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Qualitative and Quantitative Phytochemical Composition of Sargassum Vulgare at Hurghada Red Sea Coast - Egypt

Seham E. Abu Ahmed[*1], Mohamed A. Deyab[1], Fatma S. El-Ashry[1] and Magda F. El-Adl[1]

[1] Department of Botany and Microbiology, Faculty of Science, Damietta University, New Damietta 34517, Egypt

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[*] Corresponding author's E-mail: Dr_Seham2016@yahoo.com

Abstract

Macroalgae produce a wide variety of chemically active secondary metabolites. Brown seaweed; *Sargassum vulgare* and its associated seaweeds were collected from Hurghada Red sea coast of Egypt. Optimal physicochemical properties; slightly alkaline; low turbidity, moderate temperature and available nutrient content of saline water produced massive growth of *S. vulgare* (53% covering percentage) during autumn (2018). Heavy metals accumulation inside the investigated seaweed *S. vulgare* was within the usually range. The associated macroalgal species with *S. vulgare* are belonging to 9 genuses, 12 species. Chromatography, mass spectrophotometry (GC/MS) analysis revealed the presence of Twenty five bioactive compounds. The major phytochemical constituents in the chloroform extract of *S. vulgare* are n-Hexadecanoic acid 28.29 %, Heptacosane 8.04 %, trans-13-Octadecenoic acid 5.50 %, Oleic Acid 4.24 %, Palmitoleic acid 3.56 % and Hexadecanoic acid, ethyl ester 3.30 %.

Keywords: Brown Seaweed, Sargassum vulgare, secondary metabolites, GC/MS, Phytochemical.

Introduction

Macroalgae is a collective term used for seaweeds and other benthic (attached to the bottom). Macro algae can be classified as red algae (Rhodophyta), brown algae (Phaeophyta) or green algae (Chlorophyta) depending on their nutrient and chemical composition **(Manzelat *et al*. 2018)**. Seaweeds or macroalgae are some of the most important organisms maintaining the aquatic ecosystems stability **(Satheesh *et al.* 2017).** However, macroalgae differ from other marine plants such as seagrasses and mangroves in that macroalgae lack roots, leafy shoots, flowers, and vascular tissues. Macroalgae take a wide range of forms, ranging from simple crusts, foliose (leafy), and filamentous (threadlike) forms with simple branching structures, to more complex forms with highly specialized structures for light capture, reproduction, support, flotation or attachment to the seafloor and size of macroalgae ranges from a few millimeters to plants up to 3-4 m high **(Guillermo *et al*. 2008).** Secondary metabolites from macroalgal species may be potentially bioactive compounds. These bioactive compounds can be incorporated into human food products for safety and preservation as they are edible, non-toxic and inexpensive **(Hayes M *et al.* 2015)**. These compounds render the macroalgae as biological weapons which used for killing or incapacitating the targeted host **(Noora *et al*. 2019).** Marine macroalgae are rich in bioactive compounds

that can be converted to a variety of secondary metabolites with a broad spectrum of biological activities **(Yu P and Gu HF 2015)**. So macroalgae are considered as rich source for antibiotics production in the pharmacological industry **(Aurora S *et al*. 2020)**. Various natural antimicrobial compounds have been recorded in marine environment more than those in the terrestrial one **(Ireland *et al.* 1988)**. Seaweeds have been recognized as potential sources of the antibiotic substances **(Chiheb *et al.* 2009)**.

"*Sargassum*" is a genus of brown (class Phaeophyceae) macroalgae (seaweed) in the order Fucales. Most species within the class Phaeophyceae was *Sargassum* which, are predominantly cold-water organisms that benefit from nutrients upwelling **(Hogan *et al.* 2011)** grows subtidally and attaches to coral, rocks, or shells in moderately exposed or sheltered rocky or pebble areas. These tropical populations often undergo seasonal cycles of growth and decay in concern with seasonal changes in sea temperature **(Fulton *et al.* 2014)**. *Sargassum* is considered as a source of bioactive compounds that give an alternative approach to the use of the synthetic antimicrobial agents. It's able to produce a great variety of secondary metabolites **(Gonzalez *et al.* 2001; Smit 2004)** characterized by a broad spectrum of biological activities; antiviral, antibacterial **(Chakraborthy *et al.* 2010a)**, antifungal and antitumor activities. The potent antimicrobial effect of seaweeds resides in the efficiency of the extraction method **(Tuney *et al.* 2006)**, the algal species **(Valchos *et al.* 1997)** and the solvents being used **(Cox *et al.* 2010)**. Moreover, higher medicinal effect was obtained from dry seaweeds samples than from fresh samples as indicated by many studies which reported that extracts prepared from fresh seaweeds showed negligible antimicrobial activity compared to that obtained from dried seaweeds **(Manivannan *et al.* 2011)**. Many investigations have demonstrated that a high dietary intake of natural phenols with the presence of several types of antioxidants such as flavonoids **(Moraes-de-Souza *et al.* 2008)** commonly found in plants and seaweeds reduce the risk of developing some chronic diseases, and various types of cancer so it offering a rich source of new drugs with potentially lower toxicity which strongly affect on longer life expectancy **(Hodgson and Croft 2006; Halliwell 2007; Yan and Asmah 2010)**

This study aimed to reveal: the vegetation *Sargassum vulgare* and its associated macroalgae at Hurghada Red sea coast of Egypt during autumn 2018. Determine the Qualitative and Quantitative phytochemical composition of *Sargassum vulgare* which, extracted by using different solvents.

Material and methods

(1) Study area

Collection site was along Hurghada shores, Red sea coast of Egypt **(Figure 1)**; it is one of the most important places of interest for algal growth in Egypt (intertidal zone).

Figure. 1: Collection site of *Sargassum Vulgare*

(2) Physico-chemical analysis of water

Temperature determination by using a Celsius Thermometer**.**

Hydrogen ion concentration (pH) **by** using a Horizon Ecology Co pH meter 5995.

Salinity (‰), Conductivity (EC) and total dissolved salts (T.D.S) by using YSI Model 33 (yellow springs) S-C-T Meter % MHOS.

Dissolved oxygen (DO) according to (EPA 1983) modified by (Wood 1975).

Biochemical oxygen demands (BOD) by (APHA 1992).

Total alkalinity and Phenolphthalein alkalinity by using the method of Kumar and Shailaja (1998).

Chlorides detection according to Ramteke and Moghe (1988).

Ammonia – nitrogen by using according to (Dawes *et al.* 1971).

Nitrite – nitrogen according to (Adams 1990).

Nitrate – nitrogen according to Strickland and Parsons (1965).

Total nitrogen by (Kryskalla 2003).

Total phosphorus according to (EPA 1993).
Reactive (Ortho) Phosphate according to (APHA 1989).
Total hardness by (Diehl *et al.*1950).
Calcium Hardness according to Ramteke and Moghe (1988).
Magnesium Hardness according to Microkhjeldahl method of **(Hawk *et al.* 1947)**.
Determination of Heavy Metals according to Moore and Chapman (1986).

(3) Collection and preparation of seaweeds

The macro-algal species for the proposed study were collected from Hurghada, Egypt during autumn 2018. The Collected macro-algae was carefully examined and authenticated by prof. Dr. Mohammed Ali Deyab (prof. of phycology, Botany & Microbiology Department, Faculty of Science, Damietta University). The selected sample of *Sargassum vulgare* **(Fig. 2)** and its associated seaweeds were triplicated collected by hand from one quadrat (1 x 1 m) to determine the vegetation analysis of seaweed (covering %). The collected samples were washed with seawater at the sampling site to remove the adhered sediments and impurities and then packed in polyethylene bags and brought to the laboratory for further analyses.

(4) Preparation of algal sample S. vulgare

The selected predominant brown macro-algal species *Sargassum vulgare* was washed successively with tap water, distilled water to remove all the salt on the surface. The water was drained off and the seaweed was spread on blotting paper to remove excess water. The clean seaweed was shade dried at room temperature and ground to powder. The ground dried algal material stored in plastic bags in a dry place until use.

(5) Phytochemical analysis of prepared Sargassum vulgare.

Protein determination by Bradford (1976).
Total Soluble and Insoluble Sugars according to (Schortemeyer *et al.* 1997).
Lipids determination according to (Egan *et al.* 1981).
Potassium, Sodium and Calcium Ions determination by using method of (Hawk *et al.* 1947).
Heavy Metals determination according to Moore and Chapman (1986).

(6) Algal extract

The *Sargassum vulgare* powder was successively extracted using solvents of increasing polarity according to (**Arokiyaraj *et al*. 2009)** with some modifications. 15 g powder was initially soaked in 60 ml of petroleum ether in air tight conical flask for two days. The flask was periodically subjected to shaking on an electronic shaker and then it was first filtered through double layered muslin cloth and then filtered through Whatman no. 1 filter paper and filtrate was collected into sterile air tight bottle. Likewise, the above methods were repeated using diethyl ether, ethyl acetate, acetone, chloroform, and ethyl alcohol 95%, ethyl alcohol 70% and distilled water.

(7) Qualitative analysis of natural products in algal extracts

The phytochemical screening of different algal extracts was assessed by standard method as described by (**Savithramma *et. al*. 2011)**. Phytochemical screening was carried out to identify the major natural chemical groups such as alkaloids, terpenoids, steroids, tannins, saponins, flavonoids, phenols, coumarins, quinones and glycosides. General reactions in these analyses revealed the presence or absence of these compounds in the algal extracts tested.
Alkaloids identification, 2 mL of concentrated Hydrochloric acid (HCl) was added to 2 mL algal extract. Then few drops Mayer's reagent was added**.** Presence of green color or white precipitate indicates the presence of alkaloids.
Terpenoids identification, 2 mL of chloroform along with concentrated Sulphuric acid was added to 0.5 ml of the algal extract. Formation of reddish brown color at the interface indicates the presence of Terpenoids.
Steroids identification, 2 mL of chloroform and 1 mL of sulphuric acid (H_2SO_4) were added to 0.5 mL of the algal extract. Formation of reddish brown ring at interface indicates the presence of steroids.
Tannins identification, one mL of ferric chloride (5% $FeCl_3$) was added to 1 mL of the algal extract. Formation of dark blue or greenish black color indicates the presence of tannins.
Saponins identification, 2 mL of distilled water was added to 2 mL algal extract and shaken in

graduated cylinder for 15 min lengthwise. Formation of 1 cm layer of foam indicates the presence of saponins.

Flavonoids identification, 1 mL of 2N sodium hydroxide (NaOH) was added to 2 mL of algal extract. Formation of yellow color indicates the presence of flavonoids.

Phenols identification, 2 mL of distilled water followed by few drops of 10 % ferric chloride was added to 1 mL of the algal extract. Formation of blue / green color indicates the presence of phenols.

Coumarins identification, 1 mL of 10 % NaOH was added to 1 mL of algal extract. Formation of yellow color indicates the presence of coumarins.

Quinones identification, 1 mL of concentrated sulphuric acid (H_2SO_4) was added to 1 mL algal extract. Formation of red color indicates the presence of quinones.

Glycosides identification, 3 mL of chloroform and 10% ammonium solution was added to 2 mL of the algal extract. Formation of pink color indicates the presence of glycosides.

(8) Quantitative analysis of phytochemical substances in algal extracts

Estimation of Total Phenolic Content

The total phenolic content of dry extracts was performed with Folin-Ciocaltaeu assay described by **Tambe and Bhambar (2014)**.

Estimation of Total Tannin Content

The tannins were determined by Folin-Ciocalteu method as described by **Chandran and Indira (2016)**.

Estimation of Total flavonoid Content

Aluminum chloride colorimetric technique as described by **(Chang *et al.* 2002)**.

(9) Gas Chromatography Mass Spectrophotometry (GC/MS) Analysis

The GC/MS method is a direct and fast analytical approach for identification of algal extracts components. Extracts of *Sargassum vulgare* were performed using Trace GC-TSQ Quantum mass spectrometer (Thermo Scientific, Austin, TX, USA) with a direct capillary column TG–5MS (30 m x 0.25 mm x 0.25 µm film thickness). The column oven temperature was initially held at 50°C and then increased by 5°C /min to200 °C hold for 2 min. increased to the final temperature of 290°C by 30°C /min and hold for 2 min. The injector and MS transfer line temperatures were kept at 270, 260°C, respectively; Helium was used as a carrier gas at a constant flow rate of 1 ml/min. The solvent delay was 3 min, and diluted samples of 1 µl were injected automatically using AS1300 coupled with GC in the split mode. EI mass spectra were collected at 70e.v. ionization voltages over the range of m/z 50–500 in full scan mode. The ion source temperature was set at 200 °C. The components were identified by comparison of their retention times and mass spectra with those of WILEY 09 and NIST 11 mass spectral database.

Result and discussion

Physicochemical analysis of the sea water

At the study site (Hurgada, Red sea coast of Egypt) during autumn. Saline water was characterized with moderate alkaline reaction (pH of 7.8), relatively high level of salinity (41٦٠‰), substantially high content of microelements Total P (2.82 mgL^{-1}), PO_4 (0.26 mgL^{-1}), Total N (1.95 mgL^{-1}) and Nitrate (0.58 mgL^{-1}) (Table 1). Water temperature was 25˚C; dissolved oxygen concentrations were semi-stable with mean value of 11.8 mgL^{-1}. It's clear that the mean value of total calcium and magnesium hardness were 1510 mgL^{-1} and 3160 mgL^{-1} as $CaCO_3$, respectively. Also Table (1) showed that the concentrations of major cations are changed with average values of 470 mgL^{-1}, 410 mgL^{-1} and 12050 mgL^{-1} for potassium, calcium and sodium, respectively. Biological oxygen demand (BOD), free CO_2, HCO_3^-, CO_3^{2-}, total hardness, Ca hardness, K, Ca. N, Mn, Zn, Cu, Ni, Co and Cr in sea water exhibited in low level.

Present results indicate that the optimal or semi-optimal physicochemical properties of saline water resulted in high growth of seaweeds with predominantly high growth of *Sargassum vulgare* (53%) **(Abdul Qudus *et al.* 2019)**.

Table 1: physicochemical characteristics of sea water

Characteristic	Autumn
Temperature (C°)	25 ± 1.5
Salinity (‰)	4160 ± 3.3
PH	7.8 ± 0.1
EC (mmhos cm^{-1})	57.1 ± 0.1
Alkalinity (meq L^{-1})	2.9± 0.1
DO (mg L^{-1})	11.8± 0.1
BOD (mg L^{-1})	1.8± 0.01
Free CO_2 (mg L^{-1})	19.5± 0.1
HCO_3- (mg L^{-1})	0.75± 0.02
CO_3 (mg L^{-1})	2.2± 0.08
T. Hardness (mg L^{-1})	4670± 0.02
Ca Hardness (mg L^{-1})	1510± 0.03
Mg Hardness (mg L^{-1})	3160± 0.02
T. K (mg L^{-1})	470± 10
T. Ca (mg L^{-1})	410± 7.0
T. Na (mg L^{-1})	12050± 0.02
T. P (mg L^{-1})	2.82± 0.03
PO_4 (mg L^{-1})	0.26± 0.01
T. N (mg L^{-1})	1.95± 0.02
Nitrate (mg L^{-1})	0.58± 0.03
Mg (mg L^{-1})	2.69± 0.11
Fe (mg L^{-1})	1.75± 0.04
Mn (mg L^{-1})	1.93± 0.04
Zn (mg L^{-1})	0.55± 0.01
Cu (mg L^{-1})	1.68± 0.02

Each value is the mean of three replicates ± SE

Seaweeds abundance and algal sampling

The present result indicated that Surgassum vulgare **(Figure 3)** was predominant macro-algal species 53% followed by Sargassum muticum 10%, S. crispum 5%, Cystoseira trinodis 5%, Laurencia papillosa 5%, Dictyota dichotoma 5%, C. myrica 2%, Padina minor 2%, Turbinaria ornata 2%, Digenea simplex 2%, Caulerpa racemosa 2%, Halimeda tuna 2%, Codium dichotomum 2%, Cladophora koeiei 1%, Hormophysa cuneiformis 1%, Ulva lactuca 1% as shown in **(Figure 2)**. We select the consequently massive growth of Surgassum vulgare as principle seaweed for further studies to determine benefit natural product of macro-algae.

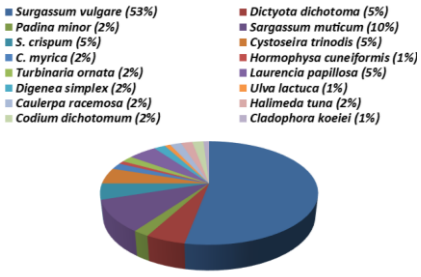

Figure 2: *S. vulgare* covering percentage and its associated macroalgal genera

Figure 3: Sargassum vulgare

Biochemical content of Sargassum Vulgare

The present result of the biochemical content revealed that, the major contents were insoluble carbohydrate (73.1 mg/g dry wt.) with relatively low content of soluble carbohydrate (36.1 mg/g dry wt.). This may be due to the algae in the adult stage and accumulate insoluble carbohydrate as secondary metabolites for protective uses **(Mariana *et al.* 2009**). The minerals represent the second position in the biochemical contents of algae. This may be due to osmotic equilibrium of algae in hyper saline aquatic environment. Furthermore it has a considerable content of protein different groups of algae exhibit varying levels of tolerance to heavy metals. **(Whitton 1970; Foster 1982b)**. It was observed greater Fe^{+},Co^{2+},Cu2+ and Cd^{2+} tolerance among the members *s. vulgare* (4.1,1.4,0.2,0.1 mg/mg dry wt.) respectively **(Table 2)**.

Table 2: phytochemical characteristics of *Sargassum vulgare*

Characteristic	mg/mg dry wt.
Protein (mgL^{-1})	15.4±0.1
Soluble Carbohydrate (mgL^{-1})	36.1±0.4
Insoluble Carbohydrate (mgL^{-1})	73.1±0.3
Lipids (mgL^{-1})	0.019±0
Total Na^{+} (mgL^{-1})	18.8±0.3
Total K^{+} (mgL^{-1})	48±2
Total Ca^{++} (mgL^{-1})	49±2
Cd (mgL^{-1})	0.059±0.0008
Fe (mgL^{-1})	4.064±0.036
Cu (mgL^{-1})	0.20±0.0033
Co (mgL^{-1})	1.43±0.0069

Qualitative phytochemical composition of Sargassum vulgare

Preliminary phytochemical screening of ten different chemical compounds (alkaloids, terpenoids, steroids, tannins, saponins, flavonoids, phenols, coumarins, quinones and glycosides) were tested in ten different extracts. In the present study, the phytochemical screening was performed with petroleum ether, diethyl ether, ethyl acetat, aceton, chloroform, ethyl alcohol 95%, ethyl alcohol 70% and distilled water extracts of *Surgassum vulgare*. Glycosides did not show any positive result for their presence in any of the ten extracts tested as shown in **Table (3)**. Among the ten different extracts, chloroform extract showed the presence of maximum number; 9 of compounds. Next to that, acetone extracts showed five compounds. Diethyl ether extracts showed four compounds. Ethyl acetate and ethyl alcohol 70% extracts showed three compounds and petroleum ether and distilled water extracts showed only two. Soils under study have high contents of phaeophyta species and the predominance species were *Sargassum. S. vulgare* extracts have potential bioactive compounds with an effective antibacterial and antifungal activity. The present study indicated that the total bioactive products and their predominance and concentration area.

Table 3: Qualitative analyses of phytochemical composition of *Surgassum vulgare* extract

Phytochemical parameters	Distilled water	Ethyl alcohol 70%	Ethyl alcohol 95%	Chloroform	Aceton	Ethyl acetat	Diethyl ether	Petroleum Ether
Alkaloids	-	-	-	+	-	-	-	-
Terpenoids	-	-	-	+++	+	+	+	-
Steroids	-	-	-	+++	+	+	+	+
Tannins	-	-	-	+	-	-	-	-
Saponins	-	-	-	++	-	+	-	+
Flavonoids	+	+	+	+++	+	-	+	-
Phenols	-	-	-	++	-	-	-	-
Coumarins	+	+	+	++	+	-	+	-
Quinones	-	+	-	+	+	-	-	-
Glycosides	-	-	-	-	-	-	-	-

++: intensely present, +: Present, - : Absent

Flavonoids showed its presence in most tested extracts. Flavonoids have antimicrobial, antiviral, antioxidant and spasmolytic activity. Flavonoids have a considerable interest recently because of their potential beneficial effects on human health in fighting diseases. Phenols showed its presence in chloroform extract of *Surgassum vulgare*. In general, phenolic compounds possessed specific physical, chemical and biological activities that make them useful as drugs. Phenolics were also responsible for the antimicrobial, anti-inflammatory, anti-viral, anticancer actions. Tannins were found only in chloroform extract. Coumarins were found in Diethyl ether, acetone, chloroform, ethyl alcohol 95%, ethyl alcohol 70% and distilled water extracts and have been used as anti-coagulant to treat lymphedema. Quinones showed its presence in acetone, chloroform and ethyl alcohol 70% extracts of *Sargassum vulgare*. Quinones confer cytotoxic activity via interference of DNA and RNA replication and mitochondrial oxidative pathways, as well as through the formation of peroxide, superoxide and hydroxyl radicals in the cell. Terpenoids were found in Diethyl ether, ethyl acetate, acetone and chloroform.

Quantitative phytochemical composition of Sargassum vulgare

Phenolics, flavonoids and tannins contents of *Sargassum vulgare* were varied according to solvents used in extraction processes. The highest total phenolics (0.918 ± 0 mg GAE/g dry wt.) and tannins (0.034 ± 0.05 mg RUE/g dry wt.) was recorded in chloroform extract, while the highest total flavonoids (0.679 ± 0.45 mg CAE /g dry wt.) was recorded in Ethyl alcohol 95% extract of *Sargassum vulgare* **(Table 4)**. **Simon *et al.* (2015)** demonstrated that extraction solvents have an effect on phenolic and flavonoid contents

Table 4: Quantitative phytochemical composition of *Sargassum vulgare* extracts

Solvents	T. phenolics (mg GAE/g dry wt.)	T. flavonoids (mg CAE /g dry wt.)	T. tannins (mg RUE/g dry wt.)
Petroleum ether	0.551	0.156	0.001
Ether	0.228	0.254	0.006
Aceton	0.329	0.243	0.000
Chloroform	0.918	0.172	0.034
Ethyle acetate	0.266	0.265	0.011
Ethyle alcohol 95%	0.421	0.679	0.002
Ethyle alcohol 70%	0.232	0.378	0.005
Water	0.199	0.018	0.001

Values are means of three analyses of the extract ±

standard deviation (n=3)

GAE: Gallic acid equivalent, RUE: Rutin equivalent, CAE: Catechin equivalent.

Gas Chromatography Mass Spectrophotometry (GC/MS) Analysis

Metabolite profiling has been developed as modern technology platform in biological samples describe complex chemical matrices and identify the compounds. In particular, GC/MS is a fast and precise tool commonly used in diagnostics, functional genomics and screening **(Rohloff, 2015)**. The present study contributes valuable information on bioactive compounds in *Sargassum vulgare*, as summarized in **(Table 5)**. *Sargassum* contained numerous bioactive compounds belonging to various classes such as fatty acids, phenolics, alkaloids, flavonoids, steroids.

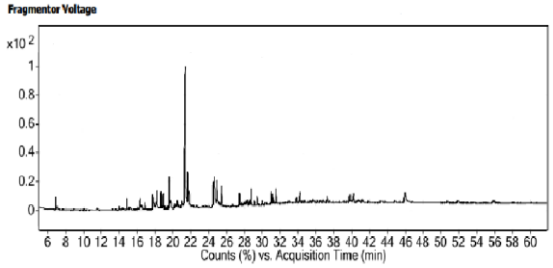

Figure 4: GC/MS chromatogram of *Sargassum vulgare* chloroformic extract

Chloroform extract of *Sargassum vulgare* was characterized by gas chromatography, mass spectrometer (GC/MS). The major constituents, retention time (RT), concentration (Area %), chemical structure of bioactive components (CSBC), molecular formula (MF) and molecular weight (MW) are presented in **(Table 5)** and **(Figure 4)**. Twenty bioactive compounds were identified in the chloroform extract of *S. vulgare*. The major phytochemical constituents are n-Hexadecanoic acid 28.23 %, Heptacosane 14.04 %, Oleic acid 9.10 %, Octadecane, 3-ethyl-5-(2-ethylbutyl) 4.8 %, Cholest-5-en-3-ol, 24-propylidene-, (3β) 4.24%, Ergosta-5,22-dien-3-ol, acetate, (3β,22E) 4.21%, and Palmitoleic acid 3.56 %. These bioactive compounds have many international knowledge uses in many fields as agriculture, pharmaceuticals, biotechnology, and industrial fields **(Michalak *et al.* 2015, Guiheneuf *et al.* 2016).**

Table 5: Chlorophormic extract components of *Sargassum vulgare* by GC/MS analysis

Compound name	M Formula	Area %
Hexadecane	$C_{16}H_{34}$	1.4143
2-(4a,8-Dimethyl-6-oxo-1,2,3,4,4a,5,6,8a-octahydro-naphthalen-2-yl)-propionaldehyde	$C_{15}H_{22}O_2$	1.4143
Tetradecanoic acid	$C_{14}H_{28}O_2$	2.2628
Nonadecne	$C_{19}H_{40}$	3.0633
Butyl myristate	$C_{18}H_{36}O_2$	2.2628
17- Octadecynoic acid	$C_{18}H_{32}O_2$	2.2628
Cyclopenta [g]-2-benzopyran, 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8-hexamethyl-	$C_{18}H_{26}O$	3.5696
Hexadecanoic acid, methyl ester	$C_{17}H_{34}O_2$	0.85
n-Hexadecanoic acid	$C_{16}H_{32}O_2$	28.23
Palmitoleic acid	$C_{16}H_{30}O_2$	3.56
Hexadecanoic acid, ethyl ester	$C_{18}H_{36}O_2$	3.30
Heptacosane	$C_{27}H_{56}$	14.04
trans-13-Octadecenoic acid (Oleic acid)	$C_{18}H_{34}O_2$	9.10
4,14-Retro-retinol	$C_{20}H_{30}O$	1.698
3-Oxatricyclo[20.8.0.0(7,16)]triaconta-1(22),7(16),9,13,23,29-hexaene	$C_{29}H_{42}O$	1.13
4-Hexyl-1-(7-methoxycarbonylheptyl)bicyclo[4.4.0]deca-2,5,7-triene	$C_{25}H_{40}O_2$	1.41
3',8,8'-Trimethoxy-3-piperidyl-2,2'-binaphthalene-1,1',4,4'-tetrone	$C_{28}H_{25}NO_7$	1.41
Octadecane, 3-ethyl-5-(2-ethylbutyl)-	$C_{26}H_{54}$	4.8
Ergosta-5,22-dien-3-ol, acetate, (3β,22E)-	$C_{30}H_{48}O_2$	4.21
Cholest-5-en-3-ol, 24-propylidene-, (3β)-	$C_{30}H_{50}O$	4.24

Conclusion

The present results indicated that semi-optimal physicochemical properties of sea water resulted in high growth of several species of seaweeds with high predominance of *Sargassum vulgare*. This study concluded also that different extracts of *Sargassum vulgare* possess varied qualitative and quantitative content of chemical compounds including alkaloids, terpenoids, steroids, tannins, flavonoids, phenols, coumarins, quinones and Saponins but lacks glycosides compactable with biological properties of macro-algae and these according to type of extract solvents. There is no single solvent which may be considered standard because it is usually different for different plant matrices. The major phytochemical constituents in the chloroform extract of *S. vulgare* are n-Hexadecanoic acid 28.29 %, Heptacosane 8.04 %, trans-13-

Octadecenoic acid 5.50 %, Oleic Acid 4.2428 %, Palmitoleic acid 3.56 % and Hexadecanoic acid, ethyl ester 3.30 %. This work also, indicated that the bioactive compounds of *S. vulgare* need further research to a scertain their biological properties.

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الملخص العربي

عنوان البحث:

سهام أبو أحمد[١]، محمد دياب[١]، فاطمة العشري[١]، ماجدة العدل[١]
[١] قسم النبات والميكروبيولوجي، كلية العلوم ، جامعة دمياط ، مدينة دمياط الجديدة ، مصر

تنتج الطحالب البنية مجموعة متنوعة من المركبات الثانوية النشطة كيميائيًا. أدت الخصائص الفيزيائية والكيميائية المثلى "انخفاض العكارة ودرجة الحرارة المعتدلة والمحتوى الغذائي المتاح والقلوية المعتدلة للمياه المالحة" إلى نمو هائل من الطحالب (٥٣%) S. vulgare خلال خريف ٢٠١٨. لذا تم جمع Sargassum vulgare والانواع المرتبطة به التي تنتمي إلى ٩ أجناس و ١٢ نوعًا ،من ساحل البحر الأحمر بمصر – الغردقة. وضحت الدراسة أن تراكم المعادن الثقيلة داخل طحلب Sargassum كان ضمن النطاق المعتاد. وأخيرا كشف تحليل الطيف الكتلي (GC / MS) عن وجود خمسة وعشرين مركبًا ثانويا في مستخلص الكلوروفورم من ضمنهم n-Hexadecanoic acid 28.23 %, Heptacosane 14.04 %, Oleic acid 9.10 %, Octadecane, 3-ethyl-5-(2-ethylbutyl) 4.8 %, Cholest-5-en-3-ol, 24-propylidene-, (3β) 4.24%, Ergosta-5,22-dien-3-ol, acetate, (3β,22E) 4.21%، و Palmitoleic acid 3.56 %.