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Evaluation the safety of drinking water in some regions of Baghdad side Rusafa

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ABSTRACT

This study aim to evaluate drinking water in some residential area, so four stations (ST1 Sadr City, ST2 The Palisten street,ST3 Zayouna , ST4 Baghdad Al gadeda) had been chosen to sample tape water in Baghdad Rusafa sector from November 2015 to march 2016. Some physical, chemical (inorganic nutrients, ions, heavy metals) and bacteriological parameters analyzed. The results were unacceptable for turbidity according to local and world standardization for drinking water which is ranged between(1.8-14.7)NTU, while TDS value ranged between(196-547mg/l)in the 2nd station ,total hardness(200-458mg/l),Ca^{+} and Mg^{+} levels range between(60-160),(11-24)mg/l respectively. Chloride levels ranged between (29.9-180mg/l), the nutrients NO_3-N, NO2-N, NH4-N levels ranged between (2.6-7mg/l) for NO_3, (1.5-4.2 mg/l) for NO_2 and (0.8-2.1 mg/l) for NH_4, the levels of NO_2 and NH_4 was higher than the Iraqi standard specifications and WHO. Heavy metals ranged between (0.001-0.15mg/l) for Fe while for Pb(0.001-0.009mg/l) and for Cu(0.001-0.7)mg/l. For the bacteriological aspect, the fourth station polluted with Coliform bacteria which reached to (300cell/m) in January 2016.

Keywords: Drinking water, heavy metals, inorganic nutrients, Coliform bacteria, Baghdad-rusafa.

1. INTRODUCTION

Drinking water and its amount, quality and other uses as well as consumption management represent the progress of populations [1]. Water quality is important for human life as drinking water and other uses for humans and animals. WHO reports mentioned that every 8 seconds a child dies due to infection with water borne diseases [2]. 50% of developing countries suffering from these diseases especially intestinal diseases and 80% from it caused by water pollution, also reports refer to 16% from world population deal with polluted water [3], so the attention brings to water purification plants that provide safe water for populations and continuous developing for its work and raw materials used to keep pace with lastest technology [4]. It is important to focus on water quality in water distribution system [5]. This study aim to ensure that drinking water quality in some areas of Baghdad is safe for human consumption.

2. MATERIALS AND METHODS

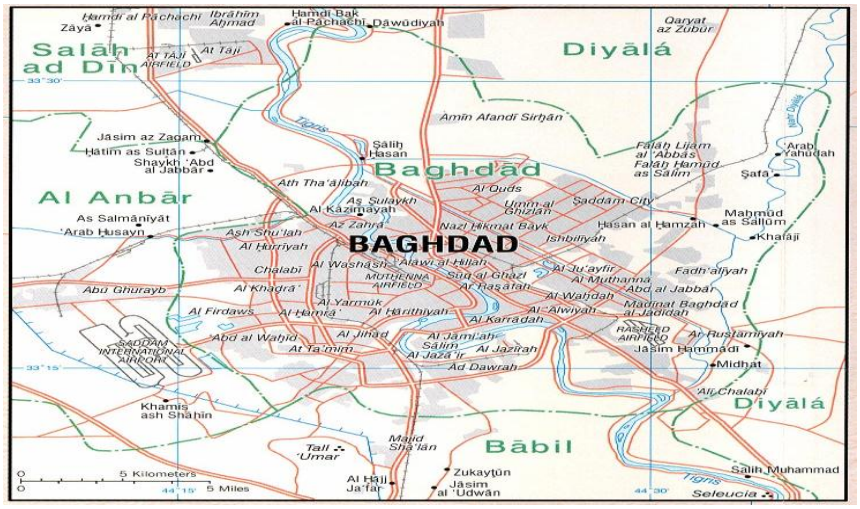
The study start with four stations selected randomly in Baghdad- Rusafa section in residential area .tap water collected with duplicate for each sample and study period start from November 2015 until March 2016 .samples of tape water collected from:

1.ST1 Sadr City
2.ST2 The palisten street
3.ST3Zayouna
4.ST4 Baghdad al gadeda

For chemical analysis samples collected in plastic bottles (2-3.5) litter closed tightly and transfer to laboratory with ice cool bag. turbidity measured by turbidity meter and total dissolved solids(TDS) by Millipore filter paper according to [6]. chlorides , Total hardness and (Ca+ , Mg+) hardness measured

according to standard methods[7] ,[8] , Cl^+ measured by [7].Fe ions measured by phenathroline method [7] also some heavy metals had been detected like Cu+2 and Pb+2 [9], While No3,No2 measured by[10], NH4 by Nesslerization Method, Coliform Bacteria have been detected according to guides line [11]and [12].

The Statistical Analysis System [13]program was used to effect of difference factors in study parameters. Least significant difference –LSD test (ANOVA) was used to significant compare between means and estimate of correlation coefficients between parameters in this study.



Map (1) Baghdad- Rusafaa district regions

3. RESULTS AND DISCUSSION

3.1 Turbidity and TDS

Turbidity caused by particulate matter like soil, clay, sand, organic and inorganic materials or microorganisms (4).Total dissolved solids (TDS) are ionized or non-ionized materials or few organic materials may be created with human activity(14).turbidity was highest in 4th station which is reach to 14.7(NTU) in winter season also approximation values appeared in stations (2 and 3) with station 4 in winter season. While the first station recorded high values in February which is reach to (7.6) NTU. The differences between stations was sagnificant($P<0.05$).The variations in turbidity values during study period confirm that water treatment plant was inefficient and exist some cracks in pipes of water network which is lead to pollute drinking water with sewage water(15).amount of added alum and method of operation and maintenance of the project quality have the effect of turbidity rates. The measured turbidity levels unacceptable limits according to standard specification and WHO (11, 16).

Total dissolved solids as shown in Table-1, the highest value was 547mg/l in 3rd station and the minimum in 4th station (134mg/l). The average of TDS was higher in winter (februrary2015) and lower in November (2015) Statistically the correlation was significant between turbidity and TDS at $p\leq0.05$, also other studies showed higher values for TDS in winter season (17) due to high perception in winter and deficiency in water treatment plants lead to high values in TDS levels (18), even though the values was acceptable less than 1000mg/l (11, 16).

3.2 Total hardness, Ca+ and Mg+ hardness

Total hardness related with Ca+ and Mg+ hardness and other divalent cations which is divided into temporary and permanent hardness (19), that confirmed by correlation between total hardness and hardness of Ca+ and Mg+ ($r=0.11$,$r=0.15$ respectively at $p\leq0.05$).The highest values of total hardness was recorded in December as shown in figure(3), The maximum value reach to(458mg/l) in 2nd station. Because of the water tend to be alkaline this is lead to hydrolyze aluminum hydroxide(gelatinous precipitation) in water and lose its sedimentation efficiency and increases water hardness(18),or highly hardness ground water leached within old and cracked water pipes (15).from the result total hardness was in acceptable value(<500mg/l)according to Iraqi specifications(417) and WHO(16,11).The second station also shown the highest value for Ca+ hardness fig(3)which is reach to (160mg/l) in December and the differences was not significant between the stations but it was significant between months of study period at $p\leq0.05$.The Mg+ recorded highest value (24mg/l) in February in 2nd station while other stations didn't show the same trend table(1).the lowest value for Ca+ (60mg/l) and Mg+ (11mg/l) hardness in 4th station in February .Ca+ and Mg+ increases in tap water due to increase salts concentration in sedimentation tanks of water treatment plant and un programmed maintenance for these tanks (20).This study agree with others that total hardness ,Ca+ and Mg+ hardness increases in winter season and exceeded the accepted Levels of hardness in Iraqi water (16, 11, 17).

Table 1: Range, standard deviation, and Duncan test for different studied stations.

Parameters	Station			
	ST1	**ST2**	**ST3**	**ST4**
Turb. (NTU)	2.2-7.6 4.9 ± 0.86 B	1.8-7.4 4.6 ±0.79 B	2.3-7.5 4.9 ±1.24 B	1.9-14.7 8.3 ±3.64 A
TDS (mg/L)	335-546 440.5 ±65.2 A	232-518 375 ±51.4 AB	196-547 371.5 ±124 AB	134-485 309.5 ±94.3 B
T.H. (mg/L)	229-439 365.5 ±89.1 A	288-458 373 ±85.6 A	250-423 336.5 ±102.4 A	200-410 305 ±116.3 B
Ca (mg/L)	95-156 125.5 ±46.3 A	80-160 120 ±54.9 A	80-148 114 ±41.7 A	60-144 102 ±409.6 A
Mg (mg/L)	12-18 15 ±4.6 AB	12-24 18 ±3.9 A	7-14 10.5 ±4.09 B	11-13 12 ±0.61 B
Cl (mg/L)	79.9-170 124.95 ±22.5 A	49.9-180 114.95 ±34.6A	39.3-170 104.65 ±37.2 A	29.9-120 74.95 ±37.0 B
No3 (mg/L)	4.6-7 5.8 ±0.94 A	3.6-4.5 4.05 ±0.46 A	3.1-5.7 4.4 ±0.62 A	2.6-6.6 4.6 ±0.88 A
No2 (mg/L)	2.8-4.2 3.5 ±0.59 A	1.7-3.4 2.6 ±0.44 A	1.5-4.0 2.8 ±0.58 A	1.5-3.9 2.7 ±0.33 A
NH4 (mg/L)	1.1-2.1 1.6 ±0.6 A	0.8-1.3 1.05 ±0.48 A	0.8-1.5 1.15 ±0.03 A	0.8-1.9 1.35 ±0.25 A
Fe (mg/L)	0.003-0.15 0.08 ±0.03 A	0.002-0.12 0.061 ±0.03 A	0.002-0.11 0.06 ±0.02 A	0.001-0.12 0.06 ±0.03 A
Pb (mg/L)	0.001-0.009 0.005 ±0.002 A	0.001-0.003 0.002 ±0.001 A	0.001-0.003 0.002 ±001 A	0.001-0.007 0.004 ±0.002 A
Cu (mg/L)	0.003-0.3 0.15 ±0.06 B	0.003-0.2 0.10 ±0.04 B	0.002-0.17 0.09 ±0.04 B	0.001-0.7 0.35 ±0.13 A
Coli form bac. (cell/ml)	0-200 100 ±50.2 AB	0-100 50 ±25.0 B	0-100 50 ±25.0 B	0-300 150 ±85.0 A

3.3 Chlorides:

Chloride found in form organic and inorganic salts that usually drifted from soil and agricultural lands (21).From table (1) chloride recorded highest value (180mg/l) in December2015 in 2nd station as well as other stations recorded higher value in same month. In February from table (1) decreased values of Cl- were noticed in which the lowest value reach to (29.9mg/l) in 4th station. Statistically 4th station is differed significantly from other stations at p≤0.05.other study showed that chloride levels was higher in summer season and lower levels in winter season (22)The chloride levels in all stations in this study didn't over the specific limits for Iraqi water (16,11).chloride levels increased due to chlorination process (23) or leached ground water to water network pipes (24).

3.4 The nutrients NH4, NO2, NO3

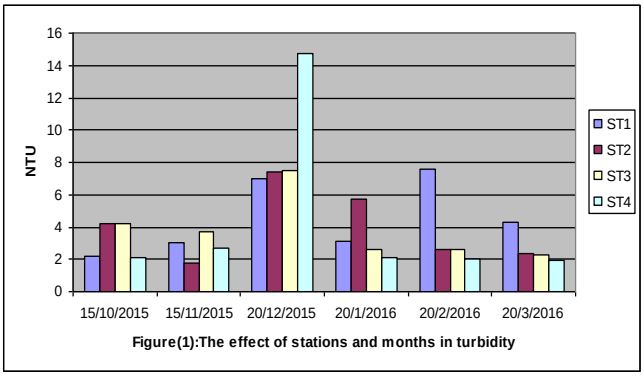
Water considered in bad condition when nitrogen level in water is high (25, 26).In January the higher values of nitrate recorded in all stations and 1st station showed a highest value which is reach to(7mg/l),as well as both of NO2-N andNH4-N show highest values ,which is reach to(4.2mg/l) and (2.1mg/l) respectively, table(1). Nitrogen-N levels in water increased due to bacteriological pollution in this station(27),this is confirmed by the significant correlation between nitratateNO3-N and NH4-N with coli form bacteria (r=0.48,r=0.56) at p≤0.01 and with NO2-N (r=0.18) at p≤0.05.according to local and world standards the nitrate NO3-N levels within acceptable limits (25-50 mg/l)while for NO2-N and NH4-N ,their levels were un acceptable to the standard limits (1-3mg/l) and(1-5mg/l) for nitrite and ammonia respectively.

3.5 Heavy metals Fe,Pb,Cu

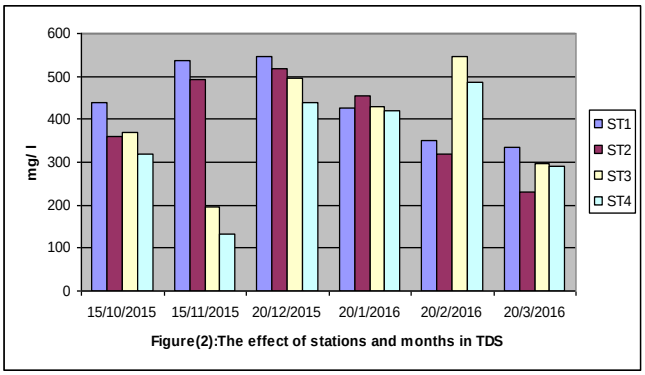
During the study period, Heavy metals values as shown in table (1) were unstable. Both of Fe and Pb recorded highest values in January(2016) ,the first one(Fe) reached to (0.15mg/l) in 1st station as well as in other stations while the lowest values(0.001mg/l) recorded in march at 4th station . Increasable values were recorded for pb which is reach to maximum value (0.009mg/l) in 1st station as shown from figure (11). In November Cu increased to a maximum value to (0.7mg/l), in 4th station. Increasing in heavy metals levels due to un efficiency process of chlorination at the end of network (28, 29) or newly used disinfection process which is lead to pollute water with heavy metals (30).From the statistical analysis there is no significant differences for Fe levels between stations through study period except in November which noticed a significant differences between stations at p≤0.05,a significant correlation between Fe and Pb (r=0.44) at p≤0.05 and Fe with Cu (r=0.28)at p≤0.01. All the values of heavy metals were in acceptable ranges according to drinking water standards for Fe (0.3 mg/l), pb(0.01) and Cu(1mg/l).

3.6 Coliform bacteria

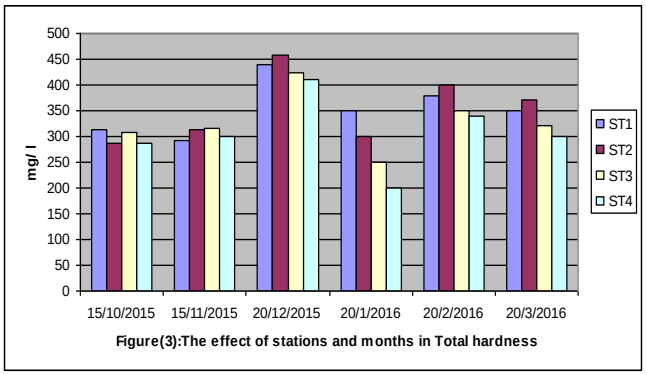
Bacteriological pollution of drinking water could easily spread water borne diseases widely (31) and coliform bacteria could cause many infections to any tissue out of the intestine (32).coliform bacteria appeared in December and January in all stations and reached to the highest levels in 4th station(300cell/ml),while other months registered (0 cell/ml)through the study period. Coliform bacteria appeared in this period because the availability of nutrient that encourage the bacterial growth(33)and (34).,as well as statistical analysis showed a significant correlation between nutrients (NO3,NO2) and coliform bacteria as mentioned before. Also statistical analysis show significant differences between stations December and January at p≤0.05.The bacteriological standards for drinking water should be (0cell/ml) for all months of study.



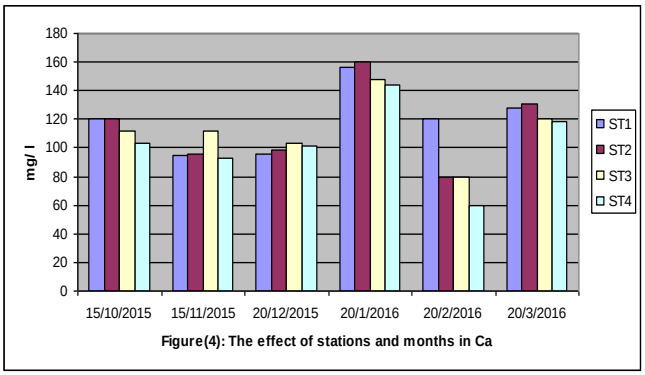
Figure(1):The effect of stations and months in turbidity



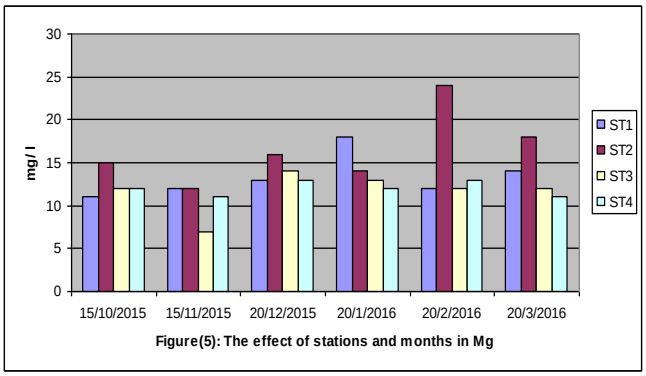
Figure(2):The effect of stations and months in TDS



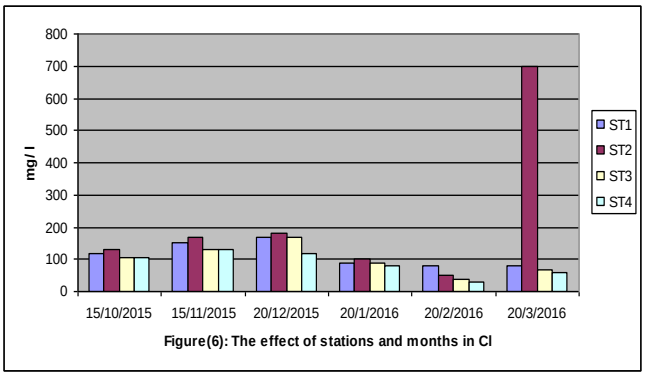
Figure(3):The effect of stations and months in Total hardness



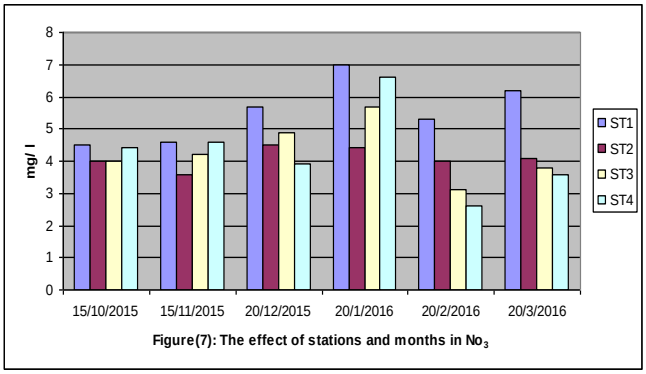
Figure(4): The effect of stations and months in Ca



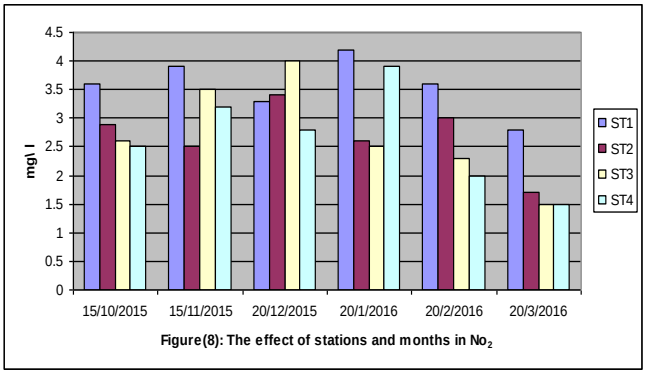
Figure(5): The effect of stations and months in Mg



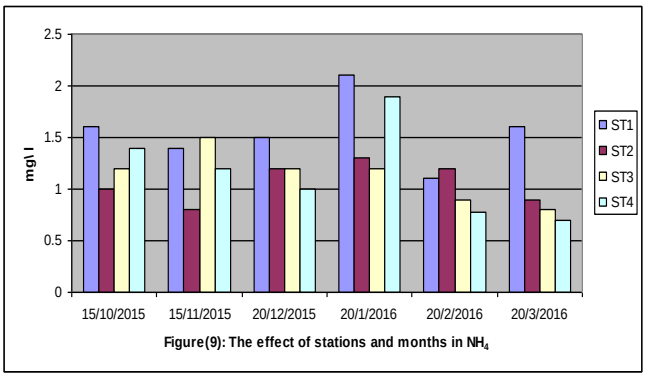
Figure(6): The effect of stations and months in Cl



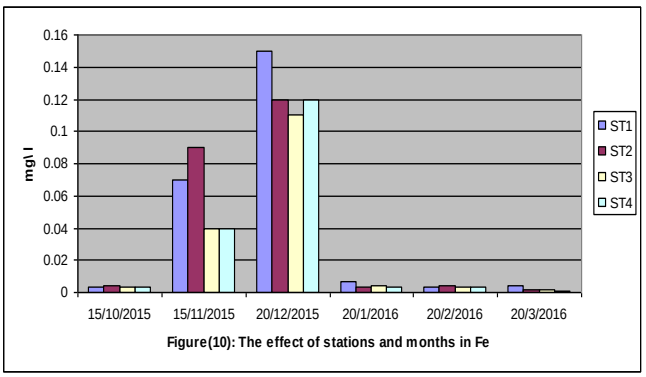
Figure(7): The effect of stations and months in No_3



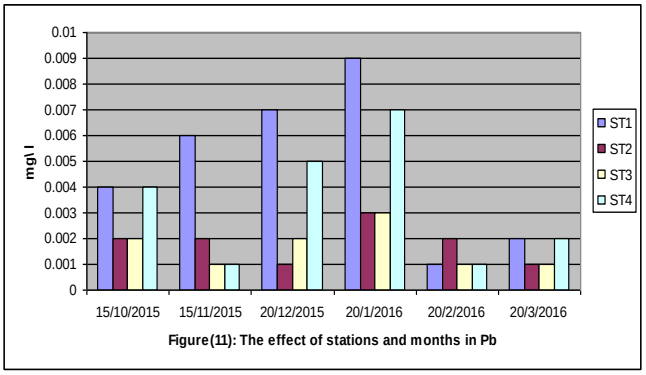
Figure(8): The effect of stations and months in No_2



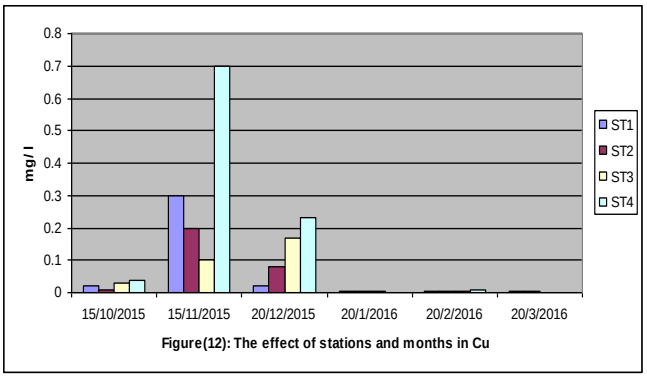
Figure(9): The effect of stations and months in NH_4



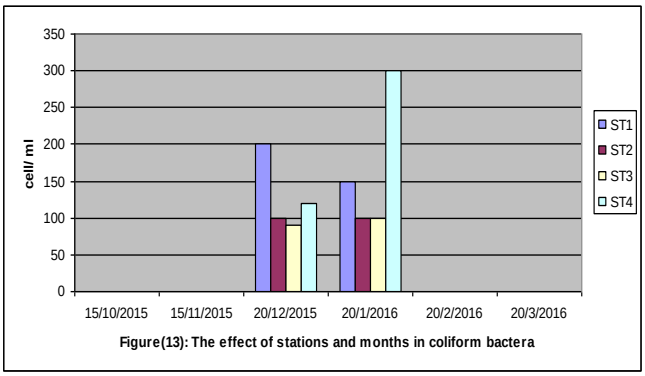
Figure(10): The effect of stations and months in Fe



Figure(11): The effect of stations and months in Pb



Figure(12): The effect of stations and months in Cu



Figure(13): The effect of stations and months in coliform bactera

4. CONCLUSION

Water quality is superior for human life. During process of four stations the result we conclude, shows that all sampling points referred that drinking water contains many pollutants which is unsafe for consuming like coliform bacteria. Turbidity and some of Inorganic nutrients exceeded the acceptable limits in all samples.

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