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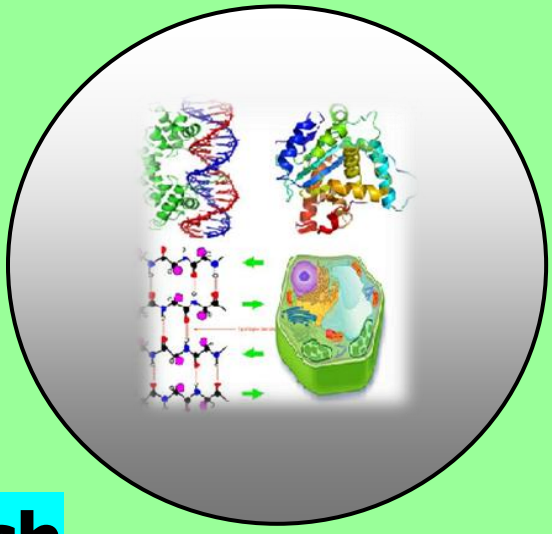
ISSN 2319-3077 Online/Electronic
ISSN 0970-4973 Print

Journal Impact Factor: 4.275
Global Impact factor of Journal: 0.876
Scientific Journals Impact Factor: 3.285
InfoBase Impact Factor: 3.66
Index Copernicus International Value
IC Value of Journal 47.86 Poland, Europe

J. Biol. Chem. Research
Volume 33 (1) 2016 Pages No. 318-326



Journal of Biological and Chemical Research

An International Peer Reviewed / Referred Journal of Life Sciences and Chemistry

Indexed, Abstracted and Cited in various International and National Scientific Databases

Published by Society for Advancement of Sciences®

J. Biol. Chem. Research. Vol. 33, No. 1: 318-326, 2016
(An International Peer Reviewed / Refereed Journal of Life Sciences and Chemistry)
Ms 33/1/22/2016

ISSN 0970-4973 (Print)
ISSN 2319-3077 (Online/Electronic)

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RESEARCH PAPER

Received: 16/11/2015 **Revised: 20/03/2016** **Accepted: 22/03/2016**

A Study on Some Physico-Chemical Properties of Boye Wetland in Jimma Town, South Western Ethiopia

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ABSTRACT

In present study water samples were collected from three different points; upper point (S1), middle point (S2) and down point (S3) of Boye wetlands in Jimma town, south western Ethiopia. Some physico-chemical properties of the collected water sample were studied in laboratory by using standard procedures. In this study some physicochemical properties were studied and compared with the standard value reported by WHO. The pH, total solids, total dissolve solids, total suspended solids hardness, alkalinity, free carbon dioxide and chloride ion were determined. The average value of this properties are 8, 353 mg/L, 278 mg/L, 87 mg/L, 128 mg/L in calcium carbonate, 103 mg/L, 90 mg/L, 99 mg/L, respectively. Based on results obtained in this study the pH value permissible with WHO value, and the alkalinity and hardness value slightly below WHO value and the free CO_2 concentration value obtained above permissible WHO standard value recommended for human consumption.

Keywords:-Physicochemical, Wetland and Water Quality.

INTRODUCTION

Wetlands are probably the earth's most important fresh water resources which provide food and habitat for many aquatic lives including threatened and endangered species. The most important step for conservation of wetlands is to maintain a proper water quality. The water quality is directly related to the health of the water body (Smith Ajay D et.al; 2013).

Water is the most common essential substance and major consistent of living things or matters which is used for different purpose such as drinking, house hold purpose ,agricultural purpose ,industrial activities, conservation of environmental ,economic conservation, chemical reaction, electrical power generating and for life of aquatic

organisms(Stanley Manaha et.al ; 2007).The health of aquatic ecosystem is depending on the physiochemical and biological characteristics (Modudhula et.al; 2012) The quality of water in any ecosystem provides significant information about available resources for supporting life in that ecosystem(Shubah et.al 1999).The wetland receives water from two rivers, Kito and Awetu. Awetu passing through Jimma town receives all types of municipal wastes and discharged to the wetland with extensive amounts of pollutants (Mitiku Wacho , et.al 1999). Boye wetland is found in Jimma town, Oromia Region, Ethiopia .It is the very initial water source for Jimma town. The main aim of this study was to analyze the physcochemical parameters of water samples collected from three sampling points of Boye wetland and to compare with the WHO standard. The major water quality parameters considered for the examination in this study are like pH, temperature, total dissolved solids (TDS), total solids (TS), total hardness, Conductivity and alkalinity

MATERIAL AND METHODS

Description of Sampling Locations and Period

Boye wetland is located in Jimma zone of Oromia regional state in south western Ethiopia, which is located 346 km away from Addis Ababa. Jimma zone is the capital and administration center of the zone. The Jimma zone covers total area of 18412.54 km^2, of which Jimma town encompasses an area of 46.23 km^2.The water samples were collected from three different points: upper point (S1), Middle point (S2) and down point (S3) of Boye wetland in Jimma town from January 2015 to May 2015. The water samples were collected from each site with cleaned plastic bottle.km

Sampling and Preservation

The samples were collected from three sampling points across the Boy wet land. Samples were drawn with the aid of plastic drawer into three same types of polyethylene bottles i.e.1.5 L for physico –chemical parameters in the three sites. The plastics bottles were previous washed and soaked overnight with 5% HNO_3 solution. To avoid any kind of contamination during sampling extra care was taken and the bottles were rinsed several times with the water being collected or filled (Shahid et al; 2014) .However, on-site analyses was comprised for temperature; electrical conductivity (EC) and pH were urgently determined when receive the sample in the laboratory because of their unstable nature. Samples were then transported to laboratory and kept at 4oC prior the time of analyses.

Materials and Chemicals

Apparatus and instruments: Beakers, filter paper, measuring cylinder, oven (model ov150ss), digital balance (model 110L), ATC pH meter (model 353), burette, pipette, funnel, conical flask, volumetric flasks, plastic bottle, evaporating dish and reagent bottle

Reagents and Chemicals*:* Sodiumcarbonate (Na_2CO_3), Ethyldiaminetetraceticacid(EDTA), Sulphuricacid (H_2SO_4), phenolphthalein, methyl orange, ErioChrome blackT, buffer solution(NH3 and NH4Cl), ethanol(CH_3CH_2OH), Silver nitrate ($AgNO_3$),Potassium Chromate (K_2CrO_4)

Experimental Analysis

Temperature, Conductivity and pH Measurements

A mercury filled centigrade thermometer calibrated from 0^0c to 100^0C was used for temperature measurements in the field.

The pH and electrical conductivity were measured using pH meter and digital conductivity meter; respectively. All analyses were carried out at a standardized laboratory and procedure. The approach ensures that the samples collected were tested in accordance with agreed requirements using competent student as well as appropriate equipment and materials. For physco-chemical analysis all the chemicals used were analytical grade. Total hardness of water was estimated by complexometric titration with EDTA.

Determinations of Total Dissolved Solids

The beaker was weighted and recorded as B, and then water sample was measured in measuring cylinder. Then the measured was filtered by using filter paper and the filtered water sample was poured into beaker, and put into an oven for 24 hours. After 24 hours the sample was removed from an oven and cooled. The beaker with dried residues was weighted by using digital balance and recorded as A. The total dissolved solids were calculated by using:

$$Total\ \ Disolved\ Solids(mg/L) = \frac{(A-B)}{ml\ \ of\ \ \ sample} X1000$$

Where A = Weight of beaker + dried residues; B = weight dried residues

Total suspended solids

The filter paper was weighted and recorded as B, and then water sample was measured and filtered. The filter paper with solid left on it was inserted into an oven one hour. After one hour the filter paper with residues was removed from an oven and cooled. The filter paper with sample was weighted by using digital balance and recorded as A. The total suspended solids were calculated by using the following equation.

$$Total\ \ Suspended\ Solids(mg/L) = \frac{(A-B)}{ml\ \ of\ \ \ sample} X1000$$

Where A = weight of beaker + dried residues; B = weight of dried residues

Alkalinity

The alkalinity of water sample was determined by measuring a sample in measuring cylinder and poured into 250 mL conical flask and two drops of methyl orange was added as indicator. The water sample was titrated by addition of 0.01M H_2SO_4 solution until the end point was achieved. The alkalinity of water sample was calculated by using:

$$Alkalinity\,(mg/L) = \frac{V\ X\ N\ X\ 50}{ml\ \ of\ \ \ sample} X1000$$

Where V = Volume of standard acid in mL; N = Normality of standard acid

Hardness

Hardness of water was determined by measuring a sample and poured into 250 mL conical flask and 2 mL of buffer solution was added. The water sample was titrated against 0.01M EDTA solution by using eriochloro black T as indicator. The hardiness of sample was determined by using the following equation.

$$\text{Hardness (mg/L)} = Hardness = \frac{V_{EDTA} M_{EDTA} (Molarmass\ of\ CaCO_3)}{Volum\ of\ \ sample} \frac{1000\,mg/g\ X\ 1\,ppm}{mg/L}$$

Where V= volume of standard EDTA in mL

Where V= volume of standard EDTA in mL

Free carbon dioxide

The water sample was measured by using measuring cylinder and poured into 250 mL conical flask. Few drops of phenolphthalein were added as indicator. The water sample was titrated with 0.1M Na_2CO_3 solution until the color was changed. The free carbon dioxide in water was determined by using the following formula.

$$Free\ Carbon\ dioxide = \frac{N\ of\ \ Na_2CO_3 * EWt\ of\ \ CO_2 * 1000 * ml\ of\ Na_2CO_3}{mm\ \ of\ sample}$$

Where N= normality of standard titrant

Chloride:- The water sample was measured by using measuring cylinder and poured into 250 mL of conical flask and 2drops of potassium chromate was added as indicator. The sample was titrated against 0.028 M $AgNO_3$ solution until the end point is achieved. The Chloride concentration in water sample was determined by using:-

$$Chloride(mg/L) = \frac{A * N * 35.5 * 1000}{ml\ \ of\ \ sample}$$

Where A=volume of standard titrant; N= normality of standard titrant

RESULTS AND DISCUSSION

The mean values of some of the selected physico-chemical parameters have been tabulated below in the table.

Table 1. The average value of some physico-chemical properties of Boye wetland.

No.	parameters	Average value obtained	WHO value	Aquaculture pond water standards as per Boyd (1998)
1	pH	8	6.5-8.5	7-9
2	Total solids(mg/L)	353.3	-	
3	Total dissolved solids(mg/L)	278.3	500	500
4	Total suspended solids(mg/L)	86.7	-	-
5	Hardness	128.3	80-120	50-200
6	Alkalinity(mg/L)	102	200	50-300
7	Free carbon dioxide(mg/L)	42.7	6	1-10
8	Chloride(mg/L)	99	250	1-100
9				2000

The physical description of water samples are temperature, pH, color, electrical conductivity, turbidity, and total suspended solids or TSS. Major chemical descriptors of water chemistry classically include major ions,Ca^{2+}, Mg^{2+},Na^{+},Cl^{-},SO_4^{2-},HCO_3^{-}(CO_3^{2-} if pH >8.2),which occur at levels exceeding 1 mg/L, minor ions such as F^{-} and borate, between 0.1 and 1 mg/L and seldom analyzed, dissolved trace elements below 100 $\mu g/L$ as common metals (Fe, Mn Al) and potential toxic metals (Cu, Cd, Hg, Pb, Zn…)or metalloids(As, Sb, Se, Sn…) (M.Meybeck , 2009). Here below the quantitative result of some physic-chemical properties of this study are presented by using line graph and table.

Temperature: As shown in fig 3.2 below, the temperatures of the samples were noted at the sampling point itself. As indicated in graph below, the temperature was 13.5, 13.6 and 13.8oC in the three sites. During the present investigation, there was no great difference between the temperatures of the three sample points of Boy wet land and it is related to the WHO standards i.e. 15 ^{o}c.

Hydrogen Ion concentration (pH): is an important parameter which is important in evaluating the acid-base balance of water. Also it is the indicator of acidic or alkaline condition of water status. WHO has recommended maximum permissible limit of pH from 6.5 to 8.5.As shown in fig 1. the current investigation were 7.2, 7.6, and 7.4 which are in the range of WHO standards. The overall result indicates that the values are within the desirable and suitable range. Basically, the pH is determined by the amount of dissolved carbon dioxide [CO_2], which forms carbonic acid in water. According to, pH of water can also be lowered by organic acids from decaying vegetation.

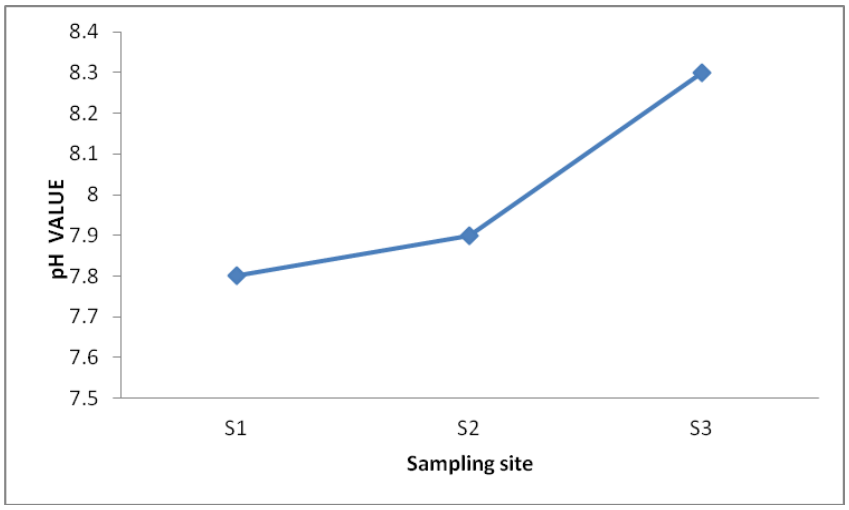

Figure 1. pH of Boye wetland water sample from three sampling points:$S_{1=}$ upper, S_2 =middle and S_3=down

Free carbon dioxide: The free CO_2 concentrations in water indicate the presence of decomposable organic matter, by bacterial action on organic matter. The free carbon dioxide of Boye wetland in S_1 was 33 mg/L, S2 40 mg/L and in S3 55 mg/L smallest concentration of free CO_2 is may be due to high photosynthetic activity.

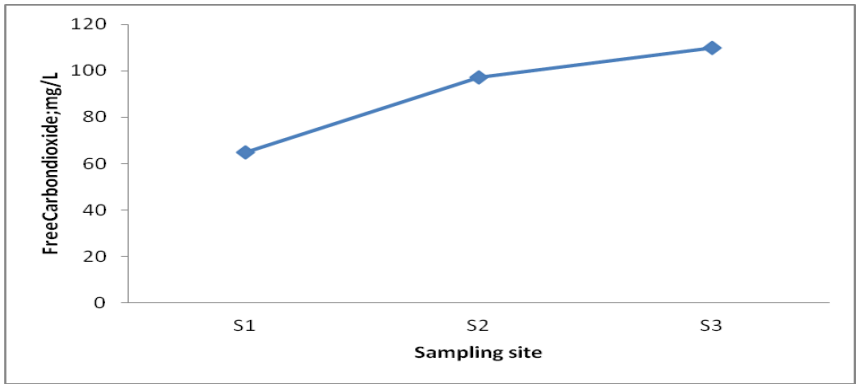

Figure 2. Free carbon dioxide of Boye wetland water sample from three sampling points: $S_{1=}$ Upper, S_2 =middle and S_3=down.

Alkalinity: Alkalinity indicate that the presence of bicarbonate, carbonate and hydroxide also silicate and phosphates less frequently in wetland. In the present study the value obtained from sites slightly differ. The reason of this difference may be due to variation of HCO^-_3, CO^{2-}_3 and OH^-. The highest value in sample S_3 from the above table 2 indicated the presence of concentration of the anions

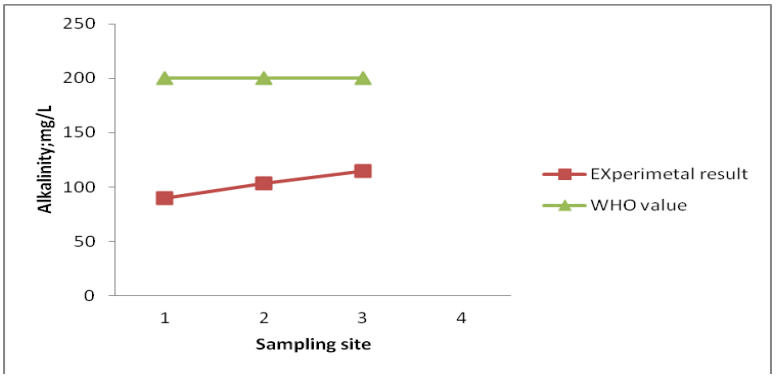

Figure 3. Alkalinity of Boye wetland water sample from three sampling points:$S_{1=}$ upper, S_2 = middle and S_3=down.

Chloride ion (Cl^-): Chloride is considered as one of the most important inorganic anion in water it occurs naturally in all types of water due to its high solubility. In the present investigation minimum chloride in sample S_3 and maximum chloride concentration in S_2.

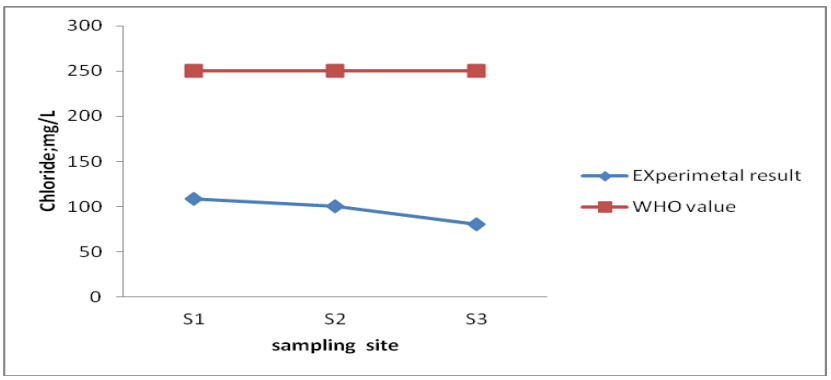

Figure 4. Chloride ion of Boye wetland water sample from three sampling points:$S_{1=}$ upper , S_2 =middle and S_3=down

Total Dissolved Solids (TDS): The result was shown in figure 5 below. This is the important parameter for the use of water. The water with high TDS value indicates that water is highly mineralized.

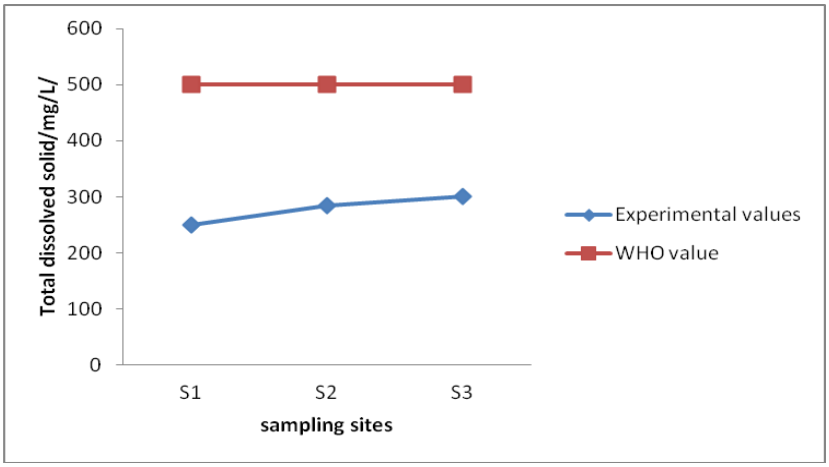

Figure 5. The total dissolved solids of Boye wetland water samples from three sampling points:$S_{1=}$ upper , S_2 =middle and S_3=down.

Total solids in water sample refer to any minerals, salts, cation and anions dissolved in water. Also the amount of mobile charge ions. From the above figure the total dissolved solids in water sample in S_3 of Boye wetland was less than S_2 and S_3. The smallest value of TDS in S_1 observed that the presence of small concentration of minerals, salts, anions and cations.

Total suspended solid :Total suspended solids are the solids which not pass through filter material and not dissolved in water in water or small solid particles which remain in suspension in water as colloid or due to the motion of the water.

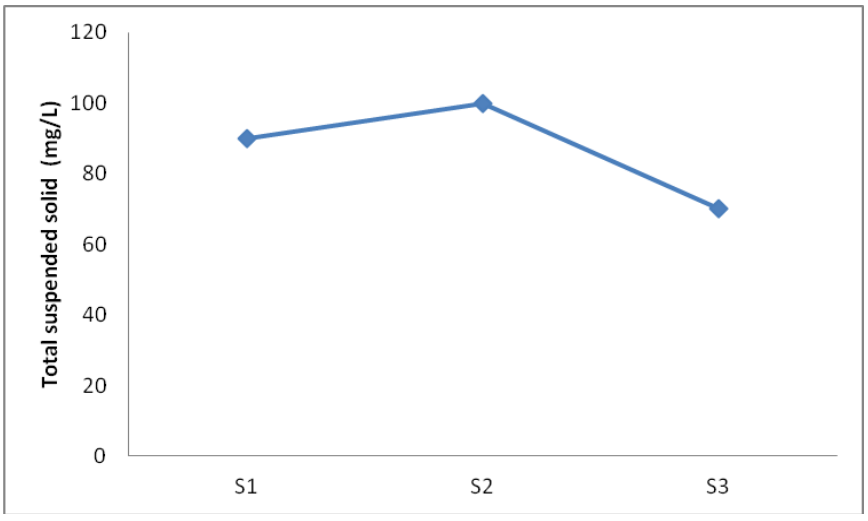

Figure 6. Total suspended solids of Boye wetland water sample from three sampling points:$S_{1=}$ upper, S_2 =middle and S_3=down.

The above result in Figure -6- show the total suspended solids obtained from each point were different. TSS of sample in S_3 was less than that of the S_1 and S_2. The smallest value of TSS in S_3 indicated the sample has not many undissolved solids.

Total Hardness: Hardness is a very important parameter in decreasing the toxic effect of poisonous element. Hardness indicate that the presence of multiple cations such as Mg^{2+}, Ca^{2+} and so on. In this study the hardness value observed from each site were different. This difference was due to the concentration of multiple cations present in each point different

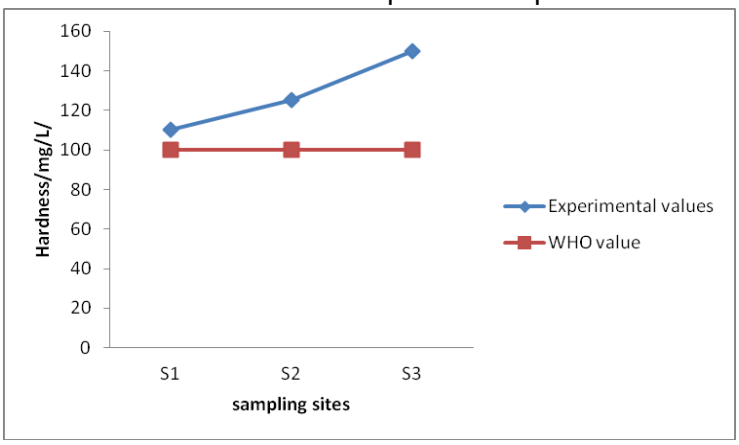

Figure 7. hardness value of water sample from three Sampling points:$S_{1=}$ upper , S_2 =middle and S_3=down

From the above figure 7 the hardness of water sample in S_3 was highest. The highest values indicated that the sample point contained more concentration of polyvalent cation.

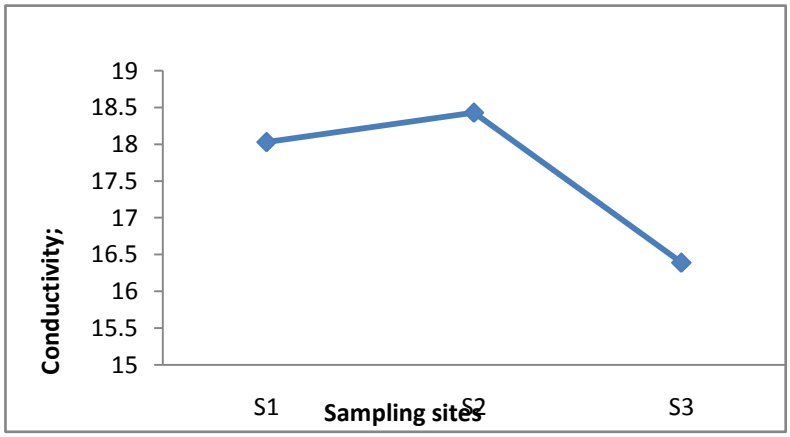

Figure 8. Electrical conductivity (S/m) values of various water samples from three Sampling points: $S_{1=}$ upper , S_2 =middle and S_3=down

The relative difference in electrical conductivity difference across the three site of Boye River indicates the variation of reduced level of ionic species.

In this study the value obtained for each parameter from the sample points were different. This difference first, due to the amount of substance concentrations presented in water sample was different from point to point within the same wetland. Because, as Boye wetland passes through Jimma town the amount and nature of municipal waste added to the wetland was different though S1 to S3.

The second due to each parameter depend on the different substance presented in water, the average value of all parameters studied in this summarized in table-1-. However, the pH average value of water sample was permissible with WHO value and some parameters below and above standard WHO value recommended for human consumptions.

CONCLUSIONS

In the study the value of physco-chemical parammeters obtained from each point were different. The difference among the three sample points of Boye wetland due to the value of all physicochemical parameters depends on the concentration of different matters present in the water. Because, as Boye wetland passes through Jimma town the amount of municipal waste added to the wetland was different though S1 to S3. In this study except total suspended and chloride the value of all parameters in sample S_3 highest. The pH, hardness and alkalinity value of Boye wetland were slightly permissible with WHO standard value. However, the value of total solids total dissolved solids and total suspended solids obtained below WHO standard value recommended for human consumption.

ACKNOWLEDGEMENTS

We are grateful to department of chemistry Jimma University for supporting necessary materials during the analysis

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