Economic and Medicinal Importance of *Ulva* sps. – An Overview

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Abstract: *The "green growth" is the most different gathering of green growth, with in excess of 7000 species filling in an assortment of territories. Kelps are the lone hotspot for agar and algin and their utilization as food, manure and feed is notable in numerous pieces of the world. Marine characteristic items have been the focal point of disclosure for new results of substance and pharmacological interest. The marine climate is a rich wellspring of both organic and substance variety. This variety has been the wellspring of interesting substance compounds with the potential for modern advancement as drugs, beauty care products, wholesome enhancements, subatomic tests fine synthetics and agrochemicals. As of late countless novel metabolites with powerful pharmacological properties have been found from the marine world. This review will focus on the economical and medicinal importance and phytochemical characteristics of Ulva sps. Also, the Ulva species is used as a traditional medicine for antibacterial, antifungal, goiter, gout, scrofula, burns, and antiulcer activity was also explored.*

Keywords: ***Ulva species*****, Antibacterial, Antifungal, Pharmacological Characteristics.**

1. Introduction

Drug market is increasing rapidly and continuously, nevertheless the demand for new pharmaceutical products disclosure is supported. The earth-bound assets have been extensively investigated, and as a result, the academia and research scientists are aiming to extract useful medicines from sea origins. [1]. A well-known technique in new drug discovery is to employ the native or local common knowledge to discover novel medications to treat various diseases. Marine algae have acquired strategy to enhance the grow in a challenging habitat, leading to substantial amount of diverse in metabolic pathways. In the recent past, the marine algal species are used as possible source of new biochemically active chemicals, notably with anticancerous, antiviral, antimalerial, antitumoral and antimicrobial activity according to recent developments in therapeutic development from natural sources [2]. Among the various marine algal species, the *Ulva* is gathering of palatable green growth that are broadly disseminated along the coasts of the world's seas and they have a fascinating synthetic structure that makes their business abuse appealing to deliver useful or wellbeing advancing food. The palatable ocean growth has found to have high healthy benefit as they are the rich wellsprings of carbs, minerals, proteins, shades, and nutrients [3 – 5]. Ocean growth are for the most part wealthy in phytochemicals with antiviral [6], antioxidant [7], antifungal [8], antibacterial [9], antitumor [10], antihypertensive [11], antihyperlipidemic [12], and antiproliferative activities [13]. Generally, the phytochemicals in kelp have a place with the synthetic classes including brominated phenols, oxygen heterocyclics, nitrogen heterocyclics, sulfur-nitrogen heterocyclics, sterols, terpenoids, polysaccharides, peptides, proteins, halogenated ketone, alkanes, and cyclic polysulfides [14]. According to the information from algae base, *U. reticulata* is discovered to be broadly conveyed in Indo-west Pacific area, South east

Asia, Southwest Asia, Northern Pacific Ocean, and Eastern and Western Indian Ocean. In South India, beach front lines of Tamil Nadu, especially Gulf of Mannar, Rameshwaram to Kanyakumari, are exceptionally focused with *U. reticulata* [15].

1.1 The taxonomic classification of this green seaweed is as follows

Taxonomic classification

Domain	:	Eukaryota
Kingdom	:	Plantae
Phylum	:	Chlorophyta
Class	:	Chlorophyceae
Order	:	Ulvales
Family	:	Ulvaceae
Genus	:	*Ulva*
Species	:	*Reticulate*

Figure 1. Seaweed of *Ulva reticulata*

1.2. Habitat, Morphology and Anatomy

Like other marine algal and *Ulva* species, *U. reticulata* prefers to grow on hard surfaces. After fertilisation, the spores or zygotes adhere to favorable substrates such as rocks, coral rubbles, or even the backs of marine turtles, mollusk shells, and crab carapaces, where they may be taken wherever these species move. The matured thalli are easily removed by water movement and become free floating stalks, or loosely entangled with other higher plants seagrasses and seaweeds. The Ulva variety belongs to the Ulvales order, which includes morphologically factor frames with a daily life history that includes the choice of isomorphic ages such as haploid gametophyte and diploid sporophyte. *Ulva spp* can fill strangely in microbes free culture however create typical morphology within the sight of their bacterial verdures[16]. The ocean growth is appended to a base for the duration of its life by hold quick, holdfast is a circle shaped from essential cells of prolonged, smaller and solid nature; the thallus is an extended sheet, two layered in thickness it is a net like, light green in shading and smooth fragile in surface; it is level with various lacunae. The diameter of lacunae

ranges form 0.4 to 7.0cm. The Ulva thallus grows parallel to the substratum and grows up to 62.4cm to 187.2cm in length and 10 to 20 cm in width; the layers of the cells dilate in some parts of the thallus and function as an air bladder; the marginal cell walls are irregularly placed polygonal in shape, arranged with their long axis at right angle to the surface of the thallus ranging from 12.4-18.6u to 24.8-27.9u; the thallus grows in elongated marginal strands These marginal strands give the air bladdeer extra strength and prevent it from bursting frequently; in the T.S of the thallus, the two layers layers of cells separated by a cavity are equal in height, with cells taller than the broad; the cells are arranged in two layers with distinct vesicular cavity; and are covered with a thick cuticle measuring 9.3 to 12.4u towards the surface; each cell condenses into a single cell often with deeply incised chloroplast is mostly located on the outer side of the cell while nucleus lies adjacent to the inner wall [17].

2. Economic Value *Ulva speices*

The expected advantage of *Ulva* as human food is identified for certain discoveries that show high calorific (2828-3725 cal/g) and protein subsance dependent on investigation in India and in Thailand, separately. In Japan, Philippines and Indonesia, Ulva is used as food as new serving of mixed greens or utilized as fixing in different food arrangements.

2.1. Animal feed, fodder and forage

Bait/Attractant

Fishmeal

Fodder/Animal feed

Forage

Invertebrate food

2.2. Fuels

Biofuels

2.3. Human food and beverage

Emergency (famine) food

Flour/Starch

Food additive

Spices and culinary herbs

Vegetable

2.4. Materials

Chemicals

Fertilizer

Green manure

Lipids

Pesticide

2.5. Medicinal, Pharmaceutical

Source of medicine/pharmaceutical [18]

3. Traditional Uses

These *Ulva* have been utilised as a source of food, feed, beautifiers, manure, and traditional medicine in a variety of countries from ancient times; in particular, it has been a staple meal in Southeast Asian countries. Ocean growth provides a rich source of largely various optional metabolites, such as terpenes, actogenins, alkaloids, and polyphenolics, as well as a vast variety of other compounds [19]. Many sea grown algals, produces a broad range of alternative metabolites, including terpenes, actogenins, alkaloids, and polyphenolics, with a high proportion of these mixtures being halogenated. Prophya was used by the Chinese and Japanese to prevent scurvy on extended travels, while chondrus has been used to heal various disorders such as, gastrointestinal concerns such as stomach throbes blockage and ulcers have been treated with chondrus, gracilaria and pteroclodra, these green growth produce phytocolloids [20].

4. Phytochemical screening

Reducing carbohydrates and proteins, which are the most important supplements, improved the quality of each concentration. Marine green growth is the main wellspring of sugars. The marine sugars show a wide range of modern, biomedical, and organic applications [21]. Marine large scale green growth is considered as a wellspring of bioactive mixtures as they can deliver an extraordinary assortment of optional metabolites. The *Ulva* are a gathering of consumable green growth that are broadly conveyed along the shorelines of the world's seas and they have a fascinating compound structure that makes their business abuse alluring to deliver utilitarian or wellbeing advancing food [22]. Ocean growth likewise contain a scope of remarkable phytochemicals not present in earthly plants. Accordingly, palatable kelp might be the lone significant dietary wellspring of a portion of these variables. A wide scope of studies has portrayed the high cell reinforcement limit of a scope of palatable kelp. Photochemical rich food varieties ought to plainly shape part of a sound adjusted eating routine. Be that as it may, the human body has various physiological, biochemical and enzymatic cycles by which it can battle oxidative pressure outside of dietary admission. The course by which the wide assortment of phenolic intensifies enters the flow isn't very much portrayed, nor is the bioavailability and half circulation of such factors in the human body. Past mediation examines where dietary cancer prevention agent admission has expanded have not proven an equal change in the absolute cell reinforcement limit of the body [23].

Table 1. Phytochemical screening and antimicrobial activities of *Ulva spe*

S.No	Algae sample used for extract	Solvent used	Phytochemical Constituents	
1.	*U. reticulata*	Methanol, ethanol, acetone, chloroform and petroleum ether	Phenolic compounds, Carbohydrates, Flavonoids, Glycosides, Alkaloids, Anthraquinones and Proteins	Phy Hea
2.	*U. reticulata* *U. lactuca* *U. fasciata*	Hexane, chloroform, ethylacetate, acetone and methanol	Terpenoids, Tannins, Cardiac glycosides and Phenolic compounds	Phy An
3.	*U. fasciata*	Methanol, hexane, chloroform, ethylacetate	Carbohydrates, Saponins, Tannins, Flavonoids, Anthocyonin, Terpenoids, Triterpenoids, Quinones, Coumarins, Phenol and Steroids	Phy
4.	*U. lactuca and U. reticulata*	Methanol and distilled water	Carbohydrates, Saponins, Gums and Mucillage, proteins	Phy An
5.	*U. lactuca*	Methanol	Alkaloids, Saponins, Flavonoids, Terpenoids, Cardiac glycosides	Phy Bio
6.	*U. reticulata* *U. lactuca* *U. fasciata*	Hexane, chloroform, ethyl acetate, acetone and methanol	Terpenoids, Tannins, Cardiac glycosides and Phenolic compounds	Phy An
7.	*U. lactuca*	Water, HCL, ethanol, ethyl acetate, methanol, chloroform, benzene, petroleum ether	Flavonoids, Glycosides, Phenolic compounds, Saponins, Steroids, Tannins, Carbohydrades, Proteins and Sugar	Phy An
8.	*U. lacuta*	Methanol	Flavonoids, Alkaloids, Steroids, Sapnonins and Phenols	Phy
9.	*Ulva sp.*	Aqueous, ethyl acetate (EtAc), and ethanol	Alkaloids, Amino acids, Flavanoids, Glycosides, Tannins, Saponins, Terpenes, and Reducing sugars	Phy An
10.	*U. intestinalis*	Methanol	Flavonoids, Terpenes and Polyphenolic compounds	Phy An
11.	*U. rigida*	Methanol	-	An
12.	*U. rigida*	Methanol, Acetone, Diethyl ether, and Ethanol	-	An
13.	*U. lactuca*	Chloroform	Poly unsaturated esters and Poly saturated alcohol	NM act
14.	*U. rigida*	Methanol	Oxypilins	An

5. Antibacterial and Antifungal Activity

Antibacterial activity of the *Ulva* was tried utilizing pathogenic microscopic organisms included *Salmonella typhi*, *Staphylococcus aureus, Escherichi coli, Pseudomonas aeruginosa, Vibrio cholerae, Vibrio parahaemolyticus, Bacillus cereus* and *Listeria monocytogenes* utilizing the agar dispersion strategy in Petri dishes. Table. 1, was shows the various *Ulva* species related to solvents used for extraction and methodology applied and antibacterial action, against various pathogenic bacterial strains against each bacterial strain was introduced the n-butanolic concentrate of the kelp powder of *U. reticulata* (25100 mg/ml) applied remarkable antibacterial movement against tried bacterial strains. The most extreme antibacterial movement was shown against *E.coli* and *B.cereus* on the whole focuses [34]. The palmitic corrosive as the significant part of the all out unsaturated fats in *U. reticulata,* and expressed that these fats from marine green growth mayh assume a significant part in the arrangement of numerous other bioactive auxillary metabolites which show their natural antibacterial movement [35].

The antifungal exercises of chloroform and ethy acetic acid derivation concentrates of *U.reticulata* against the chose five yeast type organisms and three dermatophytic strains wee assessed and he action of ethyl acetic acid drivation separate were discovered to be most noteworthy action when contrasted with different concentrates [36].[37] announced the antifungal action of marine ocean growth conventrates of *U. reticulata* against *Aspergillus niger, A. flavus, A.fumigatus, Saccharomyves cervisiae, C.albicans* and *C.glabrata.* Recent past, many researchers paid attention towards the finidng new antifungal agents from the sea grown algal specices (Table. 2).

Table 2. Antifungal activities of *Ulva species*

S.No.	Algal Species	Sovent Used	Phytochemical/s	Tested Against	Analytical Method/s applied	Reference
1.	*U. lactuca* L.	Distilled water (DW, 2 mL), 95% ethanol (10 mL), and concentrated sulfuric acid (0.72 mL)	Water-soluble protein	*Alternaria solani, A.s clavatus, A. niger, A. flavus,* and *Fusarium oxysporum*	Disk diffusion, SDS-PAG and Far-UV CD scan	[38]
2.	*U. lactuca*	Hexane, Ethyl acetate, Chloroform and Methanol	High molecular weight hydrocarbons like cyclohexane, 1,2-benzendicarboxylic acid, hexane, dodecane and octane, stigmasterol, 15-hydroxyprogesterone, beta sitosterol and fucosterol	*Aspergillus niger (A. niger) and Penicillium janthinellum (P. janthinellum)*	Agar diffusion and GC-MS	[39]
3.	*U. lactuca Linn. U. fasciata Delile. and U. reticulata Forsk*	Hexane, Chloroform, Ethyl acetate, Acetone and Methanol	Phenolic compounds, cardiac glycosides,	*Candida albicans, C. krusei, C. guilliermondi, C. parapsilosis, C. tropicalis, C. glabarata, four dermatophytes viz., Trichophyton rubrum, T. mentagrophytes, Microsporum gypseum and Epidermophyton flocossum*	Agar disc diffusion method, minimum inhibitory concentration (MIC) and minimum fungicidal concentration (MFC)	[40]
4.	*U. reticulata And U. lactuca*	Methanol, Acetone, Chloroform, Hexane and Ethyl acetate	Cell-wall polysaccharides	*A. flavus* (MTCC1883), *A. niger* (MTCC4285), *A. fumigatus,* (MTCC4964), *S. cerevisiae* (MTCC2627), *Candida albicans* (MTCC7315) and *C. glabrata* (MTCC3983)	Disc diffusion and MIC	[41]
5.	*Ulva fasciata DELILE*	Methanol	Water-soluble cell wall polysaccharides (ulvans)	*Micrococcus luteus* (MIP 200401) and *C. albicans* (ATCC 14053)	Agar disc diffusion, FTIR and ^{1}H and ^{13}C-NMR	[42]

6.	*U. intestinalis U. lactuca*, *C. racemosa*, *U. linza* and *U. reticulate.*	Acetone, Ethanol, diethyl ether, Ethyl acetate, Methanol and Petroleum ether	Lipophilic, phenolic contents, phytohormones, amino acids, total soluble nitrogen and total reducing sugars	*A. flavus*, *A.fumigatus*, *A. niger, C. albicans* and *C. tropicalis*	Well-Cut Diffusion and MIC	[43]
7.	*U. intestinalis*	Methanol	Phlorotannins	*C. albicans* (ATCC 14053), *C. krusei* (ATCC 6258) and *C. parapsilosis* (ATCC 22019)	Disc diffusion, free radical scavenging activity and total phenolic contents	[44]
8.	*U. fasciata Delile, U. intestinalis and U. lactuca*	Ethanol	Alkaloids, flavonoids, tannins, steroids and saponins	*Geotricum candidum, A. clavatus, A. fumigatus, Rhizopus oryzae and Mucor circinelloides*	Well diffusion, MIC, HPLC and LC-MS	[45]
9.	*U. lactuca*	Methanol	Polyphenol, Tannic acid, Catechin, Quercetin and Gallic acid	*A. niger* (939N), *C. albicans* (ATCC 1024) and *Mucor ramaniannus* (NRRL 1829)	Agar diffusion and MIC	[46]
10.	*U. lactuca*	Ethanol, methanol:toluene (3:1), methanol, and phosphate buffered saline (PBS)	Lipid soluble extracts, unsaturated fatty acids, organic acids and phenol compounds	*C. albicans* (ATCC 90027)	Cross streaking method, modified agar well method, MIC, MBC and TLC	[47]
11.	*U. lactuca*	Methanol, diethylether, and chloroform	Phloroglucinol, eckol, and dieckol	*C. albicans*, and *Penicillium* sp.	Agar-diffusion and Total Phenolic Content (TPC)	[48]
12.	*U. lactuca*	Methanol, Ethanol, Methylene chloride, chloroform and hexane	Glycolipid, phenolic terpenoids, unsaturated-fatty acids and hydroxylated unsaturated-fatty acids	*F. solani, Rhizoctonia solani, Sclerotinia sclerotiorum, Alternaria solani, Phytophthora infestanse and Botrytis cinerea*	Radial growth technique and GC-MS	[49]
13.	*U. prolifera*	Ethanol and Petroleum ether	Sesquiterpene, terpene, diterpene, steroid, 1,2-benzene dicarboxylic acid, bis(2-ethylhexyl) ester and palmitic acid	*C. albicans, A. niger, Mucor species, and Paeciliomyces species*	Agar Well-Diffusion, MIC, MFC, GC–MS/MS and ELISA	[50]

6. Antioxidant and Antigoiterogenic activity

The invitro cancer prevention agent action of test compound was dictated by 2,2diphenyl-1-picrylhydrazyl (DPPH) examine huge impact on freee extremists which was well equivalent with standard medication Butylated Hydroxyl Toluene (BHT). It was found to apply a useful activity against peroxidases created by DPPH test technique with an IC50 of 43.93 at 10µg. Test compound gives agreeable cytoprotective impact by showing security against peroxidative changes by bestowing cell film solidness and includes improvement of the body safeguard system [51 - 52]. The antigoiterogenic impact of *Ulva reticulata* showed decline in thyroid organ weight treated gatherings showed decrease in thyroid organ weight contrasted and goiterogenic control rodents. Creatures treated with ethanolic concentrate of *Ulva reticulata* showed the segment contained ordinary dim earthy colored delicate tissue, dark white delicate tissue and standard follicle with colloid filled in their lumina. There was less cell flotsam and jetsam and no necrotic cells in the follicular lumina when contrasted and standard medication thyroxine [53].

7. Alcohol induced ulcer and Acute oral toxicity

Antiulcer movement of *Ulva reticulata* was controlled by liquor prompted ulcer. Stomach being the chief organ of ulcer, alcohol organization to the trial fasting creatures 24 hours brought about different levels of ulcers. Prevent the improvement of gastric ulcers since thr restraint of pepsin movement alone might be adequate to recuperate the ulcers and the results of stifiling corrosive discharge can be dodged. Proteolytic movement of pepsin as the essential attacker in gastric mucosal ulceration [54]. Organization of *Ulva reticulata* at a portion of 2000mg/kg body weight did not create any social irregularities in the creatures with the exception of sratching, exiitation, adjusted dread and animosity. As completely tries creatures endure, the oral LD50j of *U. reticulata* in mice was discovered to be 200mg/kg body weight [55].

8. CONCLUSION

Marine algae growth are known to create a wide assortment of bioactive auxiliary metabolites and a few mixtures have been gotten from them for imminent improvement of novel medications by the drug enterprises. The *Ulva* have for some time been utilized as food and as a customary clinical specialist to treat different contaminations and infections. Its use in siddha frame work as a mitigating, anticancer, antibacterial and antifungal specialist as medication particles having these properties are available in this plant drug. From the survey, it very well may be reasoned that the *Ulva species* could be valuable for the improvement of business drugs in near future.

Acknowledgements

(Research Article Communication No. DrNGPASC 2020-21 BS077)

This work was supported by grants from DBT-Star Scheme and DST-FIST Scheme. The authors are grateful to the Management, Principal, Deans, Head of the Department and Faculty members of Department of Biotechnology for rendering all great research facilities, infrastructures and support of this research.

REFERENCES

[1] *Umamaheswara RM, "The economic seaweeds of India",Bulletin of the Central Marine Fisheries Research Institute., **(1970)**.*

[2] *Gnanaprakasam Adaikala raj, Manivachagam Chandrasekaran, Sakthivel jegan and Venugopalan Venkatachalan, "Phytochemical analysis and antifungal activity of Ulva species from the kanniyakumari Gulf of Mannar, south coast india", European journal of biomedical and pharmaceutical sciences., vol. 4, no. 9, **(2017)**.*

[3] *Arasaki S, T and Arasaki, "Low Calories, High Nutrition: Vegetables from the Sea to Help you Look and Feel Better", Tokyo, Japan Publications, **(1983).***

[4] *Wolf MA, K. Sciuto, C. Andreoli and I Moro, "Ulva (Chlorophyta, Ulvales) biodiversity in the North Adriatic sea (Mediterranean, Italy): Cryptic species and new introductions",J Phycol., vol. 48, no. 15, **(2012)**, pp. 10-21.*

[5] *Kong F, Y. Mao, F. Cui, X. Zhang and Z. Gao, "Morphology and molecular identification of Ulva forming green tides in Qingdao China, J Ocean Univ China., vol. 10, no. 7, **(2011)**, pp. 3-9.*

[6] *Wang H, EV. Ooi, Ang PO Jr, "Antiviral activities of extracts from Hong Kong seaweeds",J Zhejiang Univ Sci B., vol. 9, no. 9, **(2008)**, pp. 69-76.*

[7] *Indu H and R. Seenivasan. "In vitro antioxidant activity of selected seaweeds from Southeast coast of India", Int J Pharm Pharm Sci., vol. 5, no.4, **(2013)**, pp. 74-84.*

[8] *Santhanam S, M. Aseer, S. Sugathan, S. Joseph, SK.George, NS, Kalimuthusamy, "Antimicrobial activity of seaweeds extracts against multiresistant pathogens",Anna Microbiol., vol. 58, **(2008)**, no. 5, pp. 35-41.*

[9] *Rao P and K. Parekh, "Antibacterial activity of Indian seaweed extracts",Bot Mar., vol. 24, **(2009)**, pp. 577-82.*

[10] *Noda H, H. Amano and K. Arashima, "Antitumor activity of marine algae", Hydrobiologia., **(1990)**, pp. 204-205.*

[11] *Faezah S, KIS. Khoo, SZ Hoe and SK Lam, "Antihypertensive effects of edible brown seaweeds in rats, "Int J Adv Appl Sci., vol. 3, **(2016)**, pp. 103-9.*

[12] *Yoon NY, HR. Kim, HY Chung, JS Choi, "Anti-hyperlipidemic effect of an edible brown algae, Ecklonia stolonifera, and its constituents on poloxamer 407-induced hyperlipidemic and cholesterol-fed rats",Arch Pharm Res., vol. 31, **(2008)**, pp. 1564-71.*

[13] *Afef D, L. Syrine, LM. Valerie, R. Jacques, B. Abderrahman, "Antiproliferative activity and phenolics of the Mediterranean seaweed Laurencia obusta", Ind Crops Prod., vol. 47, **(2013)**, pp. 252-5.*

[14] *Bhakuni DS, DS. Rawat, "Bioactive Marine Natural Products",1st ed. India, Anamya Publishers, **(2005).***

[15] *Guiry MD, GM. Guiry, "Algae Base",Galway: World-Wide Electronic Publication, National University of Ireland, **(2017)**.*

[16] *Provasoli L and IJ. Pintner, "Bacteria induced polymorphism in axenic laboratory strain of Ulva lactuca (Chlorophyceae)", Journal of phycology., vol. 16, **(1990)**, pp. 196-201.*

[17] *Nakanishi K, M. Nishijima, M. Nishimura, K. Kuwano and N. Saga, "Bacteria that induce morphogenesis in Ulva pertusa (Chlorophyta) grown under axenic conditions",Journal of Phycology., vol. 32, **(1996)**, pp. 479-482.*

[18] *Hong DD, HM Hien and PN Son, "Seaweed from Vietnam used forfunctionfood, medicine and biofertilizer",Journal of applied phycology., **(2007)**.*

[19] *Dhargalkar VK, N. Pereira, "Seaweed: Promising plant of the Millennium",Sci Cult., vol. 71, **(2007)**, pp. 60-6.*

[20] *Patia MP, SD. Sharma, L. Nayaka, CR. Panda, "Uses of seaweed and its application to Human welfare: A Review",Int J Pharm Pharm Sci., vol. 8, **(2016)**, pp. 12-20.*

[21] *Gomathi K and Anna Sheba L, "Phytochemical screening and heavy metal analysis of Ulva reticulata",Asian Journal of pharmaceutical and clinical research., vol. 11, no. 4, **(2018)**, pp. 84-88.*

[22] *Raj.M, Chandrasekaran G A, Jegan S and Venkatesalu V, "Phytochemical analysis and antifungal activity of Ulva species from the kanniyakumari Gulf of Mannar, South Coast India",Natural products an Indian Journal., vol.12, no. 3, **(2016)**, pp. 104.*

[23] *Indra V., Daisy A., Geetha S., Seetharaman S. and Selvamuthu B, "Phytochemical profiling of seaweeds collected from pulicat lake Coramandal coast of south India", World journal of pharmacy and pharmaceutical science., vol. 5, no. 7,* ***(2016)****, pp. 1292-1297.*

[24] *Sekaran Sridhar, Periasamy Mansuya, Pandurangan Aruna, Jebamalai Suresh Kumar and Sarangam Babu, "Antibacterial Activity and Qualitative Phytochemical Analysis of Selected Seaweeds from Gulf of Mannar Region",Journal of experimental sciences., vol. 1, no. 8,* ***(2010)****, pp. 23-24.*

[25] *Doaa A. Ghareeb, Dalia F. Abd Elmegeed, Muhammed Elsayed and Muhammad El-Saadani, "Phytochemical constituents and bioscreening activities of green algae (Ulva Lactuca)", vol. 2, no. 11,* ***(2014)****, pp. 373-378.*

[26] *Whankatte V R and Ambhore J S, "Phytochemical screening and Antioxidant activity of Ulva lactuca", International journal of current research., vol. 8, no. 9,* ***(2016)****, pp. 38265-38269.*

[27] *Shankhadarwar, S. D, "Phytochemical screening of marine algae Ulva lacuta (Linn.) and Enteromorpha intestinalis (Linn.)", J. Chem. Pharm. Res., vol. 9, no. 12,* ***(2015)****, pp. 419-423.*

[28] *Princely S and Dhanaraju M.D, "Assessment of Phytochemical Constituents, In-Vitro Antimicrobial and Antioxidant Potential of Ulva Extracts from Vishakhapatnam Coast", Asian J Pharm Clin Res., vol. 10, no. 8,* ***(2017)****, pp. 87-95.*

[29] *Ismet Berber, Cumhur Avşar, Hilal Koyuncu, "Antimicrobial and antioxidant activities of Cystoseira crinita Duby and Ulva intestinalis Linnaeus from the coastal region of Sinop, Turkey", Journal of Coastal Life Medicine., vol. 3, no. 6,* ***(2015)****, pp. 441-445.*

[30] *E. Taskin, M. Ozturk, E. Taskin and O. Kurt, "Antibacterial activities of some marine algae from the Aegean Sea (Turkey)", African Journal of Biotechnology., vol. 6, no. 24,* ***(2007)****, pp. 2746-2751.*

[31] *Inci TÜNEY, Bilge Hilal ÇADIRCI, Dilek ÜNAL, Atakan SUKATAR, "Antimicrobial Activities of the Extracts of Marine Algae from the Coast of Urla (‹zmir, Turkey)", Turk J Biol 30.,* ***(2006)****, pp. 171-175.*

[32] *K. Vallinayagam, R. Arumugam, R. Ragupathi Raja Kannan, G. Thirumaran and P. Anantharaman, "Antibacterial Activity of Some Selected Seaweeds from Pudumadam Coastal Regions", Global Journal of Pharmacology 3., vol. 1,* ***(2009)****, pp. 50-52.*

[33] *Del Val AG, Platas G, Basilio A, "Screening of antimicrobial activities in red, green and brown macro algae from Gran Canaria (Canary Islands, Spain)", Int Microbiol., vol. 1, no. 1,* ***(2001)****, pp. 35-40.*

[34] *Sundaram Ravikumar, Lawrance Anburajan and Balakrishnan Meena, "Antibacterial activity of Ulva reticulata from southwest coast of Kanyakumari, India",the Journal of Coastal Life Medicine.,* ***(2016)****.*

[35] *Al-Saif S S, N. Abdel-Raouf, H. A. El-Wazanani, and I. A. Aref, "Antibacterial substances from marine algae isolated from Jeddah coast of Red Sea Saudi Arabia",Saudi Journal of Biological Sciences.,* ***(2014)****, pp. 57-64.*

[36] *Gnanaprakasam Adaikala Raja, Manivachagam Chandrasekarana, Sakthivel Jegana and Venugopalan Venkatesalu, "Phytochemical Analysis and Antifungal Activity of Ulva Species from the Kanniyakumari", European Journal of Biomedical AND Pharmaceutical sciences.,* ***(2017)****.*

[37] *Kolanjinathan K and D. Stella, "Comparative Studies on Antimicrobial Activity of Ulva reticulata and Ulva lactuca against Human Pathogens", Int. J. Pharmace. Biol. Archi., vol. 2, no. 6,* ***(2011)****, no. 1738-1744.*

[38] *Krishnamoorthi R and Sivakumar SR, "Antifungal activity of seaweed Ulva lactuca l. Extracted crude protein against pathogenic fungi", Asian Journal of Pharmaceutical and Clinical Research., vol. 12, no. 3,* ***(2019)****, pp. 393-396.*

[39] *Megha Barot, Nirmal Kumar J.I, Rita N. Kumar, "Bioactive compounds and antifungal activity of three different seaweed species Ulva lactuca, Sargassum tenerrimum and Laurencia obtusa collected from Okha coast Western India", Journal of Coastal Life Medicine., vol. 4, no. 4,* ***(2016)****, pp. 284-289.*

[40] *Raj.M, Chandrasekaran G A, ,Jegan S and Venkatesalu V, "Phytochemical analysis and antifungal activity of Ulva species from the kanniyakumari Gulf of Mannar, South Coast India",Natural products an Indian Journal., vol. 12, no. 3,* ***(2016)****, pp. 104.*

[41] *Kolanjinathan K and D. Stella, "Comparative Studies on Antimicrobial Activity of Ulva reticulata and Ulva lactuca against Human Pathogens", Int. J. Pharmace. Biol. Archi., vol. 2, no. 6,* ***(2011)****, no. 1738-1744.*

[42] *Paulert, Roberta Júnior; Smania Stadnik, Marciel J.; Pizzolatti, Moacir G, "Antimicrobial properties of extracts from the green seaweed Ulva fasciata Delile against pathogenic bacteria and fungi", Algological Studies., vol. 123,* ***(2007)****, pp. 123 – 13.*

[43] *Sheikh, H., El-Naggar, A. and Al-Sobahi, D, "Evaluation of Antimycotic Activity of Extracts of Marine Algae Collected from Red Sea Coast, Jeddah, Saudi Arabia, "Journal of Biosciences and Medicines, vol. 6,* ***(2018)****, pp. 51-68.*

[44] *Ismet Berber, Cumhur Avşar, Hilal Koyuncu, "Antimicrobial and antioxidant activities of Cystoseira crinita Duby and Ulva intestinalis Linnaeus from the coastal region of Sinop", Turkey, Journal of Coastal Life Medicine., vol. 3, no. 6,* ***(2016)****, pp. 441-445.*

[45] *Abdel-Khaliq A., Hassan H. M., Mostafa E. Rateb , and Ola. Hammouda, Antimicrobial Activity of Three Satoko Ulva Species Collected from Some Egyptian Mediterranean Seashores, International Journal of Engineering Research and General Science. Vol. 2, 5,* ***(2014)*** *pp. 648-669.*

[46] *Saidani K., Bedjou F., Benabdesselam F. and Touati, Antifungal activity of methanolic extracts of four Algerian marine algae species, African Journal of Biotechnology Vol. 11(39),* ***(2012)****, pp. 9496-9500.*

[47] *Santhanam S, Aseer M, Sugathan S, Joseph S, George SK and Kalimuthusamy N, Antimicrobial activity of seaweeds extracts against multiresistant pathogens, Annals of Microbiology, Vol. 58 (3),* ***(2008)****, 535-541.*

[48] *Benattouche Zouaouia, and Bachir Raho Ghalem, The Phenolic Contents and Antimicrobial Activities of Some Marine Algae from the Mediterranean Sea (Algeria), Russian Journal of Marine Biology, 2017, Vol. 43, No. 6,* ***(2017),*** *pp. 491–495.*

[49] *Rasha E. Selim , Soad. M. Ahmed , Saad R. El-Zemity , Sami Sh. Ramses and Yasser T. A. Moustafa, Antifungal Activity and Seasonal Variation of Green Alga (Ulva lactuca) Extracts, Asian Journal of Agriculture and Food Sciences, Vol. 03 (05),* ***(2015)****, pp. 419-427.*

[50] *Suresh Mickymaray and Wael Alturaiki, Antifungal Efficacy of Marine Macroalgae against Fungal Isolates from Bronchial Asthmatic Cases, Molecules, 23 (11),* ***(2018)****, 3032.*

[51] *Gunji, "Effects of extracts from tropical seaweeds on 2, 2-Diphenyl 1- Picryl Hydrazyl (DPPH) radicals and Caco-2, cells treated with hydrogen peroxide"., vol. 50,* ***(2005)****, pp. 3862-3866.*

[52] *Kalivarathan D, "Pharmacological Evaluation of Marine Algae of Mandapam Coast: Ulva reticulate.,* ***(2017)****.*

[53] *Nariaki F, O. Hiroshi, M. Kunitoshi and T. Toru, "Changes in thyroid function during development of thyroid hyperplasia induced by kojic acid in F344 rats", Carcinogenesis., vol. 20, no. 8,* ***(1999)****, pp. 1567-1571.*

[54] *Liu X M, Zakaria W, R. Islam, A. Radhakrishnan, H. B. Ismail and A. Chen Chan, "Anti-inflammatory and anti-ulcer activity of Calligonum comosum in rats", Fitoterapia., vol. 72,* ***(2001)****, pp. 487- 491.*

[55] *Pattama Ratana-arporn, Anong Chirapart, "Nutritional Evaluation of Tropical Green Seaweeds Caulerpa lentillifera and Ulva reticulate", Kasetsart J., vol. 40, no. 75,* ***(2011)****, pp. 83.*