ISSN 1991- 8690 الترقيم الدولي ٨٦٩٠ - ١٩٩١
website:http://jsci.utq.edu.iq Email:utjsci@utq.edu.iq

Occurrence of Halotolerant algae in Shallow Saline Water (bogs), Distributed in Basrah City, Iraq

Nida J. Al-Mousawi *Widad M. Al-Asadi

Department of Biology - Sciences of College - University of Basrah
*E: Widad220@yahoo.com

Abstract

A study was made on the halotolerant algae occurance in (32) area of shallow saline water (bogs) distributed in Basrah city south of Iraq in Jouly 2011. A total of (24) taxa were Identified. Algal were collected and maintained as unialgal culture of the locally isolated such as cyanobacterium *Arthrospira (spirulina) platensis* and micro green alga *Dunaliella salina*.

The salinity of water were around from (2.5-60.5)‰. According to the results of a total hardness (Lind, 1979) recent data revealed that the total hardness (600-144000)mg $CaCO_3$/L of studied shallow saline water were very hard.

تواجد الطحالب المتحملة للملوحة في السبخات المائية المالحة المتناثرة في مدينة البصرة – العراق

نداء جاسم الموسوي وداد مزبان طاهر الاسدي

قسم علوم الحياة – كلية العلوم – جامعة البصرة

الخلاصة

تم في هذه الدراسة تشخيص تواجد الطحالب المتحملة للملوحة من السبخات المائية المالحة (٣٢) عينة والمتناثرة في محافظة البصرة في الجزء الجنوبي من العراق. شخص (٢٤) نوع فيها ، تعد بعض البيئات كمزارع وحيدة الطحلب مثل الطحلب الاخضر المزرق Arthrospira platensis (Spirulina) والطحلب الاخضر Dunaliella salina.

تراوحت نسبة الملوحة في السبخات المائية المالحة بين (٢.٥-٦٠.٥)‰، اعتماداً على تقسيمات (Lind, 1979) اوضحت النتائج الحالية للعسرة الكلية (٦٠٠-١٤٤٠٠٠)ملغم CaCO3 /لتر للسبخات المائية المدروسة بانها شديدة العسرة.

Introduction

Algae are abundant everywhere except in sandy desert regions and on permanent snow and ice field and even in these inhospitable regions specialized algal floras can be found in favorable habitats.

A study of the composition of the flora; the relationship between these floras and the biological, physical and chemical factors operating directly or indirectly in the habitat. (Round, 1973).

The algal flora of small bodies of water is indirectly influenced by size. The relatively shallow depth, the small volume leading to rapid changes in composition of the water and the rapid fluctuations of temperature, CO_2 and pH (Round, 1973).

The saline environment support a wide range of aquatic life and this includes microscopic green algae and cyanobacteria, Blooms may occur from mid to late summer through into autumn. During a

bloom the water will take on bright blue-green color, while the algal blooms occur in saline water tend to result in a red-brown color.

The most common visible signs will be water that is dark-green to blue-green and may even be greenish-brown to red. In order for these algae to bloom the right conditions of temperature, nutrients and Light must be present lower water levels in ponds and reservoirs allow light to penetrate closer to the bottom of the water there by providing the sunlight for photosynthesis necessary for growth (Surber, 2008).

Iraq is confronted with problem of high water salinity, which is spoiling potentially fertile land and limiting agricultural activities. There is a continous in crease in the effected areas and as a result new areas of saline water are being created. These especially located in southern, Iraq. (Buringh, 1960 ; Al-Delamii, 2000).

The cosmopolitan distribution of cyanobacteria and other algae indicate that they can cope with a wide spectrum of global environment stresses such as heat, cold, desiccation, salinity, nitrogen starvation, photo-oxidation, anacrobiosis and osmotic stress etc. (Singh *et al.*, 2002).

The present investigation was stated to survey the existing type of algae, so that the truly halophilic algae in hyper saline environment.

The study of halophilic algae in the inland saline water of Iraq has been given a good attention from algologists in various part of the country.

Materials and Methods

1. Samples Collection

We selected thirty two saline water along Basrah city for our investigation, water were collected in polyethylene bottle from different saline areas of [Al-Shaeba , Al-Zubair, Al-Rumailla Al-Shemali, Al-Qabla, Al-Quzaiza, Al-Toba and Al-Nikhella and Al-Garma] in Basrah city, fig(1), during summer-2011.

Upon return to laboratory, water samples were concentration by centrifuge to obtain the algae and storage this fraction (Sedimentation) in refrigeration before examination. Using light microscope to examined the algae. For Identification of species, the following literature was consulted (Desikachary, 1959 ; Prescotte, 1975 ; Al-Handal et al., 1989 ; Al-Handal, 2009).

2. Physical and Chemical factors measurment

The second fraction of saline water (Supernatant) was used to chemical and physical analysis. A water temperature; pH values and EC were measured directly in the field by a simple thermometer (the result of temperature are around from 36-40 are not seen); digital pH meter and portable electrical conductivity meter respectively, salinity was measured by formula [EC (ms/cm) * 0.64] ‰.

The total Hardness and dissolved sulfate was measured according to Lind (1979).

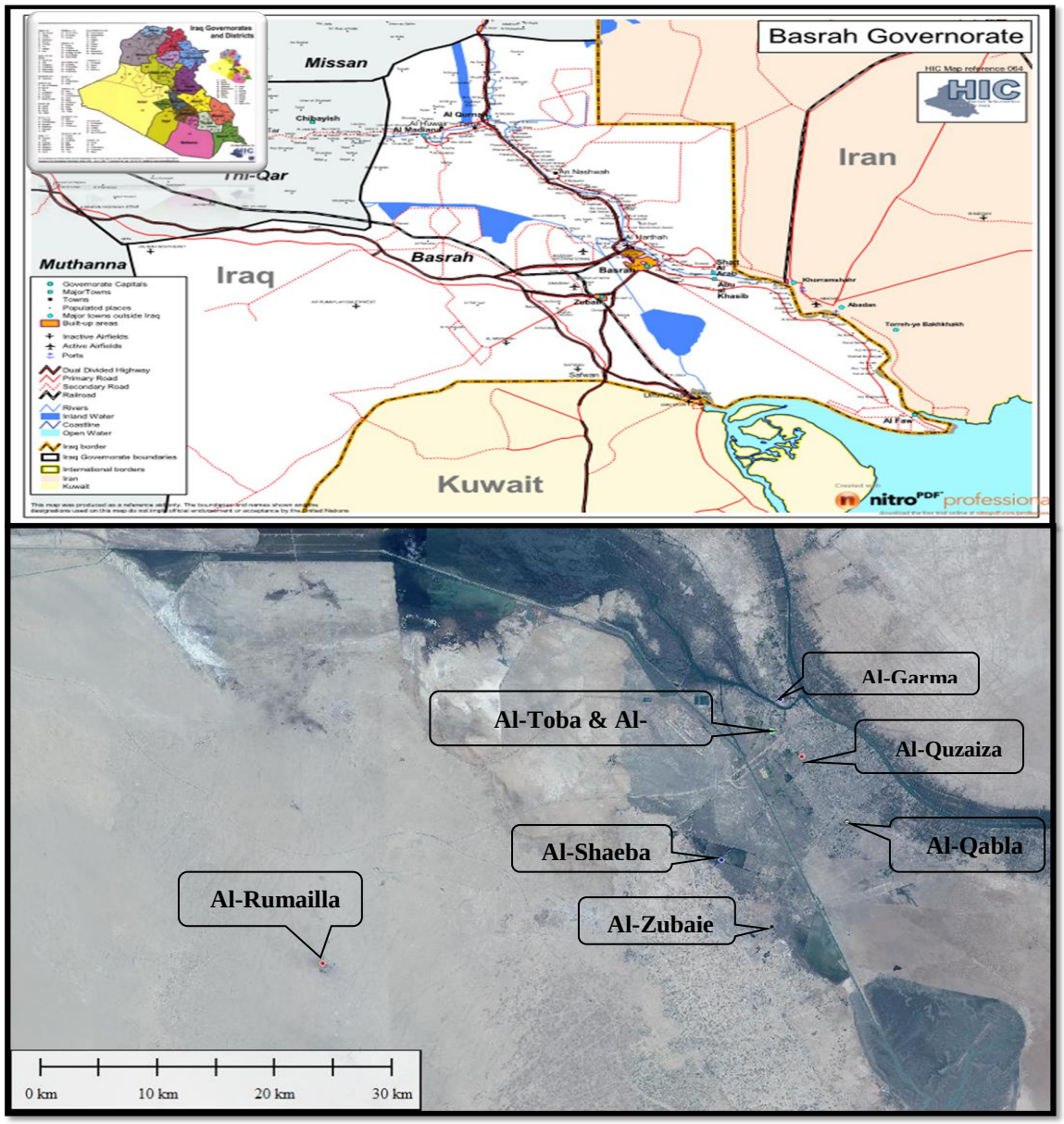


Fig. 1: Study areas showing sampling stations , Basrah City –Iraq.

Results

1. Chemical parameter of the samples collected:

The chemical date for **Fig. 1: Study areas showing sampling stations, Basrah City –Iraq.** studied area are given in table (1). Little differences can be seen in pH values for all areas

2. Microscopical observations of the shallow saline water:

Microscopical examination of sample collected from shallow saline bogs showed a and its around from (7.3) in stations (29), to (8.4) in both stations (22 ; 15).

The salts concentration range between (2.5-60.5)‰ in station (27 ; 22) respectively, with total hardness of (600-144000)mg/L in stations (7 ; 10). The dissolved sulfate concentration range between (1220-21376)mg/L in stations (11 ; 20).

dominance of unicellular green alga *Dunaliella salina*, table (2). A total of (24) taxa identified during the present study. (12) taxa belonged to

cyanophyceae; (9) to the Bacillariophyceae ; (3) to the chlorophyceae and (1) to the Euglenophyceae.

The species of *D. salina* were common and abundant in area, the majority is (78)%, table (2) second in important is blue-green algae *Oscillatoria* sp. which comprise (53)%, followed by Diatoms *Navicula* spp. (25)%.

The highest number of species (7 ; 6) were recorded in stations [(2, 5) ; (17)], respectively while no found any species in station (30), fig.(2) Plat (1, 2).

Table (1): Chemical data for studied area in the shallow salin water distributed in Basrah city-Iraq.

Sample	pH	SO_4 (mg/L)	Salinity (‰)	Total Hardness (mg $CaCo_3$/L)
١	٧.٦	٥٣١٢	٤٥.٦	25800
٢	٧.٧	١١٧٣٦	٣٤.8	18800
٣	٨.١	٢٥٢٠	٤٧.5	28400
٤	٧.٦	٣٥٢٠	٥٥.٢	29400
٥	٧.٨	٢٥٦٠	١٤.٤	15000
٦	٧.٩	٤٣٩٢	٥٠.٨	20000
٧	٧.٨	١٤٠٨	٤٧.5	600
٨	٧.٧	٤٤٤٨	٤٧.6	26200
٩	٨.٢	٢٢٠٤	٤.٩	3700
١٠	٧.٥	٢٠٢٠٠	٣٨.١	144000
١١	٧.٤	١٢٢٠	٧.2	3100
١٢	٧.٧	١٦٥٢٠	٥٨.٦	28000
١٣	٧.٦	١١٦٠٠	٥٧.٦	97000
١٤	٧.٨	١٢١٧٦	٣٩.6	49000
١٥	٨.٤	١٢٢٥٦	٥٦.٥	55800
١٦	٧.٧	١٨٣٠٨	٤٠.4	17500
١٧	٧.٦	٥٠٤٨	٤٢.٤	24400
١٨	٧.٧	٢١٢٨	١٠.٦	9000
١٩	٧.٨	١٩١٤٤	٣٩.3	36000
٢٠	٧.٥	٢١٣٧٦	٤٠.٣	63000
٢١	٧.٩	١٣١٢	٢.٩	30000
٢٢	٨.٤	٦٩٢٠	٦٠.5	52000
٢٣	٧.٦	٢٠٨٠٠	٣٤.8	39000
٢٤	٧.٩	٨٨٠٠	٥٧.٣	36600
٢٥	٧.٧	٣٤٩٦	٥٧.6	14400
٢٦	٧.٦	٢٧١٢	٦.3	4400
٢٧	٧.٦	٢٢٠٠	٢.5	6000
٢٨	٧.٤	١٨٩٦	١٦.4	8000
٢٩	٧.٣	٦٤١٦	٢٥.٥	25000
٣٠	٧.٩	١٥٣١٢	٤١.٩	41000
٣١	٧.٨	١٠٠٤٠	٥٩.8	34000
٣٢	٧.٤	٣٨٥٦	١٢.4	9000

Table (2): list of algal taxa identified in the studied area in shallow saline water distributed in Basrah city – Iraq.

Occurrence species of algae	station																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	%
cyonobacteria																																	
Oscilatoria trichoides	+				+																												6.2
O. psendogeminata					+																												3.1
O. amphibian						+	+	+																									9.3
O. chalybea									+																								3.1
O. sp.		+			+				+		+		+	+		+	+	+	+	+	+		+		+			+	+		+		5.3
Aphanothece	+					+																											6.2
Arthrospira plantensis		+																			+												6.2
Lyngbya			+																														3.1
Merismopedia glanca									+	+	+																						9.3
Microcystis sp.																		+															3.1
Micrcoleus sp.																									+	+							6.2
Chroococcus sp.	+																																3.1
Chlorophyta																																	
Lagerheimia		+			+																												6.2
Kirchnerella		+							+		+																						9.3
Dunalilla	+	+	+	+	+	+	+	+		+		+	+	+	+	+	+	+	+	+		+	+	+	+			+			+	+	78
Bacillariophyceae																																	
Navicula	+		+										+												+	+	+		+		+		25
Calonies																	+																3.1
Gyrosigma tenuirostrum			+														+					+						+					12.5
Amphora exgiata			+		+				+	+	+						+																18.7
Diatoma			+																														3.1
Cybella turgid					+																												3.1
C. sp.		+																									+				+		9.3
Coscinodiscus																	+																3.1
Nitszchia palea																											+						3.1
Euglenophyta																																	
Euglena sp.		+																			+												3.1
Total Geaero	5	7	6	1	7	3	2	2	5	3	4	1	3	2	1	2	6	3	2	2	3	2	2	1	4	2	3	3	2	0	4	1	
Cyanobacteria	3	2	1	0	3	2	1	1	3	1	2	1	1	1	0	1	1	2	1	1	2	0	1	0	2	1	0	1	1	0	1	0	
Chlorophyta	1	3	1	1	2	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	0	0	1	1	
Bacillariophyceae	1	1	4	0	2	0	0	0	1	1	1	0	1	0	0	0	4	0	0	0	0	1	0	0	1	1	3	1	1	0	2	0	
Euglenophyta	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	

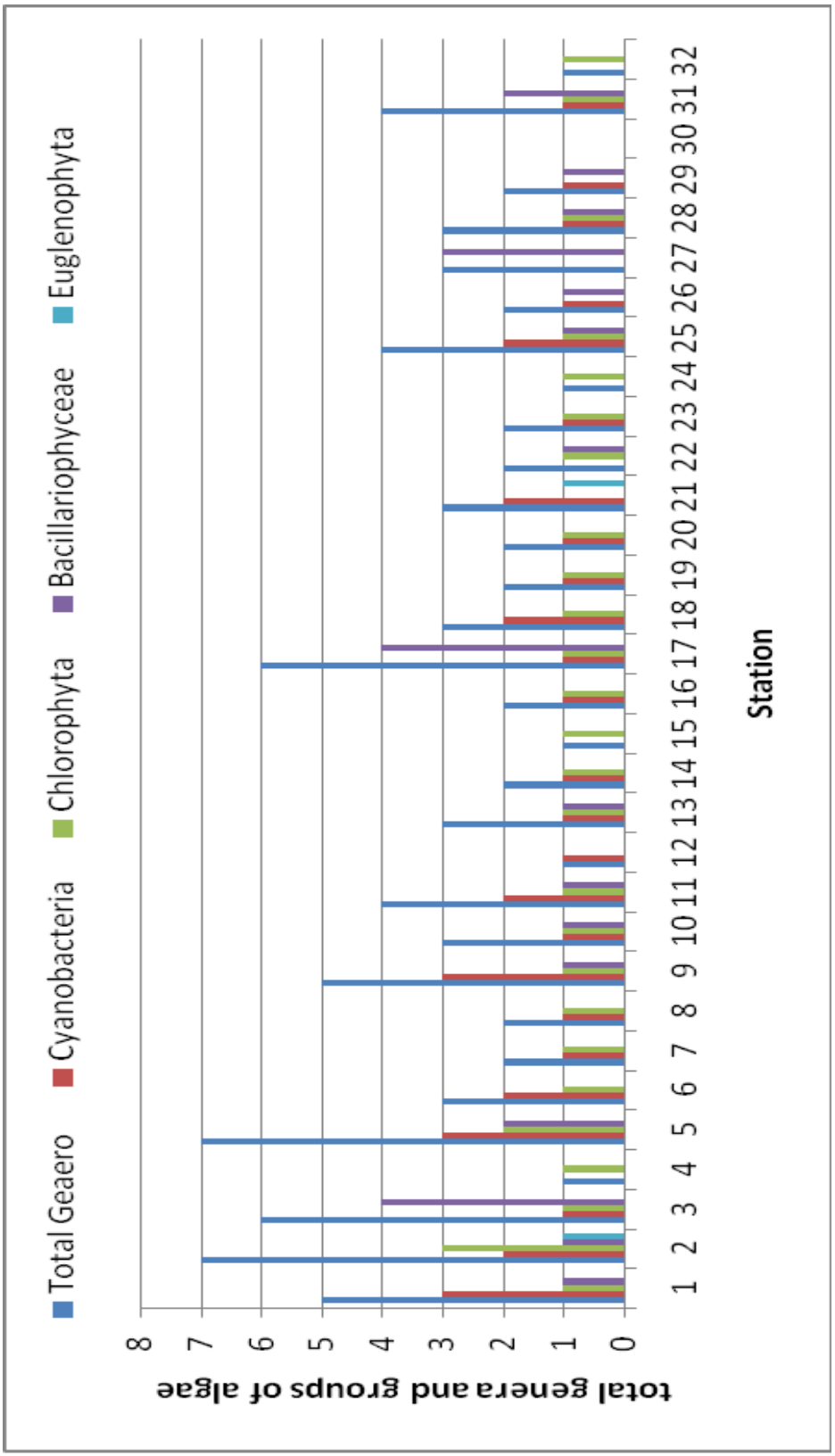
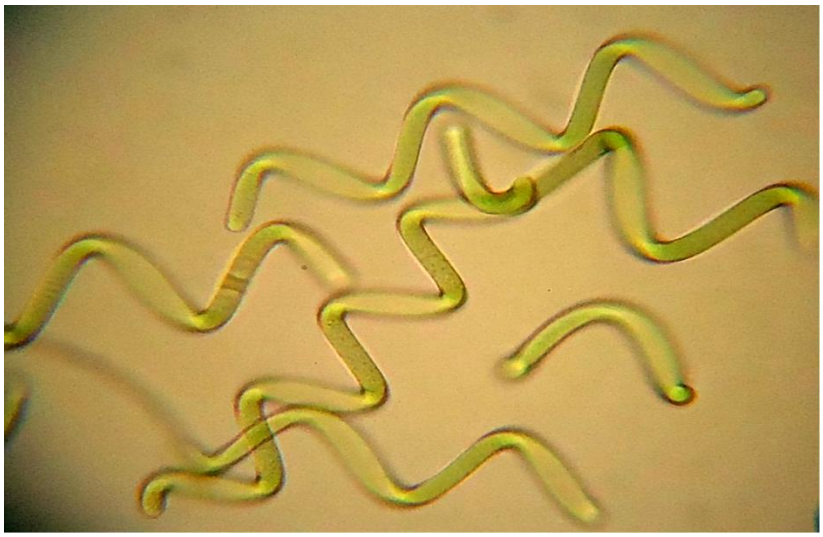
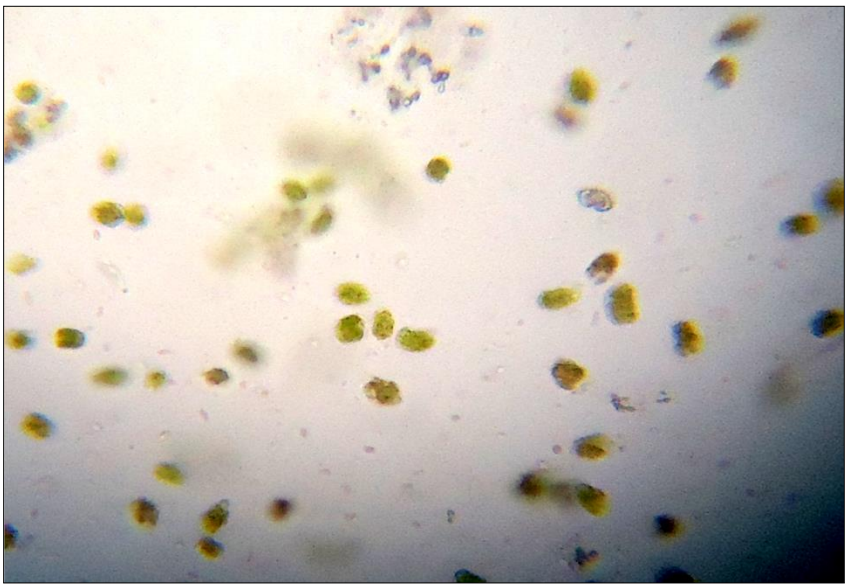


Fig. 2: A total genera and groups of algae in the studied area in shallow saline water distributed in Basrah city, Iraq.



Plat. (1): ***Arthrospira (spirulina) platensis***



Plat. (2): ***Dunaliella salina***

Discussion

The chemical data for studied area are given in table (1). The pH values for all area Lie in alkaline side and in agreement with previous studied in most of southern Iraqi ecosystems (Al-Mousawi *et al.,* 1990 ; Al-Delamii, 2000).

The value of salinity ranged from (2.5-60.5) ‰ in the studied area in many studies, the species of *Dunaliella* were found to have different salt concentration. *D. species* isolated from the Dead sea grow optimally in 2.5% salinity and tolerate up to 20% salinity (Abusara *et al*., 2011), while *D. salina* isolated from Kuwait had on optimum growth of (45) psu rather than at low salinity (25)pus (Abu-Rezq *et al.*, 2011).

Hardness values were showed little variations between stations and ranged from (600-144000)mg/L indicating the studied area are very hard according to Ling (1979).

Dissolved sulfate is the common form taken up by higher plants and is probably equally important to algae (Lind, 1979). There for we measured the concentrated sulfate in shallow saline

bogs and its ranged from (1220-21376)mg/L. The values are higher than those reported in natural water (5-50)mg/L however, much greater concentration are found in saline water.

Table (2) refered to (24) taxa identification in this study. There is a gradual transition from fresh water to marine habitents, some species are commonly found in such areas. Intertidal blue-greens have adaptability to both fresh water and marina habitats, (Pandey and Trivedi, 1995).

Cyanobacteria occur in such a wide variety of habitats, because its tolerance of high temperatures, high UV-irradiation, desiccation, free sulfide and abilities to utilize low light flux and CO_2 concentration. In addition to the occurrence of a number of truly halophilic cyanobacteria in hypersaline environment.

The physiological mechanisms of the cell have three type of mechanisms:- (Lee, 2008).

- Active export of inorganic ions in the protoplasm leading to relatively unchanged internal salt concentration.
- Accumulation of organic osmoprotective compounds such as glycosylglycerol, glycine and betaine.
- Expression of aset of salt-stress proteins such as the protein flavodoxin.

The cyanobacterium *Arthrospira* (*Spirulina*) *Platensis* is a commericially important filamentous algae we founded in tow area only (2 , 21) as unialgal culture plate (2) its used as a food additive and feed for fish, because it's a rich source of protein, mineral, vitamin B_{12} , β-carotene and essential fatty acid. (Choi *et al.*, 2008).

Sena *et al* (2010) explained that this species (Arthrospira) blooms in bicarbonate-rich environment.

The distribution of the chlorophyta seems to in the following manner. Most of the chlorophyceae and the volvocales and family Dunaliellaceae the genera *Dunaliella* a green algae that looks like *Chlamydomonus*, there are two species: one of theme *D. acidophila* is an acid-resistant sp. that exhibits optimal growth of pH 1.0 (Lee, 2008). The second sp. *D. salina* plate (1) has adapted to waters high in salt, that the most salt-tolerant eukaryotic photosynthetic organisms (Lee, 2008). Which has two mechanisms that allow it to live in water of verging salinities:

1. Ion pumps in the plasma membrane.

Plasma membrane proteins are produced when the alga is move from alow-salinity environment to one of high salinity. These protein are ion pumps that expel Na^+ from the protoplasm and control intracellular ion level.

2. Production of glycerol.

Dunaliella alga synthesis or elimination of glycerol results in an intracellular concentration that balances the external salinity and permits the cell to regain their original volum.

Dunaliella alga were collected and maintained as unialgal culture of the locally areas, stations (12, 15, 24, 32) table (2). This observation agreement with Abu-Rezq *et al.* (2010) whose isolated pure culture of *D. Saline* from Bubiyan Island, Kuwait.

The algal color of *Dunaliella* in this study was green in color at all stations, due to an increase in chlorophyll content and a decrease in β-carotene, agreement with Abusara *et al.* (2011) and Abu-Rezq (2010). But the shallow saline water are red in color may be because its producing β-carotene colored this water. When *D. Saline* blooms, usually under high light intensity, high salinity and low nitrogen concentration, it produces β-carotene in such a large quantity that the water becomes red in color (Abu-Rezq, 2010).

The species of *Navicula* (Bcillariophyceae) were common and abundant (25)% in area table (2). Kolayli and Sahin (2009) explained that the species *Navicula* were common in calcareous and slightly alkaline water.

Gupta and Agrawal (2007) found that when a change in the salinity of the medium the benthic Diatoms produced an organic osmolyte dimethyl sulfoniopropionate served as an osmoprotective agent under highly fluctuating salinity.

Conclusion:

There are many useful product from halotolerant algae including aquaculture food, feeding to fish, cosmetics, biofuel, reduction of atmospheric CO_2 , source of β-carotene such as *D. salina* are already being commercially grown in hypersaline ponds.

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