International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

A Comparative Study of Physicochemical Properties of Water of Gaber-Oun, Umm al-Maa and Mafo lakes of Libya

Ismail M. Awheda[1], Ashok Kumar[2], Abuagla Y. Ahmed[3], Husamaldin A. Gahit[4], Galal M. Zaiad[5]

[1, 2, 3, 4, 5]Department of Chemistry, Faculty of Sciences, Al-mergheb University, Al-Khums, LIBYA.

Abstract: ***The quality of Lakes water depends on various chemical constituents and their concentration, which are mostly derived from the geological data of the particular region Therefore, in the present investigation we have assessed and compared the physicochemical parameters like pH, electric conductivity(EC), total dissolved solids (TDS), total alkalinity(TA), total hardness(TH), Na^+, K^+, Cl^- of water of three Libyan lakes namely Umm al-Maa , Gaber-Oun and Mafo lakes. by using standard analytical methods. Data analysis of the results of lakes water samples were characterized by high alkaline pH, high values of total alkalinity and total suspended matter, in addition to the high amounts of sodium (Na), potassium (K) and chloride (Cl) ionsand total hardness, comparatively much higher than International Standards. The results were analysed and compared with "Libyan Standard No. 82 and "WHO Water Quality Guidelines". The results revealed that the unexpected high values of physicochemical parameters of lakes water may be attributed firstly due to extreme dry climate, and high temperature causing high rate of evaporation of surface waterand secondly, weathering of rocks and leaching of soil of particular hydro-geochemical region which leads to the accumulation of salts to high concentrations.***

Keywords: Sahara Desert (Libya) , Gaber Oun Lake, Umm al-Maa Lake, Mafo Lake,Water quality, Hydrochemistry, Physico- Chemical parameters

1. Introduction

Libya is located in tropical and subtropical region of North Africa where Al-sahara desert extends and covers most of country's land located under influence of acute dry climate conditions. Therefore, from the beginning of seventies of last century, Libya has faced a serious problem of shortage of water because of lack and variability of rainfall associated with the absence of permanent rivers.A group of about twenty lakes are located south west desert of Libya amidst the landscape of towering dunes and palm fringed oases of the sand sea. Among them, .Gaberoun, Umm al-Maa and Mafo are salty oases lakes located near the town of Awbari (Ubari).Gaber-Oun and Umm al-Maa are two more beautiful lakes which are rarely visited by tourists. The name Gaber-Oun is a compound of two names: Gaber (grave) and A'awn (a name). It was the home of a small Tuareg tribe . The ruins of their settlement are scattered between the palms at the north-western shore of the lake which has been moved elsewhere. The temperature of the water on surface is found strangely enough colder than it is a foot or two below, where it is noticeably warmer. Umm al-Maa means Mother of Water.It is about 150 km west of the town, Sabha. Mafo lake is also located nearby these lakes.

Hypersaline environments can be seen on all continents of the world [1] and have been defined asenvironments with total salt concentrations exceeding that of seawater [2].Saline and hypersaline lakes that form closed drainage basins are widely distributed. They are considered extreme environments for life [3] because of the effects of high salinity on water activity [3,4].Desert lakes are very important for educational and scientific researches as well as for ecological tourism. The location of these lakes is difficult to access and this may be one of the reasons why only few studies have been carried out on these lakes[5-7]. Therefore, the present study was undertaken in view to provide comparative data on the physical-chemical characterization of water from Gaber-Oun, Umm al-Maa and Mafo lakes. to evaluate its utility in ecological tourism and various useful purposes of mankind.

2. Methodology

2.1. Study Area

Gaber-Oun, Umm al-Maa and Mafo lakes. Gaber-Oun, Umm al-Maa and Mafo lakes are located in the Idehan Ubari (Awbari) desert of the Libyan Sahara Desert , in the southwestern Libya nearby Sabha city (see Fig.1).

Figure 1: Map of Libya showing town , Awbari .

2.2. Sampling

Water samples were collected from all the three lakes 0.5m deep to the top surface of water level in summer season in the month of June,2014(Table-1).

Samples were drawn with the aid of locally made plastic drawer into pre-cleaned bottles. Samples were analyzed immediately for parameters, which need to be determined instantly and rest of samples were refrigerated at 40° C for the remaining analysis.

Table 1: Showing samples collection sites.

Name of Site Label of Sample	Depth of Water Level
Gaberoun Lake S1	0.5 m
Umm al-Maa Lake S2	0.5 m
Mafo Lake S3	0.5 m

2.3 Hydrochemistry

The collected samples were analysed for major physical and chemical water quality parameters like pH , Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Alkalinity (TA), Total Hardness (TH), Chloride (Cl-), Sodium (Na+) and Potassium (K+) by using standard analytical methods. The pH was determined by using pH meter with combined electrode (Model – Hanna, sensitivity □ □ 0.01) EC was measured by using conductivity meter (Model – Jenway-4520)., TDS were estimated by evaporation method , TA was determined by titrimetrically [8], TH was determined by complexometrically [8], Cl- content was measured by Mohr's method [12], and Na+ and K+ were measured by employing Flame Atomic Absorption Spectrophotometry [8].The electrical conductivity (EC), pH and temperature of the water samples were determined *in-situ*.

All the studies were carried out in Analytical Chemistry Laboratory, Department of Chemistry, Faculty of Sciences, Al-Khums, Al-mergheb University, Libya

3. Results and discussion

Mean values of physico-chemical parameters are presented in Table-2.

Table 2: Mean values of the physicochemical parameters

S. No.	*Parameter*	*Sampling Point*			*WHO [9]*	*Libya Standard No. 82 [10]*
		S1	S2	S3		
1.	p H	8.91	9.88	8.96	6.5 - 8.5	6.5 - 8.5
2.	EC (mS/cm)	291.2	321.0	212.3	1.4	*
3.	TDS (g/L)	199.23	217.42	144.20	1.0	1.0
4.	TH (g/L)	6.76	3.87	1.40	0.5	0.5
5.	TA (g/L)	26.5	32.1	15.2	0.12	0.2
6.	Cl^+ (g/L)	83.13	85.04	66.52	0.25	0.25
7.	Na^+ (g/L)	45.0	47.5	37.5	0.2	0.2
8.	K^+ (g/L)	6.21	6.42	5.3	*	0.04

* = Not mentioned

The physicochemical characteristics of water resources depends on the location and management of the water sources. It includes anthropogenic discharge as well as the natural physicochemical properties of the area. The results of physicochemical analysis of water samples are discussed as below.

3.1. pH

pH affects many chemical and biological processes in the water and is used as an important tool for the analysis of quality of water. In the present study pH values of S1, S2 and S3 samples of lakes water were found 8.91, 9.88 and 8.96 , respectively, which are higher than the permissible limit as prescribed under standard values of WHO and Libyan standard.. These values indicate alkaline nature of all samples of lakes water .

3.2 EC

Electrical Conductivity is a useful tool to estimate the ions concentration and purity of water [11]. EC values were recorded in the range of 291.2, 321.0 and 212.3 mS/cm of S1, S2 and S3 samples of lakes water, respectively. EC values for all the investigated samples were found to be more than about 150 to 200 times higher to the limit prescribed by WHO and Libyan standard which indicate the presence of high amount of dissolved inorganic substances in ionized form.

3.3. TDS

Total Dissolved Solids and conductivity are usually related to each other. The TDS values were recorded as 199.23, 217.42 and 144.20 g/L forS1. S2 and S3 samples of lakes water , respectively. The TDS values of all the water samples of the selected places are very high and about 145 to 200 times higher than the limit prescribed by WHO and Libyan standard so these samples contain much higher concentrations of dissolved inorganic salts

3.4. Total Alkalinity

Alkalinity is the measurement of the amount of acid necessary to neutralize carbonate (CO3) and bicarbonate (HCO3-) ions in the water, and represents the buffering capacity of a body of water. The alkalinity of lake water depends on the types of minerals in the surrounding soils and in the bedrock. The various ions that contribute to alkalinity includes carbonates, bicarbonate, borates, hydroxides, phosphates and organic compounds. These factors are characteristics of the source of water and natural changes taking place at any given time [12]. The values of alkalinity for S1, S2 and S3 samples of lakes water were recorded as 26.5, 32.1 and 15.2g/L, respectively and found 75-160 times higher than the limit prescribed by Libyan standard.

3.5. Total Hardness

The hardness of water is due to the presence of calcium and magnesium minerals that are naturally present in the water. Hardness of water increases the boiling points of water and prevents the lather formation with soap. Total Hardness of S1, S2 and S3 samples of lakes water was measured as 6.76 , 3.87 and 1.4 g/L, respectively, which are 2.8 to 13.5 times higher than the values of permissible limit prescribed by WHO and Libyan standards .It indicates much higher values of hardness of samples of all lakes water according to the

prescribed classification of water on the basis of hardness [13].

3.6. Chloride

Chloride in lakes water is usually found as NaCl, $CaCl_2$ and $MgCl_2$ in widely varying concentrations The variation of concentration of chloride is mainly depend on the salts present in the rock and polluting materials and industrial wastes [14]. The values of chloride ions concentration was recorded as 83.13, 85.04 and 66..52 g/L for S1, S2 and S3 water samples of lakes, respectively, and found 266- 340 times higher than the WHO and Libyan standards.

3.7. Sodium

The major quantity of Sodium in lakes water found in the form of sodium chloride. Concentration of sodium ions was recorded as 45.0, 47.5 and 37.5 g/L for S1, S2 and S3 samples of lakes, respectively. These samples have shown about 185 to 235 times higher sodium ion concentration than prescribed values under permissible limit of WHO and Libyan standards.

3.8. Potassium

The major quantity of potassium in lakes water enters with weathering of rocks but the quantities increase in water due to disposal of waste water [15]. Concentration of potassium ions was estimated as 6.21, 6.42 and 5.3 g/L for S1, S2 and S3 samples of Lakes water, respectively and was found to have about 132 to 160 times higher concentration of K^+in these samples than the prescribed permissible limit of Libyan standards.

The results of the physicochemical analysis have indicated alkalinity nature in all lakes water samples.. The high values may be attributed due to the presence of alkali/alkaline metals carbonates, bicarbonates, hydroxides. borates and phosphates[16,17]. Alkaline lakes are formed when the only outlet for water is evaporation, leaving the minerals behind to accumulate [18]. Many alkaline lakes are a commercial resource for soda ash and potash, while others are popular tourist destinations for their “magical” healing properties for skin diseases(due to the mineral content). Gaber-Oun and Umm al-Maa lakes water is one of the example ofhealing properties and very much effective in curing skin diseases. The largest variety of aquatic animals survive better in pH range of 6.5-8.0. pH outside this range reduces the diversity in the stream because it stresses the physiological systems of most organisms and can reduce reproduction.

The high concentration of sodium and chloride ions in all samples of lakes water indicates the high salty nature of water It is reported that alkaline lakes (soda lakes)and saline lakes are formed under extreme environment as a result of complex interactions of the geological climate and biogeochemical conditions[19,20] They are often located in dry climate zones with high temperature and evaporation rate. These habitats are characterized by large amounts of sodium carbonates (Na2CO3 + NaHCO3) with high buffering capacity [21]. Accordingly, they create extreme pH environments because of high daily light intensities and unlimited supply of CO_3[22,23]. In dry climate, high evaporation rate exceeding inflow leads to the accumulation of salts to high concentrations [24]. Most of our findings comply wellwith the previous authors views and reports [5-7].

4. Conclusions

From the above results it can be concluded that the Gaberoun and Umm al-Maa lakes water have shown comparatively higher values of physico-chemical properties(*viz.* pH, alkalinity, electrical conductivity, total dissolved solids ,Chloride, sodium and potassium ions concentration and total hardness) than Mafo lake, However, all lakes are alkaline and salty in nature and suitable for the survival of some animals and plants. The cause of high alkalinity and salinity may be attributed due to the extreme arid environmental conditions with high temperature and evaporation rate of water as well as weathering of rocks and leaching of soil of particular hydro-geochemical region which leads to the accumulation of salts to high concentrations.

5. Acknowledgements

The authors are grateful to the authorities of Faculty of Sciences, Al-khums, Al-mergheb University , Libya for their technical support, and providing the necessary laboratory facilities..

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Author Profile

Dr Ismail M. Awheda :received the Masters degree (2003,2004) and Ph D degree (2012) in Chemistry from University of Perugia, Italy and Nottingham Trent University, UK, respectively. **Sept 2012- March 2013 :** PDF atNottingham Trent University, UK.**1995-2001 :** worked as Demonstrator , **2005 -2008 :** worked as Lecturer of Organic Chemistry for undergraduate Science and Engineering students & **at present (2013 onwards) :** working as Head of Department of Chemistry in Faculty of Sciences, Al-mergheb University, Al-khums, LIBYA . **Teaching- Specialization :** Organic Chemistry. **Research Specialization :** Synthetic Organic Chemistry.

Dr Ashok Kumar : 1977, 1982 :received the Masters and Ph D degrees in Chemistry from Kanpur University and Banaras Hindu University , respectively. **1983-1997 :** worked as PDF, RA, in Universities in India & abroad (Germany, Sweden), and as R &D Executive in industries in India .**1998 onwards :** worked / working as Faculty member and Principal in academic Institutions situated in abroad (Libya) & Kanpur, India .**Teaching Exp :** 20 yrs. **Teaching Specializations :** Organic Chemistry, (Pharmaceutical chemistry, Natural Products, Dyes Chemistry, Heterocyclic Chemistry etc), General Chemistry, Medical Biochemistry, Neuroharmacology. **Research Exp. :** 28 yrs. **Research Specializations :** Synthetic Organic Chemistry, Neurochemistry, Neuropharmacology, Phytochemistry etc.**Industrial Exp, :** 5 yrs.

Dr Abuagla Y. Ahmed: received BSc. (1995), MSc. (1998) degrees from University of Khartoum and Ph.D (2008) from Red Sea University, Port Sudan, Sudan; worked as Lecturer of Chemistry, Red Sea University & at present (2014 onwards) working as Lecturer of Chemistry in Faculty of Science, Al-mergheb University, Al-khoms, Libya. **Teaching Specialization:** Inorganic chemistry.**Research Specialization:** Inorganic chemistry (Detection of Heavy Metals).

Husamaldin A. Gahit : received M.Sc. degree in Chemistry from New Jersey Institute of Technology, Newark, New Jersey in 2012 and working as Assistant Lecturer of chemistry in the Faculty of science, Elmergib University since 2012 onwards. **Teaching Specialisations:** General chemistry, Organic chemistry, Biochemistry. **Research Specializations :** Environmental analysis, theoretical organic chemistry.

Dr Galal M. Zaiad : received B Sc (1989) , M Sc (Inorganic Chemistry)(1997) from Leuna-Merseberg High Institute Germany; Ph.D. from Mrain-Luther-Universitat, Halle-Wittenberg, Germany and worked as Lecturer of Chemistry at Al-zitona University and Al-mergheb University, LIBYA. At present working as Assistant Professor of Chemistry in Faculty of Sciences, Al-mergheb University, Al-khums, LIBYA. **Teaching- Specialization :** Inorganic Chemistry. **Research Specialization :** Inorganic analysis.