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Assessment of Physicochemical Parameters of Sombo Spring Water in Jimma Town, South-West Ethiopia

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ABSTRACT

The study was carried out to find the status of Sombo spring water of Jimma town in respect to physico-chemical water quality parameters during 2015 and 2016 following standard methods of sampling and testing. For this study, samples were collected from two sample sites. The physico-chemical Parameters included turbidity, pH, EC, temperature, total dissolved solid, dissolved oxygen, Chloride, total alkalinity, Calcium and Magnesium were analyzed. The observed values of various physico-chemical parameters of the spring water samples were compared with standard values and the result showed that seven out of ten tested parameters were within the permissible limits. Turbidity of the Sombo water was above the permissible limit while pH and dissolved oxygen values were below permissible limit range recommended by WHO for drinking water. Thus, the sombo spring water could affect human health, since the nearby community using it for drinking purpose. Therefore, it is recommended to have a frequent monitoring of the physico-chemical parameters and need the attention of the concerned body to treat the water or find other alternative safe drinking water source.

Introduction

Water is the most essential and important natural resource of the ecosystem that all life on earth need it for their survival and growth. In total, there is 1400 million billion liters of water, but most of this water is not used for drinking purpose, because 97% is sea water and only 3% is fresh water, out of which 2% is lidged in the polar ice caps and glaciers, only 1% water is available for portable use; whereas more water goes for irrigation than to drinking sanitation and all other uses [1]. Water source, includes surface water in stream and ground water in wells and springs are supporting drinking water supply, livestock needs, irrigation, industrial and many other commercial and domestic purposes [2] Ground or spring water represents an important source of drinking water in both urban and rural areas in many developing and underdeveloped countries. However, currently it is become a scarce commodity due to over exploitation and deteriorating its quality due to anthropogenic activities, industrialization, farming activities, transportation, urbanization, animal and human excretions and domestic wastes [3]

Having safe drinking water and basic sanitation is a human need and right for every citizens of all countries. People need clean water and sanitation to maintain their health and dignity. 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 [4]. However, still more than one billion people all over the world do not have ready access to an adequate and safe water supply and more than 800 million of those unsaved live in rural areas. [5]. One of the most important environment issues today is groundwater contamination and the diversity of contaminants that affect water resources. Once the groundwater is contaminated, its quality cannot be restored by stopping the pollutants from the sources. It therefore groundwater quality monitoring and testing is of paramount importance both in the developing and undeveloped world [6]. The key to sustainable water resources is to ensure that the quality of water resources are suitable for their intended uses, while at the same time allowing them to be used and developed to a certain extent.

In developing country like Ethiopia, there is a rapid increase in population; however, the common drinking water sources are limited to wells, springs, and taps. However, currently these water sources are becoming contaminated due to various activities, such as rapid industrialization in urban areas and expansion of agricultural practices in rural areas. According to a study in Ethiopia, the dominant sources of drinking water supply for major urban and rural communities were from wells and springs [7]. Peoples living around the study area are also encountered shortage of safe drinking water source as other areas in the country and as a result they have been used the spring water as drinking and for other domestic purposes.

In the present work, attempts have been made to evaluate the water quality of sombo spring water in Jimma Town, which has not been reported so far. The various physico-chemical parameters were assessed and the values obtained were compared with the Permissible/desirable values prescribed by the Ethiopian, United States Environmental Protection Agency (USEPA) and World Health Organization (WHO) guidelines to ensure the quality of spring water for its use in domestic purposes. The study will provides baseline information about water quality for the welfare of the society

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and may also help in future water resource planning for the area.

Study Area and Period

The study was conducted in Jimma Town, Jimma Zone of Oromia Region in Ethiopia. The town is located 346 km to Southwest of Addis Ababa, the capital city of Ethiopia. It is located at latitude of $07^0$49'N and 36^0 50'E, and the altitude range from 1,700 – 1,750 m above sea level [8] and the estimated total area of 46.8–100.2 km^2 with a population of approximately 2,29,857 in 2015 [9,10]. The town experiences moderate temperature with mean annual temperature of 18.9°C and has a mean annual rainfall of 1,476.89 mm [8]. The study was conducted from February 2015 to August 2016

Materials and Methods

The chemicals used were of analytical grades: Isopropyl alcohol, glycerol, conc.HCl, sodium chloride, barium chloride, sodium sulphate, silver nitrate, potassium chromate and sulphuric acid were purchased from Fine Chem Industries (Mumbai, India). Bromocresol green, methyl red, ammonium purpurate, sodium hydroxide, EDTA and Manganese sulphate were obtained from Muwaukee (99.9% Aldrich, USA). Iodide, starch, sodium thiosulphate, potassium hydroxide, sodium azide, different buffer solution were purchased from Buck scientific (Turo-grathictm, USA). All glassware and plastic container used were washed with detergent solution followed by 20% nitric acid and then rinsed with tap water and distilled water.

Sampling and Sample Analysis

Two sampling sites (named as Sample 1 & Sample 2) along Sombo spring water, were selected for sample collection. The spring water samples were collected in different time (Morning, Mid-day and Night), days and months. The collected sample were transported to laboratory by using polyethylene bottles, which were thoroughly washed and rinsed with sample to avoid any possible contamination in bottles. The collected samples were filtered and stored in refrigerator until analysis. Finally, physiochemical parameters (alkalinity, Chloride, turbidity, total dissolved solid, dissolved oxygen and Calcium) were measured using standard procedures. The sample information is given in the Table 1.

Table 1. Sample information of water samples from Sombo water Spring.

Sample Collection time	Label
Morning Spring Water	MSW
Mid-day Spring Water	DSW
Night Spring Water	NSW

Results and Discussions

The standard and the observed values of physico-chemical parameters of Sombo spring water sample were presented in Table 2. The quality of the sample water has been assessed based on physical parameter such as pH, temperature, turbidity, electrical conductivity and total dissolved solids in conjunction with chemical characteristics such as DO, alkalinity, calcium, magnesium and chlorides.

Physical Parameters

pH

The pH is a measure of the hydrogen ion concentration in water. It is the value of water indicates whether the water is acidic or alkaline (Fig. 1). The pH value obtained in this study is varied between 6.01 – 6.47. This indicate that water sample is slightly acidic and below permissible limits for drinking water set by Ethiopian limit, WHO and USEPA. The sample showed acidic behavior, which may be related to the presence of dissolved species such as bisulfate ion, H_2SO_4, disassociated hydrofluopitate acid and so on.[11].

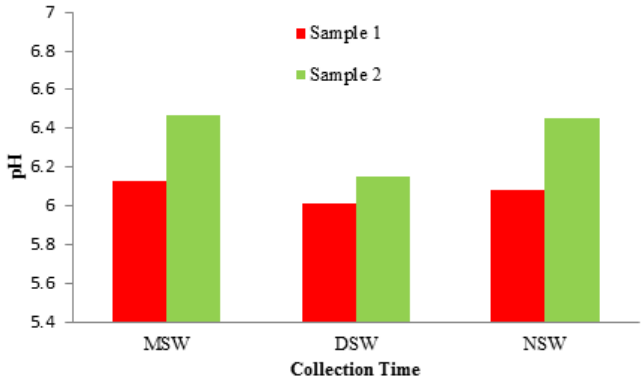

Figure 1. Comparative analysis of pH for both the samples.

Electrical conductivity

Electrical conductivity is a measure of the ability of aqueous solution to carry an electrical current that depends on the presence and total concentration of ions, their mobility, valance and on temperature. In this study the value of electrical conductivity for sample one ranges from 96.5-100.2 µs/cm and sample two was 101.9-110.01 µs/cm, which are below WHO limit (Table 2). The higher EC value in sample two indicate the presence of relatively higher dissolved minerals [12].

Turbidity

Turbidity of water affects water quality parameters such as color, when it is imparted by colloidal particles. Turbidity in water arises from the presence of very finely divided solids. The existence of turbidity in water will affect its acceptability to consumers and can be caused by sewage matter in water there is a risk that pathogenic organisms could be shielded by the turbidity particles and hence escape the action of the disinfectant [12]. In all water samples the turbidity fluctuates from 7.14-8.59 NTU, which is more than permissible limit recommended by WHO and USEPA (Table 2), this may be due to the fact that Sombo water is found unprotected, open, easily exposed to different animals such as

Table 2. Physico-Chemical Parameters of Sombo spring water.

Physio-Chemical Parameter	Sample 1			Sample 2			Ethiopian Limits (2013)	WHO (2011)	USEPA (2004)
	MSW	DSW	NSW	MSW	DSW	NSW			
pH	6.13	6.01	6.08	6.47	6.15	6.45	6.5-8.5	6.5-8.5	6.5-8.5
E.C (µs/cm)	99.00	96.5	100.20	101.90	110.01	106.33	-	250	-
Turbidity (NTU)	7.14	7.15	7.52	8.06	8.59	8.44	-	1-5	0.5-1
TDS (mg/L)	150	165	200	169.3	256	260	1000	500	500
Temperature (°C)	24.03	24.67	24.5	24.43	25.16	24.76	-	-	-
Chloride (mg/L)	39.99	74.98	84.97	49.98	74.90	24.99	250	250	-
Alkalinity (mg/L)	88.33	81.33	87.33	111.6	106.6	87.33	200	250	-
DO (ppm)	3.45	3.03	3.42	3.99	3.65	3.82	-	4	-
Calcium (mg/L)	43.16	36.80	49.91	53.33	43.05	45.71	75	200	-
Magnesium (mg/L)	2.35	2.04	2.26	3.32	2.65	2.43	50	100	-

cattle and dog , also exposed for soil erosion and household wastes.

Total dissolved solid (TDS)

Total dissolved solids indicate the salinity behavior of water. WHO and Ethiopian limit gave palatability of drinking water according to its TDS values as less than 500mg/L and 1000 mg/L are excellent level respectively. In the taken samples the value obtained varies from 150-260 mg/L and were within the permissible limit set for drinking water (Table 2).

Temperature

Temperature does not carry any significance role in terms of contamination. However, we generally prefer cool water than warm water. High water temperature (20-30°C) can enhance the growth of microorganisms and may lead to taste, odor, color and corrosion problems. The most desirable temperature for drinking water is between 4^0C to 10^0C and temperatures above 25^0C are usually objectionable. In this study the samples temperature were ranged from 24.5-24.68^{o}C and this value indicates it is below 25^0C, which is far from the standard (Table 2).

Chemical parameters

Chloride

Chlorides are common constituents of all natural water. The chloride value in this study found in between 24.99-84.97 mg/L. Since the desirable limit of chloride for drinking water is 250mg/L which is within acceptable rang for drinking [13]. Thus, the samples are potable for drinking interms of chloride content (Table 2).

Alkalinity

Alkalinity of water is defined as the ionic concentration which can neutralize the hydrogen ions. In this study total alkalinity of all water samples varies from 81.33-111.6mg/L. according to WHO and Ethiopian limits, the desired limit for alkalinity in drinking water are 250mg/L and 200mg/L respectively. The values of total alkalinity in all samples are within permissible limits for drinking water [11,14] (Fig. 2).

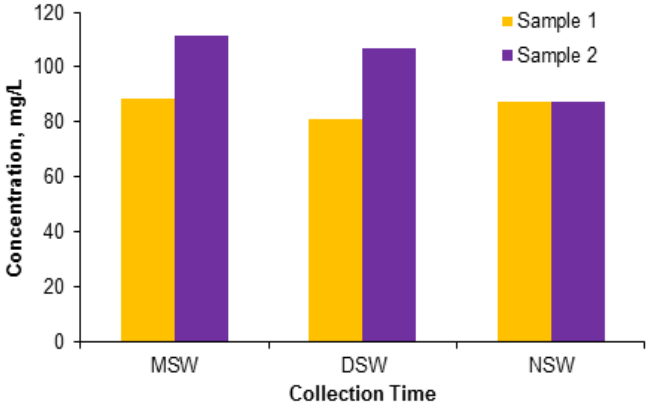

Figure 2. Comparative analysis of Alkalinity for both the samples.

Dissolved Oxygen

Dissolved Oxygen is one of the important and critical characteristics of water quality assessment. The values observed in the current study ranges from 3.03-3.99 mg/L, which is low from the standard. This may be as a result of the increased run off agricultural wastes; this water at this sample site may therefore, be considered as negligibly polluted and is suitable for most of the beneficial uses such as drinking with conventional treatment followed by disinfection. However the water is not suitable for direct drinking without a conventional treatment including disinfection [15] (Table 2).

Calcium and Magnesium

Calcium and magnesium are directly related to hardness. Calcium value in the studied area is ranging from 36.8 - 53.33mg/L while Magnesium value in studied area is varies from 2.04 – 3.32 mg/L and both of them found within permissible limit. (Table 2).

The comparison study of calcium, magnesium and chloride are presented in the figure below (Fig. 3), which indicate the total ion contents were higher in samples collected at morning time and the lowest were observed at night time in both samples.

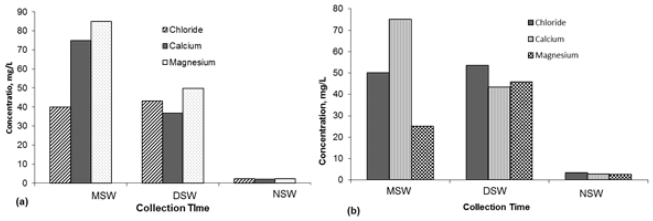

Figure 3. Comparative analysis of calcium, magnesium and chloride for the 2 samples: (a) Sample 1; (b) Sample 2.

Conclusion

The study was assessed the levels of physicochemical parameters such as temperature, pH, conductivity, turbidity, total dissolved solid, alkalinity, dissolved oxygen, calcium, magnesium and chlorine contents in the spring water sample collected from Sombo spring water in Jimma town Mandera Kochi Kebele to have insight on its quality. The water quality is directly related to health and is important for determination of water utility. Raising number of population size, lack of sufficient potable water and increasing concentration of various chemicals generating from the domestic water released into the water sources through drains are gains public concern over their adverse effects on human health and environment. The results from this study indicate that turbidity, DO and pH were not within the permissible limits given by WHO. However, the other parameters were within the permissible limits given by WHO, Ethiopian and USEPA. Hence, it is recommended that Sombo spring water can be used after conventional treatment including disinfection. Finally, authors also recommend the further investigation for the potential contamination so that water qualities of Sombo spring become usable.

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References

[1]. WHO (2004) Guidelines for Drinking-water Quality. Recommendations, 3 edn, vol 1. World Health Organization, Geneva

[2]. Zinabu Assefa Alemu, Kirubel Tesfaye Teklu, Tsigereda Assefa Alemayehu, Kifle Habte Balcha and Sisay Derso Mengesha, (2015) Physicochemical quality of drinking water sources in Ethiopia and its health impact: a retrospective study, *Environ Syst Res, 4:22*

[3]. Basavaraja, Simpi, S. M., Hiremath, K. N. S. Murthy, K. N. Chandrashekarappa, Anil N. Patel, E.T.Puttiah, (2011), Analysis of Water Quality Using Physico-Chemical Parameters Hosahalli Tank in Shimoga District, Karnataka, India, Global Journal of Science Frontier, Research, 1(3), pp 31-34.

[4]. Ackah M, Anim AK, Gyamfi ET, Acquah J, Nyarko ES, et al. (2012) Assessment of the quality of sachet water consumed in urban townships of Ghana using physico-chemical indicators: A preliminary study. Advances in Applied Science Research 3: 2120-2127

[5]. WHO⁄ UNICEF (2000) Global Water Supply and Sanitation Assessment. 2000 Report WHO⁄UNICEF, USA.

[6]. Nash, H.; McCall, G.J.(1994), Groundwater Quality; Chapman & Hall: London, UK,.

[7]. Gebrekidan M, Samuel Z (2011) Concentration of heavy metals in drinking water from urban areas of the Tigray Region, Northern Ethiopia. Coll Nat Comput Sci Mekelle Uni 3(1):105–121

[8]. N.; Tadesse. (1994), Hydrogeology of Jimma Area, M.Sc., Thesis, Addis Ababa University. Addis Ababa, Ethiopia,.

[9]. Statistical Abstract. Federal Democratic Republic of Ethiopia Central Statistical Authority. Addis Ababa, Ethiopia, CSA, 2007.

[10]. Jimma town administrative Transformation and development plan report of 2014.

[11]. Ethiopian standard (2013), Drinking water specifications, Ethiopian Standard Agency.

[12]. WHO (2011) Guidelines for drinking water quality. World Health Organization, Geneva

[13]. National Primary Drinking water regulations, Drinking water contaminants US EPA.

[14]. Premlata, Vikal, Multivariant analysis of drinking water quality parameters of Lake Pichhola in Udaipur, India. Biological Forum, Biological Forum- *An International* J.2009, 1, 97-102.

[15]. Jamie Bartram and Richard Balance; A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes 1996 UNEP/WHO