Assessment of oil content of Salicornia fertcusa seeds under salinity soils conditions in Lake Manzala, Egypt

A. Badawy [1,*], A. M. Algharib [1] and E. A. Omer [2]

[1] *Department of Environment and Bio-agriculture, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt.*
[2] *Department of Medicinal and Aromatic Plants Research, National Research Centre, Giza, Egypt.*

* Corresponding author E-mail: anasabdelaziz2020@azhar.edu.eg (A. Badawy)

ABSTRACT:

This study included Salicornia fertcusa plants collected from 7 locations in Lake Manzala, Port Said, Egypt during the winter season of 2021. The fixed oil was extracted from air dried seeds with hexane using Soxchelt apparatus. The major fatty acids of the fixed oil were studied qualitatively and quantitatively with GC-MS after methylation. The results showed that: 1) Fourteen fatty acids were identified in the fixed oil, which accounted for ca 98% of the total fatty acids. 2) Palmitic acid was identified as the major fatty acid in the Salicornia fertcusa seeds of all collected plants from different stands and ranged from 19.58 to 30.62% of the total fatty acids of the fixed oil. 3) Statistical analyses indicated that the fixed oil percentages and its main fatty acids were changed according to the soil content of Ca^{2+}, Mg, K^{+}, Na^{+}, and Cl^{-}, soil electrical conductivity values, and its physical characteristics.

Keywords*:* Salicornia fertcusa; fixed oil; fatty acids; GC-MS; lake Manzala Egypt.

INTRODUCTION

Around the world, soil salinity is a problem that is causing more and more land to deteriorate, with "salt-affected soils" covering around 7% of the terrestrial soil surface. The 1% of plants that make up the world's flora known as halophytes can adapt, thrive, and complete their life cycles in environments where the root media contains high concentrations (more than 200 mm) of electrolytes, primarily Na^{+} and Cl^{-} but also SO_4^{2-}, Mg^{2+}, Ca^{2+}, K^{+}, and HCO^{2-} (Flowers and Colmer ,2008). Salinization is the process of building up an overall concentration of liquid salts (in soil and water). It can be produced using "artificial ways" like irrigation or "natural processes" like mineral weathering and steady seawater intervention (Al-rashed *et al*., 2016).

Australia, Pakistan, Bangladesh, Thailand, and a number of Central Asian Nations are among those with unusually large tracts of saline terrain. The farming of these areas could lead to an increase in food production to feed a growing global population, which is predicted to reach about 9.1 billion by 2050. To meet this evolution, global food production will need to increase by as much as 70% by this time. Globally, almost 833 million hectares of soil have already been impacted by salt. According to estimates, more than 10% of crop land is salt-affected, which poses a serious threat to global food security. Central Asia, the Middle East, South America, North Africa, and the Pacific are some of the area's most severely impacted (FAO, 2021).

Estimates indicate that more than 10% of crop-land is salt-affected, which poses a major risk to food security worldwide. Some of the worst affected regions are in Central Asia, the Middle East, South America, North Africa and the Pacific (FAO, 2021). The high rates of soil deterioration brought on by salt are one of the main issues that developing nations deal with. As a previous result, many developing nations can use salt-tolerant plants, such as halophytes. These plants can be cultivated on already degraded, highly salinized soils that are unsuitable for conventional crops and can be used to produce food, biofuel, fodder, fiber, and other goods. These plants can also be utilized simultaneously for soil restoration. According to research carried out by Glenn *et al.* (2013) utilizing saline water to plant three halophytes (an oilseed, forage, and cereal crop), halophytes can produce a large volume of valuable agricultural products up to a root-zone salinity of up to 70 g L-1 TDS (double the salinity of seawater).

Salicornia is a genus of succulent, halophyte plants that thrive in salt marshes, on coasts, and around mangroves, according to Soliz *et al*. (2011). North America, Europe, South Africa, and South Asia all have indigenous species of Salicornia. Glasswort, pickleweed, and marsh samphire are some of the popular names for this genus; these names are also used for some other species that are not

Salicornia (Ball & Peter, 2004). These species are occasionally offered as "sea beans" on restaurant menus or for sale in retail establishments. Members of the Chenopodiaceae family, which includes roughly 1300 species worldwide ranging from annual plants to trees, include Salicornia species. With its distribution centered on the Mediterranean, Caspia, and Red Sea, this family primarily inhabits moderate to subtropical climates.

Numerous species are rather weedy and are found close to human habitation. The Salicornia species are small, succulent herbs with erect side branches and a jointed horizontal main stem that are typically less than 30 cm tall. Due to the small size of the leaves, the plant may appear to be without leaves. Many species are lush, but in the fall, their leaves become red. Wind pollinates the hermaphrodite blooms, and the fruit is tiny, succulent, and only has one seed (Ball and Peter, 2004). In Europe, the genus Salicornia, particularly the tetraploid species, is occasionally used as a vegetable.

Many trials have been conducted in the United States to harvest tetraploid species, mainly *S. bigelovii* on a large scale as a commercial source of vegetable oils since the seeds are rich in oil. Imai and co. (2004). The annual succulent herb *Salicornia fruticosa L.*, popularly known as glasswort, is a member of the Chenopodiaceae family and one of the most salt-tolerant plants. It is expanding on muddy seashores and salt marshes (Kim *et al*., 2009). This family has roughly 300 species and 25 genera in Egypt. Numerous species have been identified as having antibacterial and antihypertensive qualities, which are also indicated in traditional medicine for the treatment of toothaches and chronic rheumatic. This family members include significant amounts of minerals, necessary amino acids, essential fatty acids, coumarins, phenolic compounds, and alkaloids, according to research on some of their species (Radwan *et al.,* 2007). Salicornia spp. are grown as conventional oilseed crops under direct seawater irrigation in coastal and desert environments. Elprince & Alsaeedi (2000). Oils were physically and chemically analyzed, and the results revealed that their fatty acid makeup is comparable to that of other widely used edible vegetable oils. According to Anwar *et al*. (2002), 28% of Salicornia seeds are made up of oil.

Elsebaie *et al*. (2013a) investigated the techniques for extracting oil from glasswort seeds and found that a mixture of chloroform and methanol (2:1 v:v) produced the highest amount of oil (28.59%) from the seeds. *Salicornia fruticosa* seed oil's physical and chemical properties were also examined. The proportion of unsaturated fatty acids was 78.05%, of which oleic acid made up 56.58%, linoleic -?3 acid made up 17.40%, and linolenic -?3 acids made up 3.98%. *Salicornia fruticosa* plants were grown in the wild and harvested from seven different locations in Lake Manzala, Port Said, Egypt, for the purpose of this study.

MATERIALS AND METHODS

Plant and seed material

Plant and seed material Sampling of vegetative tissue and seeds of Salicornia fruticose accessions conducted from various sites located in Lake Manzala. A 15–20 cm long stem was sampled from at least three plants per site at the vegetative stage, the seeds were collected, air dried, and stored at 4 _C.

Parameters measured

The fresh weight of each plant was recorded, after which the material was baked at 80 _C for seven days to determine their dry weight. The crude protein content of dry tissue was calculated from its total nitrogen content, as determined using the Kjeldahl method (AOAC 1997), using a transformation factor of 6.25.

Study area

Salicornia fruticosa plants were collected from 7 locations in Lake Manzala, Egypt. Each location was divided into stands in total of 7 stands, which were located between 32.145545 East and 31.3045412 North. The geographical data (latitudes, longitudes, and alludes) of all stands are represented in Table (1*).*

Soil analysis:

The physical properties of soil samples collected from all 44 stands were analyzed to determine water content and texture according to Piper (1950). Accordingly, the soil texture of each stand was determined as shown in Table (2). On the other hand, the chemical parameters; pH, EC, organic matter, some cations (Ca, Mg, Na and K), and some anions (HCO3, Cl, and SO4) were determined according (Jackson, 1967; Allen et al., 1976). The results of these parameters are represented in Table (3).

Composition of fatty acids:

Fixed oil percentage (%)

Ten grams of Salicornia fruticosa plants air-dried seeds were separately crushed and extracted with petroleum ether (40-60 °C) for 6 hours using a soxhlet apparatus as stated in the A.O.A.C. (1970). The petroleum ether was then evaporated using a rotary evaporator. Fixed oil percentage (%), content (g/plant), and yield (Kg/Fed.) were calculated.

Fixed oil extraction:

Ten grams of the seeds from plants of each stand were separately crushed and extracted with petroleum ether (40-60 °C) for 8 hours using a Soxhlet apparatus as stated in the A.O.A.C. (1970). The petroleum ether was then evaporated using a rotary evaporator using a water bath at 50 C. Fixed oil percentages (%) were calculated. The resulting fixed oil was kept in the refrigerator for esterification before GC-MS.

Fatty acids esterification:

The fixed oil of Salicornia fruticosa seeds (100 mg) was placed in a test tube (20 ml) with a stopper and a volume of 3 ml of methanol solution of sodium methoxide (3%) was added. The mixture was heated up in a water bath at boiling temperature for 3 minutes. Then, 3 ml of methanol solution of boron trifluoride (10%) was added. The mixture was heated again for another 3 min. in a water bath. The mixture was extracted with hexane (1 ml) and diethyl ether (2 ml) in a separating funnel (50 ml) containing distilled water. The organic layer was separated into a vial (5 ml) and the solvent was evaporated according to Mota et al., (2015), Christie (1993), and Khan and Scheinmann (1978) to produce the fatty acid methyl esters that were kept for GC-MS analyses Ichihara and Fukubayash, (2010).

GC-MS analysis:

The GC-MS analysis of the fatty acid methyl esters (FAMEs) of chia oil was carried out using gas chromatography-mass spectrometry instrument stands at the Department of Medicinal and Aromatic Plants Research, National Research Center with the following specifications, Instrument: a TRACE GC Ultra Gas Chromatographs (THERMO Scientific Corp., USA), coupled with a thermo mass spectrometer detector (ISQ Single Quadrupole Mass Spectrometer).The GC-MS system was equipped with a TG-5MS column (30 m x 0.25 mm i.d., 0.25 μm film thickness). Analyses were carried out using helium as carrier gas at a flow rate of 1.0 mL/min and a split ratio of 1:10 using the following temperature program: 80 °C for 1 min; rising at 4.0 °C/min to 300 °C and held for 5 min. The injector and detector were held at 240 °C. Diluted samples (1:10 hexane, v/v) of 0.3 μL of the mixtures were always injected. Mass spectra were obtained by electron ionization (EI) at 70 eV, using a spectral range of m / z 35-500. Most of the compounds were identified using the analytical method: mass spectra (authentic chemicals, Wiley spectral library collection and NSIT library).

Statistical Analyses

Soil properties data were statistically analyzed using one way ANOVA and Post hoc-LSD tests (the least significant difference) SPSS Inc., (2009) at 0.05, 0.01 and 0.001 level of probability Snedecor and Cochran (1982).

The computer program Canoco was used for analysis the relation between oil percentage and Oil components with their environment. Canoco 4.51 is one of the most popular programs for multivariate statistical analysis using ordination methods in the field of ecology and several related fields. User's Guides of the recent Canoco versions (4.0 and 4.5) were cited more than 6300 times in the past 15 years (1999-2013, ISI Web of Knowledge).

RESULTS AND DISCUSSION

Results in Table (2) showed the Soil Physical and chemical properties of different Stands in Lake Manzala. Stand 6 showed the highest value in all chemical properties whereas Stand 7 showed the lowest value in all chemical properties**.** On the other hand, the resultsshowed significant different betweenstands in Physical and chemical properties. Results in Table (3) showed that the fixed oil percentage of the seeds of *Salicornia fruticose* plants collected from different stands in Lake Manzala, Port Said, Egypt ranged from 6.13% in stand6 to 13.33% in stand 3.These results are in agreement with those of Babaki and Gharneh (2022) who determined the fixed oil in different plant species, and showed that the highest percentage of oil (14.20%) was obtained in *Salicornia saline* plant. and the lowest amount (2.65%) was obtained in *Halostachys caspica* salinity plant. The relations between fixed oil percentage of the seeds of *Salicornia fruticose* plants in the different stands and potassium, magnesium, chloride, bicarbonate and contents in the soil of the different stands are indicated in the Figs. (1), (2), (3) and (4), respectively. It is clear that the fixed oil increased with increasing of their contents. Also fixed oil percentage of the seeds of *Salicornia fruticosa* plants was increased with increasing sand and silt values up to 74% and result in Table (3) represented that the fixed oil percentage of the seeds of *Salicornia fruticosa* plants collected from different stands in Lake Manzala, Port Said, Egypt ranged from 6.13% in stand (6) to 13.33% in the stand (3). our results are in agreement with those of Babaki and Gharneh (2022) who determined the fixed oil in different plant species, their results represented that the highest percentage of oil (14.20%) was recorded in the Salicornia saline plant. While the lowest amount (2.65%) was recorded in the *Halostachy scaspica* salinity plant. The relations between the fixed oil percentage of the seeds of *Salicornia fruticosa* plants in the different stands and potassium, magnesium, chloride, bicarbonate, and contents in the soil of the different stands are indicated in Figs. (1), (2), (3), and (4), respectively. It is clear that the fixed oil increased with the increase of contents of these elements. Additionally, the fixed oil content of *Salicornia fruticosa* plant seeds grew as sand and silt values rose to 74% and 14%, respectively, before tending to decline (Fig. 5 and 6). Table lists the main fatty acids of the fixed plant oil gathered from various sites (4). The primary fatty acids, which are made up about 98% of the fixed oil's total fatty acids, were found to be fourteen different fatty acids.

The majority of the fatty acids in the fixed oil were discovered to be palmitic acid, which ranged from 19.58% (stand-7) to 30.62% (stand-1) in all the plants that were gathered from different stands. In the relative percentages, palmitoleic acid was found in the fixed oil of all examined stands and trailed palmitic acid, ranging from 13.4% (stand-4) to 25.23%. (stand-1). The same pattern was seen with stearic acid, which was found in the fixed oil of all plants and ranged in concentration from 4.28% (stand-6) at the lowest end to 12.48% (stand-4) at the highest.

In terms of relative percentages, octadecanoic acid followed stearic acid and was found in the fixed oil of all examined stands, ranging from 3.60% (stand-3) to 11.73%. (stand-6). The maximum proportion of all components, oleic acid, ranged from 6.03% (stand-6) to 11.71% (stand-4), placing it fifth in the fatty acid profile. Myristic acid, Palmitic acid, Stearic acid, Arachidic acid, Decane, 1,1-Diethoxy, Pentadecanoic acid, Heptadecanoic acid, Tetracosanic acid, Hexacosanic acid, and Octadecanoic acid, 3-hydroxy-, methyl ester were discovered as the total saturated fatty acids. They contributed between 63% (stand-1) and 70.05%. (stand-6). While Oleic acid, Linoleic acid, Linolenic acid, and Palmitoleic acid were found to make up the majority of the unsaturated fatty acids. They comprised between 28.23% (stand-2) and 36.74%. (stand-2). With rising soil sodium, magnesium, and sand concentrations in various stands, palmitic acid and palmitoleic acid (%) in the fixed oil rose as indicated in (Figs. 7, 8, and 9). On the other hand, when the amount of SO4 in the soil increased, the percentages of palmitoleic, stearic, and tetracosanic acid declined (Fig. 10). Additionally, as EC values rose, so did palmitic, palmitoleic, and linolic acids. As EC increased, the percentages of oleic acid, linolenic acid, and myristic acid all dropped (Fig. 11). The genetics and heredity in terms of secondary metabolites, morphogenetic variability, and ontogenetic, which is the content of the different active substances in the different parts of the plant and during the stages of development, as well as environmental influences, such as weather, temperature, and other factors, can all have an impact on the chemical composition of plants, such as those found in fixed oils (Emara and Shalaby, 2011). The content of oil, which varies depending on genotype, climate, soil type, orientation, and plant development, is what determines the quality of the oil (Russo et al., 1998; Baydar *et al*., 2004).It is clear that there are many different variables, such as plant ontogeny, oil production site, photosynthesis, light quality, seasonal and climatic variations, such as temperature and rainfall, nutritional relationships, plant growth regulators, plant density, moisture, salinity, temperature, and harvesting techniques (Sangwan *et al*., 2001). The genotype (La Bella, 2019, Golkar, *et al*. 2011, as well as agronomic practices like fertilisation (Sampaio, *et al*., 2016), irrigation (Ebrahimian, *et al*., 2019), harvest date (Steberl, *et al*., 2020), and sowing date which determine whether the crop is suitable for nutritional, industrial, or pharmaceutical applications as well as the fatty acid composition of the crop are particularly influencing.

Similarly, during seed maturity, genotypes and their interactions with environmental factors primarily moisture and temperature affect the synthesis of fatty acids and the ratios of oleic and linoleic acids in the seeds (Gecgel *et al*., 2007). Additionally, the amount of linolenic and oleic acid was negatively impacted by salinity, while the accumulation of palmitic and oleic acids was positively connected with the soil EC (Narges *et al*., 2018). Oleic and linoleic acid content and soil salinity had a negative correlation (r = - 0.7), suggesting that any attempt to increase the accumulation of one of these fatty acids would probably result in a decrease in the accumulation of the other (Narges et al., 2018).

The variation in seed oil yield among the accessions suggests that this trait is strongly influenced by the plants' environment, particularly by the amount of precipitation they receive. The salinity of the soil also affects this trait, with yield being the greatest in soils with EC values between 50 and 65 dS/m. The soil EC also affects the species' capacity to amass biomass (Katschnig *et al*. 2013). Low biomass output in highly salinized conditions (65 dS/m) alters the plant's sink/source balance during seed filling, resulting in less oil accumulation. Stomatal closure, which restricts photosynthesis by obstructing the supply of carbon dioxide, is likely another factor that lowers oil yield in severely salinized settings. (Zhu *et al*., 2000).

According to Radwan *et al*. (2007), 11 fatty acids were identified using GLC analysis of fatty acid methyl esters, with palmitic acid (32.4%) and linoleic acid (14.16%) being the two predominant constituents.

Our study produced comparative results, and GC-MS analyses of fatty acid methyl esters led to the identification of 14 fatty acids. These fatty acids ranged in concentration from 19.58% to 30.62% and were found to be the major compound in all plants collected from different stands. Palmitoleic acid was identified second, and its relative percentages ranged from 13.4% to 25.23%.

CONCLUSION:

Salicornia fruticosa grow wild in LakeManzala, Egyptis palmiticacid chemo type since as it was the major fatty acid of itsfixed oil. The fixed oil percent and its main constituents were changed according to the soil content of Mg, K, Cl and HCO_3 values. Considerable differences were observed for the effect of soil texture either on fixed oil or on their fatty acids.

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Table 1: The geographical data (latitudes, longitudes and alludes) of different studied stands in lake Manzala, port said, Egypt during spring of 2021

Stands No.	E	N	Alt
1	32.261442	31.261442	1
2	32.2067884	31.2892051	1
3	32.145545	31.3045412	3
4	32.243705	31.219574	3
5	32.088595	31.338343	3
6	32.255270	31.208529	3
7	32.218138	31.275987	2

E=East N=North Alt=Alludes

Table 2: Soil Physical and chemical properties of different Stands in lake Manzala, port said, Egypt during spring of 2021.

Stand	Physical characteristics			chemical characteristics								
				Cations (meq/L)					Anions (meq/L)			
	Sand	Silt	Clay	PH	EC	Ca	Mg	Na	K	HCO_3	Cl	SO_4
1	78.87	11.07	10.07	8.76	123.17	159.77	110.30	913.03	49.20	146.37	973.97	97.53
2	77.77	13.17	9.07	8.96	95.73	124.07	86.39	707.27	37.83	113.90	752.90	94.47
3	75.77	12.83	11.40	8.28	118.37	217.10	150.23	864.56	75.53	200.10	834.72	133.43
4	77.47	10.97	11.57	8.86	115.33	149.53	103.53	850.33	45.73	137.35	906.97	91.79
5	68.67	10.70	20.63	8.31	105.90	141.00	97.75	875.76	43.32	129.23	854.73	86.23
6	68.43	19.17	12.40	8.73	139.80	242.27	153.97	1224.71	68.80	205.27	1349.47	137.13
7	77.13	10.00	12.87	8.96	68.33	88.20	61.44	501.93	27.25	81.72	535.30	54.63
LSD ($p<0.05$):	2.78	1.72	1.61	0.13	1.68	1.00	1.18	4.78	0.66	2.24	2.91	1.99
LSD ($p<0.01$):	3.86	2.39	2.23	0.18	2.33	1.39	1.64	6.63	0.91	3.11	4.04	2.76

Table 3: Fixed oil percentage of *Salicornia fruticosa* plants in different stands in lake Manzala, port said, Egypt during spring of 2021

No	Stand	Oil%
1	S1	8.45
2	S2	6.78
3	S3	13.33
4	S4	8.83
5	S5	9.78
6	S6	6.13
7	S7	8.02

Table 4: The main fatty acids of fixed oil of *Salicornia fruticosa* plant grown in stands in lake Manzala, port said, Egypt during winter and spring of 2021.

No	Fatty Acid	relative %						
		S1	S2	S3	S4	S5	S6	S7
1	Myristic Acid	1.20	1.47	0.00	0.00	0.00	0.00	0.00
2	Palmitic Acid	30.62	26.95	28.13	20.62	23.34	22.40	19.58
3	Palmitoleic Acid	25.23	14.60	22.96	13.40	16.70	14.20	17.22
4	Stearic Acid	7.31	4.91	10.32	12.42	6.59	4.28	9.32
5	Oleic Acid	7.33	7.92	6.62	11.71	9.58	6.03	6.72
6	Linoleic Acid	1.69	3.68	4.77	5.03	4.30	4.20	5.50
7	Linolenic Acid	1.59	2.03	2.39	3.42	3.56	4.68	5.44
8	Arachidic Acid	1.95	2.39	1.96	3.07	2.73	2.82	2.45
9	Decane, 1,1-Diethoxy	3.67	4.38	3.78	3.30	2.44	2.92	2.93
10	Pentadecanoic Acid	1.56	1.96	1.68	2.68	1.03	2.17	4.08
11	Heptadecanoic Acid	3.00	2.81	1.33	4.20	4.52	5.84	6.18
12	Octadecanoic Acid	5.58	11.05	3.60	10.65	10.49	11.73	7.91
13	Tetracosanic Acid	5.13	6.08	6.93	6.13	6.88	9.62	7.96
14	Hexacosanic Acid	2.98	7.00	4.39	2.19	7.31	8.72	3.56
	Total	99.84	97.23	98.86	98.84	99.47	99.61	98.85
	Total saturated fatty acids	63.00	69.00	62.12	65.26	65.33	70.5	63.97
	Total unsaturatedfatty acids	35.84	28.23	36.74	33.56	34.14	29.11	34.88

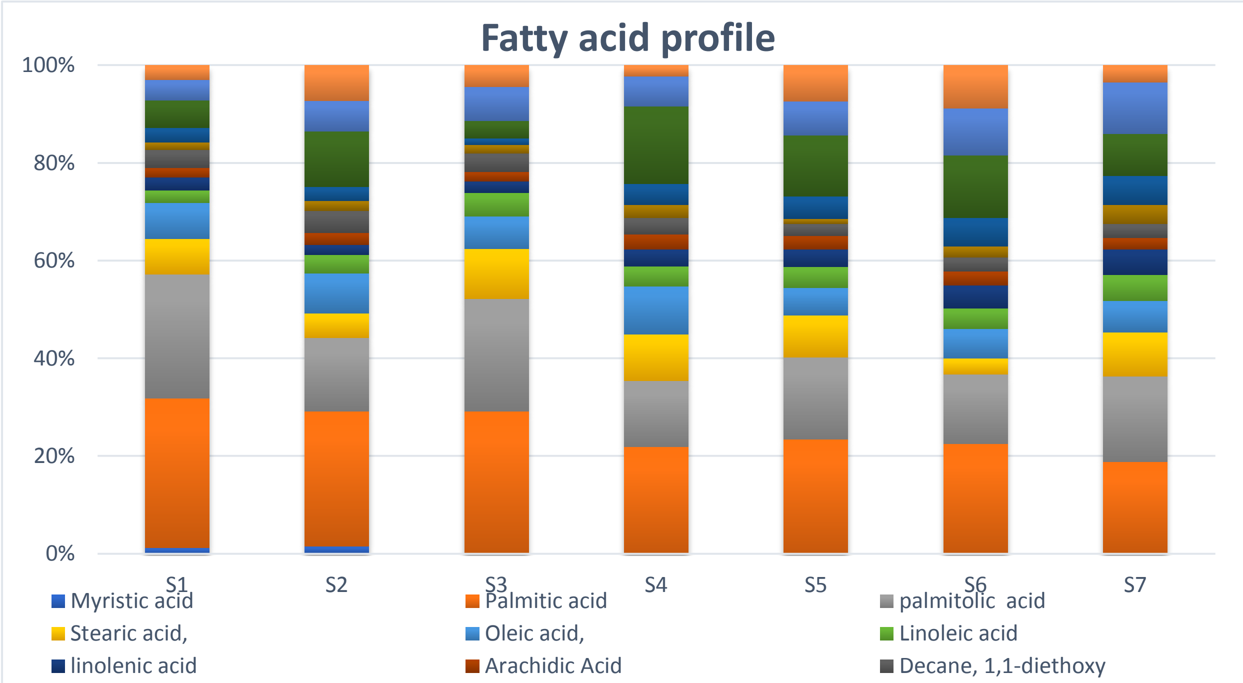

Figure 1: The main fatty acids of fixed oil of *Salicornia fruticosa* plant grown in stands in Manzala Lake, Port Said, Egypt during winter and spring of 2021

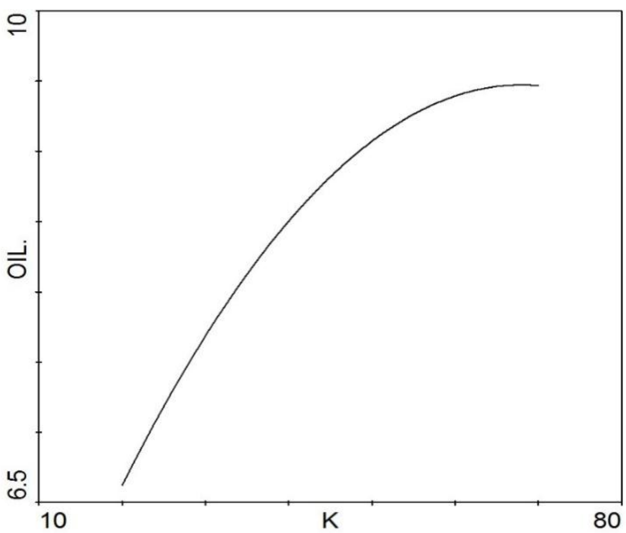

Figure 2: Relation between fixed oil of *S. fruticosa* and (K) content in the soil in different stands.

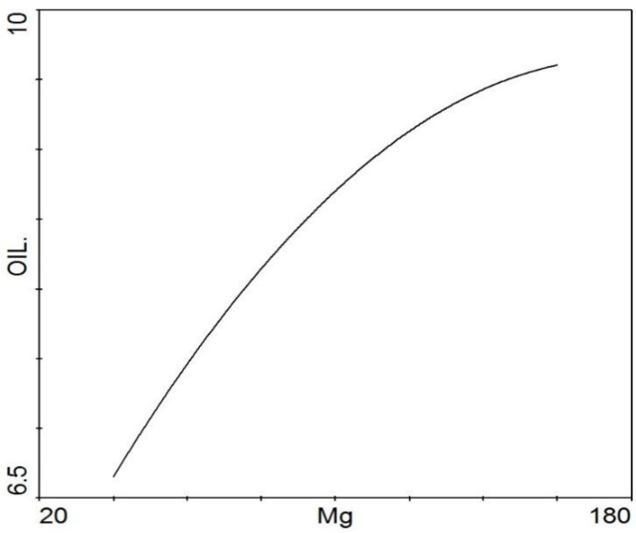

Figure 3: Relation between fixed oil of *S. fruticosa* and (Mg) content in the soil in different stands.

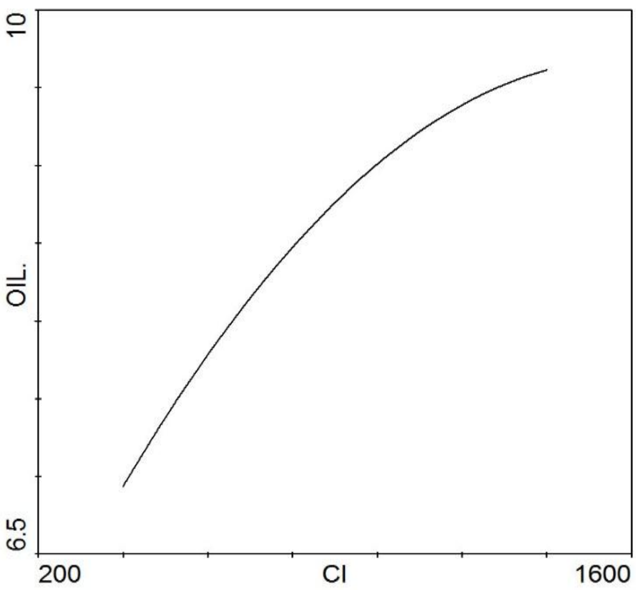

Figure 4: Relation fixed oil% of *S. fruticosa*and chloride content in the soil in different stands.

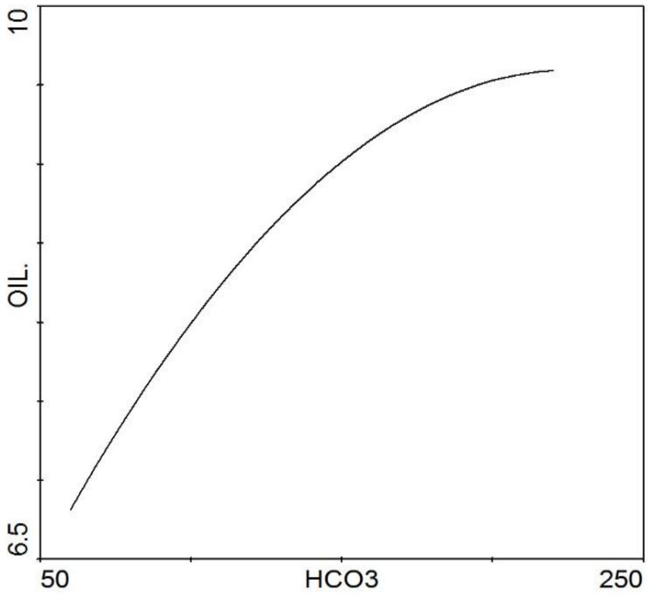

Figure 5: Relation fixed oil%of *S. fruticosa*and bicarbonate content in the soilin different stands

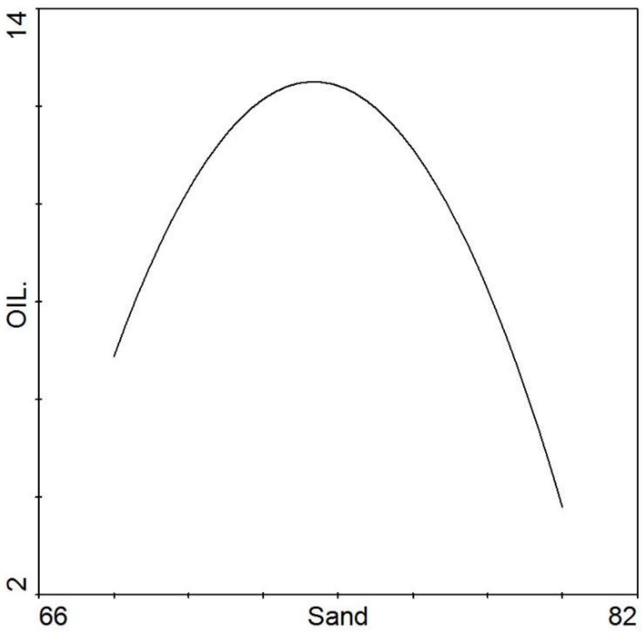

Figure 6: Relation between fixed oil% of *S. fruticosa* and sand% content in the soil in different stands.

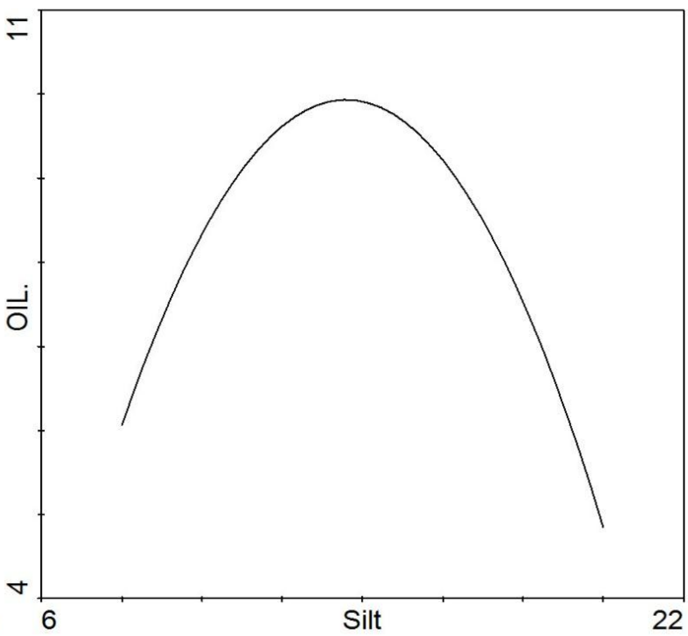

Figure 7: Relation between fixed oil % of *S. fruticosa* and silt% content in the soil in different stands.

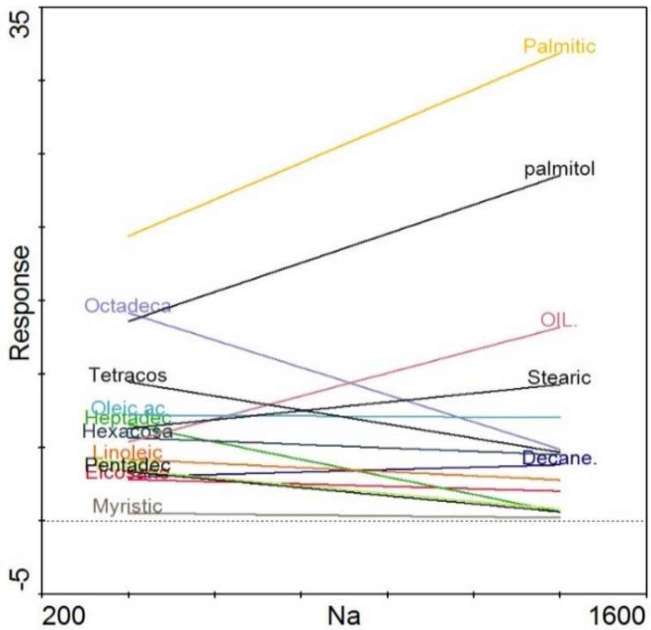

Figure 8: Relation between oil components of *S. fruticosa* and sodium content in the soil.

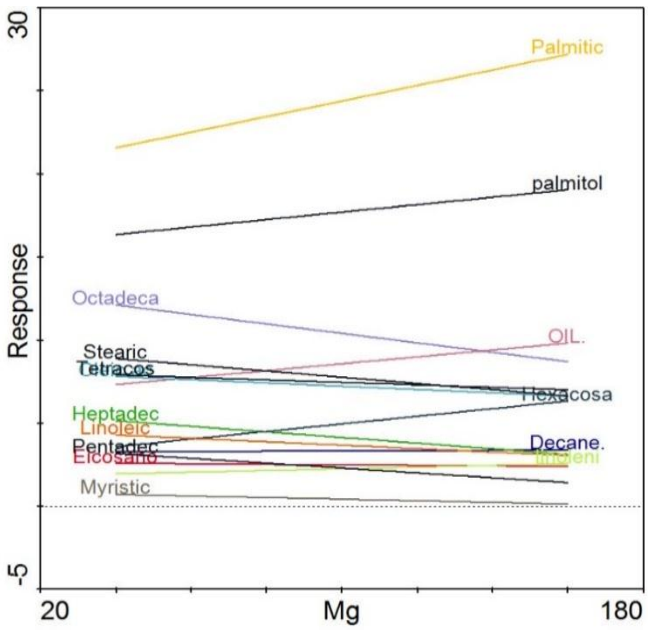

Figure 9: Relation between oil components of *S. fruticosa* and magnesium content in the soil.

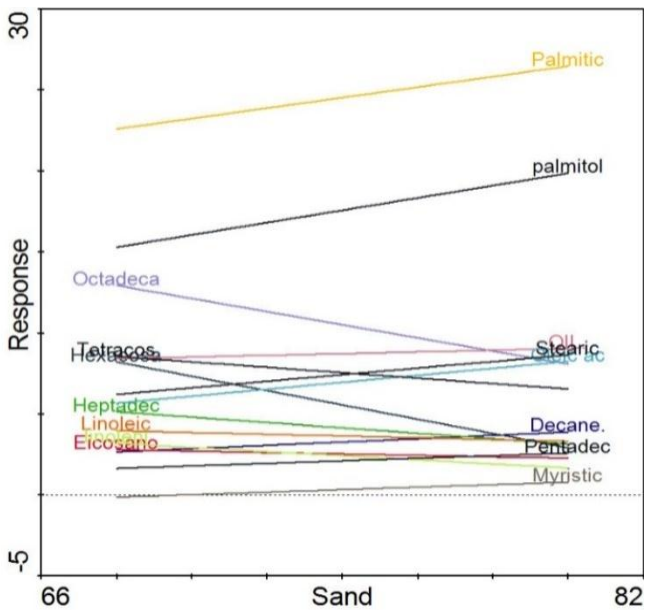

Figure 10: Relation between oil components of *S. fruticosa* and sand% content in the soil.

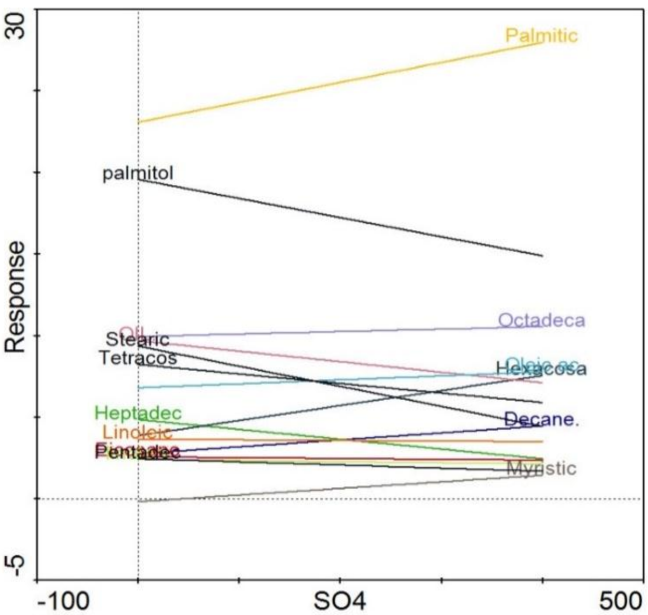

Figure 11: Relation between oil components of *S. fruticosa* and SO_4 content in the soil.

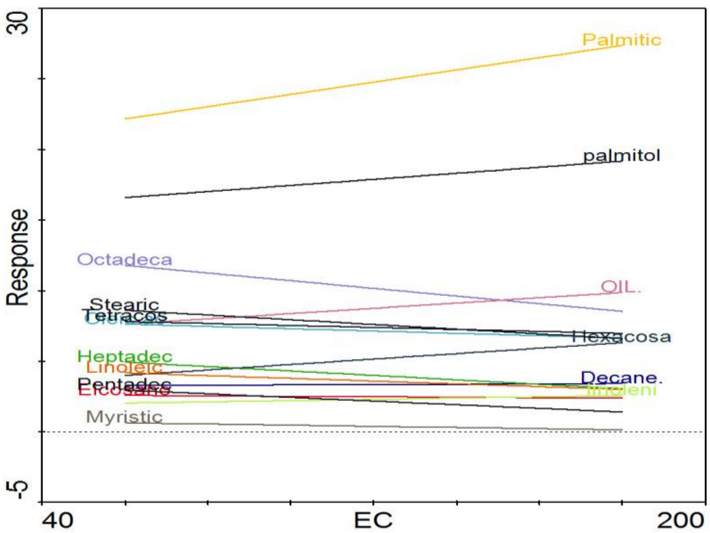

Figure 12: Relation between oil components of *S. fruticosa* and EC in the soil.

تقييم محتوى الزيت فى بذور الساليكورنيا فيرتكوزا تحت ظروف الأراضى الملحية في بحيرة المنزلة مصر

أنس عبد العزيز حسين بدوى [1,*], أحمد محمد الغريب عبد الغنى [1], السيد أبو الفتوح عمر [2]

[1]*قسم البيئة والزراعة الحيوية, كلية الزراعة بالقاهرة, جامعة الأزهر, مصر*

[2]*قسم النباتات الطبية والعطرية, المركز القومى للبحوث بالدقى, الجيزة, مصر*

* البريد الإلكتروني للباحث الرئيسي:anasabdelaziz2020@azhar.edu.eg

الملخص العربي

تضمنت هذه الدراسة نباتات تم جمعها من مواقع في بحيرة المنزلة ، بورسعيد ، مصر. خلال فصل الشتاء 2021. تم استخلاص زيت الساليكورنيا بمذيب الهكسان من البذور المجففة هوائياً باستخدام جهاز سوكسيلت. تم دراسة الأحماض الدهنية الرئيسية للزيت الثابت نوعاً وكماً باستخدام(GC-MS) بعد الإستخلاص. وأظهرت النتائج ما يلى : تم تعريف أربعة عشر حمضًا دهنيًا في مكونات الزيت و تمثل حوالي 98٪ من إجمالي الأحماض الدهنية. كما أوضحت النتائج أن حمض البالمتيك هو الحمض الدهني الرئيسي لمكونات الزيت المستخلص من بذور جميع نباتات الساليكورنيا التي تم دراستها وتراوحت نسبته من 19.58٪ إلى 30.62٪ من إجمالي مكونات الأحماض الدهنية للزيت. وأشارت التحليلات الإحصائية إلى أن نسب الزيت الثابتة والأحماض الدهنية الرئيسية قد تغيرت وفقًا لمحتوى التربة من الكالسيوم والبوتاسيوم والصوديوم والكلوريد وقيم التوصيل الكهربائي للتربة والخصائص الفيزيائية لها.

الكلمات الاسترشادية: ساليكورنيا فيرتكوزا, الزيت الثابت, الأحماض الدهنية ,GC-MS, بحيرة المنزلة, مصر