

SUITABILITY ASSESSMENT OF SOME WELLS WATER FOR IRRIGATION IN WADI ALSHATTI, SOUTH WEST OF LIBYA

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ABSTRACT

This study was conducted to investigate ionic composition and some chemical properties of some wells water in Wadi Al-Shatti region, South-West of Libya, to assess its suitability for irrigation. The obtained results indicated that most studied samples have been slightly acid to neutral pH with range of 6.5-7.0. Three samples only had slightly alkaline pH with rang of 7.1-7.8. Most samples had high salt content. Electrical conductivity of samples was ranged from 940 to 4890 $\mu\text{S cm}^{-1}$. Sodium was the dominant cation. As anion, sulphate dominated in most samples whereas chloride in few. The concentrations of cations in the studied samples were in the order: $\text{Na}^+ > \text{Ca}^{2+} > \text{K}^+ > \text{Mg}^{2+}$. Results indicated noticeable low magnesium, and high to very high potassium concentrations. Chloride concentrations were moderately to extremely high. All samples had low concentration of boron, but some have significant amount of nitrate. Most samples had high total hardness which may cause foliar deposits of calcium or magnesium carbonate under overhead irrigation. PH_c confirmed that none of the studied samples had a tendency for scaling or corrosion.

Key Words: Irrigation water, Wells Water, Water Quality, Libya.

INTRODUCTION

Since nearly four decades, Libya adopted proper plan to develop agriculture, to increase food production and create jobs in addition to installation of the settlement in Saharan regions, especially in Fezzan district, south of Libya. Wadi Al-Shatti is one of Fezzan regions. Agrarian development in these regions includes huge agriculture project for strategic cereal crops and forage crops production in addition to middle and small private farms.

High quality of irrigation water is essential for agricultural land and the development of the arable land, especially in arid and semi-arid regions. Irrigation water of low quality decreased crop production and could lead to soil degradation through sodicity and salinity or toxicity. Saline water and water with high carbonate and bicarbonate concentration are unsuitable for foliar applications and may cause marginal leaf burn and in severe cases can lead to defoliation and significantly yield loss. High levels of sodium in irrigation water can damage soil structure and may be toxic to plants. Other chemical

constituents of irrigation water can affect plant growth directly through toxicity or deficiency, or indirectly by altering availability of nutrient elements. High concentrations of chloride or sulphate in irrigation water reduce soil phosphorus availability and organic acids content in plant tissue to less than the optimum level (Mengel and Kirkby, 2001). High boron concentration in irrigation water may reduce crops production through its toxicity. Water with high hardness is unsuitable for sprinkler irrigation. Also, water quality is the basic element in fertigation program, which must take in a consideration plant needs, soil properties and technological requirements of the fertigation systems. The higher the plant requirements and the technologically advanced system, the higher the quality demands. All soils in Wadi Al-Shatti have coarse texture, very low organic matter, very low amount of nitrogen, phosphorus, calcium and magnesium; and very low amount of available copper, manganese and zinc (Al-Tamimi, 2006). So, fertigation with drop or sprinkler irrigation is a fundamental farming practice to compensate essential plant elements, and widely spread in Wadi Al-Shatti regions.

Ground water only is the source of water used for irrigation and domestic uses in all southern part of Libya. Wells are the main source of water in Wadi Al-Shatti with limited number of springs. With increasing population there is a growing demand for ground water for domestic uses and crops production. Due to extensive utilization of ground water as a result of lateral and vertical expansion in crops production, water quality may have been changed. So this work was carried out to investigate chemical properties of some wells water in Wadi Al-Shatti regions, South of Libya, and to assess its suitability for irrigation.

MATERIALS AND METHODS

Location and Aquifer in the Study Area

Wadi Al-Shatti is located at eastern-north part of Murzuk Basin, with long of 200 Km and width between 8-20 Km (15 Km in mean). Its boarder is between $20^{\circ} 27'$ to $27^{\circ} 39'$ latitude and 13 to 15 longitudes (Abulokmah and Al-Makrezy, 1995). The area is characterized by sever dry climate, low humidity, high wind velocity, very scarce rainfall and high evapo-transpiration.

The studied wells are aquifering their water from aquifer belongs to Murzuk basin which divided to lower and upper aquifers. Lower aquifer begins from the depth of 1000 m. The upper level of the upper aquifer now is at 132 m depth. The sedimentary rocks forming the basin are related to Messak formation which has been divided to the lower "Jarmah Member" and the upper "Awbari

Member" (Strojexport, 1980). Lithostratigraphic division is mainly based on the essential component of siltstone intercalated with clays in the Jarmah Member of the Ordovician-Cambrian period and completely built of sandstone in the Awbari Member of Mesozoic period (Stefek, and Rohlich, 1984).

Water Sampling and Analysis

Water samples from 27 wells of Wadi Al-Shatti region, south of Libya were collected in duplicate in clean sampling container with screw caps, after water pumping at least for 45 min. Figure 1 shows the location of the study area and table 1 explains the location sites of samples. Each container was rinsed twice with the sample water before sample collection. Electrical conductivity (EC) and pH were determined in situ after collecting each sample immediately. Samples were kept cooled during transport and storage at 4 °C until analysis. Sodium and potassium ions have been determined by atomic emission spectrophotometry method using flame photometer. Calcium, magnesium, chloride, bicarbonate and carbonate ions have been determined by titrimetric methods. Sulphate was determined by gravimetric method. Ammonium and nitrate were determined by optical spectrophotometry. All previous chemical analyses were carried out after Rump (1999). Soluble orthophosphate was determined by modified method of Murphy and Riley, as was described by Watanabe and Olsen (1965). The accuracy of major ions analysis was checked by calculating electroneutrality (E.N.) since positive and negative charges in water must be in balance. Electroneutrality percentage was calculated after Appelo and Postma (1999) using this equation:

$$\% E.N. = \frac{\text{sum of cations} - \text{sum of anions}}{\text{sum of cations} + \text{sum of anions}} \times 100$$

Where ions concentrations in $meq l^{-1}$. The accepted limit or certain is between 0-5 %, 5-10 should be probable certain and >10 % is uncertain and should be not useful for interpretation. Accuracy analysis explained that major ions analysis was within the acceptable limit. For total dissolved solid (TDS) determination, samples were filtered using a Whatman papers no. 42. TDS was determined by weighing, after evaporating 100 ml of each sample to dryness using vapor bath, and then dried at 105 °C for 24 hrs using electrical oven. Total hardness (TH) was calculated using this equation as reported by Al-Tamimi (2015):

$$TH = [Ca^{++}] \times 2.497 + [Mg^{++}] \times 4.117$$

Where, TH is in mg equivalent l^{-1} calcium carbonate, and Ca^{2+} and Mg^{2+} concentration in $mg l^{-1}$. Water hardness classes were determined according to

USDA guidelines. Sodium adsorption ratio (SAR) was calculated according to the following equation proposed by USDA salinity Lab. (Richards, 1954):

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}}$$

Where; Na, Ca and Mg concentration are in $meq\ l^{-1}$.

Residual sodium carbonate was calculated using the formula proposed by Eaton to assess the danger of free carbonate as was mentioned by Al-Tamimi (2015):

$RSC = (CO_3^{2+} + HCO_3^-) - (Ca^{2+} + Mg^{2+})$, where RSC and ions concentrations in $meq\ l^{-1}$. Potential salinity (PS) was calculated using the equation proposed by Doneen as was described by Al-Tamimi (2015) as follow:

$PS = [Cl] + \frac{1}{2}[SO_4]$, where Cl, SO_4 and PS in $meq\ l^{-1}$. Water aggressiveness was determined using Langelier index (LI) to assess its corrosiveness and precipitation ability. It was calculated using this formula (Al-Tamimi, 2015):

$LI = pH_a - pH_c$, where pH_a and pH_c are the determined and calculated pH respectively.



Fig. 1. Location of the study area

RESULTS AND DISCUSSION

pH

Water pH was within the range of the value proposed by FAO for irrigation water quality (Ayers and Westcott, 1985). Apart from three samples (samples No. 18, 21 and 22), which had slightly alkaline pH, the rest samples tends to be slightly acid to neutral (Table 1). Sample's pH can be divided into four categories, i.e. very slightly acid ($6.5-7.0<$), neutral (7.0), very slightly alkaline ($>7-7.5<$) and slightly alkaline ($>7.5-8.0<$). Water pH highly correlated with the type of soluble salts and concentration of soluble CO_2 in water. According to Henry's law, solubility of CO_2 positively related to its pressure and negatively to temperature. Low pH may be due to the absence of alkaline salts. Slightly acid pH for water samples from Wadi Al-Shatti and other places aquifer their water from Murzuk basin was well known and reported by other workers (Kalash et al., 1981 ; Al-Tamimi and Alaswd, 2014).

EC and TDS

Results showed wide variation in EC and TDS of the studied wells water expressed in $\mu\text{S cm}^{-1}$ and mg l^{-1} respectively (Table 1). EC values were between $940 \mu\text{S cm}^{-1}$ to $4890 \mu\text{S cm}^{-1}$ while TDS values were between $940\text{-}4890 \text{ mg l}^{-1}$. Variation in EC may be due to differences in salt concentration and type, which related to differences in ionic compositions, charge and the accompanying difference in the electrical conductivity, while TDS variation reflect variation in ground water feeding, ion exchange and replacement, and mineralogy and chemistry of bearing rocks of the aquifer. High salinity of some wells water was exceeded the permissible high value proposed by FAO (Ayers and Westcott, 1985) for irrigation water ($3000 \mu\text{S cm}^{-1}$).

Table 1. Locations, depth and some chemical properties of the studied samples

Sample No.	Location			Wells Depth, m	pH	EC ₂₅ $\mu\text{S cm}^{-1}$	TDS mg l^{-1}
	Place Name	Longitude, East	Altitude, North				
1	S.B*.1	27° 29`	14° 17`	345	6.87	1060	689
2	S.B. 5	27° 29`	14° 18`	336	6.70	1500	990
3	S.B. 10	27° 29`	14° 18`	448	7.00	1400	920
4	S.B. 14	27° 29`	14° 19`	315	6.51	940	620
5	S.B. 15	27° 29`	14° 22`	309	6.80	1160	765
6	S.B. 17	27° 29`	14° 23`	355	6.90	1150	745
7	S.B. 20	27° 29`	14° 23`	331	6.90	1560	1030
8	S.B. 25	27° 30`	14° 23`	414	6.91	1520	1010
9	Ashkida	27° 33`	14° 31`	55	6.50	3860	2432
10	AbuGhrdqa	27° 35`	14° 24`	100	6.74	2320	1500
11	Qiera	27° 32`	14° 20`	-	6.52	2950	1280
12	Brak- W	27° 35`	14° 15`	130	7.10	1130	751
13	Zilwaz	27° 34`	14° 11`	30	6.70	4230	2688
14	Zwaya	27° 35`	14° 14`	100	6.60	1020	679
15	Tamzwa	27° 34`	14° 11`	50	6.60	4880	3075
16	Sharakh	27° 33`	14° 11`	50	6.60	4890	3090
17	Dbwat-3	27° 38`	14° 08`	400	7.03	1300	860
18	Dbwat-9	27° 38`	14° 08`	400	7.21	1440	944
19	Aqar	27° 33`	14° 10`	110	6.90	1420	930
20	Qurdah	27° 29`	14° 01`	100	6.80	1310	845
21	Zehra-1	27° 50`138"	14° 27`	57	7.20	4850	3055
22	Zehra-2	27° 50`138"	13° 27`	28	7.80	4540	2862
23	Tmsan-1	27° 50` 20"	13° 26`	40	6.90	3890	2470
24	Tmsan-2	27° 50`100"	13° 26`	30	6.70	4110	2585
25	Edri-1	27° 30`	13° 16`	25	6.60	4200	2640
26	Edri-2	27° 30`	13° 16`	60	6.90	1700	1096
27	Edri-2	27° 30`	13° 16`	55	6.91	1820	1192

*S.B. =South Brak Agriculture Project, W=West.

Increase in salinity may be caused by high pumping rates. Salinity of wells from Al-Dabwat Agriculture Project (Well No. 17 and 18) was close to the results reported by Ellwood and Hickes (2003). This may be due to close period of the previous study to this study. Positive relationship was found between water salinity and wells depth. Very highly saline water was found in shallow wells (<100 m depth). These wells water can cause salinity accumulation and damaged soil, so it mustn't be used. Water quality of the studied samples can be classified according to USDA system (Richards, 1954) to; highly saline water which consist 59.3 % out of the total samples, and very highly saline, which consist 40.7 % of the total sample. Highly saline water must be used with caution to avoid reduction of crop production and salt accumulation in soil, while very highly saline water mustn't be used. In general, salinity of studied wells from Ashkida (sample No.9) was found to be higher than that recorded by previous studies (Broad of Sebha Water, 1979; Kalash, et al. 1981) which were 720-780 $\mu\text{S cm}^{-1}$.

According to FAO guidelines for evaluation of water quality for irrigation (Ayers and Westcott, 1985), the degree of restriction with using these water for irrigation due to salt content can be as follows; 41% will show slight to moderate restriction, and the rest (49 %) will show sever restriction, (Table 3).

Ions species

The data presented in Table 2 confirmed the dominance of Na^+ over other cations. Their concentrations were between 92.7-898.6 mg l^{-1} and highly correlated with EC ($r=0.982$). The cations in all of the studied samples were in the order: $\text{Na}^+ > \text{Ca}^+ > \text{K}^+ > \text{Mg}^+$. Calcium concentrations show wide range (16.4-269.0 mg l^{-1}) and highly correlated with the EC ($r=0.815$). Some samples had high concentration exceeded the critical level (100 mg l^{-1}) to be used in phosphate fertigation (Hijazi, 1999). High to very high potassium concentration (14.1-79.0 mg l^{-1}) was found. This result was in agreement with the results reported by other workers about wells water from other locations in Libya (Kalash et al., 1980 ; Al-Tamimi and Alaswd, 2014). Its concentrations were more many times than the usual range of potassium in irrigation water (0-2 mg l^{-1}) reported by FAO (Ayers and Westcott, 1985). High water potassium is of great importance in planning K-fertilization programmes for lands irrigated with such as water. Magnesium was found in low concentration (7.2-39.5 mg l^{-1}), though it is within the limits of common irrigation water quality (0-60 mg l^{-1}) reported by FAO (Ayers and Westcott, 1985). Apart from five samples which dominated by chloride as anion i.e. 17, 18, 25, 26, and 27, the rest samples were

dominated by sulphate. All samples have moderately to extremely high chloride concentrations and cover the range of 137.4 - 947.1 mg l⁻¹. So it can cause low, moderate or severe degree of chloride restriction when used in surface or sprinkler irrigation. Leaf edge burn and chloride toxicity, resulting from root uptake or excessive foliar absorption under overhead irrigation are well known when such as water used, especially in dry climate. Sulphate was found in wide range (101.3-1520.6 mg l⁻¹). High concentration of sulphate ion was found in highly saline samples (samples; 9, 13, 15, 16, 21, 22, 23, 24 and 25). On the other hand, HCO₃⁻ was the third anion and present in low concentrations (76.2 - 219.6 mg l⁻¹). All samples were free from carbonate.

Table 2. Ions concentrations of the studied samples*

Wells No.	Na ⁺	Ca ²⁺	K ⁺	Mg ²⁺	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻	NO ₃ ⁻	B
	mg l ⁻¹								
1	149.5	34.4	34.8	16.8	97.6	150.8	223.2	1.30	0.10
2	244.9	30.0	35.2	20.4	91.5	202.3	360	1.60	0.10
3	226.5	30.0	31.3	19.8	85.4	170.0	364.8	1.09	0.01
4	162.6	16.4	26.2	11.4	76.2	161.5	176.2	2.30	0.10
5	182.2	24.2	34.0	18.8	97.6	180.0	234.2	1.7	0.10
6	186.1	24.6	35.2	12.1	103.7	182.8	208.8	1.10	0.15
7	280.6	24.4	35.2	16.1	79.3	210.1	403.2	2.10	0.10
8	277.8	19.8	33.2	14.2	79.3	190.3	402.2	2.99	0.12
9	670.0	106.0	72.7	32.2	115.9	555.9	1025.3	1.60	0.28
10	324.7	135.0	28.5	20.4	103.7	374.5	524.2	7.7	0.12
11	449.4	136.6	55.5	21.5	189.1	447.3	660.5	6.5	0.22
12	148.3	42.0	53.6	18.2	109.8	163.3	234.7	9.0	0.14
13	715.7	137.8	55.5	36.4	97.6	540.6	1224.5	6.5	0.18
14	92.7	57.0	64.1	21.4	122.0	137.4	208.8	4.4	0.06
15	872.6	141.1	64.9	29.3	109.8	662.1	1373.3	1.89	0.02
16	786.6	225.6	68.8	22.1	97.6	558.8	1520.6	2.00	0.18
17	199.4	50.8	17.6	16.0	79.3	333.3	101.3	7.40	0.08
18	243.1	49.0	15.6	15.4	100.6	363.9	127.2	7.30	0.28
19	215.0	79.2	14.5	7.2	85.4	205.9	336.5	1.70	0.38
20	140.7	87.0	46.9	19.8	146.4	193.8	253.0	12.2	0.02
21	898.6	122.6	15.6	35.5	219.6	798.7	1072.3	6.69	0.07
22	851.5	108.0	14.1	20.3	219.6	720.6	982.6	6.21	0.08
23	607.9	203.2	39.9	15.2	122.0	695.4	832.8	1.21	0.07
24	620.3	244.0	45.3	21.7	146.4	758.6	832.8	1.21	0.06
25	556.6	269.0	79.0	39.5	134.2	947.1	667.7	9.23	0.06
26	249.8	85.6	29.7	18.1	140.3	335.5	270.7	1.23	0.05
27	272.3	86.8	19.5	21.1	128.1	351.5	302.4	9.00	0.05

*CO₃²⁻, NH₄⁺ & P concentrations= 0.00 to 0.001

Soluble boron in the studied samples was found in low concentration and cover the range of 0.02-0.38 mg l⁻¹ (Table 2). This means that no boron toxicity expected when using these water for flood, drip or sprinkler irrigation (Ayers and Westcott, 1985). Some samples shows significant amount of nitrate (>5 mg l⁻¹) which should be taken into account in soil fertility program. Presence of significant concentrations of nitrate in these samples indicates a possible contamination of water source. This was due to using water soluble nitrogenous fertilizer, with fertigation practices for long seasons. Absence of ammonium and phosphate ions from samples confirmed that samples were not polluted with urban waste or organic source.

Sodicity

Two parameters were used to evaluate sodicity which were: SAR and RSC. Data presented in Table 3 show that SAR and RSC values had a wide range. Its values were between 2.65 to 18.33 (meq l⁻¹)^{1/2} for SAR and between -18.46 to -0.37 meq l⁻¹ for RSC. According to USDA classification for irrigation water depending on water SAR, 17 samples (63%) had low SAR, 8 samples (30%) shown moderate SAR, and the rest two samples shown high SAR. The soils of Wadi Al-shatti had medium to coarse texture (Sandy clay loam, loamy sand and Sand), low cation exchange capacity, and some of them characterized by low permeability due to presence of clay pan or clay textured subsurface horizons. Clay mineralogy in these soils dominated with kalonite, illite and some montmorillonite (Obaid et al., 1998). Using water with high or even moderate SAR in such as soils may limit calcium and magnesium uptake by plant and built up sodicity. Values of RSC for all samples were negative. This means that the concentration of Ca²⁺ and Mg²⁺ ions were higher than the concentration of HCO₃⁻ and CO₃²⁻ ions. In other words, there is no residual carbonate.

Water Classification

According to American Salinity Laboratory guideline for classification of irrigation water (by using EC and SAR), it is clear that the studied samples lies in five classes (Table 3), which were; high saline-low sodicity (C₃S₁), high saline-medium sodicity (C₃S₂), very high saline-medium sodicity (C₄S₂), very high saline-high sodicity (C₄S₃) and very high saline-very high sodicity (C₄S₄). This means that all water was not suitable for sensitive crops and must be used with caution only in good permeable soils.

Table 3. Some chemical parameters used to assess water suitability and Water Classification

Sample No.	SAR	RSC	PS	pH _c	TH	Classification	LI
1	5.20	- 1.52	6.57	7.9	156.0	C ₃ S ₁	- 1.11
2	8.42	- 1.70	9.45	7.9	160.0	C ₃ S ₂	- 1.27
3	7.85	-1.75	8.59	7.9	157.5	C ₃ S ₂	- 0.97
4	7.51	- 0.52	6.38	8.2	88.5	C ₃ S ₂	- 1.977
5	6.72	- 1.18	7.51	7.9	139.0	C ₃ S ₂	- 1.178
6	7.64	- 0.54	7.32	8.0	112.0	C ₃ S ₂	- 1.181
7	10.78	- 1.26	10.12	8.1	128.0	C ₃ S ₂	- 1.258
8	11.60	- 0.87	9.55	8.1	108.5	C ₃ S ₃	- 1.259
9	14.58	- 6.08	26.34	7.5	399.0	C ₄ S ₃	- 1.145
10	6.87	- 0.73	16.01	7.6	422.5	C ₄ S ₂	- 0.915
11	9.41	- 5.52	19.48	7.3	431.0	C ₄ S ₂	- 0.931
12	4.79	- 1.82	7.04	7.7	181.0	C ₃ S ₁	- 0.676
13	13.97	- 8.32	27.98	7.6	496.0	C ₄ S ₃	- 0.942
14	2.65	- 2.63	6.04	7.6	231.5	C ₃ S ₁	- 1.077
15	17.42	- 7.69	32.95	7.5	474.5	C ₄ S ₄	- 0.940
16	13.35	- 11.52	31.58	7.6	656.0	C ₄ S ₄	- 1.038
17	6.23	- 2.57	10.44	7.9	193.5	C ₃ S ₂	- 0.919
18	7.74	- 2.08	11.57	7.8	186.5	C ₃ S ₂	- 0.666
19	6.91	- 3.16	9.30	7.7	228.0	C ₃ S ₂	- 0.869
20	3.53	- 3.60	8.09	7.4	300.0	C ₃ S ₁	- 0.670
21	18.33	- 5.49	33.67	7.2	454.5	C ₄ S ₄	- 0.042
22	19.66	- 3.49	30.73	7.3	353.5	C ₄ S ₄	+ 0.456
23	11.06	- 0.37	28.26	7.4	571.5	C ₄ S ₃	- 0.545
24	10.57	- 10.61	30.04	7.3	650.5	C ₄ S ₃	- 0.844
25	8.36	- 18.46	33.63	7.3	837.0	C ₄ S ₂	- 0.724
26	6.38	- 3.49	12.27	7.4	289.5	C ₃ S ₂	- 0.566
27	6.78	- 4.00	13.05	7.6	305.0	C ₃ S ₂	- 0.754

Potential salinity (PS)

According to Doneen criteria, result in table 3 shown that eleven samples can be classified as moderate water quality from the view point of PS when used in soils with moderate permeability (PS= 5-10) i.e. samples No. 1-6, 8, 12, 14, 19 and 20. Thirteen samples classified as moderate water quality when used with highly permeable soils (PS=7-15) i.e. 2, 3, 5 to 8, 12, 17 to 20, 26 and 27. Only three samples can be classified as good water quality from the view point of PS when used in highly permeable soils (PS<7) (samples 1, 4, and 14) and none of these samples can be classified as good water quality when used with moderate permeable soils.

Total hardness (TH)

Apart from samples of the south Ashkida Agriculture project (samples 1-8), which had normal and acceptable level of hardness (100 to 160 mg CaCO₃/l) in accordance to hardness classification proposed by American Society of Agriculture Engineers. The rest 19th samples contained high to very high total hardness (181-656 mg CaCO₃ l⁻¹) (Table 3). Total hardness up to 150 mg CaCO₃ l⁻¹ considered desirable for plant growth (Hijazi, 1999). Although plant can tolerate high levels of hardness, and toxicity is not normally, but excessive hardness may cause foliar deposits of calcium or magnesium carbonate under overhead irrigation. So, wells water No. 9-27 should not be used with sprinkler irrigation.

Calcite equilibrium consideration

Calcite equilibrium occurred in soil would affected by chemical properties of added irrigation water. Calculated pH (pH_c) values of water have been used to determine water ability to dissolve or precipitate calcite. Values more than 8.4, demonstrated water tendency for calcite dissolution, while values less than 8.4 indicated water tendency to precipitate calcite (Ayers and Westcott, 1985). Values of pH_c for all wells water (Table 3) indicated the tendency to precipitate calcite.

Water aggressiveness

Langelier index was used to evaluate aggressive potential of water. Negative values less than -2 suggested a significant potential for corrosion and positive value >2 suggested a significant potential for scales formation in the piping. Apart from sample No. 22 which had low positive value (+ 0.456), the rest samples had negative value (-0.042 to -1.977) (Table 2). This result confirmed that none of the studied samples had a tendency for scaling or corrosion.

CONCLUSIONS

According to analytical results for the wells water, the following can be concluded:

- The salinity of studied groundwater widely varied from medium to very high. Most samples (90 %) can cause slight to sever salinity restriction.
- In most samples the pH is slightly acid to neutral, whereas three samples were slightly alkaline. The pH of all samples was within the permissible level of the FAO standards for irrigation water.

- Noticeable high potassium content in all wells water, and significant amount of nitrate in some, must be in consideration when planning for potassium and nitrogenous fertilization programmes for soils irrigated with these water.
- Most samples contained high total hardness, and can precipitate carbonate on plant forage if used in sprinkler irrigation.

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تحري ملائمة مياه بعض الآبار للري في منطقة وادي الشاطئ جنوب غرب ليبيا

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المستخلص

أجريت هذه الدراسة لكشف التكوين الأيوني وبعض الصفات الكيميائية لمياه بعض الآبار في منطقة وادي الشاطئ، جنوب غرب ليبيا لتحري صلاحيتها للري. أظهرت النتائج أن الأس الهيدروجيني لمعظم عينات الدراسة كان بين خفيف الحامضية والمتعادل وبمدى بين 6.5-7.0، بينما كان الأس الهيدروجيني لثلاث عينات فقط خفيف القاعدية بمدى بين 7.1-7.8، وكانت الإيصالية الكهربائية للعينات بين 940 إلى 4890 ميكروسيمنز سم⁻¹، ومعظمها كان ذا ملوحة مرتفعة، وكان الصوديوم هو الأيون الموجب السائد، يليه الكالسيوم ثم البوتاسيوم فالمغنسيوم، وأظهرت النتائج انخفاض تركيز المغنسيوم وارتفاع تركيز البوتاسيوم، وكانت السيادة للكبريتات على بقية الأيونات السالبة في معظم العينات، بينما ساد الكلوريد في عدد قليل منها، وكان تركيز الكلوريد بين متوسط إلى شديد الارتفاع، بينما كان تركيز البورون منخفضاً في جميع العينات، إلا أن بعضها احتوى على تراكيز مرتفعة نسبياً من النترات، وكانت بعض العينات شديدة العسرة، والتي يمكن أن تسبب ترسيب الكالسيوم أو المغنسيوم بشكل كربونات عند استخدام هذه المياه في الري بالرش. أكدت نتائج الأس الهيدروجيني المحسوب أن جميع العينات ليس لها ميل لإحداث التآكل أو لترسيب قشور الكربونات في الأنابيب.

الكلمات المفتاحية: مياه ري، مياه آبار، نوعية المياه، ليبيا.