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An Abridged Review of Beneficial Potentials of a Brown Seaweed, *Padina tetrastromatica*, (Dictyotaceae)

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ABSTRACT

A good number of research articles were published so far for evaluating antioxidant, antibacterial, antimicrobial, antifungal, antidiabetics, antihyperlipidemic, acetylcholinesterase inhibitory activity and *in-vitro* cytotoxic activities in *Padina tetrastromatica*. Solvents are important for extracting potential compounds from natural sources. Frequency of solvents used for extraction is also portrayed and the results are discussed in this article. Methanol was the highest frequency as solvent for extraction purpose. DPPH method was found to be used mostly for the in vitro antioxidant activity evaluation purpose. From this demonstration, it was recognized that *Padina tetrastromatica* is an imperative target to find out novel therapeutic agents to combat life menacing illness.

INTRODUCTION

The marine environment offers an extremely rich resource for important compounds of novel and biologically active metabolites. It also represents a great challenge which requires inputs from various scientific areas to bring the marine chemical diversity up to its therapeutic potential. So far, many chemically unique compounds of marine origin, with different biological activities, have been isolated and a number of them are under investigation or being developed as new pharmaceuticals. In recent years, new sources of natural substances, such as marine macroalgae, have been explored. Marine algae or seaweeds are used in traditional medicine in many parts of the world. The production of inhibitory substances from seaweeds was noted as early as 1900. Since then numerous studies have been carried out to find novel compounds from marine algae of Phaeophyta (Figure No.1).

India has an extensive coastline along with several representations of marine algae. Few studies, however, have been done on the pharmacological potential of their bioactive secondary metabolites. Because these studies are particularly scarce for algae from the coast of Tamil Nadu, the present study focused on the *in-vitro* cytotoxic activity of marine algal species *Padina tetrastromatica*. This screening was intended to identify novel compound with cytotoxic activity for further isolation and identification of active compounds. This review was attempted to screen 16 research articles published during 1980 to till date on research works related to various activities and especially on cytotoxic activity in *Padina tetrastromatica*, towards their screening, isolation and characterization of potential compounds.

Figure No.1: Appearance of *Padina tetrastromatica* after collection

Table No.1: Solvent used for extraction purpose in *Padina tetrastromatica*

S. NO.	EXTRACTION METHOD	SOLVENT USED	REFERENCE
1	Maceration	**Methanol**	Rashmi, *et al* 2010.[2]
2	Maceration	Aqueous phosphate buffer	Johnsi Christobel, *et al* 2011.[3]
3	Soxhlet apparatus	Acetone, Chloroform, ethanol, ethyl acetate, **Methanol**	Pushparaj, *et al* 2013.[4]
4	Soxhlet apparatus	Chloroform, ethyl acetate, **Methanol**, Hexane	Sakthivel Jegan, *et al* 2018.[5]
5	Boiling	Distilled water	Rajeshkumar, *et al* 2016.[6]
6	Boiling	Distilled water	Kaithavelikkakatha, *et al* 2016.[7]
7	Successive extraction	Hexane, DCM, ethyl acetate, **Methanol**, acetone	Yin Yin Chia, *et al* 2015.[8]
8	Maceration	Chloroform, **Methanol**, Petroleum ether	John Peter Paul J, *et al* 2013.[9]
9	Soxhlet apparatus	Chloroform, **Methanol**, Peteroleum ether, water	Johnson M, *et al* 2014.[10]
10	Maceration	**Methanol**	Uma Maheshwari.M, *et al* 2017.[11]
11	Soxhlet apparatus	Chloroform, **Methanol**, Peteroleum ether, water	Divya Nair, *et al* 2019.[12]
12	Shaking water bath	**Methanol**	Kokilam, *et al* 2013.[13]
13	Soxhlet apparatus	Chloroform, Ethanol, Peteroleum ether	Subhash, *et al* 2016.[14]
14	Boiling	Distilled water	Manoj, *et al* 2013.[15]
15	Maceration	**Methanol**	Hajimehdipoor, *et al* 2017.[16]
16	Soxhlet apparatus	Ethanol	Radhika D, *et al* 2017.[17]

Table No. 2: Isolation and characterization of phytoconstituents from *Padina tetrastromatica*

S. NO.	ISOLATED COMPOUND	CATEGORY	CHARACTERIZATION	REFERENCE
1.	Fucoidan, Alginic acid, Glucan	Polysaccharides	NMR analysis, IR fingerprinting	Paramita Karmakar, *et al* 2010.[18]
2.	Fucoidan	Sulphated polysaccharides	UV-spectral analysis, HPLC fingerprinting	Shri Devi, *et al* 2016.[19]
3.	Phlorotannins	Tannin	TLC,HPLC,LC-MS	Divya Nair, *et al* 2019.[12]
4.	Ascophyllan	Sulphated polysaccharides	IR spectral analysis	Sulaiman Mohsin, *et al* 2013.[20]
5.	Alginic acid	Polysaccharides	None	Kokilam G, *et al* 2013.[13]

Table No. 3: Instrumentation Analysis in *Padina tetrastromatica*

S. NO.	INSTRUMENTATION ANALYSIS	COMPOUNDS	REFERENCE
1	UV spectral Analysis, HPLC Finger Printing	Screened the Spectral Peaks	John Peter Paul J, *et al* 2013.[9]
2	HPLC Fingerprinting, UV Spectral Analysis	Confirmed the presence of phenolic compound based on spectral peaks	Johnson M, *et al* 2014.[10]
3	LC-MS Profiling	Camptothecin, Ripazepam, Strophanthidin, Dodecanamide, Dimethystilbosterol.	Yin Yin Chia, *et al* 2014.[8]
4	GC-MS Analysis	Coumarin, Flavone, 7-Hydroxyflavone, Olenic acid, Methyl oleate	Uma Maheshwari.M, *et al* 2017.[11]

Table No.4: Phytochemical Screening and Estimation on *Padina tetrastromatica*

S.NO	PHYTOCHEMICAL SCREENING	PHYTOCHEMICAL ESTIMATION	REFERENCE
1	NONE	Protein, Carbohydrates, Lipids, Phenolic content, Flavonoid	Kokilam G, *et al* 2013.[13]
2	NONE	Phenolic content, Phlorotanin	Divya Nair, *et al* 2019.[12]
3	NONE	Flavonoid content	Y.Sarojini, *et al* 2012.[21]
4	NONE	Phenolic content, Flavonoid content	Yin Yin Chia, *et al* 2014.[8]
5	Alkaloid, Flavonoid, Phenolic compound, Terpenoid, Steroid	NONE	Uma Maheshwari.M, *et al* 2017.[11]
6	Alkaloid, Flavonoid, Phenolic compound, Diterpenoid, Steroid, Cardiac glycoside, Coumarin	NONE	Sakthivel Jegan, *et al* 2018.[5]
7	Flavonoid, Protein, Aminoacid, Tannin, Phenolic compounds	NONE	M.Ponnanikajamideen, *et al* 2014.[22]
8	Steroids, Triterpenoids, Reducing sugar, Phenolic content, Saponin, Xanthoprotein, Tannin, Flavonoid, Glycoside, Anthroquinone	NONE	Johnson M, *et al* 2014.[10]

Table No. 5: Pharmacological Activity on *Padina tetrastromatica*

S. NO.	ANTIMICROBIAL ACTIVITY	PATHOGENS USED	METHOD	REFERENCE
1	**Antibacterial Activity**	*Staphylococcus aureus, Streptococcus sp., Pesudomonas aeruginosa, E.coli, Micrococcus luteus, Proteus mirabilis, Vibrio alginolyticus, Vibrio fisheri, Vibrio harveyi and Klebsiella pneumoniae*	Agar Disc Diffusion Method	Johnsi Christobel, *et al* 2011.[3]
2	**Antimicrobial Activity**	gram positive bacterial strains (*Staphylococcus aureus, Bacillus subtilis, Lactobacillus acidophilus)* and gram negative bacterial strains (*Pseudomonas aeruginosa, Escherichia coli, Proteus mirabilis*)	Agar Disc Diffusion Method	Pushparaj, *et al* 2013.[4]
3	**Anti-MRSA ACTIVITY**	*Staphylococcus aureus*	Agar Disc Diffusion Method	Sakthivel Jegan, *et al* 2018.[5]
4	**Antibacterial Activity**	*Salmonella typhi, Vibrio cholera, Shigella flexneri* and *Pseudomonas aeruginosa*	Agar Disc Diffusion Method	Uma Maheshwari.M, *et al* 2017.[11]
5	**Antiviral Assay Virucidal Assay**	PFU	Well plate method	Paramita Karmakar, *et al* 2010.[18]
		Viral suspension	Test Tube method	
6	**Antibacterial Activity**	*E.coli, A.hydrophila*	Kirby-Bauer disc diffusion method	Kaithavelikkakatha, *et al* 2016.[7]
7	**Antifungal Activity**	*Aspergillus niger, Aspergillus flavus, Aspergillus fumigatus, Candida albicans, Fusarium sp*	Agar Disc Diffusion Method	Rajeshkumar, *et al* 2016.[6]
8	**Antibacterial Activity**	*Bacillus subtilis, Proteus sp, Streptococcus sp*	Agar Disc Diffusion Method	Ponnanikajamideen, *et al* 2014.[22]

S.No	PHARMACOLOGICAL ACTIVITY	PARAMETER INVOLVED	REFERENCE
9	**Anti-Inflammatory Activity**	Gelatin zymography	Divya Nair, *et al* 2019.[12]
10	**Anticoagulant Activity**	APTT ASSAY Prothrombin Time Hepairinoid Activity	Manoj, *et al* 2013.[15]
11	**Anticonvulsant Activity**	Maximal electroshock-induced convulsion Pentylenetetrazole-induced convulsion	Subhash, *et al* 2016.[14]
12	**Anti-Inflammatory Activity**	Carrageenan induced paw edema	Sulaiman Mohsin, *et al* 2011& 2013.[20]
13	**Antipyretic Activity**	Yeast induced pyrexia	Radhika, *et al* 2017.[17]

Table No.6: *In-vitro* cytotoxic Activity on *Padina tetrastromatica*

S. NO	CYTOTOXIC ACTIVITY	METHOD	CELL LINE USED IN THE STUDY		REFERENCE
1	**In Vitro Cytotoxic Assay**	Brine Shrimp Lethality Test	NONE		Rashmi, *et al* 2010.[2]
2	**Invitro Cytotoxic Assay**	Brine Shrimp Lethality Test	NONE		Aseer Manilal, *et al* 2016.[23]
3	**Cytotoxic Activity**	MTT ASSAY METHOD	184B5	Human breast cell line	Yin Yin Chia, *et al* 2015.[8]
			MCF-7	Human breast adenocarcinoma cell line	
4	**Cytotoxicity Evaluation Assay**	MTT ASSAY METHOD	A-549	Non-small cell lung carcinoma	Hajimehdipoor , *et al* 2017.[16]
			HT-29	Human colorectal adenocarcinoma	
			HepG-2	human hepatocellular carcinoma	
			MCF-7	Human breast adenocarcinoma cell line	
5	**Cytotoxic Assay**	MTT ASSAY METHOD	MCF-7	Human breast adenocarcinoma cell line	Clara Gnana Selvi, *et al* 2016.[24]

Table No.7: *In-vitro* antioxidant Activity on *Padina tetrastromatica*

S.NO	INVITRO ANTIOXIDANT ACTIVITY	ABSORBANCE nm	REFERENCE
1	DPPH ASSAY	517	Rashmi.C, *et al* 2010.[2]
	REDUCING POWER ASSAY	655	
	FERROUS ION CHEALATING ACTIVITY	562	
2	DPPH ASSAY	517	Yin Yin Chia, *et al* 2014.[8]
	SUPEROXIDE ANION RADICAL	560	
	NITRIC OXIDE SCAVENGING	540	
	HYDROXYL RADICAL SCAVENGING	550	
	SOD ASSAY	560	
	CATALASE ASSAY	340	
	GLUTATHIONE REDUCTASE	340	
3	DPPH ASSAY	517	Uma Maheshwari.M, *et al* 2017.[11]
	ABTS ASSAY	730	
	PHOSPHOMOLYDENUM ASSAY	695	
	FERRIC ION REDUCING POWER ASSAY	700	
4	DPPH ASSAY	517	Sulaiman Mohsin, *et al* 2013.[20]
	SUPEROXIDE RADICAL	560	
	HYDROXYL RADICAL SCAVENGING	520	
	REDUCING POWER ASSAY	700	
5	TOTAL ANTIOXIDANT ACTIVITY	695	Kokilam G, *et al* 2013.[13]
	DPPH ASSAY	517	
6	DPPH ASSAY	517	Divya Nair, *et al* 2019.[12]

CONCLUSION

The present study outlines that *Padina tetrastromatica* as natural brown algae with potential constituents that have been used in combating the threatening disease. Since numerous phytochemical screening has been done in this species in which Methanol is considered as most commonly used solvent for extraction purpose. The above mentioned seaweed has showed significant pharmacological activity in recent studies. However, the studies clearly

specify that compound responsible each activity should be undertaken, meanwhile most common isolation done in the above species is Polysaccharide but instrumental analysis reveals the presence of secondary metabolites like Flavonoid, Camptothecin, Coumarin but isolation of such metabolites yet to be screened in future. So that marine derived secondary metabolite from *Padina tetrastromatica* can be expected to combat with life threatening disease like Cancer, Diabetes.

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