Identifying of the bioactive compounds from two aquatic cyanobacteria, *Leptolyngbya* sp. and *Desertifilum* sp., with antioxidant and antimicrobial activities

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Abstract:

Cyanobacterial metabolites have gained a great attention during the last few decades, as they are a potential source for bioactive compounds. In the present study the total phenolic and flavonoid compounds in the biomass of *Leptolyngbya* sp. Q1 (MZ504747) and *Desertifilum* sp. Q2 (MZ504748) were estimated and their methanolic extracts were screened for their free radical scavenging activity against 2,2-diphenyl-1-picrylhydrazyl (DPPH) and antimicrobial activity (well diffusion method) against different Gram-positive, Gram-negative bacteria in addition to *Candida albicans.* The results showed that *Leptolyngbya* sp. had higher total phenolic compounds content (8.89± 0.89 mg GAE/g DW) and total flavonoid content (1.72± 0.01 mg QE/g DW) compared to those recorded in *Desertifilum* sp. Both extracts were detected to have antioxidant activity against DPPH free radicals, and the IC_{50} values were 2.18 and 2.85 mg/ml for *Leptolyngbya* sp. and *Desertifilum* sp., respectively. Also, *Leptolyngbya* sp. extract was determined to have higher antimicrobial activity against tested microorganisms compared to *Desertifilum* sp. extract. Finally, the GC-MS profile for both extracts indicated the presence of phenolic compounds, saturated and unsaturated fatty acids such as 3-Allyl-2-methoxyphenol, Tetradecanoic acid (Myristic acid), n-Hexadecanoic acid (Palmitic acid), Phytol, Linoleic acid, Linolenic acid, Palmitoleic acid, cis-Vaccenic acid and other bioactive compounds of well-known pharmaceutical and industrial importance.

Keywords: Cyanobacteria, *Leptolyngbya*, *Desertifilum*, Phenolic, Flavonoids, Antioxidant activity, Antimicrobial activity.

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Introduction

Cyanobacteria are a great group of oxygenic photosynthetic microorganisms that are broadly distributed in diverse habitats including aquatic " fresh, marine, and brackish water" and terrestrial environments, also they can resist and survive wide ranges of various environmental conditions including pH, temperature, salinity and light intensity **(Martínez-Franc´es and Escudero-O˜nate 2018; Nainangu *et al.*, 2020).** Recently, cyanobacteria are considered as a promising source for production of novel alternative biomolecules including pigments, amino acids, phenolic compounds, polyunsaturated fatty acids, sulphated polysaccharides, proteins and vitamins **(El Semary 2012; Demay *et al.*, 2019).** These biomolecules were reported to exert antioxidant, antimicrobial, anticancer and other biological activities and are useful as possible therapeutic agent **(Ananya and Kamal 2016).** The biomass of cyanobacteria had been studied by several investigators and was reported to contain various types of bioactive compounds including flavonoids, tannins, saponins, glycosides, terpenoids and alkaloids **(El Semary *et al.*, 2009; Abd El-karim 2016).** Despite its high importance in production of alternative natural products with biotechnological and pharmaceutical applications and the ability of their biomass to be used as food products or dietary supplement the commercial scale production and microalgae market is still restricted to only few strains **(Kim *et al.*, 2015).** The organic solvent extracts of marine cyanobacteria showed efficient effects against different species of microorganisms and proved to have cytotoxic influence against some tumor cell lines **(Martins *et al.*, 2008; Gara-Ali *et al.*, 2021).** Cyanobacteria found to contain polar and nonpolar lipids which have a role in algal protection against extreme environmental conditions such as high salinity,

desiccation and high light intensity **(Ananya and Kamal 2016).** The continuous rise in multidrug resistance bacterial community increase the pressure on scientists to search for new antibiotics of natural origin for treatment the infectious diseases caused by antibiotic resistance bacteria and reduce the increased medical cost and mortality **(Ventola 2015; Singh *et al.*, , 2021).** In addition, the accumulation of reactive species and free radicals in human cells and tissues leads to progression of several diseases such as cancer, diabetes and other metabolic disorders. The antioxidant compounds can eliminate the destructive effects caused by these free radicals **(Pizzino *et al*., 2017)**. Therefore, new native cyanobacterial species should be screened deeply to achieve algal database with potential therapeutic and biotechnological applications **(Zaki *et al*., 2021).** *Leptolyngbya* is attractive cyanobacterial genus, is widely distributed in various types of ecological habitats including desert, marine, freshwater, rice fields and alkaline lakes **(Cirés *et al*., 2017)**. The secondary metabolites of marine *Leptolyngbya* have been reported to possess potent biological activities **(Li *et al*., 2020)**. *Desertifilum* sp. is filamentous cyanobacterium described from harsh environments such as hot dry deserts, warm springs and mangrove ponds **(Dadheech *et al*., 2014)**, based on our knowledge it's worth mentioning that the current study is one of the preliminary studies related to *Desertifilum* sp isolated from Egyptian lakes. The current study aimed to screen the methanolic extract of two cyanobacterial isolates from saline lake in Egypt "Lake Qarun" for their antioxidant and antimicrobial activities followed by identifying the chemical composition of their extracts using GC-MS analysis searching for valuable compounds with biotechnological applications.

Materials and Methods

Organisms and culture conditions

Two cyanobacterial isolates were used in this study. The first one *Leptolyngbya* sp Q1 (MZ504747) figure (1-a) is isolated from Lake Qarun (saline lake), and the second one *Desertifilum* sp. Q2 (MZ504748) figure (1-b) is isolated from the estuary of El-wady drain in Lake Qarun. The isolates were cultured in 1L flasks containing 500 ml of BG-11 medium with a 7.1 pH, and for culturing marine species, 10 g/L NaCl was added to prepare marine BG11 medium **(Allen 1968)**. The inoculated flasks were incubated at $28^0C \pm 2^0C$ and 16:8 light dark cycle of 37 µmol m^{-2} s^{-1} photon flux density for about 3 weeks.

Extracts preparation

The biomass was harvested by centrifugation at 6000 rpm for 10 min, washed with distilled water and re-centrifuged then the supernatant decanted and the pellet dried at 50^0C till constant weight. One gram of each isolate dry biomass were grounded to fine powder, packed into a Soxhlet apparatus (ACM-54097- W. ACMAS Technologies PVT Ltd., India) and extracted three times with 100 ml absolute methanol at 60–65°C for 3–4 h. The filtrates were combined and concentrated under reduced pressure (using rotary evaporator, RV10, IKA), dried and weighed.

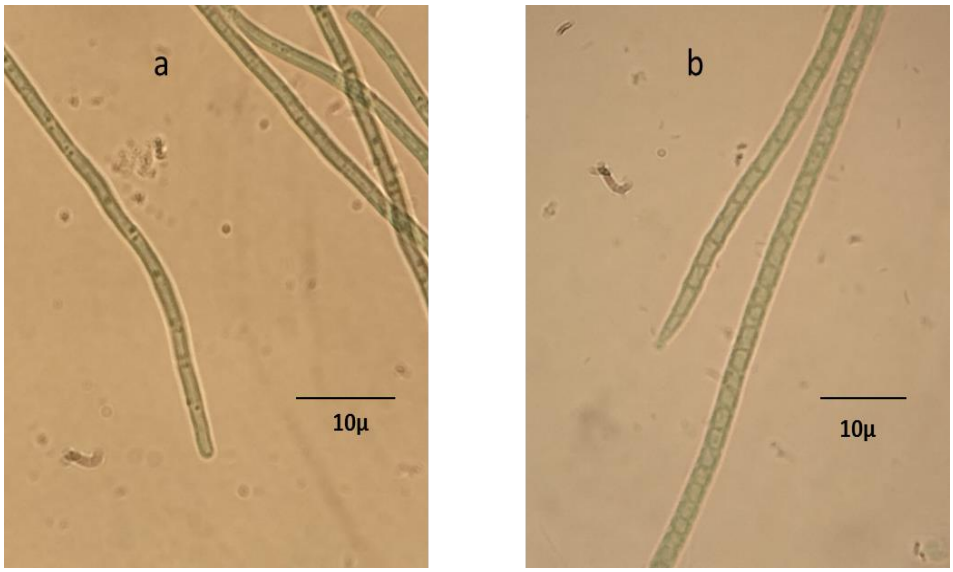


Fig. 1. Photomicrographs of *Leptolyngbya* sp. (a) and *Desertifilum* sp. (b)

Total phenolic content (TPC).

Total phenolic content was determined by the Folin–Ciocalteu method (**Singleton and Rossi 1965)**, the absorbance was measured at 765 nm and the total phenolic content calculated from Gallic acid standard curve and expressed as mg Gallic acid equivalent of 1 g dry weight (mg GAE/g DW).

Total flavonoid content (TFC).

Total flavonoid content was determined using aluminium chloride colorimetric method **(Jia *et al*., 1999)** the absorbance was measured at 415 nm and the total flavonoid content was calculated from Quercetin calibration curve and expressed as mg Quercetin equivalent of 1g dry weight (mg QE/g DW).

Antioxidant activity

According to **Yen and Duh (1994**), the antioxidant activity was determined by evaluating the free radical scavenging activity of cyanobacterial extracts against DPPH. Briefly, 200 µl of methanolic extract was mixed with 2.8 ml of freshly prepared 0.1 mM DPPH methanolic solution, and kept in dark at room temperature for 30 min. After that, the decrease in coloration of DPPH solution was determined by measuring the absorbance at 517 nm; DPPH solution without test sample was used as control, and the scavenging activity percentage was calculated using the formula:

$$\text{Scavenging activity (\%)} = [(A0 - A1)/A0]*100$$

Where A0 = Absorbance of control and A1 = Absorbance of test sample after 30 min

Serial dilutions of each extract were tested to estimate the IC_{50} value "half maximal inhibitory concentration ".

Antimicrobial activity

The bacterial strains including Gram-negative bacteria (*Aeromonas hydrophila*, *Salmonella typhi* ATCC-15566, *Escherichia coli* ATCC-25922, *Pseudomonas aeruginosa* PTCC-1074), and Gram-positive bacteria (*Staphylococcus aureus* ATCC-47077, *Staphylococcus epidermidis*) were cultured overnight at 37 ^{0}C in tryptic soy broth medium (TSB, Difco Laboratories, Detroit, USA). Whereas, the yeast strain (*Candida albicans* ATCC- 10231) was cultured in Potato dextrose broth medium (HiMedia Laboratories Pvt. Ltd) at 37 ^{0}C for 48hr. All pathogen species were provided by Hydrobiology lab, National institute of Oceanography and fisheries (NIOF). The antimicrobial activity was determined using agar well diffusion method (**Valgas *et al*., 2007; Gonelimali *et al*., 2018)**. Briefly, Mueller–Hinton agar (Oxoid) plates were inoculated with 100µl of each bacterial culture by spreading the inoculum over the entire agar surface, wells with 6 mm diameter were punched within agar plates using sterile cork borer. Then, 50 µl of the cell free extract previously dissolved in DMSO (50 mg/ml) were introduced into the wells and the plates were incubated at 37 ^{0}C for 24 hr. Sabouraud dextrose agar medium (Oxoid) was used for assessing the antimicrobial activity against *Candida albicans*. The diameters of complete inhibition zones were measured. DMSO was introduced as negative control and Amikacin 30 mcg as positive control.

Chemical composition (GC-MS) analysis

The chemical profile of each cyanobacterial extracts was performed using gas chromatography coupled with mass spectrometry (GC-MS) "Agilent 7000 series Quadruple Gas chromatography mass spectrometry" with electron impact ionization, and the carrier gas was helium. The Injector temperature was set at 300ºC and the GC run time was 52min. the instrument was operated according to protocol mentioned by **Abd El-karim 2016.** The compounds of extracts were compared to NIST MS spectral library and Agilent's Retention Time Locked (RTL) database to identify them.

Results and Discussion

Phenolic and flavonoid compounds are of the most important biologically active compounds that produced by cyanobacteria and received a great attention for their potential antioxidant activity and health beneficial properties **(Singh *et al*., 2017**). The results of current study showed that the biomass of *Leptolyngbya* sp. Q1 (MZ504747) has higher TPC (8.89± 0.89 mg GAE/g DW) than that of *Desertifilum* sp. Q2 (MZ504748) (Table 1). The TPC of *Leptolyngbya* sp. Q1 was greater than that recorded for *Leptolyngbya* sp. KC45, *Phormidium* sp. PD40-1, *Cyanosarcina sp. SK40, and Scytonema* sp. TP40 which are thermotolerant cyanobacteria studied by **Pumas *et al*. (2011)** and have TPC ranged from 1.88 to 6.24 mg GA/g dw. Despite the TPC of *Leptolyngbya* sp. Q1 were higher than described for *Phormidium. corium* (5.41 mg GAE/g dw), *Spirulina major* (7.15

mg GAE/g dw), *Oscillatoria sancta* (7.81 mg GAE/g dw), *Chroococcus turgidus* (7.94 mg GAE/g dw) and *Nostoc commune* (8.19 mg GAE/g dw) it was less than that recorded for *Phormidium tenue* (9.2 mg GAE/g dw), *Lyngbya confervoides* (13.80 mg GAE/g dw), *Oscillatoria geminata* (16.33 mg GAE/g dw) and *Oscillatoria fremyii* (17.37 mg GAE/g dw) as reported by **Rai and Rajashekhar (2015).** Although the low TPC content of *Desertifilum* sp. Q2 isolate compared to *Leptolyngbya* sp Q1 in the current study, its TPC was higher than the value reported for *Cyanosarcina* sp. SK40 (1.88 ± 0.04 mg GAE/g dw) **(Pumas *et al*., 2011)** and *Nostoc commune* 71μg/ GAE/g freeze dried algal biomass **(Jerez-Martel *et al*., 2017).** Comparing results of the current study with that of four fresh water cyanobacteria reported by **Hossain *et al*. (2016)**, the TPC of *Leptolyngbya* sp. Q1 was superior than that of *Oscillatoria* sp. (2.96 mg QE/g DW), *Lyngbya* sp. (5.02 mg QE/g DW), *Microcystis* sp. (2.65 mg QE/g DW), and *Spirulina* sp. (1.78 mg QE/g DW). Whereas, *Desertifilum* sp. Q2 TPC (2.03± 0.01) was higher than that of *Spirulina* sp. but lower than the other three species. **Blagojević *et al*. (2018)** reported that the phenolic content in cyanobacterial biomass could be increased through manipulating nitrogen conditions.

Cyanobacteria produce wide variety of flavonoid compounds such as flavonols, isoflavones and dihydrochalcones and other poly-phenolic compounds which are important for human health **(Klejdus *et al*., 2010; Rai and Rajashekhar 2015; Ali and Doumandji 2017)**. In the present study (Table 1), *Leptolyngbya* sp. Q1 has greater TFC (1.72± 0.01 mg QE/g DW) than *Desertifilum* sp. Q2 (0.43± 0.03 mg QE/g DW). The total flavonoid content of *Leptolyngbya* sp. Q1 was higher than that of *Phormidium tenue* (1.44 mg QE/g DW), *and Phormidium corium* (0.74 mg QE/g DW) and similar to the value that had been recorded for *Skeletonema costatum* (1.79 mg QE/g DW) but lower than

values documented for *Oscillatoria fremyii and Oscillatoria geminate* which have total flavonoid content 4.5 and 4.41 mg QE/g DW, respectively **(Rai and Rajashekhar 2015**). The TFC recorded by **Hossain *et al*., (2016)** of four freshwater cyanobacteria was much higher than that reported in the current study. *Leptolyngbya* sp. Q1 and *Desertifilum* sp. Q2 biomass are promising sources for phenolic and flavonoid contents and their content from valuable compounds my increase through manipulating their culture conditions.

Table (1). Total phenolic, total flavonoids constituents and Antioxidant activity IC_{50} of the studied cyanobacterial biomass extracts.

Isolate name	TPC mg GAE/g DW.	TFC mg QE/g DW.	Antioxidant activity IC_{50} mg/ml
***Leptolyngbya* sp. Q1 (MZ504747)**	**8.89± 0.89**	**1.72± 0.01**	**2.18**
***Desertifilum* sp. Q2 (MZ504748)**	**2.03± 0.01**	**0.43± 0.03**	**2.85**

Antioxidant activity

DPPH is widely used to evaluate free radical scavenging activity of natural products due to its stability, reproducibility and simplicity **(Kuda *et al*., 2007),** the higher scavenging activity reflects higher antioxidant activity **(Park *et al*., 2004).** In the present study, the crude extracts of both cyanobacterial isolates

were found to have scavenging activity against DPPH free radical and their antioxidant activity increased with the increase in extract concentration as shown in figure (2). The IC_{50} value for *Leptolyngbya* sp. Q1 and *Desertifilum* sp. Q2 were 2.18 and 2.85 mg/ml, respectively. The antioxidant activity may be due to their phenolic and flavonoid contents **(Hossain *et al.*, 2016).** The IC_{50} values determined in the current study were coordinated with that recorded for *Limnothrix obliqueacuminata* (2.95 mg/ml), *Oscillatoria acuta* (2.63 mg/ml), *Calothrix brevissima* (2.24 mg/ml), *Lyngbya* sp. (2.61 mg/ml), *Phormidium tenue* (2.69 mg/ml) and *Anabaena doliolum* (2.64 mg/ml), better than recorded for *Microcheate tenera* (4.28 mg/ml) and *Nostoc ellipsosporum* (8.91 mg/ml) but lower than determined for *Chroococcus* sp. (1.56 mg/ml), *Cylindrospermum* sp. (1.27 mg/ml) and *Calothrix geitonos* (1.06 mg/ml) **(Singh *et al.*, 2017)**. The crude extracts of cyanobacteria were proved to contain natural compounds that have powerful antioxidant activities by several researchers (**Jerez-Martel *et al.*, 2017; Badr *et al.*, 2019; El-Chaghaby *et al.*, 2019; Nainangu *et al.*, 2020)**. Not only the total phenolic content which is responsible for the tested biological activities, but it acts synergistically with other constituents as flavonoids, fatty acids.

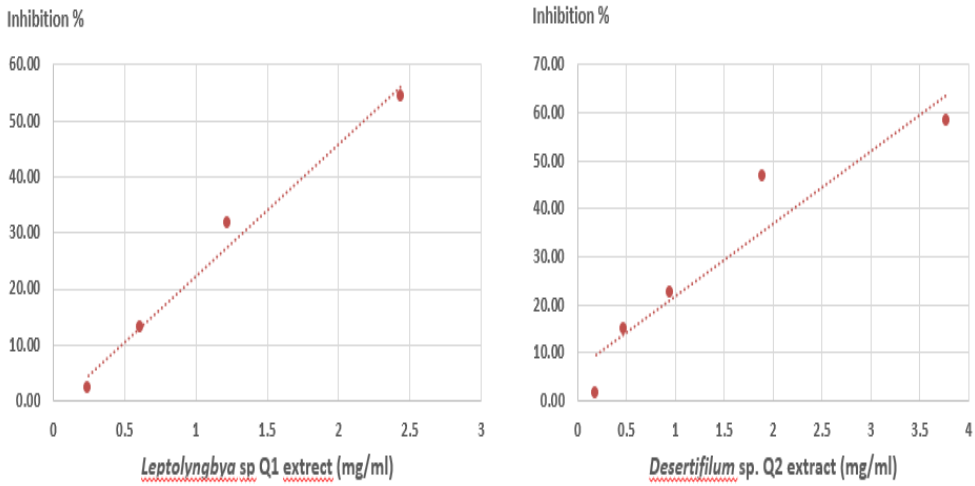


Fig. 2. Free radical scavenging activity of cyanobacterial crude extracts against DPPH

Antimicrobial activity

Numerous studies have been interested with investigation of cyanobacterial extracts as a promising source for novel antimicrobial agents **(El-Sheekh *et al*., 2006; Dussault *et al*., 2016; Nainangu *et al*., 2020; Singh *et al*., 2021).** Data located in Table (2) indicated that the crude extracts of *Leptolyngbya* sp. Q1 and *Desertifilum* sp. Q2 isolates showed diverse antimicrobial activity

against Gram-positive, Gram-negative and yeast species. *A. hydrophila*, *S. typhi*, *E. coli*, *Ps. aeruginosa* and *Candida albicans* were more sensitive to *Leptolyngbya* sp Q1 extract while *S. epidermidis* was more sensitive to *Desertifilum sp.* Q2 extract and both extracts affected *S. aureus* similarly. The highest inhibition zone was made by *Leptolyngbya* sp Q1 extract against *Candida albicans* (14.3±0.9 mm). Many studies interested with investigation of antimicrobial activity of cyanobacterial extracts have been concluded that the antimicrobial effect depends on the type of cyanobacterial species and tested organism **(Malathi *et al.*, 2014; Gheda and Esmail 2020).** Cyanobacteria were reported to produce a lot of chemical compounds such as phenolic, alkaloids, flavonoids and unsaturated fatty acids with antimicrobial and cytotoxic activities as a defense mechanism against other competent microorganisms **(Mundt *et al.*, 2003; Demay *et al.*, 2019). Heidari *et al.* (2012)** tested seven cyanobacterial species for production of antimicrobial agents and declared that the methanolic extracts of the studied cyanobacterial species had antimicrobial activity against the tested Gram-positive, Gram-negative and yeast species. The methanolic extract of *Arthrospira platensis* had been reported to contain Arachidonoyl dopamine and fluocinolone compounds, these compounds have shown a potential antifungal activity as well as antibacterial activity against multidrug resistance strains **(Singh *et al.*, 2021)**. The lipophilic fractions of *Leptolyngbya* sp. extract were identified to include butylated hydroxytoluene (BHT), which has both antioxidant and antimicrobial activities **(El Semary 2012). Demay *et al.*, (2019)** identified oscillapeptin (kulolide-like analogs depsipeptide) from *Oscillatoria margaritifera*, this compound showed antibacterial and cytotoxic activities.

Table (2): Antimicrobial activity of cyanobacterial extracts against pathogenic microorganisms (Inhibition zone measured in mm).

Isolate name	*A. hydrophila*	*S. typhi*	*E. coli*	*Ps. aeruginosa*	*S. aureus*	*S. epidermidis*	*C. albicans*
***Leptolyngbya* sp Q1 (MZ504747)**	**9.7±0.9**	**10.7±0.5**	**10.3±0.9**	**11±0.8**	**9.7±0.5**	**9.7±0.5**	**14.3±0.9**
***Desertifilum* sp. Q2 (MZ504748)**	**8.0±1.0**	**10.3±0.5**	**9.3±1.2**	**NZ**	**9.7±0.9**	**10.7±0.5**	**13.7±0.5**
Amikacin 30 mcg	**9±1.0**	**14±0.8**	**16±1.4**	**15±0.5**	**17±2.0**	**20.5±1.5**	**N.A**

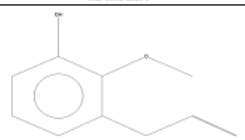
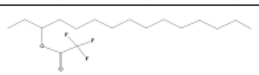
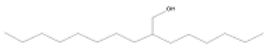
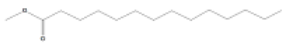
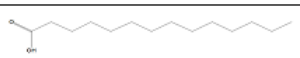
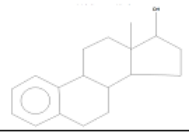
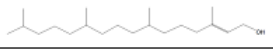
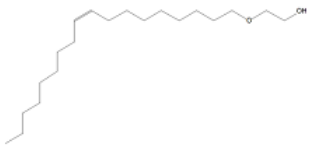
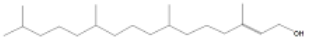
- Results were mean ± SD of triplicates
- NZ=No zone.
- N. A= Not applied

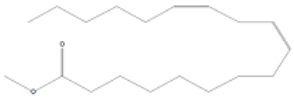
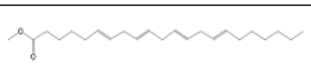
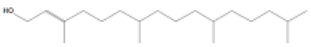
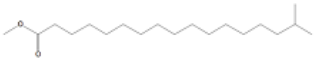
GC/MS profile of isolated cyanobacterial extracts

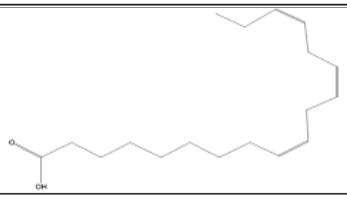
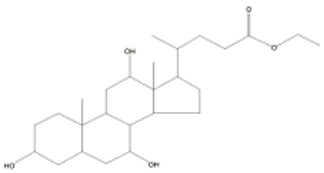
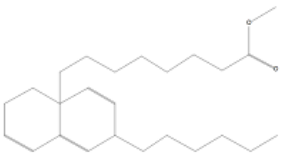
GC/MS profile for isolates *Leptolyngbya* sp. Q1 and *Desertifilum* sp. Q2 were characterized by numerous active biomolecules. Tables and figures (3 & 4) represented the major peaks, its retention time, molecular structure, molecular formula, molecular weight and area percentage obtained from each extract. The major peaks identified from *Leptolyngbya* sp. Q1 extract were 3-Allyl-2-methoxyphenol (1.29%), Methyl myristate (0.88%), Myristic acid (5.86%), Phytol (10.66 %), Methyl palmitoleate (0.7%), Palmitic acid, methyl ester (2.68%), Palmitic acid (9.21%), Methyl isostearate (1.01%), Linolenic acid (8.45%),

Linoleic acid, methyl ester (1.5%) and Phthalic acid, di(2-propylpentyl) ester (3.15%). While, the extract of *Desertifilum* sp. Q2 contained 3-Allyl-2-methoxyphenol (0.66%), Myristic acid (1.41%), Phytol (4.56%), Methyl palmitoleate (0.76%), Palmitic acid methyl ester (5.05%), Palmitoleic acid (11.37%), Palmitic acid (7.91%), Methyl isostearate (2.2%), cis-Vaccenic acid (12.77%) and Phthalic acid, di(2-propylpentyl) ester (1.79%). Many of the identified compounds have various bioactivity, long chain fatty acids 'mainly unsaturated fatty acids such as linoleic acid, linoleic acid and cis-vaccinic acid were determined to have antimicrobial activity through disturbing phospholipid composition and altering membrane permeability **(Hamazaki *et al*., 2016; Hobby *et al*., 2019; Alsenani *et al*., 2020).** In addition, 3-Allyl-2-methoxyphenol is phenolic compound and has several pharmaceutical importance as anti-inflammatory, anaesthetic, antihistaminic, antimicrobial and antioxidant activities **(Jadhav *et al*., 2004; Uddin *et al*., 2017).** Myristic acid is used in cosmetics and has beneficial medical practice as it has immunomodulatory functions and has positive effect on cardiovascular health **(Hubbard *et al*., 1996; Ruiz-Nunez *et al*., 2016).** Similar to the current results *Chlorococcum minutum* NIOF17/002 extract was described to contain fatty acids such as hexadecenoic acid, 9, 12-octadecadienoic acid, α-linolenic acid and cis-11-eicosenoic acid which have antimicrobial and antioxidant activities **(Elshobary *et al*., 2020)**. GC–MS analysis of *Nostoc carneum* extract identified the presence of main compounds as hexadecanoic acid (palmitic acid), Phytol, Linoleic acid and Linolenic acid **(Farghl *et al*., 2019).**

Table (3): GC/MS profile of *Leptolyngbya* sp. Q1 (MZ504747).

NO.	Phytochemical compound	Rt	M. structure	M. formula	M. wt.	Area %
1	3-Allyl-2-methoxyphenol	6.24		$C_{10}H_{12}O_2$	164	1.29
2	3-Trifluoroacetoxypentadecane	6.44		$C_{17}H_{31}F_3O_2$	324	0.38
3	2-Hexyl-1-decanol	11.97		$C_{16}H_{34}O$	242	1.55
4	Tetradecanoic acid, methyl ester (Methyl Myristate)	12.53		$C_{15}H_{30}O_2$	242	0.88
5	Tetradecanoic acid (Myristic acid)	13.41		$C_{14}H_{28}O_2$	228	5.86
6	Estra-1,3,5(10)-trien-17-ol	14.4		$C_{18}H_{24}O$	256	0.66
7	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	14.48		$C_{20}H_{40}O$	296	7.27
8	2-Methylhexadecan-1-ol	14.58		$C_{17}H_{36}O$	256	0.81
9	2-cis-9-Octadecenyloxy ethanol	14.85		$C_{20}H_{40}O_2$	312	0.45
10	2-Hexadecen-1-ol, 3,7,11,15-tetramethyl	15.12		$C_{20}H_{40}O$	296	2.68

NO.	Phytochemical compound	Rt	M. structure	M. formula	M. wt.	Area %
11	9-Hexadecenoic acid, methyl ester, (Z)- (Methyl palmitoleate)	15.45		$C_{17}H_{32}O_2$	268	0.7
12	Hexadecanoic acid, methyl ester (Palmitic acid, methyl ester)	15.73		$C_{17}H_{34}O_2$	270	2.68
13	9-Hexadecenoic acid	16.0		$C_{16}H_{30}O_2$	254	1.78
14	n-Hexadecanoic acid (Palmitic acid)	16.3		$C_{16}H_{32}O_2$	256	9.21
15	9,12-Octadecadienoic acid (Z,Z)-, methyl ester (Linoleic acid, methyl ester)	17.74		$C_{19}H_{34}O_2$	294	1.5
16	6,9,12,15-Docosatetraenoic acid, methyl ester	17.81		$C_{23}H_{38}O_2$	346	1.97
17	2-Hexadecen-1-ol, 3,7,11,15-tetramethyl-, [R-[R*,R*-(E)]]- (Phytol)	17.94		$C_{20}H_{40}O$	296	0.71
18	Heptadecanoic acid, 16-methyl-, methyl ester (Methyl isostearate)	18.07		$C_{19}H_{38}O_2$	298	1.01
19	cis-9,cis-12-Octadecadienoic acid (Linoleic acid)	18.22		$C_{18}H_{32}O_2$	280	8.45

NO.	Phytochemical compound	Rt	M. structure	M. formula	M. wt.	Area %
20	9,12,15-Octadecatrienoic acid, (Z,Z,Z) (Linolenic acid)-	18.31		$C_{18}H_{30}O_2$	278	8.74
21	Ethyl 3,7,12-trihydroxycholan-24-oate (Ethyl iso-allocholate)	18.49		$C_{26}H_{44}O_5$	436	0.66
22	4-Hexyl-3-(7-methoxycarbonylheptyl) bicyclo [4.4.0]deca-2,5,7-triene	19.88		$C_{25}H_{40}O_2$	372	1.24

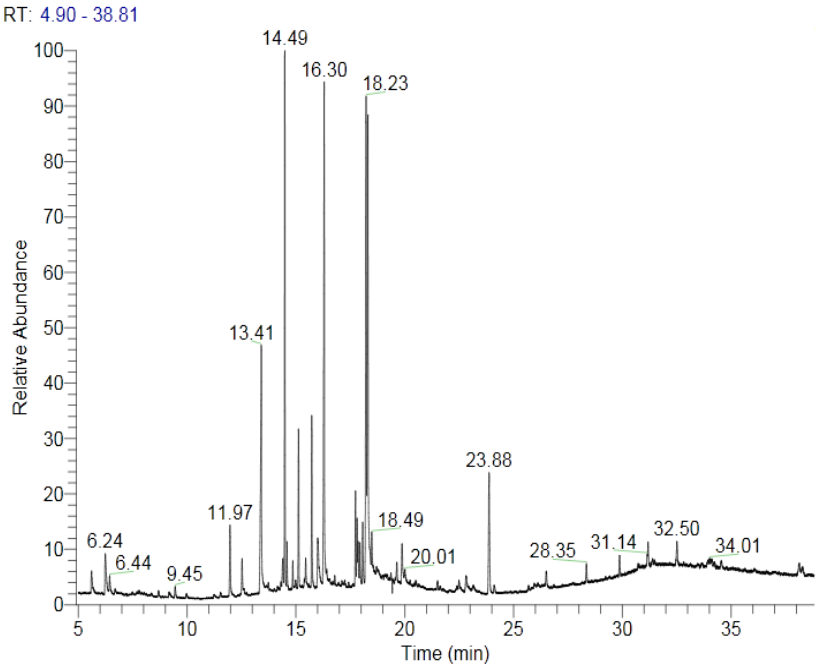
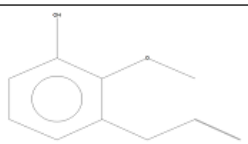
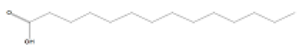
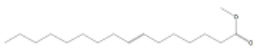
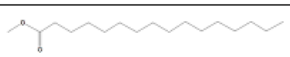
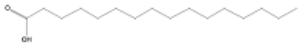
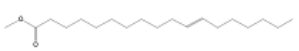
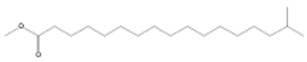
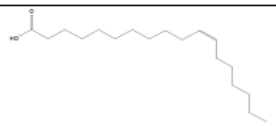
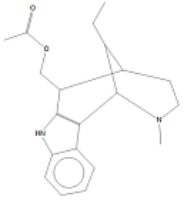
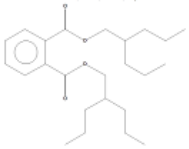


Fig. 3. GC/MS chromatogram of *Leptolyngbya* sp. Q1 (MZ504747).

Table (4): GC/MS profile of *Desertifilum* sp. Q2 (MZ504748).

NO.	Phytochemical compound	Rt	M. structure	M. formula	M. wt.	Area %
1	3-Allyl-2-methoxyphenol	6.26		$C_{10}H_{12}O_2$	164	0.56
2	Tetradecanoic acid (Myristic acid)	13.34		$C_{14}H_{28}O_2$	228	1.41
3	3,7,11,15-Tetramethyl-2-hexadecen-1-ol (Phytol)	14.48		$C_{20}H_{40}O$	296	3.22
4	7-Hexadecenoic acid, methyl ester, (Z)-	15.35		$C_{17}H_{32}O_2$	268	0.81
5	2-Hexadecen-1-ol, 3,7,11,15-tetramethyl (Phytol)	15.12		$C_{20}H_{40}O$	296	1.34
6	9-Hexadecenoic acid, methyl ester, (Z)- (Methyl palmitoleate)	15.45		$C_{17}H_{32}O_2$	268	0.76
7	Hexadecanoic acid, methyl ester (Palmitic acid, methyl ester)	15.72		$C_{17}H_{34}O_2$	270	5.05
8	cis-9-Hexadecenoic acid (Palmitoleic acid)	16.02		$C_{16}H_{30}O_2$	254	11.37
9	n-Hexadecanoic acid (Palmitic acid)	16.28		$C_{16}H_{32}O_2$	256	7.91

NO.	Phytochemical compound	Rt	M. structure	M. formula	M. wt.	Area %
10	11-Octadecenoic acid, methyl ester	17.8		$C_{19}H_{36}O_2$	296	1.72
11	Heptadecanoic acid, 16-methyl-, methyl ester (Methyl isostearate)	18.07		$C_{19}H_{38}O_2$	298	2.2
12	11-Octadecenoic acid, (Z)- (cis-Vaccenic acid)	18.27		$C_{18}H_{34}O_2$	282	12.77
13	Dasycarpidan-1-methanol, acetate (ester)	18.48		$C_{21}H_{28}N_2O_2$	326	0.94
14	Phthalic acid, di(2-propylpentyl) ester	23.87		C24H38O4	390	1.79

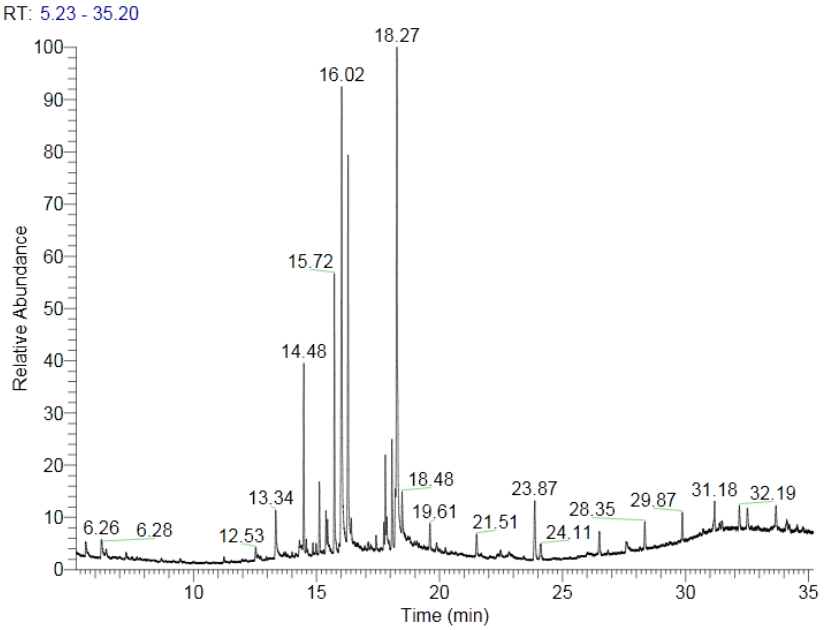


Fig. 4. GC/MS chromatogram of *Desertifilum* sp. Q2 (MZ504748)

The outcome of GC/MS analysis gave good impression about the ability to use the extracts of *Leptolyngbya* sp. Q1 and *Desertifilum* sp. Q2 as a sources for production of numerous active compounds with well-known biological activity.

Conclusion

The current study demonstrates the importance of *Leptolyngbya* sp. Q1 and *Desertifilum* sp. Q2 as promising sources for production of alternative active biomolecules. The results showed that the biomass of the two cyanobacterial isolates contained noticeable mounts of phenolic and flavonoid compounds which have antimicrobial and antioxidant properties. In addition, GC/MS profile of both cyanobacterial isolates revealed many active compounds including saturated, unsaturated fatty acids, alcohols and phenolic compounds that could be used for medical, cosmetics and food industries.

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تحديد المركبات الطبيعية التى لها نشاط مضاد للأكسدة ومضاد للميكروبات لعزلتين من السيانوبكتريا إحداهما تتبع جنس *Leptolyngbya* والأخرى تتبع جنس *Desertifilum*.

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للسيانوبكتريا اهمية كبيرة فى انتاج العديد من المركبات الطبيعية ذات الأهمية الحيوية كمضادات للأكسدة والميكروبات الممرضة. فى هذه الدراسة تم تقدير نسبة المركبات الفينولية والفلافونات فى الكتلة الحيوية لعزلتين من السيانوبكتريا المائية الأولى تتبع جنس *Leptolyngbya* والأخرى تتبع جنس *Desertifilum* كما تم تقييم مدى فعالية مستخلصات الميثانول للعزلتين كمضادات للأكسدة وايضا كمضادات لأنواع مختلفة من الميكروبات بالإضافة الى توصيف بعض المركبات الموجودة بالمستخلصات باستخدام جهاز الإستشراب الغازى ومطياف الكتلة. وقد اثبتت الدراسة احتواء السلالة التابعة لجنس *Leptolyngbya* على تركيزات اكبر من المركبات الفينولية والفلافونية مقارنة بالأخرى التابعة لجنس *Desertifilum*. ايضا أثبتت الدراسة وجود نشاط مضاد للأكسدة والميكروبات للمستخلصات المستخرجة من السلالتين مع وجود أفضلية للعزلة التابعة لجنس *Leptolyngbya* على العزلة الأخرى ، وقد دعمت نتائج جهاز الإستشراب الغازى ومطياف الكتلة هذه النتائج حيث ثبت احتواء المستخلصات على نسب متفاوتة من المركبات الفينولية والأحماض الدهنية المشبعة والغير مشبعة والتى يرجع اليها الأنشطة الحيوية للعزلتين والتى يمكن أن يكون لها أهمية علاجية و اقتصادية.