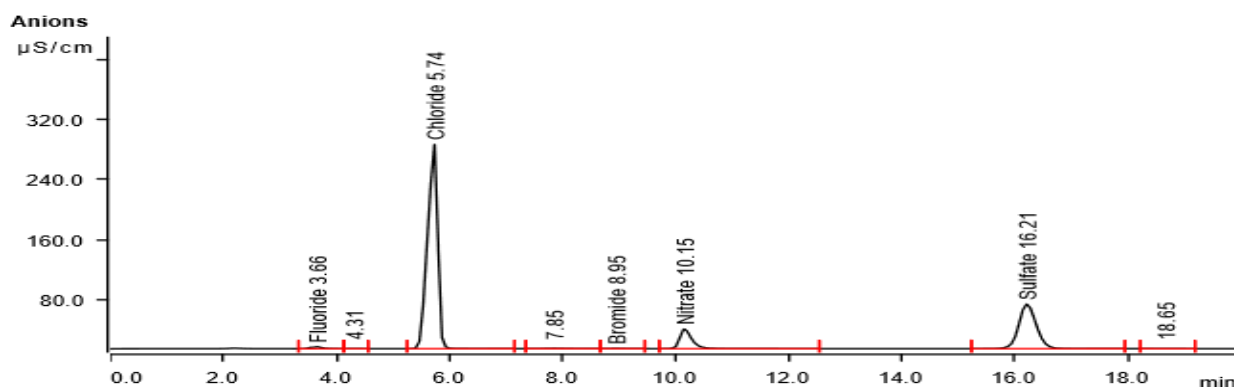


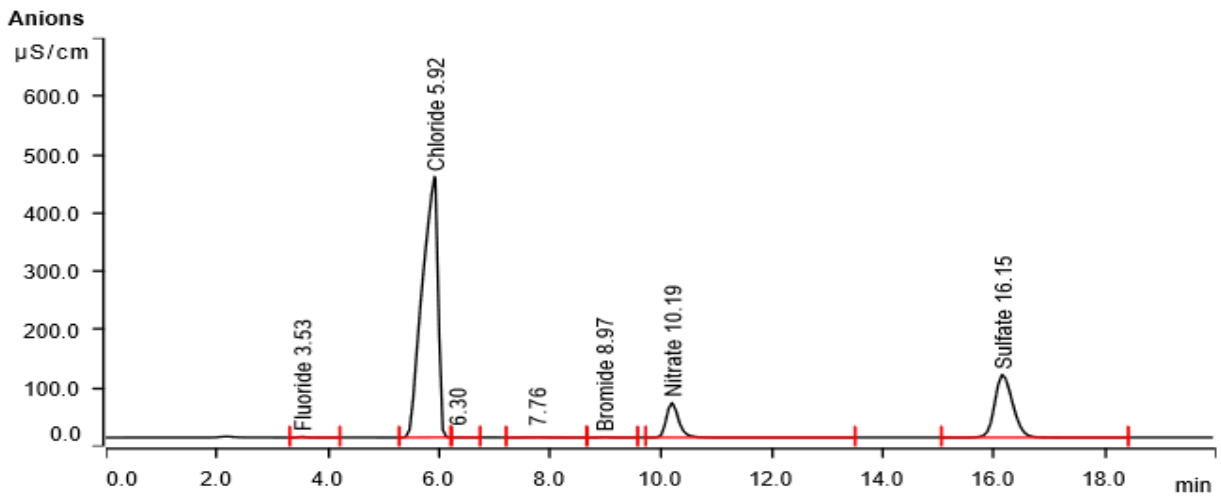**Fig.1: Badadiya water sample**



**Fig.2: Bharapar water sample**
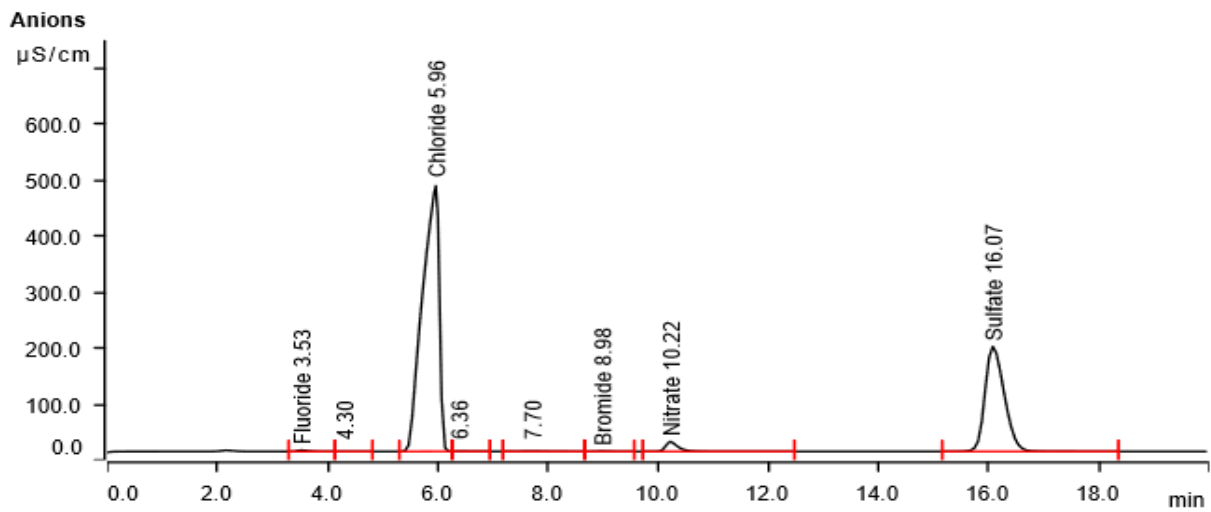
**Fig.3: Bhujodi water sample**
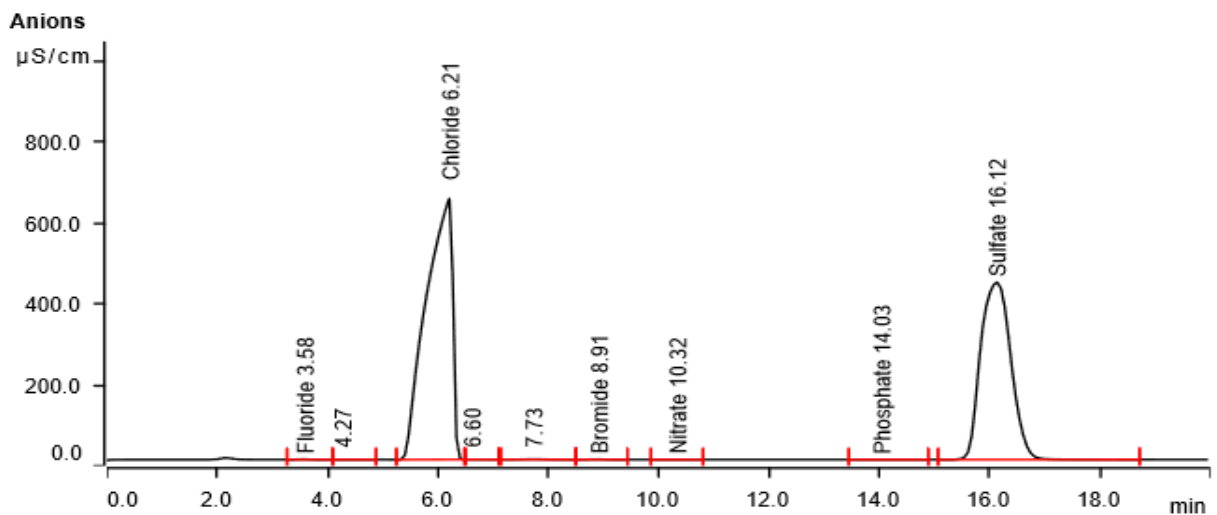


**Fig.4: Haripar water sample**



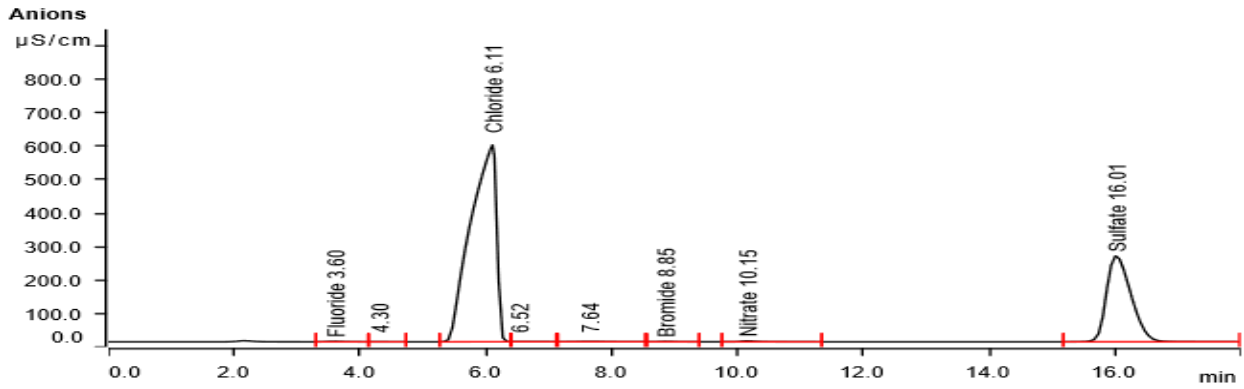**Fig.5: Kachchh university water sample**
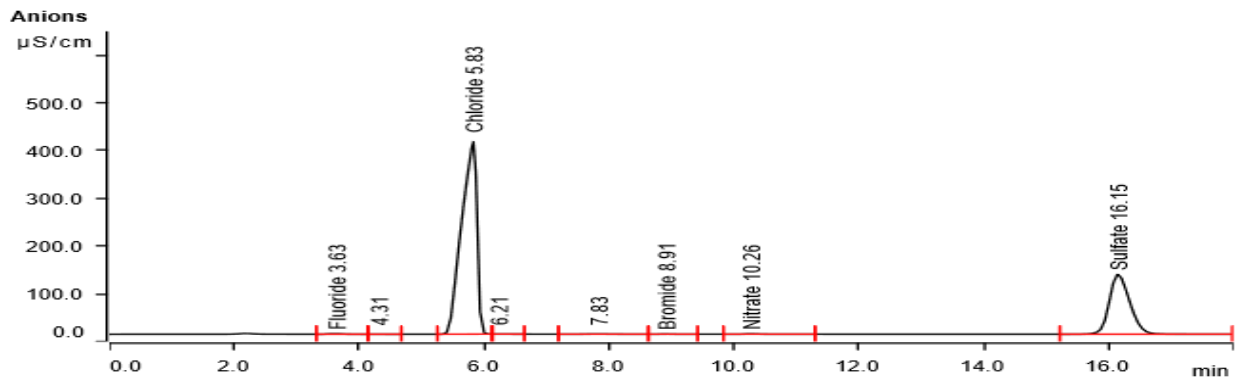
**Fig.6: Kera water sample**



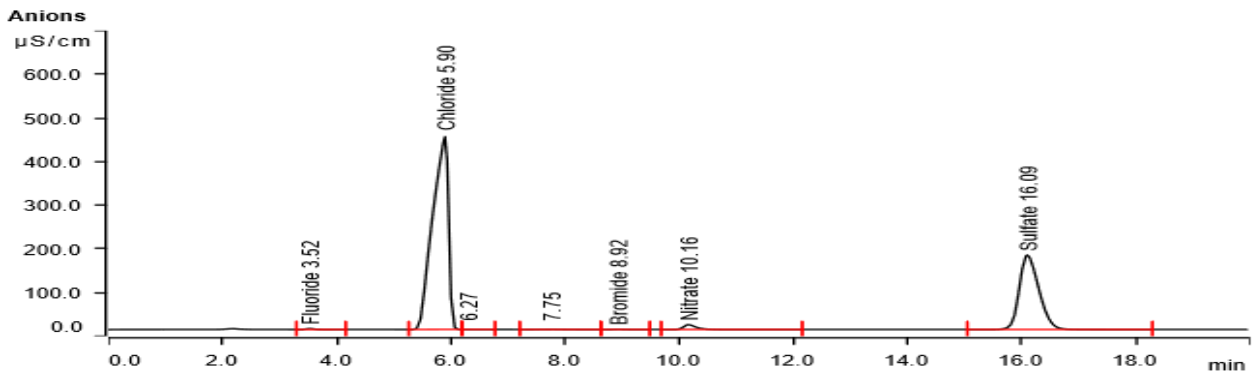**Fig.7: Madhapar water sample**



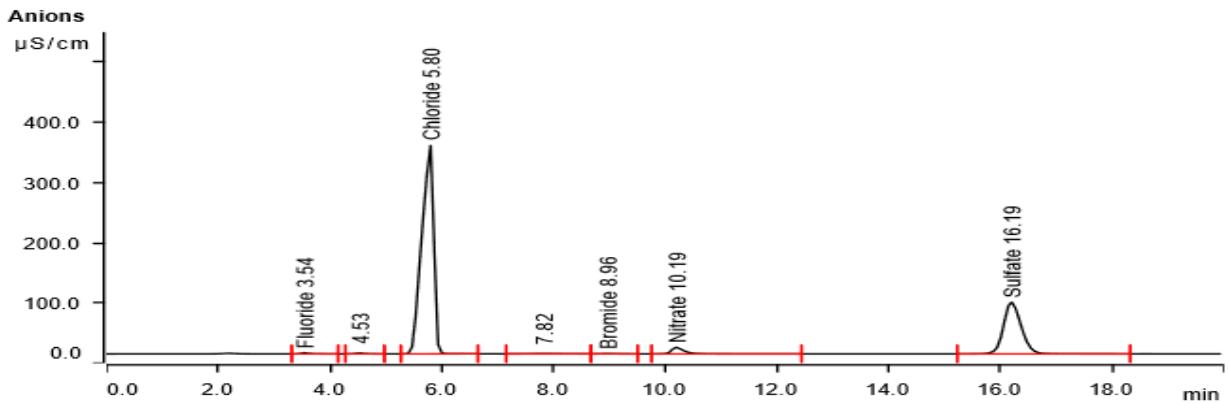**Fig.8: Mirzapar water sample**



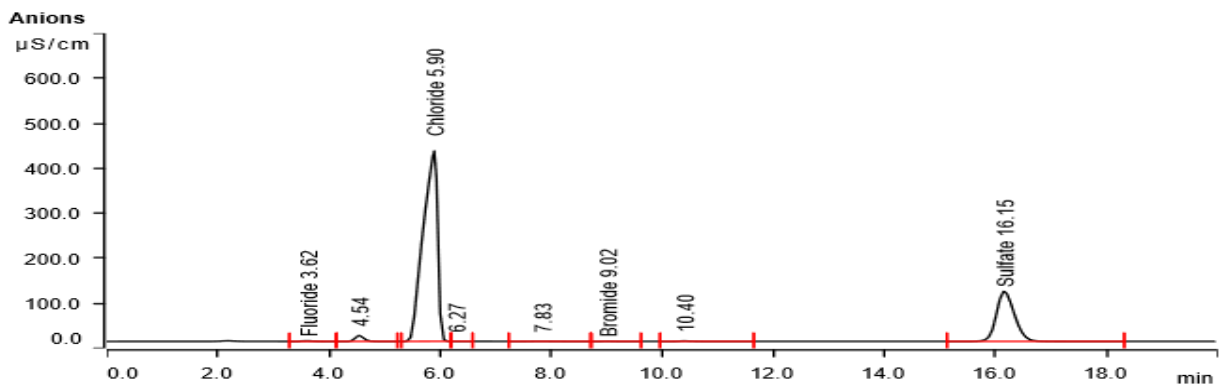**Fig.9: Sanatorium hospital water sample**
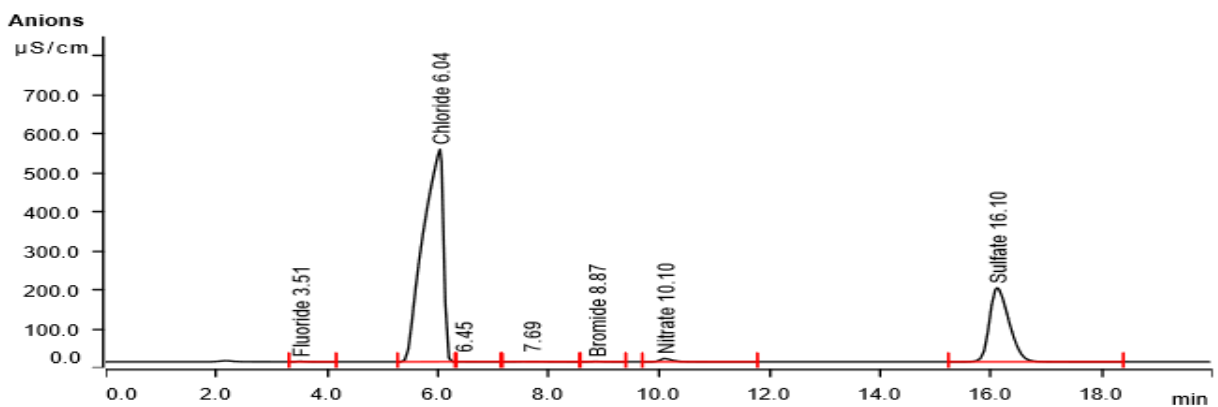
**Fig.10: Sedata water sample**



**Fig.11: Sukhpar water sample**



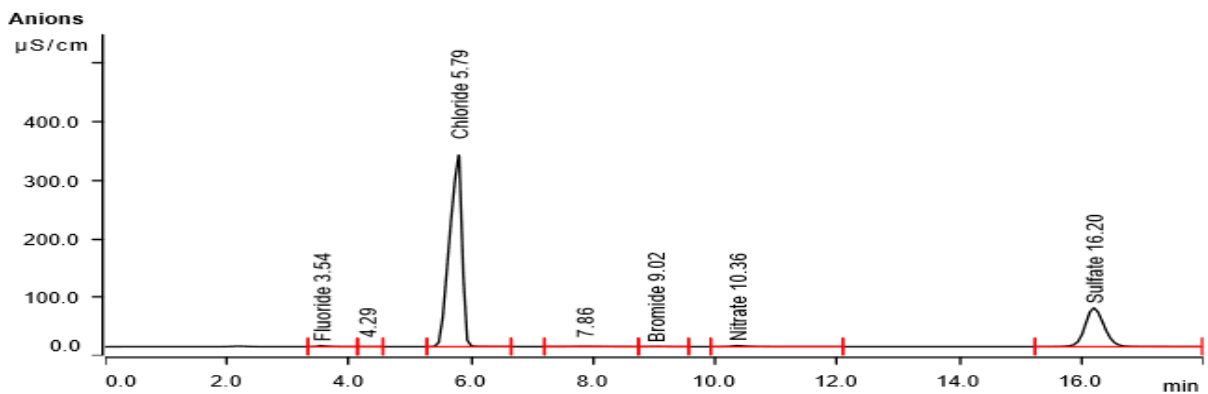**Fig.12: Tapkeshwar water sample**
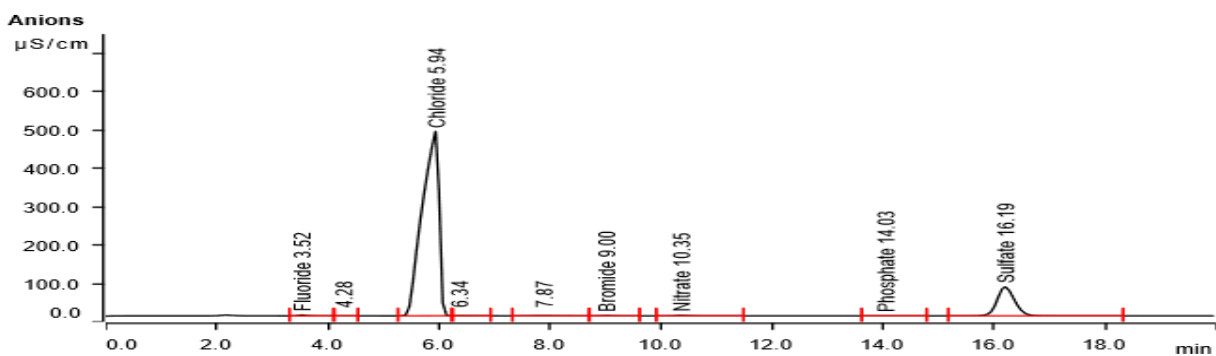


**Fig.13: Order of Elution and Retention Time for the Anions**

| Parameter | Peak number | Retention time |
|-----------|-------------|----------------|
| Fluoride | 1 | 3.608 |
| Chloride | 2 | 5.517 |
| Bromide | 3 | 8.520 |
| Nitrate | 4 | 9.802 |
| Phosphate | 5 | 14.018 |
| Sulphate | 6 | 16.312 |

Operating Parameters Employed for the Determination of $F^-$, $Cl^-$, $Br^-$, $NO_3^-$, $PO_4^{3-}$ and $SO_4^{2-}$ by Ion Chromatography with Suppressed Conductivity Detection

| Parameter | Setting/value |
|-----------|---------------|
| Detection mode for anions | Conductivity |
| Eluent composition | 84mg/L $NaHCO_3$ and 1.340mg/l $Na_2CO_3$ |
| Flow-rate of fluent | 1 ml/min |
| Pressure | |
| Analysis time | 20min |
| Loop | 20μL |
| Suppressorregeneran | 50 mm $H_2SO_4$, millipure water. |
| Column | |

EC, pH, alkalinity and heavy metal analysis of drinking water

| Location | pH | EC | Cu | Fe | Mn | Zn | P | Alkalinity |
|----------|-----|------|------|-------|------|------|----|-----------|
| Sukhpar | 6.72 | 1.80 | 1.49 | -0.03 | 2.14 | 0.81 | 15 | 730 |
| Mirzapar | 7.22 | 1.08 | 1.74 | 2.41 | 2.14 | 1.15 | 16 | 2470 |
| Sanitarium hospital | 6.94 | 1.06 | 1.06 | -0.06 | 1.85 | 0.77 | 21 | 1250 |
| Sedata | 7.22 | 1.03 | 1.08 | 0.16 | 2.08 | 1.08 | 14 | 1750 |
| Haripar | 6.55 | 1.04 | 1.55 | 5.19 | 2.63 | 1.27 | 16 | 1190 |
| University | 6.82 | 1.03 | 1.58 | 0.31 | 2.77 | 1.78 | 02 | 1050 |
| Badadiya | 6.88 | 0.96 | 1.86 | -0.08 | 1.92 | 0.69 | 22 | 1630 |
| Madhapar | 7.12 | 1.22 | 1.74 | 0.43 | 1.99 | 1.18 | 33 | 1430 |
| Tapkeshwar | 7.26 | 1.03 | 1.56 | 0.01 | 1.98 | 1.91 | 12 | 1200 |
| Kera | 7.18 | 1.52 | 2.09 | -0.04 | 1.07 | 0.79 | 42 | 1870 |
| Bharapar | 7.06 | 1.66 | 1.48 | -0.01 | 2.1 | 0.07 | 06 | 2200 |
| Bhujodi | 6.74 | 1.98 | 1.95 | 0.11 | 2.07 | 0.9 | 60 | 1620 |

Concentration of Anions in Drinking Water in Bhuj Taluka of Kachchh region

| Location | Fluoride | Chloride | Bromide | Nitrate | Phosphate | Sulphate |
|----------|----------|----------|---------|---------|-----------|----------|
| Standard | 10ppm | 10ppm | 10ppm | 10ppm | 10ppm | 10ppm |
| Sukhpar | 0.952 | 381.498 | 0.746 | 5.979 | - | 177.145 |
| Mirzapar | 0.9218 | 422.284 | 0.821 | 34.396 | - | 232.231 |
| Sanatorium hospital | 1.142 | 626.555 | 1.243 | | - | 309.323 |
| Sedata | 0.797 | 1132.334 | 2.646 | 26.668 | - | 574.861 |
| Haripar | 1.004 | 1763.485 | 3.416 | 0.244 | 0.135 | 2061.413 |
| University | 1.171 | 1374.349 | 2.618 | 8.109 | - | 857.566 |
| Badadiya | 1.949 | 279.473 | 0.767 | 81.105 | - | 156.756 |

| Madhapar | 1.250 | 697.178 | 1.454 | 35.675 | - | 500.597 |
| Tapkeshwar | 1.336 | 827.588 | 2.108 | 4.2421 | 0.081 | 203.237 |
| Kera | 0.825 | 562.744 | 0.835 | 2.404 | - | 350.459 |
| Bharapar | 0.779 | 715.087 | 1.575 | 192.294 | - | 297.551 |
| Bhujodi | 1.636 | 817.269 | 1.771 | 56.915 | - | 563.470 |

## IV. CONCLUSION

- According to above result it is concluded that chloride concentration in Bhuj Taluka of Kachchh region like Sukhpar 381.4 ppm, Mirzapar 422.2 ppm, sanatorium hospital 626.5 ppm, Sedata 1132.3 ppm, Haripar 1763.4 ppm, Kachchh university 1374.3 ppm, Badadiya 279.4 ppm, Madhapar 697.1 ppm, Tapkeshwar 827.5 ppm, Kera 562.7 ppm, Bharapar 715.0 ppm, Bhujodi 817.2 ppm shown out of limit according Indian standard for drinking water-specification IS 10500: 1991 and WHO.

- Sulphate concentration in Bhuj Taluka of Kachchh region like Sukhpar 177.14 ppm, Mirzapar 232.23 ppm, sanatorium hospital 309.32 ppm, Sedata 574.86 ppm, Haripar 2061.41 ppm, Kachchh university 857.56 ppm, Badadiya 156.75 ppm, Madhapar 500.59 ppm, Tapkeshwar 203.23 ppm, Kera 350.45 ppm, Bharapar 297.55 ppm, Bhujodi 563.47 ppm shown out of limit according Indian standard for drinking water -specification IS 10500: 1991 and WHO.

- Nitrate concentration in Bhuj Taluka of Kachchh region like Mirzapar 34.39 ppm, Sedata 26.66 ppm, Badadiya 81.10 ppm, Madhapar 35.67 ppm, Bharapar 192.29 ppm, Bhujodi 56.91 ppm shown out of limit according Indian standard for drinking water -specification IS 10500 : 1991 and WHO.

- Nitrate concentration in Bhuj Taluka of Kachchh region like Sukhpar 5.97 ppm, Haripar 0.244 ppm, Kachchh university 8.109 ppm, Tapkeshwar 4.242 ppm, Kera 2.404 ppm shown of under limit according Indian standard for drinking water -specification IS 10500 : 1991 and WHO.

- Where in the case of fluoride, Bromide, phosphate concentration, in Bhuj Taluka of Kachchh region were limit according Indian standard for drinking water -specification IS 10500 : 1991and WHO.[9,6]

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