



Original Research Article

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Extraction, characterization and bioactive evaluation of secondary metabolites from *Sargassum wightii*

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Article Info

Abstract

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Sargassum wightii (*S. wightii*) is a species of brown seaweed that is commonly found in the Indian Ocean and other tropical regions. Brown seaweed is rich in a range of bioactive compounds, including fucoidans, laminarin, alginates, and phlorotannins. After extraction, the crude extract is typically further purified using techniques such as Gas Chromatography Mass Spectrometry (GC-MS). The extracted secondary metabolites from *S. wightii* have a range of potential applications, including in the food, pharmaceutical, and cosmetic industries. Several methods have been employed for the extraction of secondary metabolites from *S. wightii*, including solvent extraction, microwave-assisted extraction, ultrasound-assisted extraction and supercritical fluid extraction. Solvent extraction is the most commonly used method, where solvents such as methanol, ethanol, acetone and chloroform are used to extract the metabolites. The present study aimed to investigate the phytochemical profile and anti-diabetic potential of *S. wightii* extracts. FT-IR spectroscopic analysis revealed the presence of bioactive compounds, including alkaloids, flavonoids, and phenolics. HPLC analysis identified methanolic extract. The anti-diabetic activity of the extracts was evaluated using alpha-amylase inhibition. The results demonstrated significant inhibition of alpha-amylase activity IC₅₀ = 50.35 and enhancement of glucose uptake. These findings suggest that *S. wightii* extracts possess potential anti-diabetic properties, warranting further investigation for the development of phyto-based treatments for diabetes management.

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Introduction

Secondary metabolites from seaweed are potentially helpful sources of therapeutic medicines. The synthesis and development of new compounds from this seaweed has been revealed to be rapidly rising, while marine algae remains underutilized among these sources. The

term marine algae refer to macro algae, which are also known as seaweeds. Seaweeds are an economically important source of non-flowering plants that have been revealed to have the ability to synthesis many secondary metabolites such as phenols, terpenes, and steroids, all of which have extensive medical applications [1]. Unique photochemical, vitamins, and minerals found in

seaweeds operate as strong antioxidants. They are often employed in food, cosmetics, and nutraceuticals because to their economic and dietary resources. They have also been discovered to contain proteins, carbohydrates, vitamins, and minerals, all of which are used in animal nutrition. Seaweeds are an easily available renewable resource. Secondary metabolites are organic compounds generated by organisms such as plants, algae, bacteria, and fungi. They are biosynthetically produced from parent metabolites. These compounds are restricted to a small number of species within a taxonomic group and have no direct function in an organism's growth, development or reproduction. Future perspectives and applications of seaweed cellulose are also covered in this paper [2]. There was discovered to be a significant amount of cellulose in several types of seaweed. The paper emphasizes how products made from seaweed cellulose were comparable in terms of their properties to those made from products made from plant cellulose. Many pathogens produce toxins that contaminate produce after harvesting, which can result in significant financial losses for crop production globally. Although not all of the aforementioned issues arise with all crops, simultaneously, or with complete predictability, it is currently accepted agricultural practice [3]. To control plant pathogens, this method relies on the use of numerous synthetic chemical pesticides; however, the widespread application of pesticides is bad for ecosystems, consumers, and farmers. Transgenic crops with various disease-resistance genes have been obtained from distant, typically wild relatives through the development of molecular biology techniques. However, the limited number of crops in which disease resistance has been achieved through genetic modification or insertion (GMO crops) will need regulatory clearance from government authorities in order to be successfully implemented. The various seaweeds can be used to achieve sustainable strategies of induced biotic resistance in significant cultivated plants. Plants have a built-in immune system that they can use to defend themselves against pathogen aggression. Induced systemic resistance (ISR) or systemic acquired resistance (SAR) is two ways that plants react to pathogen infestations (ISR). Salicylic acid and pathogenesis-related (PR) proteins are the mediators of SAR, which regulates hypersensitive reactions to pathogen infestations [4]. The potential benefits of seaweed to the bio-based economy are methodically examined in this essay. The potential methodologies for biorefineries are also discussed,

along with the environmental and financial elements of sustainability. Finally, a summary of the development process, by-product promotion, financial support, and societal acceptance strategy is provided, which is crucial when assessing the viability of seaweed-based products. To achieve sustainable development goals, it is crucial to adhere to sustainable-led management practices and put feedstock and cutting-edge technology at the centre of the diseconomy revolution [5]. The typical habitat of seaweed, a macroscopic alga, is the bottom of shallow coastal seas. On rocks, pebbles, shells, black water, and marine plants, it normally grows at a depth of 180 meters. Based on pigmentation, they are divided into three subgroups: green algae (Chlorophyceae), red algae (Rhodophyceae), and brown algae (Phaeophyceae). Seaweeds were reportedly dried and fed to horses, sheep, and cattle up to when fodder was scarce [6]. This seaweed has been traditionally used in folk medicine for its diverse health benefits. Recent studies have highlighted the anti-inflammatory, antioxidant, and anti-cancer properties of *Sargassum* species. However, the phytochemical profile and anti-diabetic research is not addressed. The main objective of this research is to analyse the the presence of phytochemicals, check for phenol content and detect Antioxidant activity (DPPH radical scavenging). The presence of phenol was determined by Gas chromatography mass spectrometry (GC-MS). Analyse the anti-diabetic activity of *Sargassum wightii* extracts using in vitro assays, the characterization of phytochemical profile of *Sargassum wightii* using FT-IR spectroscopy and HPLC analysis and to identify potential bioactive compounds responsible for the anti-diabetic activity.

Materials and methods

Materials

Collection of Seaweed

Sargassum wightii was collected from the east-coast Tamil Nadu (Kovalam) of India. *S. wightii* is a very common brown alga found intertidal on Hawaiian reefs and throughout the Pacific and Indian Ocean. It is normally found in small clusters attached to the crevices of basalt rocks in high wave action areas as well as in the crevices of coral heads at 20-30 meters deep [7]. The morphological characteristics of this alga enable it to survive extreme environmental conditions. It was potential invasive even in its native habitat in Hawaii.

This species has shown very successful tendencies in areas near development with high nutrients and high water motion.

Methods

Grinding the seaweed (*Sargassum wightii*)

A bag of seaweed which is dried and covered in a bag without any air goes inside and it is grinded with the help of grinding mechanism. Until the seaweed become powder form. After that the powder is measured with the help of weighing machine [7]. The total amount of grained seaweed is 652.805 g. In the total amount of seaweed we have 50 g of seaweed and in that seaweed powder we add 3500 mL distilled water (H₂O). It is kept for stirring to mix the metabolites in seaweed. Stirring is kept for 500 – 600 rpm and temperature at 60 °C for 20 minutes [8]. The samples were washed thoroughly with tap water and then distilled water to remove the associated biota and salt debris and then shade dried for 2–3 weeks.

Filtration

The filtration method is done with the help of the mesh cloth that is used to filter the seaweed cake and the distilled water separate. This process is done 3 – 4 times with the help of the mesh and distilled water [9]. The remaining water is discarded and the seaweed cake is again stirred and kept for centrifuge this propos is to segregate the metabolites in seaweed. After centrifuge rotary is done with the distilled water which is stirred and centrifuged. Rotary is done for 2-3 days.

Dialysis

A semi-permeable membrane, such as porous cellulose, and a tube that is sealed on both sides to store a protein solution make up the dialysis device. The tube is immersed in a much bigger container with buffer. Low-molecular-weight particles will pass across the semi-permeable membrane, whereas protein molecules, which are larger than these particles, will stay inside the tube [10]. To reverse buffers that are inside and outside the dialysis tube will change during diffusion, on the other hand, until equilibrium is reached. In this equilibrium, the Donnan effect can be shown to preserve electrical neutrality on both sides of the membrane. Proteins can't diffuse over a membrane because of their size, thus they stay inside. It should be stressed that while polyvalent proteins prevent charged

particles from leaving the membrane surface, they are unable to produce an equilibrium potential. Finally, during the dialysis process, the buffer inside the dialysis machine changes. The tube is gradually replaced by the solution in the outer vessel [11]. The tube's minute contaminants are successfully removed using this technique. In conclusion; dialysis is one of the most widely used techniques for separating peptides and proteins from their natural matrixes. As a result, obtaining is made possible by combining dialysis with high-yield extraction techniques. The protein content of SP isolates is higher than that of other purification methods.

Drying process

The washed seaweeds were divided into 3 groups for drying process, including air-drying at room temperature; freeze drying and vacuum oven-drying. Throughout the drying procedure, all samples were dried until constant weight was attained. The air-dried (AD) samples were exposed to ambient temperature of 25° C for 6 days [12]. The vacuum oven dried (OD) samples were prepared by spreading samples evenly in a single layer on trays and placed in a vacuum oven and dried at 40 ± 5° C, maintained for 29 h. The freeze dried (FD) samples were prepared by subjecting fresh samples to over- night freezing at 80 C in a freezer (Thermo Scientific) followed by lyophilizing in a freeze dryer until constant weight was attained [13]. All dry samples were subsequently ground into fine powder with a laboratory-scale blender, and then sieved using a 200 mm-sized sieve. The fine powdered samples were collected in screw-capped bottles and stored in refrigerator until further use.

Purification of seaweed extract

N-Butane 50mL and Chloroform 250mL is added to the conical flask and well mixed. In a 50mL of falcon tube the extracted seaweed (*S. wightii*) is added and the N-Butane and Chloroform mixed solution is added in the falcon tube until it is filled in falcon tube and centrifuge 10 minutes at 4°C and 2500rpm [14]. This process is repeated for 3 times. After centrifuge supernatant is discarded the pellet is kept.

Acetone is added in the falcon tube with the remaining pellet and shaken well and kept for centrifuge for 20 minutes at 4°C and 4000rpm. This process is repeated for 3 times. After centrifuge supernatant is discarded the pellet is kept.

Gas Chromatography and Mass Spectrometry Analysis (GC-MS)

The *Sargassum wightii* extract was filtered on a Durapore-HV membrane filter disk with 2.5 cm diameter and 0.45µm pore size by vacuum filtration. The filtrate was then transferred into a 1.5 mL eppendorf tube and frozen in liquid nitrogen. Frozen samples were stored at -80 °C till metabolite extraction. Metabolites were extracted immersing the filter in 1 mL of 90% (v/v) methanol containing 0.1 µg mL⁻¹ U-13C-sorbitol followed by vortexing for about 5 seconds, the filter (attached to the eppendorf) was removed and the remaining solution was centrifuged at 20,000g for 5 minutes at 4°C. The sample was dried by a vacuum concentrator (SpeedVac concentrator, Thermo, Waltham, MA). Gas chromatography-mass spectrometry (GC-MS) analysis was performed by using GC-MS system. The GC column used was fused HyperSep silica capillary column (30 m X 0.25 mm X 0.25 µm) used with helium (carrier gas) at 1.51 mL for 1 minute. The mass spectrometer was operated in the electron impact mode at 70 eV. The split ratio was 1:10 and injection volume was 1 µL. The injector temperature was 250°C while the set oven temperature was 70°C per 3minutes, which rose to 250°C/14 minutes [15]. Mass start time was at 5 minutes and end time at 35 minutes. Peak identification of crude *Sargassum wightii* extract was performed by comparison with retention times of standards and the mass spectra obtained was compared with NIST libraries (NIST 11-Mass Spectral Library 2011 version) with an acceptance criterion of a match above a critical factor of 80%.

Phytochemical screening

Phytochemical examination was carried out for all the extracts according to standard protocols. For terpenoids, extract was dissolved in 2 mL of chloroform and evaporated to dryness. To this, 2 mL of concentrated H₂SO₄ was added and heated for about 2 minutes. A greyish color indicated the presence of terpenoids. The presence of steroids was indicated by development of a greenish coloration by mixing extract with 2 mL of chloroform. Then 2 mL of each of concentrated H₂SO₄ and acetic acid were poured into the mixture. In tests for phenols and tannins, extract was mixed with 2 mL of 2% FeCl₃ solution. A blue-green or black coloration indicated the presence of phenols and tannins [16]. Detection for flavonoids was conducted by dilution of extract with 2 mL of NaOH and the mixture turned to

intense yellow coloration. Once HCl was added, the solution became colorless. As for saponins, extract was mixed with 5 mL of distilled water in a test tube. This was shaken vigorously. Formation of stable foam was considered as indication for the presence of saponins.

Total Phenolic Content (TPC) assay

Folin-Ciocalteu techniques were used to determine the phenolic content of *S. polycystum*. In each well of a 96-well plate, 20 µl of aqueous extract of various concentrations were added together with approximately 100 µl of Folin-Ciocalteu's reagent and 80 µl of 7.5% (w/v) sodium carbonate. Using an ELISA plate reader (Thermo multiskan go) and a blank (solvent without extract) [7], the absorbance was measured at 765 nm after 30 minutes of incubation at room temperature and in the dark. Gallic acid (0–1 mg/mL) was employed as a standard curve, and quercetin served as the positive control.

Antioxidant activity (DPPH radical scavenging)

The DPPH radical scavenging activity of extracts was determined in accordance using 96- well plate with slight modifications. DPPH reagent (0.3 mM) was prepared by weighing 1 mg of DPPH powder and dissolved in 8.4534 mL of methanol. Seaweed extracts and ascorbic acid were prepared and diluted in DMSO to get the stock solution with concentration of 10 mg/mL and 1.0 mg/mL, respectively. A total of 50 µL of various concentrations sample ranging from 0 to 3.0 mg/mL were mixed in 96 wells plate with 150 µL of 0.3 mM DPPH solution in methanol [9]. The assays were performed in triplicates. The mixture was incubated for 30 minutes in the dark at ambient temperature and the absorbance was measured at 517 nm using ELISA plate.

Fourier Transform Infrared (FT-IR) Spectroscopy Analysis

FT-IR analysis was conducted to identify potential biomolecules present in the polyphenol extraction from marine brown algae *S. wightii*. Twenty milligrams of the crude sample were mixed with four different filtered solvent extractions (n-hexane, dichloromethane, ethyl acetate, and methanol) and analyzed using FT-IR spectroscopy [14]. The analysis was performed at the Department of Sophisticated Analytical Instrument Facility (SAIF), IIT campus, Chennai. FT-IR spectra were recorded within the range of 400-4,000 cm⁻¹.

Various stretching vibration modes were identified and assigned to determine the functional groups present in the polyphenol extraction from marine brown algae.

High-Performance Liquid Chromatography (HPLC) Analysis

Advanced chromatography employed in the current work to identify the phytoconstituents found in the methanolic extracts of the selected algae. The Shimadzu LC-20AD HPLC system, which includes a model LC-20AT pump, UV-Visible detector SPC-20AT, injector fitted with a 20-loop, and an auto-injector SIL-20AT, used carry out the MPLC method. A Shimadzu C-18 column (4.5×250mm, 3µm size) with a C-18 guard column [15].

Anti-diabetic activity

Algae sample was taken in various concentrations at 20, 40µl, 60µl, 80µl, 100µl and control in test tubes 250µl of α-amylase is added in each in each test tube and mixed. Each test tube was incubated at room temperature. Then 500µl of starch was added and incubated for 3 minutes at room temperature [16]. 500µl of DNS was added and kept at water bath at 50degreeC for 5 minutes. The antidiabetic activity was read at 540 nm in UV Spectroscopy.

Results and discussion

Collection of seaweed

The seaweed (*S. wightii*) was collected from the Kovalam beach, along the eastern coast of Tamil Nadu. The collection was carried out by local fishermen and women, who use traditional methods such as handpicking or cutting the seaweed from rocks, the collected seaweed was dried and used for extraction. Seaweed that has been dried and sealed in a plastic container with no air is placed inside and ground with the aid of a grinding machine. After that, weighing equipment is used to measure the powder. There are 652.805 g of seaweed in total. Exacgly 3500 mL of distilled water (H₂O) was added to the 50 g of seaweed powder that makes up the whole amount of seaweed.

Dialysis

A common technique for this is dialysis, which passively and selectively spreads pollutants across a

semi-permeable membrane, such a dialysis tube. The smallest molecules present in solutions, such as salts, reducing agents, and preservatives, are typically removed by dialysis. This method is straightforward but time-consuming because separation is dependent on diffusion rate. The dialysis machine consists of a tube that is sealed on both sides to hold a protein solution and a semi-permeable membrane, such as spongy cellulose.

Phytochemical screening

Seven distinct chemical components (steroid, phenol, tannins, saponins, flavonoids, terpenoids, and glycosides) were examined in five separate extracts using preliminary phytochemical screening. A total of 5 tests for the presence or absence of the chemicals came back flavonoids positive. Only eight people had unfavorable results, though. The flavonoids positive results show that all five of the solvent extracts tested steroid, saponins, and glycosides contain these substances. The highest concentrations of steroid, saponins, and terpenoids were found in each of the five extracts. Phenol in extracts was placed next to this. Methanol extract among the five distinct extracts revealed the presence of the most compounds, followed by chloroform and acetone extracts at 6 compounds 3.1. Only three compounds were found in the hexane extract while five compounds were found in the 70% ethanol extract. The findings of phytochemical analysis of different *S. polycystum* extracts showed that of different secondary metabolites in varying concentrations. In general, seaweeds are regarded as therapeutic plants since they are abundant in metabolites, have undergone considerable research, and are used in the pharmaceutical sector. It was shown in the current investigation that all *S. polycystum* extracts contained tannins. Numerous medications made of tannin are used as astringents in medicine.

Antioxidant activity (DPPH radical scavenging)

Extracts' capacities to scavenge DPPH radicals were assessed using the 96-well plates with a few minutes or variations are used. Weighing 1 mg of DPPH powder and dissolving it in 8.4534 mL of methanol produced 0.3 mM of DPPH reagent. To create a stock solution with concentrations of 10 mg/mL and 1.0 mg/mL, respectively, seaweed extracts and ascorbic acid were produced and diluted in DMSO. In a 96-well plate, 50 l of samples at varied concentrations between 0 and 3.0

mg/mL were combined with 150 l of a 0.3 mM DPPH solution in methanol. The assays were carried out three times. The mixture was incubated for 30 minutes at

room temperature and in the dark, and the absorbance was assessed at 517 nm using a thermo multiskan ELISA plate reader.

Table 1. GC-MS findings of *Sargassum wightii*.

Peak Report TIC				
Peak#	R.Time	Area	Area%	Name
1	3.611	420233	4.68	Methyltris(trimethylsiloxy)silane
2	4.138	344069	3.83	OCTANE, 6-ETHYL-2-METHYL-
3	4.244	131849	1.47	2,3,6,7-TETRAMETHYLOCTANE
4	5.031	260527	2.90	OCTANE, 6-ETHYL-2-METHYL-
5	10.703	446498	4.97	Dodecane, 2,6,11-trimethyl-
6	12.769	305176	3.40	Dodecane, 4,6-dimethyl-
7	21.264	313380	3.49	Hexadecane
8	26.472	171806	1.91	1-Nonadecene
9	29.878	276370	3.08	Eicosane
10	31.025	270734	3.01	HEXADECANE, 2,6,10,14-TETRAMETHY
11	32.219	410343	4.57	n-Nonadecanol-1
12	34.622	196257	2.18	HEXATRIACONTANE
13	34.904	980486	10.91	Hexadecanoic acid, methyl ester
14	35.398	1319077	14.68	Dibutyl phthalate
15	36.171	438684	4.88	1-Nonadecene
16	36.290	129196	1.44	Eicosane
17	37.929	301695	3.36	9-OCTADECENOIC ACID (Z)-, METHYL
18	38.282	131768	1.47	Tetrapentacontane
19	38.368	713952	7.95	Methyl stearate
20	38.951	163358	1.82	OCTADECANE
21	39.443	297814	3.31	1-Nonadecene
22	39.540	98009	1.09	Dotriacontane
23	42.337	216666	2.41	1-Hexacosanol
24	44.137	535992	5.97	Bis(2-ethylhexyl) phthalate
25	44.982	110749	1.23	Octacosanol
		8984688	100.00	

FT-IR spectroscopic analysis

FT-IR analysis was conducted on the polyphenol extraction from marine brown algae *S. wightii* to determine the functional groups present. The FT-IR spectrum provided a detailed fingerprint of the molecular components, revealing several characteristic peaks. A broad band observed at 3,363 cm^{-1} was attributed to O-H stretching vibrations, indicative of hydrogen-bonded alcohol and phenol groups. This peak is significant as it confirms the presence of phenolic compounds, which are known for their antioxidant properties. The peak at 1,640 cm^{-1} corresponded to C=C stretching vibrations typical of alkenes. This peak suggests the presence of unsaturated compounds, which are often involved in various biological activities. A

peak at 1,404 cm^{-1} was assigned to C-H stretching vibrations of alkanes, which indicated the presence of simple hydrocarbon chains within the extract. Additional peaks at 1,240 cm^{-1} and 1,075 cm^{-1} were associated with C-H deformation and C-O or C-C stretching vibrations, respectively. These peaks are characteristic of carbohydrates and polysaccharides, confirming the presence of these compounds in the extract. The spectrum also showed a peak at 889 cm^{-1} , which can be attributed to C-H bending of glucose or galactose units, and a peak at 669 cm^{-1} , which is related to C-S stretching vibrations of sulfates. These results highlight the complex composition of the *S. wightii* extract, containing a rich array of phenolic compounds, carbohydrates, and polysaccharides. The presence of these functional groups underscores the

potential of *S. wightii* for various biological applications, particularly due to its antioxidant properties conferred by phenolic compounds and its potential health benefits related to carbohydrates and polysaccharides.

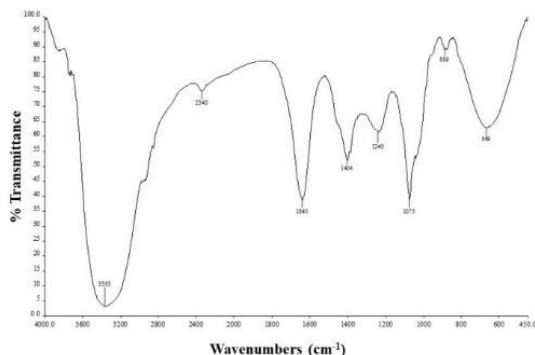


Fig. 1: FT-IR analysis of polyphenol extracted from marine brown seaweed *S. wightii*.

HPLC analysis

RP-HPLC profile of methanolic extract was examined and two-component namely gallic acid and quercetin should obtain at distinct retention times. It was remarked that two main peaks were eluted with a retention time of (11.835 min) and a retention time of 4.457 min identified at 278 nm and 370nm respectively. This major compound was identified as gallic acid and quercetin.

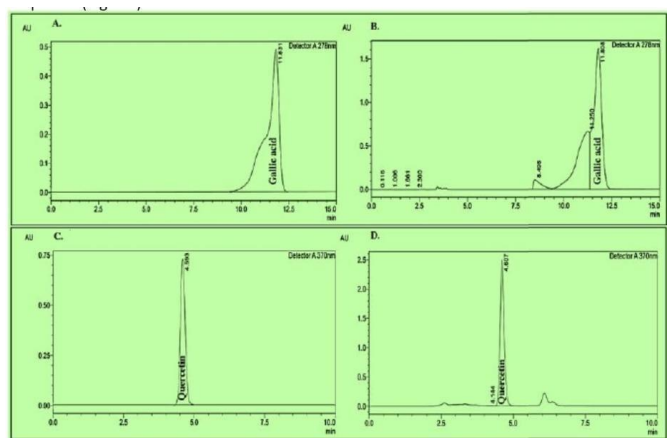


Fig. 3: HPLC chromatogram of methanolic extract.

A) Standard gallic acid peak at retention time 11.835 min detected at 278 nm *S.wightii* Showed gallic acid peak at retention time 11.808 min detected at 278 nm
C) Standard quercetin peak at retention time 4.593

min detected at 370 nm. *S.wightii* showed quercetin peak at retention time 4.607 min detected at 370 nm.

Table 2. HPLC condition for standards gallic acid and quercetin

Parameters	Gallic Acid	Quercetin
Mobile Phase	Methanol and 0.4% phosphoric acid (49:51)	Methanol and acetonitrile (50:50)
Flow Rate	1.0 ml/min	1.0 ml/min
Wavelength	378 nm	370 nm
Temperature	35 °C	35° C
Column	C18 (4.6x250 mm,5µm)	C18(4.6x250 mm,5µm)
Retention Time	11.80 min	4.59 min

Anti-diabetic activity

α -amylase test

Algae sample was taken in various concentrations at 20, 40µl, 60µl, 80µl, 100µl and control in test tubes 250µl of α -amylase is added in each in each test tube and mixed. Each test tube was incubated at room temperature. Then 500µl of starch was added and incubated for 3 minutes at room temperature. 500 µl of DNS was added and kept at water bath at 50°C for 5 minutes. The Antidiabetic activity was read at 540nm in UV Spectrophotometer.

Table 3. Anti-diabetic activity of *Sargassum wightii*.

Concentration(mg/ml)	OD value	Anti-diabetic activity%
control	0.169	0
20µl	0.176	4.142
40µl	0.188	11.24
60µl	0.189	11.83
80µl	0.21	24.26
100µl	0.262	55.02

Conclusions

Brown seaweed *S.wightii*, which is prevalent in the Indian Ocean and because of their unfavorable environments, they have a natural defense system. This study shows the metabolite profiling and characterization of the bioactive compounds in *S. wightii*, which can be further investigated and isolated to be used in the production of pharmaceuticals and functional food supplements to treat a variety of diseases like hypertension, diabetes, and inflammatory disorders, opening new algal industry opportunities for this seaweed globally.

The present study demonstrated that *S.wightii* has rich source of secondary metabolites. These findings recommended that *S.wightii* could be a potential source of natural antioxidant having great importance as a therapeutic agent and preventing oxidative stress related degenerative diseases. Further purification, identification and characterization of the active compounds would be our priority in future studies.

The several *S.wightii* extracts went through to a preliminary phytochemical screening in the current investigation, and the results revealed the presence of alkaloids, flavonoids, phenolic compounds, steroids, tannins, glycosides, and proteins in the extracts. These exploratory phytochemical tests have identified active substances with medicinal potential action. The yield of total phenolic content, total flavonoids, and total tannins from *S.wightii* are affected by the extraction solvents. Thus, these seaweeds might be harvested and effectively used in the production of goods for the benefit of mankind. The present study investigated the phytochemical profile and anti-diabetic potential of *Sargassum wightii* using FT-IR spectroscopy, HPLC analysis, and in vitro assays. The results demonstrate that *Sargassum wightii* extracts possess significant anti-diabetic activity, attributed to the presence of bioactive compounds such as fucosterol, sargachromanol, and other polyphenolic compounds. These findings suggest that *Sargassum wightii* may be a valuable source of natural anti-diabetic agents.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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