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Review Article

Medicinal Use of an A Brown Seaweed Ancient Algae *Sargassum Polycystum:* A Review

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Abstract:
Sargassum polycystum , a brown seaweed, contains various nutrients and bioactive compounds that have antioxidant and healing properties. Sargassum polycystum (sargassaceae) is a marine species found in large communities on rocks in lower intertial zone in relatively calm water. The medicinal algae is also called as Sargassum polycystum , HalimiumLasianthum and Sargaco in Portuguese. These are nutritious and rich source of bioactive compound such as vitamins, carotenoids, dietary fibers, protein and minerals. And also it contain biologically active compound like terpenoids, flavonoids, sterols, sulfated polysaccharides, polyphenols, sargaquinoic acids, sargachromenol, pheophytine when isolated using distillation processes. These isolated compounds exhibit different biological activities like analgesic, hepotoprotective property, Anti-bacterial and anti-microbial activity, Anti-diabetic activity, Antiwrinke activities and skin-whitening activity (cosmetic industry), neuroprotective, anticoagulant, antiviral activity etc,. Hence Sargassum polycystum have great potential to be used in pharmaceutical and nutraceutical areas. This review paper explores varies therapeutic potential and health benefits of Sargassum polycystum .

Keywords: Sargassum polycystum , Distinctive characteristics, Field identification, Life history and reproduction, pharmacological, phytochemical composition, antifouling, marine, methanol, nutritional uses.

Introduction:

Sargassum polycystum (sargassaceae) is a marine species found in the large communities on rocks in lower intertidal zones in relatively calm water. The erect branches have numerous spines on the stem. Leaves are lanceolate to oblong with serrations, and vesicles are spherical. The plants are 1-2m high.[1] Plants dark-brown, 20-30 cm in height with the basal portion forming a thick discoid holdfast; upper portion richly branched; axes of the plant rough due to presence of short processes; leaves about 2 cm long and 0.5 ram broad, becoming smaller upwards; margins of the leaves dentate and apex rounded; mid rib more or less conspicuous; vesicles small, spherical and 1-2 mm broad; receptacles somewhat spinulose and very much refined. It grows in all months of the year on rocks, stones and dead corals in the littoral and sub littoral regions. This alginophyte is available in exploitable quantities. It is used as raw material along with other species of *Sargassum* for the production of sodium alginate[2]. Recent study showed that athrogenic diet caused significant elevation in plasma cholesterol, triglyceride, LDL, serum MDA, NO, leptin and TNF-alpha levels while, it produced significant decline in plasma HDL and serum adiponectin levels compared with lean control rats. However, treatment of dyslipidemia rats with species of Sargassum methanolic extract induced significant improvement of plasma lipid profile, marked decrease in serum MDA, NO, leptin, TNF-alpha level in concomitant with remarkable increase in serum adiponectin level. These results indicated that species of Sargassum extract plays a vital role in ameliorating dyslipidaemia and its complications particularly oxidative stress and implication. This could be attributed to the hypolipidemic effect, antilipidperoxidative activity and antinflammatory property of species of *Sargassum* methanolic extract. [3]

Two third of the world is surrounded by sea with a huge of living things which bring a great profits for human being, among them are seaweed. Seaweed has been used in many aspects such as medicine,industry, food production, especially in agriculture. In agriculture many products of seaweed were used as foliar fertilizers to increase crop production. By bioassay test, many scientists have mentioned about the plant hormones and micro elements in side brown seaweed Ascophylum nodosum a Norwegian brown seaweed. Vietnam has a coast line about 3260 km, approximately 638 species of

seaweeds were determined, and *Sargassum polycystum* C.Ag (brown seaweed) is the greatest specicy and has proved its advantages in agriculture. *Sargassum polycystum* C.Ag seaweed extract has been applied and has helped to increase the farming productions, but there is no report about its mechanism effects on plants. The alkalined extract of *Sargassum polycystum* C.Ag was bioassayed for the presence of auxins, gibberellins and cytokinins-like substances. The result has proved in *Sargassum polycystunl* C.Ag: auxins-like presents in seaweed extract at the concentration 20 - 40 mg/l while cytokinins - like substances in 0.01 - 0.1 mg/l, but abscisic acid, gibberellin like substances do not detect in the sample.[4]

Field identification

Studies in Singapore on the *Sargassum polycystum* community is still in infancy with only one study conducted by Low , which found only a total of five species despite 41 recorded in literature and ten deposited in the local herbaria. The *Sargassum polycystum* species present in Singapore can be differentiated and identified using the figure guide below (Fig. 2).

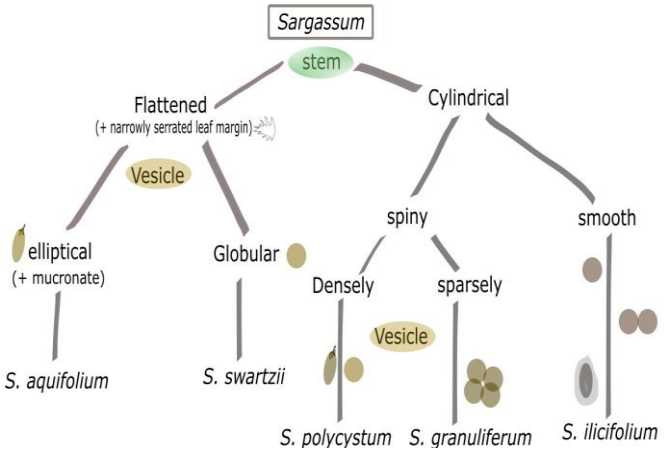
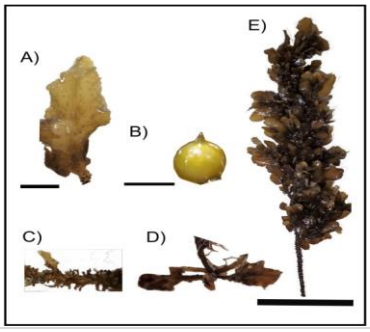


Fig.1. Morphological field guide for the identification of Singapore Sargassum species (Diagram by Yip Zhi Ting).

Distinctive characteristics

Sargassum polycystum exhibits distinct morphology of variable thallus size depending on the exposure of water currents [5.] They are distinguished from other species by their discodial or conical holdfast, muricated stems with "y" shaped spine-link protuberances, leaves linear to lanceolate or oblong with irregularly and finely serrated margins, percurrent midrib, spherical or ovoid vesicles (smooth or mucronated) (Fig. 3) [5]. Male and female receptacles (reproductive parts) are located on different plants (unisexual) [5.].



Classification:

Empire	: Eukaryota
Kingdom	: Chromista
Phylum	: Ochrophyta
Class	: Phaeophyceae
Subclass	: Fucophycidae
Order	: Fucales
Family	: Sargassaceae
Genus	: Sargassum

Fig.2.Morphology of the A) leaves, B) vesicles, C) stem, D) holdfast and E) thallus of Sargassum polycystum . Scale bar: thallus = 5 cm; leaves = 1 cm; vesicles = 2 mm. (Image by: Yip Zhi Ting)

Life history and reproduction

The macroalgae genus *Sargassum polycystum* adopts a heteromorphic life history (distinct sexual haploid and asexual diploid stages) and oogamous fertilisation (union of mobile male and immobile female gametes)[6]. Sargassum polycystum is a dioecious macroalgae (male and female gametangia are formed on different individuals) [6] and sexual reproduction involves the fusion of motile sperm cells and sessile egg cells of the oogonium [7]. The motile young germlings developed from the fertilized zygotes are released from the female receptacles which then begin their journey for the search of a suitable substrate to adhere onto (Fig. 3) [7].

Fig. 3. Life cycle of the macroalgae genus Sargassum (Nguyen, 2015).

Economic importance

General usage

Sargassum polycystum serves a multitude of purpose from its usage as fertilizer, human food (click on link for tasty and nutritious recipe!), agricultural feed (fodder) and medicine, to controlling heavy metal (Pb, Cd) pollution and biogas production as dense stands makes them a good biomass source [8] .

Therapeutic potential and pharmacological importance of Sargassum polycystum.

Antihepatotoxic potential:

1) B.Meena et all., (2008) were reported that ethanol extract of *Sargassum polycystum* on hepatic antioxidant status in D-galactosamine-induced hepatitis in rats. Prior to oral administration of *Sargassum polycystum* extract (125mg/kg body weight for 15 days) considerably ($P<0.05$) attenuated the D galactosamine induced increases in the level of diagnostic marker enzyme in plasma of experimental rats. It also demonstrated an antioxidant activity against D galactosamine induced hepatitis by inhibiting the stimulation of lipid peroxidation and by preserving the hepatic enzymatic and non-enzymatic antioxidant defense system at near normal. The antihepatotoxic potential of *Sargassum polycystum* might be

related to its antioxidant property and membrane stabilizing action.
Diagnostic marker enzyme [alanine aminotransgerase (ALT), aminotransferase (AST), lactate dehydrogenase (LDH), creatine phosphokinase (CPK) and lipid peroxides].[9]

2) J Anggadiredja et al., (1997)were reported that methanol extract of *Sargassum polycystum* showed antioxidant activity with fresh material then the dry form and the n-hexane extract of L.obtusa was more active than the diethylether and methanol extracts. [10]

3) M.Johnsonet al., (2019) were reported that chloroform extract of *Sargassum polycystum* was reported to produce highest phenols, acetone, petroleum ether, methanol respectively. The total phenols, flavonoids and alkaloids may be responsible for the antioxidant activities. [11]

4) Hanumantha Rao et al.,(2005) were reported that the oral administration of *Sargassum polycystum* on alcoholic extract showed significant diminution in the severity of toxic hepatitis in acetaminophen induced rats by maintaining the activities of tricarboxylic acid enzymes with concomitant improvement in the hepatic mitochondrial antiperoxidative status when compared with intoxicated animals. It was reported that the study indicated that the protective effects of *Sargassum polycystum* extract was may be due to the presence of some active compounds that where inhibitory against the free radicals generated during lipid peroxidation in acetaminophen induced toxic hepatitis. [12]

5) Ade Arsianti et al., (2020)were reported that phytochemical composition and evaluation of Marine Algal SargassuPolycstum for Antioxidant activity and in-vitro cytotoxicity on Hela Cells (IC50 value of 38.3 µg/ mL), which is potential to be developed as a candidate for new anti-cervical cancer agents. Whereas ethylacetate extract of *Sargassum polycystum* with IC50 value of 298.32 µg/mL on DPPH free radical, is potential to be developed as a natural antioxidant. [13]

Anti-bacterial and anti-microbial activity:

1) PeriyakaliSaravanaBhavan et al., 2018were suggested that the study was conducted to explore the phytochemicals and the antibacterial activity of the marine alga *Sargassum polycystum* . The preliminary screening for phytochemicals showed the presence of tannins, polyphenols, saponins, cardiac glycosides and quinones.
Among these bioactive compound, 3 compounds (1,2benzenedicarboxylicdibutylester and 13, docosenamide of ethanolic extract and 3,5 diaminodeoxymethoxy of methanolic extract, showed the binding affinity and ability to react with exotoxin-A of pseudomonas aeruginosa, a common pathogenic bacterium of fishes and prawns. The in vitro antibacterial assays revealed that both ethanolic and methanolic extracts of S.polycystem possessed the ability to inhibit the growth of P.aeruginosa. Therefore, aquaculture medicine could be prepared with S.polycystem.[14]

2) Chong Chiao et al, (2011)were used seaweeds in pharmaceutical and biochemical application as they posses biological activities which contributes to the discovery of natural therapeutic agents. *Sargassum polycystum* was examined using disc diffusion and broth microdilution methods. The bioactivity of the seaweed extracts was expressed as minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). Gram positive bacteria especially B cereus was more susceptible to the seaweed extracts (MIC= 0.0130 to 0.065 mg/ml). Generally *Sargassum polycystum* extracts exhibited higher bacteriostatic activity against all the tested bacterial strains when compared with P.australis. n-hexane extracts of S.polycystum exhibited promising bacteriostactic agents against B.cereus (MIC= 0.065 mg/ml) with MIC value lower than the standard MIC of potential antimicrobial drug (0.100 mg/ml).[15]

3) Jonathan MallillinBolanos et al., (2017) were investigated that the antibacterial and anti-fungal activities of four species Sargassum namely: S.polycystum, S.oligocystum, S.crassifolium and S.cristaefolium collected along the coastal areas of Diora-Zinungan Sta. Ana Cagayan, Philippines. The powdered extract of seaweeds were prepared using sequential extraction with different organic solvents in order to increasing fractions (ethanol, n-hexane, dichloronmethane ethyl acetate and aqueous) were examined for antimicrobial activity by using disc diffusion assay on 13 strains of aquaculture pathogens. The n-hexane, dichloromethane, ethyl acetate extracts displayed different antimicrobial activity against different aquaculture pathogenic bacteria and fungi whereas ethanoic extracts showed higher antimicrobial activity than aqueous extracts. The Sargassum species showed a significant antimicrobial activity against Gram-positive and gram negative as well as the fungus. Researcher reported that the among the tested brown seaweeds, *Sargassum polycystum* showed better antimicrobial activity that has potentially used as antimicrobial agent and as natural immunostimulant with aquaculture industry for the treatment of microbial diseases and improvement of the health status of commercially important aquaculture species.[16]

4) Subramanian palanisamy et al., (2019) were reported that therapeutically potential of fucoidan fraction-2 (Fu-F2) isolated from *Sargassum polycystum* was evaluated for the development of antibacterial against the human and animal pathogenic bacteria by in vitrso and in vivo analysis. The Fu-F2 contained 51.12 + 0.86 % of total sugar and 20.41 + 0.91 % of sulfate. The structural characterization of Fu-F2 was performed by HPLC, FTIR and NMR analysis and reported inour earlier study. The in vitro antibacterial assay such as MIC,MBC, killing kinetics, disk diffusion, protein leakage, ROS and confocal laser scanning microscopy demonstrate that Fu-F2 possesses the highest antibacterial activity (21+ 1.0 mm). Was recorded at the concentration of 50microgm/ml against pseudomonas aeruginosa and the lowest activity (16 + 0.53mm) was registered against Staphylococcus aureus. In the in vivo analysis, the pretreatment group with Fu-F2 at the concentration of 15 mg/0.1 kg through feed exhibited the

highest survival (83.3%) and antioxidant activities (P< 0.05) than the fish infected with pathogen. Thus, the present findings suggest that the Fu-F2 of *Sargassum polycystum* encompasses significant antibacterial properties and that can be used as therapeutic agent for controlling the bacterial disease.[17]

5) vikiwulandari et al., (2019) were states that marine biofuling causes a lot of damage to the shipbuilding aquaculture in a industry because of the increasing maintenance costs. The main cause of this research was to measure the effectiveness of seaweed to inhibit bacterial biofilms and determine their inhibitory concentrations. In this study *Sargassum polycystum* and ulva reticulate was collected from Punaga cost, Takalar South Sulawesi, and extracted with the help of methanol to determine the potential of extract as antifouling. 50gm of seaweed was collected and extracted with 300ml of each solvent (:6 w/v) for three times maceration. Where *Sargassum polycystum* showed highest antibacterial activity by agar diffusion assay and shows inhibition zone range from 13.35 to 15.80 mm. [18]

6) P H Budi et al., (2019) werereported that Tilapia fillet is one of the fish product which is known as perishable food. The purpose of this study was to see te effect *Sargassum polycystum* ethanol extract in resisting the deterioration rate of tilapia fillet quality. The tilapia was given three treatment that was soaked with 1% S. Polycystum ethanol, positive control (washed with 10ppm chlorine water), and negative control (water) was then stored for 10days at temperature of 4° c. Result showed that the soaked tilapia fillets with S. Polycystum with ethanol extract was better than control with water. Treatment with *Sargassum polycystum* ethanol extract act as an antibacterial compound similar to the positive control, but better than the negative control. This can also be used in extending the shelf fish of tilapia fillets in low temperature by two days longer than negative control.[19]

7) Kandhasamy, M et al., (2008)were worked on the antibacterial activities of four vital marine algae, viz., Ulva lactuca, Sargassum wightii, Padinagymnospora and Gracilaria edulis were examined for the human bacterial pathogens, namely, Vibrio cholera, Staphylococcus aureus, Salmonella paratyphii, Shigelladysentriae, Pseudomonas aeruginosa, Shigellaboydii and Klebsiella pneumoniae. Hence reported Mthanol extracts of seaweeds exhibited broad spectrum of antibacterial activity.[20]

8)Moyano J. et al., (2006)were reported that in an early study reported that the antibacterial activity of methanol extract methanol extract of seaweeds inhibited the growth of S. aureus and B. subtilis (gram positive bacterium) [21]

9)Faulkner et al., (2001) and Blunt et al., (2012) were reported that the seaweeds were found to exhibit chemical compounds such as tannins, terpenoid, cardioglycosides, phlobatannins, steroids, saponnin, phenol, amino acids, and proteins. The presence of secondary metabolites in corroboration with earlier reports, it was included that for the brown seaweed, *Sargassum polycystum* has antibacterial potential. Thus, the marine algae are among the richest source of known novel bioactive compounds. [22,23]

10)Dharmautama M et al., (2019) weresuggested the effect of *Sargassum polycystum* extract in inhibiting the growth of Streptococcusmutans and Candida albicans which was used in denture cleaning preparations. The extraction were usingmacerated method with 96% methanol as solvent. Sargassum polysistum extract activity weretested with several concentration of 1,25 %, 2,5%, 5%, 7,5% and 10%. Streptococcus mutanswhich was incubated for 24 hours and Candida albicans for 48 hours. Control group were using sodiumperborate denture cleanser. *Sargassum polycystum* seaweeds extract showed antibacterial andantifungal activities with 2,5% minimal inhibitory concentration of Streptococcus mutans and 1,25%for Candida albicans. Sargassum polycystum extract inhibiti the growth of Streptococcus mutansand Candida albicans and can be developed into a denture cleanser.[24]

Antiwrinke activities and skin-whitening activity (cosmetic industry)

1)Fernando IS et al., (2018) were reported that algae have shown promising cosmetizing properties. Seaweed polysaccharides has received attention in bifunctional and physicochemical characteristics. The seaweed algae was collected from srilanka and evaluated their cosmetizing properties. Based on fourier transform spectroscopy infrared (FTIR) spectroscopy and monosaccharide composition analysis, the purified polysaccharides were rich in fucoidan, relatively high amount of sulfate content was found in both fucoidans. *Sargassum polycystum* showed,-diphenyl-1-picrylhydrazyl (DPPH) and alkyl radical –scavenging activities, antiflammatory effect on kipopolysaccharide stimulated RAW 264.7 macrophages, collagenase and elastase inhibitory properties and skin-whitening effects via direct inhibition of tyrosinase, and intracellular melanin synthesis indicating promising cosmetizing effects.[25]

Other uses:

1) Fernando IP et al.,(2020) were reported that Fucoidan was purified from *Sargassum polycystum* was induces Apoptosis through mitochondria-mediated pathway in HL-60 and MCF-7 cell.[26]

2) Sivaraj R et al.,(2015) were reported eco-friendly synthesis of gold nanoparticles (AUNPs) using the seaweed S.Polycystum C. Agardh extract, Biological synthesis for nanoparticle using plants. This synthesis was monitored by UV-Vis spectroscopy and was found to be complete within 30 mi. elemental gold was confirmed by different mapping method. Such as FT-IR spectroscopy, X-ray diffraction (CRD) and X-ray spectroscopy (EDX), scanning electron microscopy (SEM). The bio reduced AuNPs exhibited remarkably good anti-bacterial activity against pathogens specifically Pseudomonas aeruginosa (20mm) which is more susceptible.[27]

3)Bhuvaneswari s et al., (2013) were tried to evaluate the

presence of different bioactive constituents in the methanolic extract of Champiaparvula which could contribute to different biological activities in In vitro Antioxidant activity of marine red algae Chondrococcushornemanni and Spyridia fusiformis.[28]

4) Raghavendran HR et al., (2004) weresuggested the effect of pretreatment with hot water extract of marine brown alga *Sargassum polycystum* . (100 mg/kg body wt, orally for period of 15 days) on HCI-ethanol (150 mM of HCI-etha-nol mixture containing 0.15 N HCI in 70% v/v ethanol given orally) induced gastric mucosal injury in rats was examined with respect to lipid peroxides, antioxidant enzyme status, acid/ pepsin and glycoproteins in the gastric mucosa. His work suggested that the seaweed extract contains some anti-ulcer agents, which may maintain the volume/acidity of gastric juice and improve the gastric mucosa antioxidant defense system against HCL-ethanol induced gastric mucosal injury in rats. [29]

S.polycystum used against acne vulgaris:

1) Kok JM et al., (2016)were reported that during their research project the antioxidant and in vitro antibacterial properties of methanol fractions (F1-F2) obtained through column chromatography were studied. The mass spectrometry profile of F1 and F2 revealed chorophyll a and fucoxanthin as the major anti-acne constituents hence from the findings they suggest that the extract of *Sargassum polycystum* serve as promising source for topical application against acne vulgaris. [30]

S.polycystum used in cardiac activity:

1) S Abdillah et al., (2013) had worked on anti-aggregation activity of crude fucoidan of *Sargassum polycystum* . Platelet is one of the most important factors in blood clots formation. It plays a significant role in homeostasis process but in excess, it causes different cardiovascular diseases such as myocardial infraction, atherothrombosis disease, and coronary artery disease. Hence to reduce the occurrence of these diseases, anti-platelet agents can be used to prevent blood clots formation.

S Abdillah and group had conducted to test the antiplatelet activity of crude fucoidan from the brown seaweed on mice. The measurement parameter used included bleeding time coagulation time and decrease in plasma uptake by the addition of ADP as a platelet aggregation agent. The mice used were divided into 5 groups: normal control group (0.1 % Na-CMC suspension), positive control group (0.1 % Na-CMC suspension group), and the crude fucoidan doses of 50 mg, 100mg and 200mg. the results showed that the positive control and crude fucoidan with doses of 50m, 100mg and 200mg groups could prolong coagulation time bleeding time and also increase the decrease in plasma uptake after ADP addition. Significant difference were also observed with normal control but positive control of clopidogrel did not show any significant difference.[31]

Anti- stress activity of Sargassum polycystum :

1) Lailatussifa R et al., (2016) were tried to evaluate the anti-stress effect of polyphenol extract of *Sargassum polycystum* which was done by using a cold restraint animal stress model. S.polycystum extract were administered orally at dosages of 150 and 450 mg/kg. Diazepam, was used as a std drug at 0.18 mg/kg po .it was reported that both dosage shown good anti-stress effects. When cold restraint stress was applied to the animals an imbalance in levels of biochemical parameters was seen including glucose, trigllycerides, cholesterol, alkaline phosphatase, alanine aminotransferase and aspartate amino transferase. After administration of polyphenol extract of *Sargassum polycystum* near normalization was seen hence oral dosage of 150 and 145 mg/kg exerted anti-stress effects. [32]

On renal system:

1) Padmakumar et al., (1997) were tried to evaluate the effect of antibacterial activity of *Sargassum polycystum* . The antibacterial activities of acetone, ethanol and water extracts of *Sargassum polycystum* . Among three extracts, the acetone extracts of *Sargassum polycystum* showed maximum activity in Staphylococcus aureus (Fig.4) and minimum inhibitory activity showed against Escherichia coli. The antibacterial activities of the seaweeds have been reported in the literature attributing them to the presence of bioactive principles, such as tannins, flavonoids, terpenoids, cardioglycosides, phlobatannins, steroids, saponins and phenols. The maximum antibacterial activity was reported in the class Rhodophyceae (80%) followed by the Chlorophyceae (62.5%) and the Phaeophyceae (61.9%). [33]

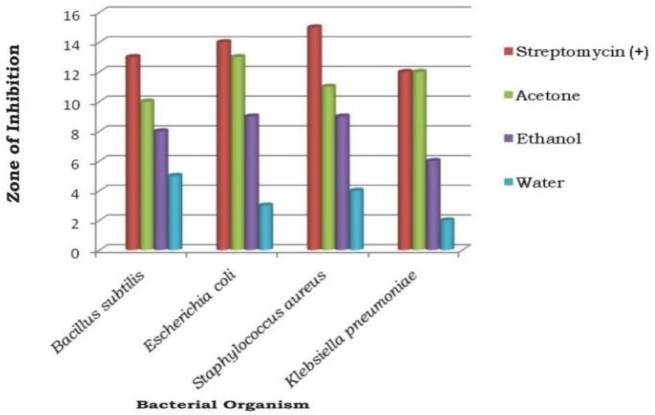


Fig.4. The acetone extracts of Sargassum polycystum showed maximum activity in Staphylococcus aureus.

Antidepresent / Anti- Stress Activity

1) RadiptaLailatussif et al., (2016) were tried to evaluate Anti-stress effects of polyphenol extracts of *Sargassum polycystum* were evaluated. Polyphenol extracts of *Sargassum polycystum* and diazepam were compared for anti-stress activities using a cold restraint animal stress model. *Sargassum polycystum* extracts were administered orally at dosages of 150 and 450 mg/kg. Diazepam, an anti-stress agent, was used as a standard drug at 0.18 mg/kg p.o. Both dosages of *S. polycystum* extracts showed good anti-stress effects. Due to cold restraint stress there was an imbalance in levels of biochemical parameters,

including glucose, triglycerides, cholesterol, alkaline phosphatase (ALP), alanine aminotransferase (ALT), and aspartate amino transferase (AST), which were near normalized following administration of *S. polycystum* extracts. Polyphenol extracts of S. polycystum at oral dosages of 150 and 450 mg/kg exerted anti-stress effects.[34]

Antidiabetic property of Sargassum polycystum:

1) MahsaMotshakeri et al.,(2013) were recited that the consumption of of either ethanoic or water extracts of *Sargassum polycystum* dose dependently reduced dyslipidaemia in type 2 diabetic rats. S. polycystum is a potential insulin sensitizer, for a comestible complementary therapy in the management of type 2 diabetes which can help reduce atherogenic risk. An experimental was conducted on both doses of alcohol extract of *Sargassum polycystum* and the 300 mg per kg water extract, which showed significantly reduced blood glucose and glycosylated haemolobin (HbA1C) levels. Serum total cholesterol, triglyceride levels and plasma atherogenic index were significantly decreased after 22 days treatment in all seaweed groups. Unlike metformin, *Sargassum polycystum* did not significantly change plasma insulin in the rats, but increased the response to insulin.[35]

2)Raghavendran HR et al., (2005)were aimed to eaxamine the protective effect of *Sargassum polycystum* against alcoholic exact which showed chages in liver michondrial enzyme against acetaminophen induced hepatitis in experimental rats. [36]

3) Ade Arsianti et al., (2020) confirmedtheir work and reported that ***Sargassum polycystum*** has promising natural antioxidant and anti-cervical cancer agants. The ***Sargassum polycystum*** was collected extracts were applied for thin TLC analysis, phytochemistry test, total phenolic and total flavonoid contents, as well as for antioxidant activity test by DPPH (2,2-diphenyl-1-picrylhydrazyl) method, and in vitro cytotoxicity evaluation on HeLa cells by MTT (3-[4,5-dimethylthiazol-2-yl]-2,5- diphenyltetrazolium bromide). Hence phytochemical analysis showed positive for metabolites of flavonoid, steroid, tannin and glycoside. TLC analysis revealed that *S. polycystum* extracts containing four phytochemical components. Ethylacetate extract of *S. polycystum* showed the highest total phenolic content, and exhibited greater antioxidant activity than ethanol extract. Total phenolic and total flavonoid content in ethylacetate extract are 548.61 µg/mL and 40.06 µg /mL, respectively. Ethylacetate extract of ***Sargassum polycystum*** with IC_{50} value of 298.3 µg/mL is assigned to have a weak antioxidant activity against DPPH free radical. [37]

4) Motshakeri M et al., (2014) were reported that all the treated diabetic groups revealed marked improvement in the histopathology of the pancreas compared with the control diabetic group. When two dietary doses of SP ethanolic and aqueous extracts on the pancreatic, hepatic, and renal morphology of type 2 diabetic rats (T2DM). T2DM was induced by feeding rats on high calorie diet followed by a low dose streptozotocin. After 22 days of treatment, the pathological lesions of the livers and kidneys in the diabetic rats were quantitatively and qualitatively alleviated ($p<0.05$) by both the SP extracts at 150 mg/kg body weight and by metformin.Oral administration of 300 mg/kg body weight of aqueous and ethanolic extracts of SP and metformin revealed pancreas protective or restorative effects. The seaweed extracts at 150 mg/kg body weight reduced the liver and kidney damages in the diabetic rats and may exert tissue repair or restoration of the pancreatic islets in experimentally induced diabetes to produce the beneficial homeostatic effects.[38]

5) Motshakeri M et al., (2013) were reported that the consumption of either ethanolic or water extracts of S. polycystum dose dependently reduced dyslipidaemia in type 2 diabetic rats. S. polycystum is a potential insulin sensitiser, for a comestible complementary therapy in the management of type 2 diabetes. Both doses of the alcohol extract of S. polycystum and the 300 mg kg−1 water extract, significantly reduced blood glucose and glycosylated haemoglobin (HbA1C) levels. Serum total cholesterol, triglyceride levels and plasma atherogenic index were significantly decreased after 22 days treatment in all seaweed groups. Unlike metformin, *Sargassum polycystum* did not significantly change plasma insulin in the rats, but increased the response to insulin.[39]

6) Firdaus M et al., (2021) were reported that the results showed the diabetic rat group suffered from hyperglycemia and diabetes symptoms. Treatment of ***Sargassum polycystum*** decocts on type 2 diabetes mellitus rats decreased blood sugar levels and improved diabetes symptom. However, the results were not as optimal as in diabetic animals treated with metformin. They concluded that ***Sargassum polycystum*** decoct can reduce hyperglycemia and diabetes symptoms in rats with type 2 diabetes mellitus.[40]

7) Awang AN et al., thisstudy was designed to investigate the anti-obesity properties of the Sabah brown seaweed, ***Sargassum polycystum***, on body weight and blood plasma levels of rats fed a high-fat diet supplemented with different doses of the seaweed powder. The Male Sprague Dawley rats were divided into five groups, representing control negative (CN) group, control positive (CP) group, low dosage group (LDG), medium dosage group (MDG) and high dosage group (HDG). The study duration was 8 weeks. All groups were fed high-fat diet throughout the study except for CN group, which was fed normal rat chow. LDG, MDG and HDG were supplemented high-fat diet with 2.5, 5.0 and 10.0 % seaweed powder, respectively. By comparing with the CP group, it was found that the HDG (10.0 % seaweed treatment diet) showed the greatest effect in suppressing weight gain, followed by the MDG (5.0 % seaweed treatment diet) and LDG (2.5 % seaweed treatment diet). The HDG decreased the levels of plasma total cholesterol and triglycerides. This finding shows that S. polycystum powder treatment had a positive effect on the inhibition of weight gain and has a promising value in preventing obesity.[41]

Anti-larvicidal Activity

Vinoth S et al., (2019) were reported Anti-larvicidal Activity of Silver Nanoparticles Synthesized from *Sargassum polycystum* Against Mosquito Vectors. Mosquitoes act as vectors of pathogens and parasites that cause dreadful diseases (malaria, dengue, chikungunya, yellow fever, lymphatic filariasis and Japanese encephalitis) in human beings. Synthetic chemical insecticides cause undesirable consequences in human beings and thus affect the ecosystem. Marine source based nanosynthesis has been reported as cheap and cost effective alternative for mosquito management. Hence developed an ecofriendly protocol for the synthesis of nanoparticles using seaweed extract. The synthesized nanoparticles were characterized using UV–visible spectroscopy, FTIR, SEM, EDAX and XRD. They found that the extract treated at 60 °C was found to be more effective in synthesizing the nanoparticles. SEM analysis revealed that the Sp-AgNPs were predominantly cubical in shape and size ranges from 20 to 88 nm. The three strong diffraction peaks were observed by XRD analysis and it confirmed the crystalline nature of silver nanoparticles. Synthesized Sp-AgNPs were tested against four mosquitoeslarvaes (An. stephensi, Ae. aegypti, Cx. quinquefasciatus and Cx. tritaeniorhynchus) and their mortality was examined. They found that Ae. aegyptihad shown higher mortality rate of about 80% and 90% after 48 h and 72 h of treatment with Sp-AgNPs and moderately toxic against Cx. quinquefasciatus larvae and it had shown maximum of 80% mortality rate at 72 h of treatment. The mosquito larvae An. stephensi and Cx. tritaeniorhynchus had shown less response compared to others tested. So we believe that, fabricated Sp-AgNPs will be the promising eco-friendly tool to control Ae. aegypti and Cx. quinquefasciatus vectors.[42]

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