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Physicochemical parameters, Heavy metals and some ions Analysis in drinking water in selected Districts of Gedio Zone, Ethiopia

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ABSTRACT: Contamination of drinking water is an important health risk factor due to the attendant toxic effect linked to it. We therefore assessed the quality of water samples in each of the study areas of Gedyo Zone where water quality suspected with some problems by Zonal water quality administrative. In this study, heavy metals, fluoride, phosphorus light metals and physicochemical parameters of the water samples including pH, turbidity, total dissolved solids (TDS) were determined. The pH ranged from 6.77 to 8.19; while turbidity ranged from 3.78 to 40.2 NFU for borehole water in the study areas. On the other hand, TDS was in the order of 1.83 to 62. The levels of fluoride and phosphorus are in the acceptable range according to WHO permissive limit. Mean concentration of heavy metals for the water samples in all of the study areas were found to be in WHO acceptable range. However, Iron (Fe) level in Dilla College of Teacher`s Education (DCTE) exceeded WHO permissive level. Findings from this study show that water sources in the DCTE has high amount of iron and its turbidity is very high compared to other site in the study areas, which needs further treatment before dispatching for the public use.

KEYWORDS: Drinking-water; physicochemical parameters; heavy metals; Fluoride and phosphorus.

INTRODUCTION

Water is one of the abundantly available substances in nature; it is an essential constituent of all animals and vegetables matter and forms about 70% of the matter of earth crust (APHA, 1980). Water is mostly used for industrial and municipal purposes (Gasim et al., 2007). Today human activities are constantly adding industrial, domestic and agricultural waste to ground water reservoirs at an alarming rate (Gautam, 1990). Ground water contamination is generally in irreversible. Excessive mineralization of ground water degrades water quality producing an objectionable taste, odor and excessive hardness (Horrison).

It is always better to protect ground water first rather than recycling on technology to clean up water from contaminated source (ICMR, 1975). Polluted ground water is the major cause for the spread of epidemics and chronic diseases of man. It causes typhoid, dysentery, diarrhea, tuberculosis and hepatitis (Trivedi D.K. and Goal P.K, 1984).

Contaminants are substances that are dissolved in water and make it unfit for use. Some contaminants can be easily identified only by assessing the taste, odor and turbidity of the water because pure water remains tasteless, colorless and odorless. However, most cannot be easily detected and require testing to reveal whether or not water is contaminated. Physico-chemical parameters of water are important to determine the quality of drinking water as according to WHO (1996). The physical parameters that are likely to give rise to complaint from consumers are color, taste, odor and turbidity while low pH causes corrosion and high pH results in taste complaints (Chan et al., 2007). Some anions like phosphate, fluoride, sulphate, nitrite and nitrate and cations like Ca^{+2} , Mg^{+2} , Na^{+} and K^{+} are essential parameters for drinking water.

Heavy metals also can be contaminant if they found above permissive value. Heavy metals are elements of high atomic numbers. They have high utilities in industrial applications from papers to automobiles, by their very characteristic

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properties. They are found in the deep bowels of the earth as ores (complexes of mixtures). The metals are segregated from these ores, leaving behind the tailings that find their way into the environment as toxic pollutants (Gan et al., 2004 ; VAN Cauwenbergh et al., 2004; Koch et al., 2004). They get into the water bodies directly from point sources as sewage, and non-point sources as runoff and more insidiously as atmospheric deposition that are transported from long distances. Heavy metals affect every level of the food web, from producers in the trophic levels to the highest order carnivore by residing in the system and magnifying at every trophic status. Due to the impact of the heavy metal ions on human metabolism, trace heavy metal analysis is an important part of public health studies (Acar et al., 2004; ARE et al., 2002). Some transition metals at trace levels in our metabolism are important for good health. Heavy metals normally occurring in nature are not harmful to our environment, because they are only present in very small amounts. However, if the levels of these metals are higher than the levels of healthy life, the roles of these metals change to a negative dimension. The main sources of the heavy metal ions directly are food and water and, indirectly, industrial activities and traffic. Drinking water is also an important source for heavy metals for humans (Afzali et al., 2005; Shishehbore et al., 2005; Ghaedi et al., 2005). Gedyo Zone has the number water source which supplies the public mostly for domestic purpose which is obtained from underground or surface water. Even though the water has been using for drinking purpose no study has been conducted regard to the quality parameters especially toxicity in case of heavy metals and physicochemical characteristics. Moreover, the area was suspected with water quality problems by water quality assurance office of Gedyo Zone.

MATERIALS AND METHODS

Instrument used

Conductivity meter, pH meter, turbidity meter, flame photometer, UV- visible spectrophotometer, Flame Atomic absorption spectrophotometer (FAAS)

Sample collection

The drinking water samples were collected in pre-washed (with detergent, de-ionized distilled water, diluted HNO_3, de-ionized distilled water, respectively) polyethylene bottles from 3 stations in Gedyo Zone (DCTE, Gedeb and Bedesa). pH, conductivity and turbidity of the samples were measured while collecting the samples. Totally 6 liters from three sites were collected (3 liters for the determinations of main ions and 3 liters for metal determination).

Chemical analysis

The turbidity of water sample was directly determined by the portable turbidity meter (Jenway 6035) at room temperature. pH was carried out at room temperature by portable pH meter (Jenway 370) after calibration by using calibrating standard. Conductivity and TDS were carried out at 25^{o}C by conductivity meter (Jenway 470) after calibration with calibration solution HI-7031, Henna instrument Hungry (Asadullah et al.,2013). Total hardness was determined by volumetric method (EDTA-titration). Sodium and potassium were determined by flame photometer.

Acidified water samples were analyzed for Heavy Metal (HM) (Cr, Cd, Cu, Fe, Ni, Mn, and Zn) with the help of atomic absorption spectrometer (Perkin-Elmer AAS-700). Standard working solutions of all concerned metals were prepared by appropriate dilution of 1000 mg/L certified standard solutions Fluka Chemica (Buchs, Switzer-land) in de-ionized water (M. Soylak et al., 2002; Degu et al, 2014; Zaher and Sameer , 2012).

Fluoride was determined by the following Procedure: A standard graph is prepared by using fluoride concentrations ranging from 0.005 mg/L to 0.150 mg/L at 570nm. A reference solution is prepared by adding 4ml of acid zirconyl-SPADNS reagent to 21 ml of distilled water. A volume of filtered sample (21ml) was taken in a test tube; 4ml of acid zirconyl-SPADNS reagent was added to the sample along with a reference solution. The mixture was left for about 30 min for complete colour development and the optical density was read at 570 nm (Zaher and Sameer , 2012).

Phosphorus was determined by the following Procedure*:* To 50ml of the filtered sample, 4 ml of ammonium molybdate reagent and about 4 drops of stannous chloride reagent was added. After 10 min the colour developed was measured photometrically at 690nm and calibration curve was prepared. A reagent blank was always run with same treatment with distilled water as sample. The value of phosphate was obtained by comparing absorbance of sample with the standard curve and expressed as mg/L. All the chemicals used during analysis were of analytical grade.

RESULT AND DISCUSSION

Physicochemical characteristics of drinking water in three site of Gedyo Zone have been carried out for different parameters, like, pH, turbidity, TDS and conductivity. The result shows in the table 1. The pH values for water samples from all the study areas showed that they were acceptable range compared with the WHO permissible pH range guideline in drinking water of 6.5 to 8.5 . The turbidity of the sample ranged from (3.78 to 40.2 FNU). Turbidity values showed that one of the study areas has very high turbidity which was above the WHO limit for drinking water (5FNU). The range of TDS for the water samples from (67 to 110 mg/L) from all the study locations were below the WHO guideline value of 1,000 mg/L (Zaher and Sameer, 2012; WHO 2006). All Physicochemical parameters found in the permissible limit in different organizations except turbidity of DCTE which was above the permissible limit. This high turbidity most probably due some suspended and dissolved solids from the original water source or erosion my entering to source.

Table 1 shows different value of physicochemical parameters

Parameters	Sample sites		
	DCTE	Gedeb	Bedesa
Conductivity in µs	138.19	156.3	96.8
pH	8.19	6.97	6.77
Temperature in ^{0}C	24.4	24.3	24.3
Turbidity in FNU	40.2	3.78	4.59
Total dissolved solids	96.733	109.41	67.76

Ions fluoride, Phosphorus, were determined by using UV-visible spectrophotometer potassium and sodium were determined by using flame photometer; the result obtained for each site is given in the following graph 1.

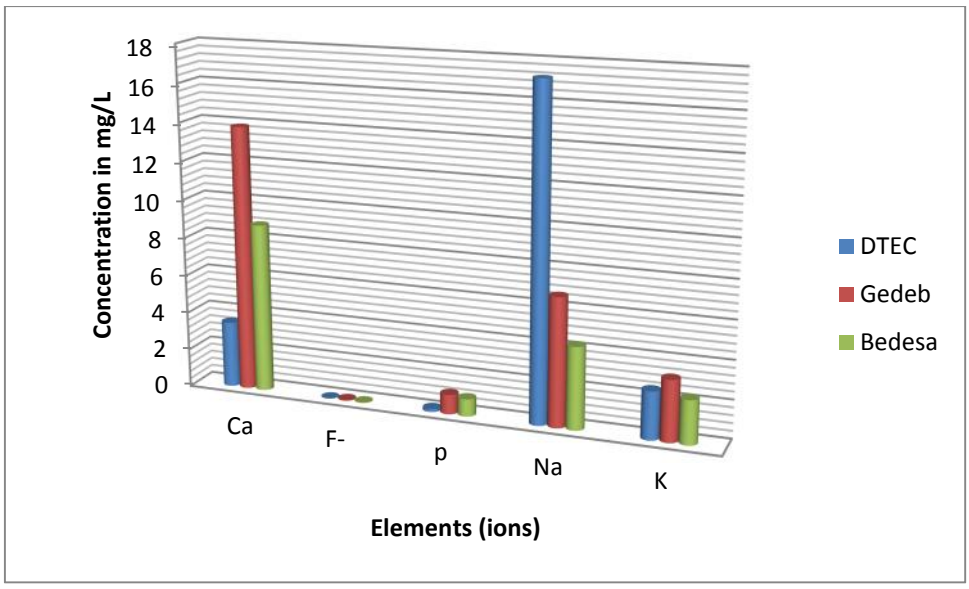

Figure 1 Concentration of different ions

From the concentration of heavy metals determined in the study areas given in table2 the concentration of Fe (mg/L) was exceptionally high for water sample in DTEC. The water sample has mean Fe concentrations (0.6 mg/L) that are above the WHO standard value of 0.3 mg/L for Fe (WHO, 2006). Iron is the common element in the earth`s crust. As water percolates through soil and rock it can dissolve these minerals and carry them into ground water. Also, iron pipes can corrode and leach iron a house hold water supply (Mark and Monty, 2014; Bruce and Sharon, 2014).

Table 2. The level of different heavy metals in the three sites

Sample site	Types of Heavy metals unit (mg/L)							
	Fe	Cu	Zn	Cd	Ni	Co	Cr	Pb
Bedesa	ND	0.054 ±0.0006	ND	ND	ND	0.082± 0.0009	ND	ND
DCTE	0.60 ± 0.0020	0.047± 0.0002	0.98 ± 0.0018	ND	ND	0.066± 0.0003	ND	ND
Gedeb	ND	0.050 ± 0.0002	0.53 ± 0.0013	ND	ND	0.068± 0.0004	ND	ND

ND = the result is less than method detection limit

CONCLUSION

The result on this study showed that the two sites, Gedeb and Bedesa sites were safe to drinking purpose according to different organizations but the third site Dilla College Teachers` Education (DCTE) not safe for drinking purpose because turbidity of the water was much higher than the permissive limit according to different organizations. Moreover, the concentration of iron in DCTE above WHO permissive limit. The researchers recommended that the water in DCTE need further treatment for its removal of heavy metals and to clean up different suspended and dissolved solid which cause high turbidity.

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