Physicochemical Study of Drinking Water used from Selected Groundwater in Misurata Area

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Abstract— This study was conducted on underground water samples from wells in Misurata area. This area is extended from Edafnia in the west of Misurata to Tawarga at the east, (about 70 km distance) this area divided into ten lines perpendicular to the sea coast. Five water samples were collected for each line, where the length of each line was about 10 km. The purpose of this study was to know the deterioration reasons for ground water used in drinking, and to evaluate quality during the summer season, from May to October 2014. Some physical and chemical properties such as Temperature, pH, Turbidity, DO, COD, BOD, Total Hardness, Alkalinity, Acidity, TSS, TDS, TS, EC, Salinity, Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, PO_4^{3-}, SO_4^{2-}, NO_2^-, NO_3^- and some heavy metals such as Fe, Mn, Cu and Zn were measured during in this study. The results of analysis indicated that, all measured parameters were within permissible limit compared with international standard for drinking water.

Keywords: Drinking water, groundwater, Misurata, physical and chemical properties

INTRODUCTION

Water is essential to maintain and sustain human life, animal and plant [1].The availability of good quality water is an indispensable feature for preventing disease and improving quality of life [2]. Safe drinking water is a human birthright as much as clean air, however much of the world's population does not have access to safe drinking water. Of the 6 billon people on earth, more than one billon lack access to safe drinking water [3]. Groundwater constitutes an important source of water supply for domestic and agriculture purposes in Libya. Ground water is believed to be comparatively much cleaner and free from pollution than surface water. Water pollution is a state of deviation from pure condition, whereby its normal function and properties are affected. However, prolong discharge of industrial effluents, domestic sewage and solid waste dump causes the groundwater to be polluted thereby creating health problems [1].The natural water analysis for physical and chemical properties including trace element contents are very important for public health studies. These studies are also a main part of pollution studies in the environment [4-10]. Also, investigations of the quality of drinking water samples have been continuously performed by researchers around the world. The determinations in drinking water have been performed using classical analytical techniques including titrimetry, gravimetry and modern instrumental techniques such as atomic absorption spectrometry (AAS), inductively coupled plasma-mass spectrometry (ICP-MS), ultraviolet visible spectrophotomety (UV-Vis), etc. Because of the low cost and easiness in usage, atomic absorption spectrometry is the main instrument for the determinations of the trace heavy metal ions in drinking waters in the analytical chemistry laboratories [11-13].

Water pollution arising from the presence of foreign substances (organic, inorganic, bacteriological, or radiological) which tends to degrade the quality of water has become a serious concern today [14]. Trace metals are natural components of the hydrosphere and many are necessary, in minute quantities, for the metabolism of organisms (e.g. arsenic, copper, iron, molybdenum, tin, etc.) [15]. The presence of toxic metals such as Pb and Cd in the environment has been a source of worry to environmentalists, government agencies, and health practitioners. This is mainly due to their health implications since they are non-essential metals of no benefit to humans [16]. Trace metals have been referred to as common pollutants, which are widely distributed in the environment with sources mainly from the weathering of minerals and soils [17]. However, the level of these metals in the environment has increased tremendously in the past decades as a result of human inputs and activities [18]. Aside from anthropogenic sources, ways of water contamination can also be from natural sources. Metal pollution comes from both natural and anthropogenic sources [19].

These problems are much more acute in areas which are densely highly populated, heavily industrialized and have shallow ground water tables.

Rapid urbanization, among other factors has further degenerated groundwater quality due to exploitation of natural resources and improper waste disposal practices. Hence, there is always a need for concern over the protection and management of groundwater quality [20], Groundwater is naturally replenished by surface water from precipitation, streams and rivers when this recharge reaches the water table. Rain water dissolves soluble salts from vegetations, topsoil, river bed, lake bed into water bodies, hence most ions (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+} and NH_4^{+}) in rain water are also found in surface and groundwater [21].

MATERIALS AND METHODS

The area of study is shown below **(Fig. 1)**.

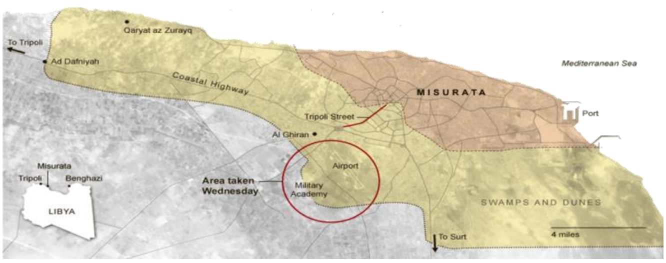

Figure 1: Area of study

SAMPLE COLLECTION: 10 representative water samples were taken randomly from different locations in Misurata area. The wells were selected from major quarters within the town while the tap water was located in city. All samples were collected in the same day. Water samples were collected from ten different points, one each month interval for six months from May to October 2014. The description of the sampling areas is shown **(Table 1)**. Before collection, the mouth and the outer parts of the borehole taps were sterilized using flame, and allowed to cool by running water for about 1 minute. Each sample for analysis was collected using a clean two litres plastic container with a screw cap which was thoroughly washed with detergent, soaked with acid and rinsed with distilled water. At the point of collection, the container was rinsed three times with the water sample and few drops of HNO_3 were added immediately to prevent loss of metals, bacterial and fungi growth. All the samples were stored in laboratory, freshly refrigerated at 4°C in a cooler packed with, ice blocks prior to analysis to avoid microbial action affecting their concentration. All the chemicals used were of the analytical grade.

Table 1: Sampling Area Descriptions

Sampling Number	Location	Description
1	Ad Dfniyah	Community, farmers
2	Zurayq	Community, farmers
3	Zawyat Al Mahjub	Community, farmers
4	Al Ghiran	Community, farmers Workshop Area
5	Yader	Mechanical Workshop Area
6	Grara	Mechanical Workshop Area
7	Qasr Ahmad	port, Workshop Area
8	Taminah	Community, farmers
9	Al kararim	Community, farmers, Workshop Area
10	Tawurgha	Community, farmers, Workshop Area

PHYSICOCHEMICAL ANALYSIS:

The procedures for determination of parameters were performed according to WHO standard [26]. pH values were determined using pH meter and temperature values were recorded by a mercury-glass thermometer graduated in units of °C. The electrical conductivity (EC) was determined using conducto-meter while the totals dissolve solid (TDS) in the water samples detected using the Hach TDS meter, all these parameters were determined on the spot. The total hardness (THD), magnesium hardness (MHD), calcium hardness (CHD), acidity, chloride, alkalinity and total solid (TS) were estimated by titrimetric analysis [22]. For determination of metals 5ml of concentrated hydrochloric acid was added to 250ml of each water samples and evaporated to 25ml. The concentrate was transferred to 50ml flask and diluted to mark with deionized water [23]. Trace metals in the water samples namely Fe, Mn, Cu and Zn were determined using atomic absorption spectroscopy (Buck model 200A), while sodium and potassium were determined by Flame Photometer. The anions such as (SO_4^{2-}, PO_4^{3-}, NO_2^- and NO_3^-) were determined using UV-Visible spectrophotometer. Results obtained were averages of triplicate determination.

RESULTS AND DISCUSSION

The results of physicochemical analysis of water sample from selected wells are shown below **(Table 2)**.

Table 2: The Mean values ± Sd of physicochemical analysis

Sample parmeter	Ad Dfniyah	Zurayq	Zawyat Al Mahjub	Al Ghiran	Yader	WHO standard
Temp (°C)	25.5±0.01	26.5±0.1	26.0±0.1	26.5±0.01	26.5±0.1	30-33 °C
pH	7.0±0.2	7.5±0.1	7.5±0.4	7.0±0.2	7.0±0.05	6.5-8.5
Turbidity(NTU)	1.9±0.07	2.0±0.09	2.5±0.05	2.3±0.1	3.0±0.1	5 NTU
DO mg/l	3.1±0.5	4.5±0.2	4.0±0.7	4.3±0.09	4.0±0.2	7.5 mg/l
COD mg/l	3.8±0.2	4.5±0.1	4.2±0.5	4.5±0.3	4.2±0.1	7.5 mg/l
Alkalinity mg/l	9.0±1	8.2±0.8	8.3±0.4	10.6±0.5	7.3±0.2	100mg/l
Acidity mg/l	20.0±2	33.5±1.5	17.3±1	19.5±1.7	20.0±1	100mg/l
TSS mg/l	30.0±1.2	31.0±0.6	31.05±0.3	34.0±0.7	29.0±1	30 mg/l
TDS mg/l	199.0±5	490.0±1.8	530.0±2.3	478.0±5.2	358.0±6.1	250-500 mg/l
TS mg/l	46.3±1.3	40.0±0.8	42.0±0.5	52.5±0.6	42.5±0.3	500 mg/l
EC µs/cm	214.5±2.8	325.0±7.1	276.0±3.5	277.0±2.5	312.5±2.6	500 µs/cm
Salinity mg/l	239.0±3.1	228.0±5	214.5±1.9	259.0±2.4	268.0±5	200-250 mg/l
Nitrate mg/l	8.0±0.2	10.0±0.3	10.0±1	11.0±0.5	10.5±0.6	10 mg/l
PO_4^{3-} mg/l	3.5±0.6	4.0±0.1	4.2±0.5	4.0±0.2	4.5±0.1	0-5 mg/l
BOD mg/l	7.0±0.1	8.0±0.2	8.0±0.1	6.5±0.2	7.5±0.2	6-9 mg/l
Total Hardness mg/l	118.0±5	112.0±2	91.0±3	124.0±1.5	119.0±3	200 mg/l
Ca^{2+} mg/l	51.3±0.6	42.5±0.2	36.5±0.4	49.0±0.2	63.0±0.5	75 mg/l
Mg^{2+} mg/l	117.5±8	90.0±2	102.0±7	105.0±3	82.0±5	150 mg/l
Cl^- mg/l	14.0±0.9	25.0±0.2	37.0±0.7	33.0±0.1	31.0±0.0	250 mg/l
SO_4^{2-} mg/l	175.0±2	165.0±6	140.0±4	150.0±9	190.0±5	400 mg/l
NO_2^- mg/l	0.1±0.0	1.0±0.0	1.0±0.0	0.1±0.0	0.2±0.0	10 mg/l
Fe (mg/l)	0.4±0.0	0.2±0.0	0.1±0.0	0.5±0.0	0.2±0.0	0.3 mg/l
Mn (mg/l)	0.1±0.0	0.3±0.0	0.5±0.0	0.5±0.0	1.0±0.0	0.5 mg/l
Cu (mg/l)	1.0±0.0	0.5±0.0	0.4±0.0	0.5±0.0	0.4±0.0	1.0 mg/l
Zn (mg/l)	1.0±0.0	0.5±0.0	1.2±0.0	1.5±0.0	0.4±0.0	5.0 mg/l
Na (mgl)	29.5±0.6	25.0±0.2	12.0±0.2	20.0±0.1	35.0±1.2	200 mg/l
K (mg/l)	19.0±0.9	3.5±0.3	3.0±0.1	4.0±0.2	4.0±0.1	20.0 mg/l

The temperature of studied water samples ranged between 25.5 to 27.5 °C as shown **(Table 2)**. Cool water is generally more potable for drinking purposes, because high water temperature enhances the growth of micro-organisms and hence, taste, odour, colour, and corrosion problems may increase [24]. Metal corrosion problems are also associated with high temperature especially at a pH of the water to be more acidic [25].

The pH values obtained ranged from 6.5 to 7.5. All samples fell within the WHO standard for potable water. The pH of water should be controlled, pH lower than 7 may cause metal corrosion while pH higher than 8 lowered the activity of disinfection by chlorine.

In the case of turbidity, the values ranged between 1.8 to 2.7 NTU, which were below the limit of 5 NTU [26].

The chemical oxygen demand (COD) ranged from 3.5 to 5.0 mg/l, and dissolved oxygen (DO) ranged from 3.1 to 5.0 mg/l are below the WHO permissible limit.

The biochemical oxygen demand (BOD) values ranged from 6. 5 to 9.9 mg/l. It was within WHO permissible limit. The BOD higher than WHO permissible limit assigned of a slight pollution of the groundwater.

Alkalinity values ranged from 6.2 to 11.0 mg/l. which were lower than WHO permissible limit.

The acidity values of all samples ranged from 10.5 to 33.5 these values were within the limit prescribed by WHO except Zurayq site. This attributed to effect of waste water.

The values of TS ,TDS and TSS as shown in Table 2,ranged from 32.1 to 55.5,199 to 579 and 22 to 34 mg/l respectively. all sites were relatively lower than the value prescribed by WHO except Taminah site with value of 579 mg/l. This may be due to groundwater pollution by waste waters [27].
The range of EC, chloride and sulfate are 200.0 to 433 µs/cm, 14 to 48mg/l and 123 to 190 mg/l respectively. In all sites, these values were within the limit prescribed by WHO. The high values of EC is considered as a monitor for increasing TDS in water [28].
The rang of salinity is 214.5 to 308.5 mg/l , the values for all site were below the recommended standard value of 250 mg/l by WHO, except Tamina, AlGhiran, Tawurgha and Yader sites **(Table 2)**. It was observed that the salinity of samples increased with increasing chloride in water **(Table 2)**.
The total hardness of studied samples ranged between 91-178mg/l . All values fell within the WHO permissible limit. The water could be classified a moderately hard water according to WHO. Except the value of Tawurgha site. The moderately hard water is preferred to soft water (≤50mg/l). For drinking purposes as hard water is associated with low death rate from heart diseases [29].
Nitrate values in the samples ranged from 8 to 12 mg/l while the nitrate ranged between 0.03 – 1.1 mg/l **(Table 1)**. The values were below the WHO standard. The safe nitrate limit for domestic water is set at 45 mg/l [26].

The phosphate values for all samples ranged from 3 to 5 mg/l **(Table 2).** This indicated that phosphate values were generally within the acceptable limit according to WHO standard**.**
The sulfate values of studied sites ranged between 123-246 mg/l . indicated that sulfate values were generally below WHO permissible limit of 200-500 mg/l.
Calcium and magnesium values for all samples were ranged between 37–71 and 82–118mg/l respectively **(Table 2)**. All values were generally below WHO permissible limit of 200 and 150 mg/l respectively.
Sodium and potassium values for all samples were ranged between 12-48 and 1–4 mg/l respectively. The values were relatively lower than the value prescribed by WHO. The presence of potassium and sodium in the water sample might be of assistant to the consumers in the maintenance of electrolyte in the body plasma, thus eliminating the shock that could arise from renal insufficiency [30].
The concentration of metals in the water samples **(Table 2)**. The concentration range of Fe, Zn, Mn and Cu were 0.1-2.7, 0.4- 5, 0.1-1.0 and 0.1-1.0 mg/l respectively. The values for all sites were relatively lower than the value prescribed by WHO. The results obtained for Zn, Mn and Cu were similar to those obtained by Al-Assawi *et al* in 2003 [31].

CONCLUSION

The results of analysis of the present study appeared that all parameters studied were below permissible limits with some exception specially nitrate in Al kararim and Al Ghiran and iron in Qasr Ahmad, Taminah, Al Ghiran and Al kararim

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