

REVIEW

Phytochemical and Pharmacological Profile of Brown Marine Algae *Stoecheospermum marginatum*

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Abstract

Marine organisms are rich source of structurally new and biologically active metabolites. There have been many reports of macro algae-derived compounds that possess a broad range of biological functions, such as antibiotic, antiviral, antioxidant, antiinflammatory, cytotoxic, and antimitotic activities. Bioactive components have been revealed in many marine algae. Marine algal compounds are predominantly found with diverse functional groups and hence have different properties. Based on the above said concept, data mining was done on the brown marine algae *Stoecheospermum marginatum*, the studies such as microscopic evaluation, preliminary phytochemical analysis, antimicrobial activity, antioxidant activity, apoptosis studies via ROS induced mitochondrial mediated caspase dependent pathway in murine B16F10 melanoma cells and anticancer activity were reported. This review provides compiled data for the researchers for developing a novel lead compound from the brown algae *Stoecheospermum marginatum*.

Keywords: *Stoecheospermum marginatum*, brown marine algae, bioactive components, caspase.

Introduction

Marine algae are known as a potential source of bioactive substances. Marine polysaccharides such as agar alginates and carrageen obtained from seaweeds are used in pharmaceuticals as well as in food industries. *Stoecheospermum marginatum* is a brown marine algae found in Indian Ocean to Australian ocean. It is potentially utilized as human health food in salads, drugs, fresh meal in breeding form animals, manure for cultivation of vegetable and raw material for production of high percentage of alginic acid and mannitol. The genus *Stoechospermum* comprises 5 species namely *Stoechospermum maculatum*, *S. marginatum*, *S. patens*, *S. polypodioides* and *S. suhrii* (Pakyaw *et al.*, 2009). The review on *S. marginatum* gives a detailed data mining of updated information on its geographical distribution, pharmacognosy, phytochemistry and pharmacological studies.

Geographical distribution

Stoechospermum marginatum widely distributed from South Africa of the Indian Ocean to Australia of the Pacific Ocean. In India, it is available only in the coastal region of the Bay of Bengal (Pakyaw *et al.*, 2009).

Pharmacognostic studies

Morphological characters: The thallus of *S. marginatum* is flat, fairly thick and dichotomously branched. Each branch is notched at the apex (Kumaresan *et al.*, 2008).

Microscopic characters: The thallus of *S. marginatum* is flat and isolateral. A mature sporangium contains four tetraspores.

Fig. 1. *Stoechospermum marginatum*.



In *Stoechospermum marginatum*, at certain regions of the thallus, there are raised hemispherical sporangial bodies. The sporangia are deeply sunken in the ground tissue with a thin covering. Each sporangium contains numerous elongated, cylindrical spores. The spores have echinate surface and are darkly staining. In *Stoechospermum marginatum*, the epidermal layers distinct and cutinized. The epidermal cell is small, squarish, thick-walled and darkly staining. About 8 or 9 layers of homogeneous compact parenchyma cells are present between the epidermal layers. The stalk portion of the thallus contains wider epidermal layer with vertically elongated cells. In between the epidermal layer, there are about five layers of large horizontally elongated cells with undulate walls. The marginal part of the stalk is slight, thick and rounded (Kumaresan *et al.*, 2008).

Physico-chemical analysis: Physico-chemical analysis revealed presence of 92% w/w moisture content, 11.6% w/w of total ash, 1.7% w/w acid insoluble ash, 6.0% w/w sulphated ash, 2.62% w/w petroleum ether soluble extractive, 6.81% w/w of benzene soluble extractive, 11.32% w/w of chloroform soluble extractive, 16.95% w/w methanol soluble extractive and 19.27% w/w of water soluble extractive (Kumaresan *et al.*, 2008).

Phytochemical studies

Stoechospermum marginatum showed the presence of alkaloids, glycosides, tannins, saponins, triterpenoids, phenols, sterols, carbohydrates, proteins, fats, flavonoids and steroids reported from *S. marginatum* (Kumaresan *et al.*, 2008; Utpal *et al.*, 2012).

Essential oils: Octane, nonanone, hexadecanoic acids, sclarene, accidol acetate, manoyl oxide, ethyl octadecanoate, docosene, 2-keto-manoyl oxide, palustrol and 4-epi-abietol were reported from the methanolic and dichloromethane (1:1) extract of *S. marginatum* (Akbar and Khakpoor, 2012).

Phthalate ester: Dibutyl phthalate, phthalic acid bis (iso-octyl) ester and bis (iso-nonyl) phthalate were reported from the methylene chloride extract of brown algae *S. marginatum* (Wahiduiia and De Souza, 1995).

Spatane diterpenoids: Spatane diterpenoid, 5(R), 19-diacetoxy-15,18(R and S), dihydro spata-13, 16(E)-diene were reported from *S. marginatum* (Loka Reddy *et al.*, 2016).

Sulfated fucans: Sulfated fucans consists of a backbone of (1 → 4) and (1 → 3)-linked- α -L-fucopyranosyl residues reported from aqueous extract of *S. marginatum* (Utpal *et al.*, 2012).

Pharmacological studies

Cytotoxic activity: Ten spatane compounds isolated from *S. marginatum* were screened for cytotoxic activities against B16F10 cancer cell line with IC₅₀ values of 3.28, 3.45, 3.62 and 4.11 μ g/mL (Chinnababu *et al.*, 2015).

Apoptotic study: Spatane diterpenoid, 5(R), 19-diacetoxy-15,18(R and S), dihydro spata-13, 16(E)-diene isolated from *S. marginatum* were investigated for the apoptosis via ROS induced mitochondrial mediated caspase dependent pathway in murine B16F10 melanoma cells. The result showed morphological alterations, nuclear condensation and DNA fragmentation, which leads to cell growth inhibition in a concentration-dependent manner. Data indicated that it induces the generation of ROS, consequentially caused alteration in Bax/Bcl-2 ratio that disrupted the inner mitochondrial transmembrane potential resulting in Cytochrome c redistribution to the cytoplasm and activation of caspase-mediated apoptotic pathway. Flow cytometric analysis clearly indicated that the DDS inducing phosphatidyl serine externalization

and mediated "S-phase" arrest in cell cycle. In addition, results also found that it induced apoptosis through deregulating PI3K/AKT signaling pathway (Loka Reddy *et al.*, 2016).

Antiproliferative and angiostimulatory activity: The methanolic extract of *S. marginatum* is reported for its antiproliferative and angiostimulatory activity by using Rat-cornea assays (Rashmi *et al.*, 2014).

Anti-bacterial activity: Ethanolic extract of *S. marginatum* was investigated for antibacterial activity by agar well diffusion test using *Staphylococcus aureus* (PTCC 1113), *Staphylococcus epidermidis* (PTCC 1349), *Bacillus anthracis* (PTCC 1036), *Escherichia coli* (PTCC 1330) and *Pseudomonas aeruginosa* (PTCC 1310) (Akbar and Khakpoor, 2012), Klebsiella species and *Vibrio cholerae* (Rodrigue *et al.*, 2004), Salmonella and Enterococci (Kayalvizhi *et al.*, 2012).

Antifungal activity: *Stoechospermum marginatum* screened against the fungal pathogen *Aspergillus niger*, *Candida albicans*, *Penicillium*, *Aspergillus flavus* and *A. terreus* (Rodrigue *et al.*, 2004; Kayalvizhi *et al.*, 2012; Nirmal kumar *et al.*, 2014).

Antioxidant activities: The *in vitro* anti-oxidant activity *Stoechospermum marginatum* was investigated using DPPH hydrogen peroxide scavenging assay method. It is reported that the brown algae exhibited remarkable antioxidant properties by scavenging the free radicals (Akbar and Khakpoor, 2012).

Conclusion

The perception on brown marine algae *Stoechospermum marginatum* showed the presence of unique and novel phytomolecules. This review focused on the pharmacological activity on angiostimulatory, anticancer, antibacterial, antifungal and antioxidant properties. Hence, the future scientific research should be focused on the molecular mechanism based screening for revealing the novel lead molecules for future drug discovery from *S. marginatum*.

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