

# Analysis of Physicochemical Parameters of Drinking Water in Samunaber and Piazza district, Gondar Town

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## Abstract

Physicochemical parameters; pH, Conductance (K), Total Dissolved Solid (TDS), Total Alkalinity (TA), Hardness, Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Sulphate (SO<sub>4</sub><sup>2-</sup>), Chloride (Cl), Fluoride (F), Lead (Pb) and Cadmium (Cd) were analyzed using standard analytical techniques. The mean values of physicochemical parameters in the town, higher values from the two districts are: pH (8.72 ± 0.15), Conductivity (362 μs ± 7.2 μs), Hardness (514 ppm ± 50.3 ppm as CaCO<sub>3</sub>), DO (5.2 ppm ± 0.35 ppm), TDS (1566 ppm ± 58 ppm), COD (531 ppm ± 8.1 ppm), SO<sub>4</sub><sup>2-</sup> (3.75 ppm ± 0.35 ppm), Cl<sup>-</sup> (162.1 ppm ± 2.0 ppm), F<sup>-</sup> (0.025 ppm ± 0.004 ppm), TA (30.0 ppm ± 1.2 ppm), Pb (0.130 ppm ± 0.010 ppm), Cd (0.0078 ppm ± 0.00035 ppm). The pH, Hardness, TDS, Pb and Cd higher values of the water samples analyzed in two districts of this study are not within the acceptable limits set by WHO for safe drinking water. However the maximum values of SO<sub>4</sub><sup>2-</sup>, Cl<sup>-</sup>, F<sup>-</sup>, TA, conductivity, analyzed in the two districts are within the maximum permissible level set by the WHO (World Health Organization) for safe drinking water.

**Keywords:** Physicochemical properties • pH • TDS • COD • DO • Alkalinity • Conductivity

## Introduction

Water is an essential component for life on Earth, which contains minerals extremely important in human nutrition. Natural contamination of water resources mainly results from normal geological phenomena such as ore formation. It is observed that human activities are a major factor determining the quality of the surface and groundwater through atmospheric pollution, effluent discharges, use of agricultural chemicals, eroded soils and land use. It is noted that contamination of drinking water with heavy metals has a considerable impact on the world population health. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. Water quality deals with the physical, chemical and biological characteristics in relation to all other hydrological properties [1].

The potential sources of water contamination are geological conditions, industrial and agricultural activities, and water treatment plants. These contaminants are further categorized as microorganisms, inorganics, organics, radionuclides, and disinfectants. The inorganic chemicals hold a greater portion as contaminants in drinking water in comparison to organic chemicals. A part of inorganics are in mineral form of heavy metals. Heavy metals tend to accumulate in human organs and nervous system and interfere with their normal functions. In recent years, heavy metals such as Lead (Pb), Arsenic (As), Magnesium (Mg), Nickel (Ni), Copper (Cu), and Zinc (Zn) have received significant attention due to causing health problems [2].

The term “heavy metals” refers to any metallic element that has a relatively high density and is toxic or poisonous even at low concentration. “Heavy metals” is a general collective term, which applies to the group of metals and metalloids with atomic density greater than 4 g/cm<sup>3</sup>, or 5 times or more, greater than water. However, being a heavy metal has little to do with density but concerns chemical properties. Heavy metals include Lead (Pb), Cadmium (Cd), Zinc (Zn), Mercury (Hg), Arsenic (As), Silver (Ag), Chromium (Cr), Copper (Cu), Iron (Fe), and the platinum group elements [3].

Fluoride and arsenic are a great health problem worldwide. The public health burden of these two chemicals far exceeds that of other chemical contaminants in drinking-water, but globally it is masked by the public health impact of microbial contamination. Also other physical-chemical parameters can deteriorate water quality. Heavy metals, like lead, chromium (VI), cadmium and mercury are dangerous for human health, since they are toxic and can be carcinogenic. In spite of this, few studies have been conducted to assess their concentrations in drinking water in developing countries [4].

Access to safe drinking water is key to sustainable development and essential to food production, quality health and poverty reduction. Safe drinking water is essential to life and a satisfactory safe supply must be made available to consumers. However, developing countries, like Ethiopia, have suffered from a lack of access to safe drinking water from improved sources and to adequate sanitation services. The WHO revealed that seventy five percent of all diseases in developing countries arise from polluted drinking water. Acceptable quality shows the safety of drinking water in terms of its physical, chemical and bacteriological parameters [5].

Like other developing countries drinking water quality is major issue in Ethiopia and studies related to drinking water quality of Gondar town, samunaber and piazza district have not been conducted. Water plays an important role in human life. It is necessary for industry, agriculture and human existence. The healthy water ecosystem is depended on the physico-chemical and biological characteristics. In this context, paper aims to analyze the physico-chemical properties of drinking water collected from different places of Gondar town. This water is basically used for drinking and domestic purpose [6].

## Objectives of the study

**General objectives:** The present study aimed to evaluate the drinking water quality by taking water samples from Samunaber and Piazza district of Gondar, Ethiopia

**Specific objectives:** To determine water quality parameters such as pH, turbidity, conductivity, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and heavy metals such as Cu, Zn, Mg, Fe, Cd, Pb, Cr, As, Hg, and tin (Sn) were analysed in each water sample.

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## Materials and Methods

### Study area

Drinking water samples were collected from North Gondar town which is found in Amara regional state, located at 421 Km from Addis Ababa, the capital city of Ethiopia and, north of Lake Tana and southwest of the Semen Mountain. It has a latitude and longitude of 12°36'N 37°28'E with an elevation of 2133 meters above sea level. The averages temperature here is 19.3°C and the annual rainfall is 1151 mm. Drinking water samples were collected from two sampling sites (Samunaber and piazza) of Gondar town. This water released by Gondar municipality is basically used for drinking purpose and domestic activities.

### Instruments and equipment's

The following are list of the major apparatus used during the experiments in this study: Pipettes, safety goggles, digital analytical balance (Mettler Toledo, Model AT250, and Switzerland) and oven (J. P. select, Spain), Inolab Cond Level 1 WTW Conductometer (Germany), were used. A pH/ION meter (HANNA instrument, HI 9025, Singapore) equipped with pH glass electrode was used to measure the pH value of sample solutions. Buck Scientific Model 210 vgp (East Norwalk, USA) atomic absorption spectrophotometer equipped with deuterium ark back ground correctors was used for analysis of the analyte metals using air -C<sup>2</sup>H<sup>2</sup> flame.

### Sample collection

All of the drinking water samples were taken from the tap water of residential areas. All of the sampling sites are open for public such as restaurants and private houses. Both the Water Samples from samunaber and Piazza district were randomly collected from three different stations in the morning using Polythene bottle. Prior to the sampling all the bottles were washed and rinsed thoroughly with distilled water. Standard methods were followed for sample collection and preservation.

### Laboratory analysis

The measurements of water quality parameters in water samples were carried out according to the standard methods of Techniques of Water-Resources Investigations of the United States Geological Survey. Therefore, the accuracy and precision of following methods are well approved and cited in the scientific literature [2]. The Water samples were immediately brought in to Laboratory for the Estimation of various Physico-chemical parameters, like water temperature, conductivity and pH were recorded at the time of sample collection by using Thermometer and Pocket Digital pH Meter.

### Experimental procedure

The other Parameters Such as DO, Hardness, Alkalinity, Chlorides and COD were estimated in the Laboratory by using Titration method, but Pb

and Cd were determined by using Flame Atomic Absorption Spectrometer (Spectra 20 plus, Varian), fluoride was determined by using fluorometer. TDS and sulphate amount of water sample determined by using gravimetric analysis.

## Results and Discussion

Mean values of the Total Alkalinities (TA), pH and conductance values at 25°C (K), Dissolved Oxygen (DO), Total Hardness (HD), sulphate, Total Dissolved Solid (TDS) and Chemical Oxygen Demand (COD) of the drinking water samples are shown in Table 1.

### pH of water

The pH value of water samples collected from Samunaber and Piazza were in the range of 8.03 to 8.72, which is alkaline with a temperature value of 25°C and 28°C respectively.

### Total dissolved solids

The mean TDS for samunaber water was found to be 1566 mg/l and for piazza was 1256 mg/l. From the results, it is clear that water samples of studied area are not suitable for drinking in terms of TDS, it is above the permissible level of the WHO.

### Conductance

The conductance value of piazza water sample and samunaber water sample is shown in Table 1. The results reveal that obtained value is below the WHO slandered value of drinking water. It is in accordance with the accepted value.

### Total hardness

In the present investigation, total hardness for both districts shown in Table 1. The total hardness of water is below WHO standard for both districts. Results revealed that both drinking water samples from both districts are suitable for drinking in terms of total hardness.

### Chemical oxygen demand

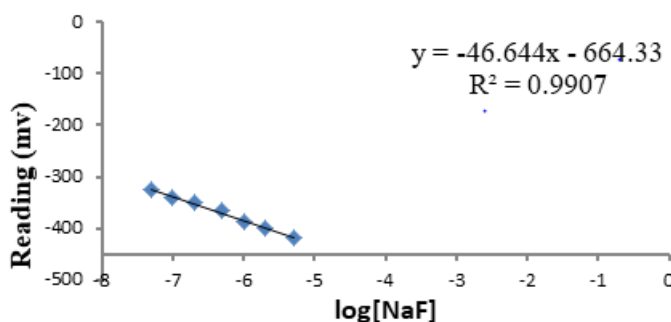
Chemical Oxygen Demands (COD) is an important parameters for oxygen required to degradation of organic matter. In this case a result of COD parameter was not agreed with slandered data.

### Dissolved oxygen

Dissolved oxygen is a most important aquatic parameter, whose existence is essential to aquatic fauna. It plays an important role in life process of animals (Figure 1). In this study DO values are with good agreement with the American Public Health Association standard vales (Table 2).

Place	pH	K(μS)	HD (ppm as CaCO3)	DO (ppm)	TDS (ppm)	COD (ppm)
Samunaber	8.03 ± 0.02	229 ± 6.0	514 ± 10.3	4.7 ± 0.32	1566 ± 58	472 ± 7.5
Piazza	8.72 ± 0.15	362 ± 7.2	306 ± 10.3	5.2 ± 0.35	1256 ± 40	531 ± 8.1
Standards	6.5-8.5 (WHO)	1400 (WHO)	500 (WHO)	5-9 (EU)	1000 (WHO)	<20 (APHA)

**Table 1.** Average concentration (Mean ± SD, n = 3) values of physico-chemical parameters of drinking water samples and compared with drinking water quality standards.



**Figure 1.** F- working solution.

No	1	2	3	4	5	6	7
Con. of NaF standards (ppm)	0.5	1	2	5	10	20	50
Log [NaF]	-7.3	-7	-6.7	-6.3	-6	-5.7	-5.3
Reading (mv)	-325	-341	-345	-346	-386	-399	-419

**Table 2.** Working standard solution for fluoride determination.

## Fluoride

In this study the measured value of F<sup>-</sup> ion of the water samples were under the maximum allowable values (Figures 2 and 3). Therefore regarding the fluoride content of the water, there is a good agreement with the standard values (Table 3).

## Alkalinity

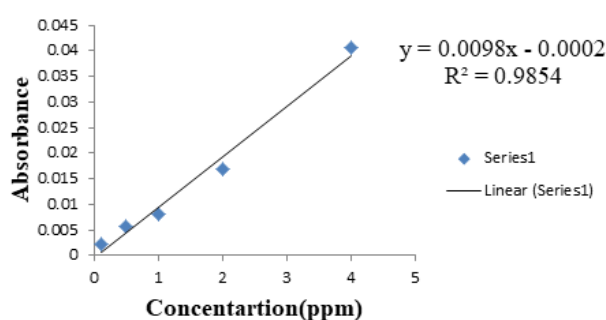
Alkalinity is a measure of the total ion concentration of CO<sub>3</sub><sup>2-</sup>, OH<sup>-</sup> and HCO<sub>3</sub><sup>-</sup> ions. The maximum amount of alkalinity set by WHO is 500 mg/L. Our result shows that alkalinity of water samples from both districts is within the standard data.

## Chlorides and sulphate

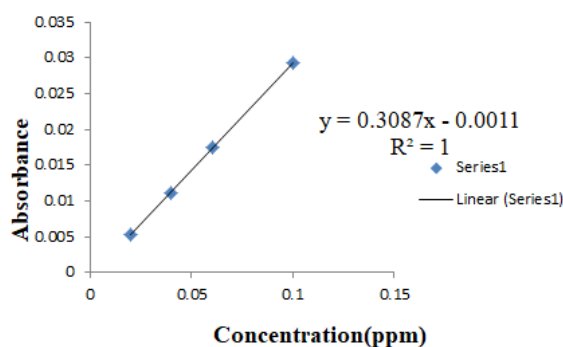
Chloride and Sulphate value found is below the WHO standard for both water samples of the districts.

## Lead and cadmium

In the present study the barley concentration of Cd and Pb in both water samples is above the maximum permissible concentration. There for this study shows that both water samples have some toxicity of Pb and Cd. The increase in cadmium, and Pb concentration most probably may be due to high natural abundance in the soil, in localized mineral zones [7,8].



**Figure 2.** Plot of Pb working solution.



**Figure 3.** Plot of Cd working solution.

Place	[SO <sub>4</sub> <sup>3-</sup> ] (Ppm)	[Cl] (ppm)	[F] (ppm)	TA (ppm)	Pb (ppm)	Cd (ppm)
Samunaber	2.18 ± 0.34	161.2 ± 3.7	0.025 ± 0.004	22.6 ± 1.7	0.124 ± 0.003	0.0078 ± 0.00035
Piazza	3.75 ± 0.35	162.1 ± 2.0	0.026 ± 0.004	30.0 ± 1.2	0.130 ± 0.010	0.0078 ± 0.00030
WHO [7]	200	250	1.5	500	0.01	0.003

**Table 3.** Average concentration (Mean ± SD, n=3) values of physico-chemical parameters of drinking water samples and compared with drinking water quality standards, WHO.

## Conclusion

The result in Samunaber and Piazza revealed that the district water samples contain high TDS, COD, Pb, Cd which is above maximum permissible level. There for there should be good laboratory treatment plant to make the water safe for drinking. Thus, in both sites drinking water is not quite safe, because some of the parameters analysed were above the maximum permissible limit set by the WHO in drinking water. It is noted that, the treatment process in the study area is done by "experience" and not by scientific method. This system is very dangerous and should be

discarded with immediately. To prevent this, Government should provide a scientifically equipped laboratory for testing the water produced before reaching the consumer.

In general the present study showed that the some parameters were at a level of pollution and may cause harmful effect on to the human health.

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