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Assessment of Environmental Impact On, Wadi El-Natrun Depression Lakes Water, Egypt

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Abstract: Assessment of environmental Impact was established to provide and evaluated the background picture of water quality of Wadi El-Natrun depression Lakes water. Physico-chemical characteristics (air and water temperatures, electrical conductivity (EC), total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), salinity, pH, dissolved oxygen (DO), chemical oxygen demand (COD), CO_3^{--}, HCO_3^-, Cl^-, SO_4^{2-}, Na^+, K^+, Ca^{2+}, Mg^{2+}, NO_2^-, NO_3^-, NH_3, PO_4^{3-}, total phosphorus (TP) and SiO_2) were measured and used as indicators to evaluate the water quality of lakes. Results indicated that the salinity ranged between 20-400‰ (hypersalin water). EC 88000-201000 µS/cm. TS, TDS and TSS are very high levels. pH values were found to be in the alkaline side 9.12-9.84. and HCO_3-concentrations are very high and ranged between 3000-12000 and 1330-6480 mg/l, respectively. SO_4^2-and Cl-are very high concentrations. Na^+ and K^+ are more concentrations than Ca^{2+} and Mg^{2+}. DO was near to depletion. COD is slightly high concentrations. The nutrient salts, NO_2^-, NO_3-are not detected during all investigation seasons. NH_3 was ranged between 0.03-0.514 mg/l. PO_4^3-and TP were high concentrations during all seasons except for autumn. SiO_2 was ranged between 0.7-2.25 mg/l during autumn / summer and not detected during winter / spring. It was concluded that Wadi El-Natrun depression lakes are a unique aquatic ecosystem among saline lakes due to the hyper saline and alkaline waters.

Key words: Physico-chemical characteristics % Water % Wadi El-Natrun depression lakes % Egypt

INTRODUCTION

Inland saline lakes have received attention in recent years due to their sensitivity to climatic changes. Climatic conditions must reach a certain degree of aridity for effectively removing of water by evaporation or freeze drying and so produce a progressively concentrated brine [1,2]. Changes in evaporation rates and precipitation can affect the physical and chemical characteristics in such lakes [3-7]. Changes in water chemistry and lake depth in turn control the distribution and abundance aquatic life. In this respect, inland saline lakes need to be considered in developing concepts concerning the geochemical and biological characteristics of evaporation [8].

Wadi El-Natrun, with its alkaline lakes, is an elongated depression about 90 Km North West of Cairo between latitudes 30° 15` north and longitude 30° 30` east (Fig. 1). Its average length is 60 Km and average width about is 10 Km. The bottom of the Wadi is 23 m below sea-level and 38 m below the water level of the Rosetta branch of the Nile [9]. The lowest part of the depression, encircled by contour zero, covers an area about 272 Km^2. Inland lakes and crusts occupy the area surrounded by contour zero[10].

Chemical and physical studies on the Wadi El-Natrun lakes are very few. Taher [8] reported that, the area of the Wadi has a mainly arid climate, with low and very variable rainfall, a long dry summer, high rates of evaporation and low humidity. All lakes had pH values of 8.5-9.5 and salinity from 283-540 g/l. The main ionic components were SO_4^{2-}, Cl^-, CO_3^--and Na^+. Traces of Mg^{2+} were also present.

The present study aimed to give a complete information on the physical and chemical characteristics of Wadi El-Natrun depression lakes water.

MATERIALS AND METHODS

The present study was extended from autumn 2003 to summer 2004 during four successive seasons. In the first big area lake (I) name El-Bida four brine water samples on the shore sides around the lake were collected. In the second small area lake name El-Hammra, one brine water sample was collected from the shore side of the lake. As well as ground water sample was collected from well originated on the first lake, this sample was considered as a control. The positions of stations I, II, III and IV in the first lake, station V in second lake and well ground water are represented in the map of studied (Fig. 1).

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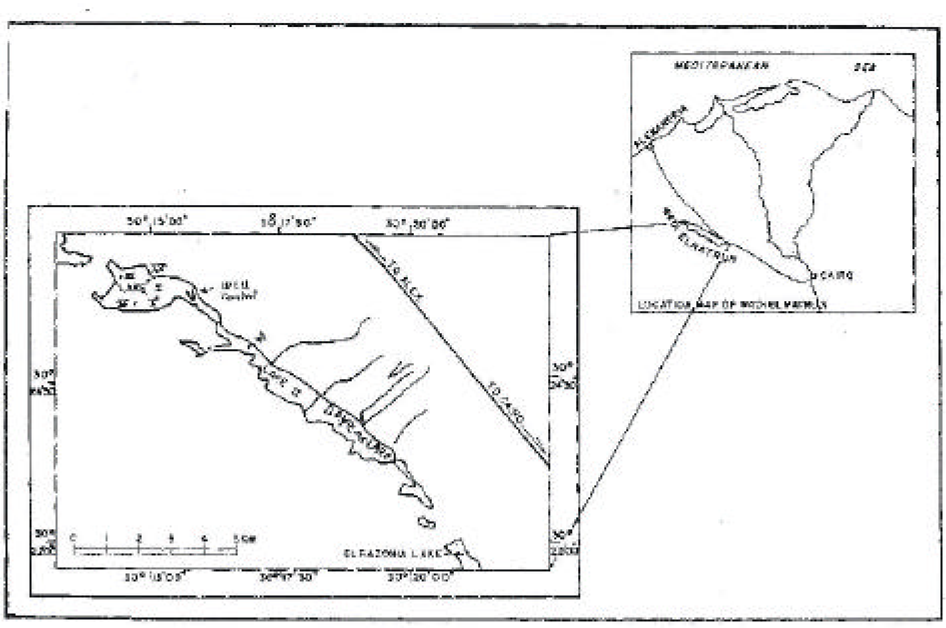

Fig. 1: Wadi El-Natrun, with its alkaline lakes

Brine water samples were collected manually using polyethylene gloves and stored in 500 ml polyethylene bottles. The samples were preserved in an ice-box and returned immediately to the laboratory. The chemical parameters were determined according to the method described in APHA [11]. TS were measured by evaporating a know volume of well mixed sample at 105 °C. TDS were determined by filtrating a volume of sample with glass micro fiber filter (GF/C) and a know volume of filtrate was evaporated at 180 °C. TSS is directly obtained by subtraction of TS-TDS. DO was determine by using Winkler method due to addition of mangenous sulfate and alkaline KI solution to sample. COD was performed by $KMnO_4$ method. $CO_3^{--}$and HCO_3-were determined titration against 0.025 N H_2SO_4. Cl-was determined by titration against $AgNO_3$ argenometric method. $SO_4^{--}$was determined by turbidity method. Na^+ and K^+ were measured directly using flame photometer Model Jenway PFP, U.K. Ca^{2+} and Mg^{2+} were determined by EDTA titrametric method. Concentration of NO_2^-, NO_3^-, NH_3, PO_4^{-3} and SiO_2 were determined using the colorimetric techniques with formation of reddish purple azo-dye, copper and hydrazine sulphates reduction, phenat, stannous chloride reduction and molybdosilicate methods, respectively. TP was measured as reactive phosphate after digestion by using ammonium per-sulphate method. Salinity, electrical conductivity, air and water temperatures, as well as pH values were measured using Hydrolab, Model "Multi 340 I/SET".

Statistical Analysis: The relationships between the different physical chemical studied parameters were assigned by computing the correlation coefficients (r) using Microsoft Office Excel (2003).

RESULTS

The physical and chemical measurements in the Wadi El-Natrun depression lakes water are presented in tables 1-4. Results revealed that the high concentration values of the most studied physical and chemical parameters during different seasons were recorded at station V in second lake then stations I, II, III and IV in first lake. However the ground water well was characterized by high concentration values in definite chemical parameters e.g. SiO_2, NO_2-and NO_3-during different seasons and very low concentrations in other physical and chemical parameters at compared with hyper saline lakes water.

DISCUSSION

The saline lakes of Wadi El-Natrun show a distribution of some environments similar to that found in playa-ephemeral lake and perennial saline lake complexes described elsewhere [1,12]. The maximum water level in the lakes was observed between December and March (winter season) and the minimum levels during summer, however the second lake (El-Hamara) reached to approximately drying. Also, shallow saline pools shrink in

Table 1: Physico-chemical measurements of the water in the Wadi El-Natrun depression lakes during autumn 2003

	First Lake				Second Lake	
Stations Parameters	I	II	III	IV	V	Well Control
Air Temperature (°C)	30	31	31	31	31	30
Water Temperature (°C)	26	27	26	27	27	25
EC (µScm^{-1})	105300	88000	178000	133100	201000	700
Salinity (‰)	20	30	120	160	300	0.0
TS (mgl^{-1})	140684	111124	314948	208220	403804	1620
TDS (mgl^{-1})	79432	75204	187300	137268	273347	1268
TSS (mgl^{-1})	61252	35920	127648	70952	130457	352
pH	9.63	9.71	9.44	9.55	9.40	8.24
DO (mgl^{-1})	2.8	2.4	0.8	0.6	nil	4
COD (mgl^{-1}	27	29	31	29	32	13
CO_3^{-}- (mgl^{-1})	4000	3000	5000	5400	9000	10
HCO_3- (mgl^{-1})	1330	1330	3240	1940	4860	373
Cl- (mgl^{-1})	35500	30130	85100	53200	131200	171
SO_4^{-}- (mgl^{-1})	13041	10400	20600	19000	25160	37
Ca^{2+} (mgl^{-1})	181	160	160	160	280	16
Mg^{2+} (mgl^{-1})	50	146	146	146	195	10
Na^{+} (mgl^{-1})	49300	56000	94300	58400	98400	221
K^{+} (mgl^{-1})	458	572.6	1282.6	641.30	1626.10	13
NO_2- (µgl^{-1})	ND	ND	ND	ND	ND	2.18
NO_3- (µgl^{-1}	ND	ND	ND	ND	ND	90
NH_3- (mgl^{-1})	0.261	0.80	0.28	0.28	0.18	0.16
PO_4^{--}- (µgl^{-1})	3575	1446	674	838	707	213
TP (µgl^{-1})	1600	1550	1524	1823	1390	220
SiO_2- (mgl^{-1})	ND	ND	ND	ND	ND	17

ND: Not Detected

Table 2: Physico-chemical measurements of the water in the Wadi El-Natrun depression lakes during winter 2004

	First Lake				Second Lake	
Stations Parameters	I	II	III	IV	V	Well Control
Air Temperature (°C)	33	33	33	34	34	34
Water Temperature (°C)	29	28	29	29	29	28
EC (µScm^{-1})	164200	166000	165600	167000	184000	662
Salinity (‰)	170	173	175	180	400	0.0
TS (mgl^{-1})	192000	195000	196000	202000	381000	428
TDS (mgl^{-1})	112748	112200	112000	119000	263220	300
TSS (mgl^{-1})	79252	82800	84000	83000	117780	128
pH	9.73	9.70	9.79	9.73	9.81	8.30
DO (mgl^{-1})	1	0.8	0.7	0.6	0.5	1.8
COD (mgl^{-1}	18	23	25	26	34	4
CO_3^{-}- (mgl^{-1})	9000	8600	8800	10400	11000	13
HCO_3- (mgl^{-1})	5508	3000	3300	2268	4860	300
Cl- (mgl^{-1})	116985	117000	117885	124075	233970	255
SO_4^{-}- (mgl^{-1})	17700	18000	18500	19000	25000	36
Ca^{2+} (mgl^{-1})	802	980	1100	1202	1202	400
Mg^{2+} (mgl^{-1})	488	280	300	244	732	244
Na^{+} (mgl^{-1})	43700	44000	44500	45650	63800	421
K^{+} (mgl^{-1})	466	500	550	835	737	7.50
NO_2- (µgl^{-1})	ND	ND	ND	ND	ND	22
NO_3- (µgl^{-1}	ND	ND	ND	ND	ND	66
NH_3- (mgl^{-1})	0.194	0.191	0.192	0.190	0.514	0.335
PO_4^{--}- (µgl^{-1})	56	58	55	82	102	122
TP (µgl^{-1})	556	550	500	511	325	312
SiO_2- (mgl^{-1})	2.00	2.00	2.00	2.11	2.25	12.00

ND: Not Detected

Table 3: Physico-chemical measurements of the water in the Wadi El-Natrun depression lakes during spring 2004

	First Lake				Second Lake	
Stations Parameters	I	II	III	IV	V	Well Control
Air Temperature (°C)	38	38	37	38	39	38
Water Temperature (°C)	36	35	35	36	36	30
EC (μScm^{-1})	145000	146300	146700	147000	164200	604
Salinity (‰)	121.2	131.3	131.3	130	414	0.0
TS (mgl^{-1})	142440	157680	154060	155790	428740	1230
TDS (mgl^{-1})	115480	146880	148610	145140	383360	1100
TSS (mgl^{-1})	26960	10800	5450	10650	4510	130
pH	9.26	9.28	9.29	9.30	9.12	7.97
DO (mgl^{-1})	0.53	0.47	0.33	0.55	0.27	4.00
COD (mgl^{-1}	26	24	23	25	25	8
CO_3^-- (mgl^{-1})	4600	5000	5100	5200	11000	13
HCO_3- (mgl^{-1})	2536	2592	2268	2592	6480	381
Cl- (mgl^{-1})	63810	71000	71000	74500	173700	128
SO_4^-- (mgl^{-1})	3840	6320	5900	6630	8250	126
Ca^{2+} (mgl^{-1})	88	66	66	66	56	16
Mg^{2+} (mgl^{-1})	40	34	34	27	25	6
Na^+ (mgl^{-1})	28300	29200	29400	30000	47600	173
K^+ (mgl^{-1})	583	603	618	618	2751	5
NO_2- (μgl^{-1})	ND	ND	ND	ND	ND	2.18
NO_3- (μgl^{-1}	ND	ND	ND	ND	ND	104
NH_3- (mgl^{-1})	0.10	0.12	0.25	0.17	0.21	0.16
PO_4^{--}- (μgl^{-1})	2624	2902	1492	1621	416	996
TP (μgl^{-1})	2684	2973	2330	2422	500	1018
SiO_2- (mgl^{-1})	ND	ND	ND	ND	ND	11.1

ND: Not Detected

Table 4: Physico-chemical measurements of the water in the Wadi El-Natrun depression lakes during summer 2004

	First Lake				Second Lake	
Stations Parameters	I	II	III	IV	V	Well Control
Air Temperature (°C)	37	40	40	41	41	37
Water Temperature (°C)	35	39	39	39	39	32
EC (μScm^{-1})	164500	163500	163500	164100	192500	930
Salinity (‰)	152	172	172	172	384	0.2
TS (mgl^{-1})	218430	218350	198440	218300	471640	956
TDS (mgl^{-1})	214000	214120	194460	214700	464310	660
TSS (mgl^{-1})	4430	4230	3980	3600	7330	296
pH	9.72	9.80	9.81	9.84	9.55	8.27
DO (mgl^{-1})	0.4	0.4	0.4	0.4	0.4	3.0
COD (mgl^{-1}	24	24	28	26	29	4
CO_3^-- (mgl^{-1})	10000	10000	10100	10200	12000	25
HCO_3- (mgl^{-1})	3240	1296	2916	3240	3240	365
Cl- (mgl^{-1})	85080	80826	82953	81535	177250	156
SO_4^-- (mgl^{-1})	16393	18031	17506	17544	22195	56.00
Ca^{2+} (mgl^{-1})	46	40	40	40	40	15
Mg^{2+} (mgl^{-1})	49	73	73	73	78	12
Na^+ (mgl^{-1})	168350	175670	176900	176480	249680	1132
K^+ (mgl^{-1})	598	544	544	536	3991	5
NO_2- (μgl^{-1})	ND	ND	ND	ND	ND	2.18
NO_3- (μgl^{-1}	ND	ND	ND	ND	ND	20.10
NH_3- (mgl^{-1})	0.10	0.08	0.061	0.043	0.030	0.12
PO_4^{--}- (μgl^{-1})	348	348	634	501	164	156.4
TP (μgl^{-1})	3108	3223	2400	2189	393	380
SiO_2- (mgl^{-1})	1.20	1.23	1.55	1.50	0.70	11

ND: Not Detected

volume by > 60 % following evaporation in summer. Morphological evidence for former higher shorelines in the form of small beach scraps can be observed in some small lakes. Due to high evaporation rates in these lakes, the number of lakes present at any time is therefore variable; for instance Stocker, [13] recorded 16 lakes in Wadi, while Imhoff *et al.* [14] noted 6 lakes and Taher, [8] was collected samples from 3 lakes, in present study (2003-2004), samples were collected from only 2 lakes.

Temperature is strong and great important factor for aquatic ecosystem, as it affects the organisms as well as physical and chemical characteristics of water [15]. As expect the high water temperature was recorded during summer and the lower values in winter due to the more or less of air temperature. The area of Wadi El-Natrun has a mainly arid climate with low and very variable rainfall, a long day summer, high evaporation rates and low humidity [8].

The water is undergoing significant fluctuations in EC. The EC values were recorded very high values during all seasons especially summer following by autumn then spring and the lower values in winter. The increase in EC values at all investigated stations is related to the increase in total dissolved solids and water temperatures [16]. The EC values of ground well water control were very small when compared with EC values of Wadi El-Natrun lakes water. Also, values of EC at all stations of first lake were low as compared with second lake, this may be attributed to the dilution by large amount of ground water discharged from the well, situated at this lake.

Salinity is among the most important environmental factor and exerts various effects on the vitality of marine organisms. The high values of salinity were recorded during autumn, summer then spring and the lower values during winter. This could be mainly attributed to the changes in water levels of the lakes, as well as evaporation rates during different seasons. The salinity lower values of first than second lake is related to the dilution effect by the ground well water at first lake. Generally, the very high values of the Wadi El-Natrun lakes water salinity, could be mainly attributed to the salty rock nature of the Natrun area. Therefore water of these lakes is classified under hyper saline water (EC, greater than 60000 µS/cm) according to Bowman [17].

Solids refer to suspended and dissolved matter in water. They very useful parameter describing the chemical constituents of the water and can be considered as general of edaphic relations that contribute to productivity within the water body [16]. TS and TDS values were found in the same trend of the EC and salinity. However, the higher values of TS and TDS were recorded during summer 198440-218430 and 194460-214700 mg/l, respectively in first lake and it was of very high values in second lake 471640 and 464310 mg/l, respectively, this may be due to dilution effect of ground water in first lake. On the other side, the lower values were recorded during winter. This also could be due to the high evaporation rates during summer which facilitate in the accumulation of different dissolved salts in Natrun Lake water. TS and TDS ranges of ground well water control were found to be 425-1620 and 300-1268 mg/l, respectively during different season. This results were coincident with that reported by Taher [8] on the same lakes. He found that TDS ranged between 283000-557000 mg/l in first and second lakes.

Wadi El-Natrun lakes water classified undergoing highly alkaline water during all investigation seasons without spatial variation. The ranges of pH values in first lake were 9.26-9.85 and in second lake 9.12-9.81 during different seasons. On the other side, pH values of ground water control were found to be 7.97-8.30. This result agrees with that found by Taher [8]. He recorded that, lake water was highly alkaline and pH was reasonably constant ranging from 8.51 in first lake and 9.45 in second lakes.

Wadi El-Natrun lakes water is very poor in oxygen during all investigation seasons. The ranges were found to be 0.33-2.8 and nil-0.5 mg/l in first and second lakes, respectively during all seasons. Also, the ground water is defined and characterized by very low DO. However DO ranging from 1.8-4 mg/l in the current well water. The very low DO near to depletion may be attributed to the nature of the close and hyper saline lakes, but this lead to death of most phyto and zooplankton species as well as the lakes are dead and become similar to Dead Sea. BOD was not available to determined because the very low DO. Frequent occurrences of hypoxia due to sudden shutdown of DO have cased significant reduction of fishery harvests, toxic algal blooms and biotic diversity [18] and may result in reducing conditions in sediments, which may release previously bound toxicants into the water column [19]. The recorded values of DO at all stations of first and second lakes were less than the guideline values cited by USEPA [20] for the protection of aquatic life (for warm water biota: early life stages = 6 mg/l, other life stages = 5.5 mg/l for cold water biota; early life stages = 9.5 mg/l, other life stage = 6.5 mg/l).

COD values were inverse to DO and were significant during all investigation seasons. The significant values of COD may be due to organic acids originating from decaying swamp grass in the depression and microbial decomposition of organic matter in the sediment of the lakes. This interpretation is coincident with that reported by Taher [8]. The high values of pH is an indication to the high values of $CO_3^{--}$and $HCO_3^-$of Wadi El-Natrun lakes water during different seasons. The maximum concentrations of CO_3^{--}were recorded during summer 10000-12000 mg/l and the lower values were recorded during winter 3000-9000 mg/l.

The HCO_3^-concentrations showed slight variation during different seasons and ranged between 1330-6480 mg/l at two studied lakes. On the other side, the ranges of $CO_3^{--}$and HCO_3-in the ground water control were 10-25 and 300-381 mg/l during different seasons respectively. The high concentrations of $CO_3^{--}$and HCO_3-in Wadi El-Natrun lakes water may be related to the nature of the depression area and the increase in pH values facilitate in the formation of two ions. Taher [8] determined $CO_3^{--}$and HCO_3-and found the same ranges of the present results.

The high salinity and TDS values of Wadi El-Natrun lakes water indicating that the increase in Cl-and SO_4^--concentration. However the ranges of two ions in the second were higher than in the first lake during different seasons. The values of Cl-and SO_4G^2 in ground water well were lower than in hyper saline water lakes. This could be mainly attributed to the weathering of gypseous clay component in Wadi El-Natrun depression lake.

The calculations of the % of each anion reveled that, the major anion in Wadi El-Natrun lakes water was Cl-and SO_4^{--}, while the minor anions CO_3^--and HCO_3^-. This results agrees with that reported by Taher [8]. He showed that, the water type of the Wadi El-Natrun lakes is Cl-to SO_4^{--}-Cl^-.

Ca^{2+} and Mg^{2+} concentrations were increased during autumn season and relative increase during winter. The lower values were recorded during hot seasons (spring-summer). The high values of Ca^{2+} and Mg^{2+} during cold season (autumn-winter), may be related to dissolution of Ca^{2+} and Mg^{2+} from the surrounding gypseous rocks and sediment which release into water because of the wind velocity ranges between 12 and 20 Km/h in December and June respectively [8,16].

The high salinity values and the nature of Wadi El-Natrun lakes water responsible for the very high concentrations of sodium in first and second lakes during all seasons. The very high sodium concentrations were recorded during summer is mainly related to the high evaporation rates during this season which concentrated some ions especially sodium. Also, the second lake has highly salts content than first lake (diluted by ground water dischanging from well present here). The potassium concentrations behave the same trends as Na^+ during all seasons.

The calculations of each cation revealed that, the Na^+ is predominant cation (98.4 %) and the other cations K^+, Ca^{2+} and Mg^{2+} are very minor. Also, this result is coincident with that reported by Taher [8] the Natrun lakes water dominated by Na^+, while Ca^{2+} and mostly Mg^{2+} were below detection limits.

Nutrient salts (NO_2^-, NO_3^-, NH_3, PO_4^{3-}, TP and SiO_2) play an important role in the productivity of the aquatic ecosystem supporting the food chain for phyto-and zooplanktons as well as fish [21].

NO_2^--N and NO_3^--N were not detected in the Wadi El-Natrun lakes water at all stations during different seasons as represented. The depletion in NO_2-and NO_3^-, may be related to denitrification of ions into ammonia which it only detected nitrogen ion form. This interpretation is supported by Diaz *et al.* [22] for Lake Lasalada De Chiprana (Spain); Morales *et al.* [23] for Lake Maracaibo (Venezuela). On the other side, NO_2^--N and NO_3^--N were detected during different seasons in the ground water sample collected from the well situated at this lakes.

Ammonia-N accounted for the major proportion of total soluble inorganic nitrogen. It fluctuated in wide ranges during different seasons and within normal guide lines (0.48-2.68 mg/l at pH 8.6), USEPA [20].

The cycling of phosphorus within lakes and rivers is dynamic and complex, involving adsorption and precipitation reactions, inter change with sediments and uptake by aquatic biota [24]. The increase in the ortho and total phosphorus may be related to the high alkalinity noticeable in the Natun lakes water which facilitate in the sedimentation of phosphorus then redissolution from sediment to water under high pH values of the lakes. And supported by Mesnage and Picot [25] and Herrera-Silvenia[26]. Also, the fluctuations of total phosphorus are mainly affected by two factors; the sedimentation rate and renewable rate of water [27], as well as the release of phosphorus from sediment under favorable conditions by either deposition or resuspension process [28].

The silica were not detected during winter / spring period, while detected during autumn / summer period. On the other hand, there is noticeable increase in silicate concentrations in ground water sample collected during different seasons which is especial character for ground water as reported by Abdo [29]. The relative increase and detection of SiO_2 during autumn / summer period may be related to the alkaline pH of water accelerates the release of silicate from sediments to the over lying water [30].

Correlation coefficient (r) is one of the most important statistical tests used for identification of correlation among different physical and chemical parameters measurements in the water ecosystem. In the present study, the EC values possessed a strong positive relationship with salinity, TS, TDS at $P < 0.05$ ($r = 0.91$, 0.99 and 0.95) during different seasons. Also, salinity values are positive correlation with TS and TDS ($r = 0.9$) at $P < 0.05$ during different seasons. This indication on the strong relationships among physical parameters (EC, salinity, TS and TDS) in the hyper saline ecosystem. pH values with CO_3^{2}-and HCO_3-are dependent on each other through (r = 0.5, 0.37,-0.95,-0.92,-0.96,-0.98 and-0.89,-0.33) during autumn, winter, spring and summer seasons respectively. CO_3^{2}-concentrations had strong positive correlations with Na^+ and K^+ during different seasons ($r = 0.88$ and 0.92). Also, CO_3^{2}-concentration values were found positive correlations with Ca^{2+} and Mg^{2+} ($r = 0.71$, 0.56, 0.88, 0.63 and 0.43) during different seasons. As well as, Cl-values had strong positive correlations with Na^+ and K^+ ($r = 0.98$ and 0.86), this reveals that the Ca^{2+} and Mg^{2+}, Na^+ and K^+ may be occur in the Wadi El-Natrun Lakes as carbonate and chloride salts. Cl-correlated significantly with SO_4^{-}($r = 0.85$) and represented the same behaviour of two anions in Wadi El-Natrun lakes. Na^+ and K^+ are take the same manner in the ecosystem ($r = 0.9$). Nutrient salts (NO_2^-, NO_3-and NH_3, PO_4^{--}, TP and SiO_2) had very weak in correlations.

The comparison between present results with previouse studies on the same lakes, [8]. pH values in the same rages. TDS, CO_3^{--}, Na^+ and $SO_4^{-}$are lower, but HCO_3^-, Cl^-, Ca^{2+} and Mg^{2+} are higher than that reported by Taher, [8]. On the other side, the comparison of the present results with another world saline lakes e.g in Alberta and Saskatchewan; pH (9.43-9.53), DO (0.31-.5 mg/l), salinity (22-160 ppt) TDS (24-161 g/l) and EC (15.6-201.35 mS/cm) determined by Bowman and Pschs [17]. These values are lower than present results except for DO are in same ranges. Also, a comparison of the Wadi El-Natrun Lakes with the lakes studied by Seaman *et al*. [48] in Southern Africa revealed an entirely different chemistry. The Southern Africa lakes are much less saline (< 50 g/l), pH (9.2-10.4), the most common pattern of anion dominance is Cl-> HCO_3-+ CO_3^--which is similar to Wadi El-Natrun brines.

In conclusion, Wadi El-Natrun appear to be a unique aquatic ecosystem among saline lakes characterized by hyper saline, highly alkaline, poor in DO, NO_2^-, NO_3^-, SiO_2 and decreased Ca^{2+}, Mg^{2+}, K^+ and rich in Cl^-, SO_4^{--}, Na^+, CO_3^{--}, HCO_3-as well as relative increase in PO_4^{--}-and TP. It is recommended to increase the numbers of under ground water wells influx in the lakes to improve the water quality and dilution of salinity lakes. As well as, these lakes in this area with these clear climatic conditions, the alkaline water of the lakes can be uses in healthy tourism purposes.

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