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Research Article

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## A Study on Antioxidant and Antioxidant Activity of Selected Seaweeds from Hare Island of Tuticorin Coast

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**Abstract:** The high frequency of occurrence of degenerative diseases necessitates searching for a natural, cost effective resource enriched with antioxidant potentials. The present investigation was carried out in thirteen seaweeds abundantly distributed in Gulf of Mannar. The study revealed that total phenolic content was found to be more in *Spathoglossum asperum* (3.65 mg GAEs/g) followed by *Padina pavonia* (4.75 mg GAEs/g) and *Padina tetrastrromatica* (4.27 mg GAEs/g). Higher amount of flavonoid content was found in *Spathoglossum asperum*, *Padina pavonia* and *Padina tetrastrromatica*. Seaweeds such as *Hypnea musciformis*, *Padina tetrastrromatica*, *Acanthophora spicifera*, *Amphiroa anceps* were noted for their high proline content. Tannin content was high in *Padina tetrastrromatica* ( $63.77 \pm 3.01$  mg CE/g) *Spathoglossum asperum* ( $50.6 \pm 4.34$  mg CE/g) and *Caulerpa scalpelliformis* ( $50.20 \pm 3.01$  mg CE/g). Vitamin-C and vitamin-E content were high in *Stoechospermum marginatum*. Among the investigated seaweeds *Stoechospermum marginatum* (58.37%) showed more effective free radical scavenging activity.

**Keywords:** butylatedhydroxyanisol (BHA), phlorotannins, antioxidative, scavenging activity, defense systems

## INTRODUCTION

Seaweeds are considered as a source of bioactive compounds as they are able to produce a great variety of secondary metabolites characterized by a broad spectrum of biological activities. Compounds with antioxidant, antiviral, antifungal and antimicrobial activities have been detected in brown, red and green algae<sup>1-3</sup>. Antioxidant compounds play an important role against various diseases like chronic inflammation, cancer and cardiovascular disorders and ageing processes<sup>4</sup>, and thus have considerable commercial potential in medicine, food production and cosmetic industry. Antioxidants in biological systems have multiple functions, including defending against oxidative damage in the major signaling pathways of cells.

Several synthetic antioxidants, such as butylatedhydroxyanisol (BHA), butylatedhydroxytoluene (BHT), and tertbutylhydroquinone (TBHQ) are commercially available however; their use is now restricted due to their side effects<sup>5</sup>. These findings have reinforced the efforts for the development of alternative antioxidants from natural origin. Marine algae, like other photosynthesizing plants, are exposed to a combination of light and oxygen that leads to the formation of free radicals and other strong oxidizing agents. However, the absence of oxidative damage in the structural components of macroalgae like polyunsaturated fatty acids and their stability to oxidation during storage suggest that their cells have protective antioxidative defense systems<sup>6,7</sup>.

In fact, algae have protective enzymes (superoxide dismutase, peroxidase, glutathione reductase, catalase) and antioxidant molecules like phlorotannins, ascorbic acid, tocopherols, carotenoids, phospholipids, chlorophyll related compounds, bromophenols, catechins, mycosporine-like amino acids, polysaccharides, etc. which are similar to those of vascular plants<sup>8,9</sup>. Over the past decades, seaweeds extracts have been reported to possess biological activity of potential medicinal value<sup>10</sup>. Therefore, the present study aims to search and quantify natural and safe anti-oxidative agents from different seaweeds found along the coastal region of Hare Island.

## MATERIALS AND METHODS

Seaweeds such as *Ulvalatuka*, *Ulvareticulata*, *Caulerpascalpelliformis*, *Caulerparacemosa*, *Valoniopsisachynema*, *Padinatetrastromatica*, *Padinapavonia*, *Stoechospermummarginatum*, *Spathoglossumasperum*, *Gracilariacorticata*, *Amphiroaanceps*, *Acanthophoraspicifera*, and *Hypneamusciformis* were collected from Hare island, Thoothukudi during July 2012 and were washed using tap water several times in order to remove associated salts, sand and epiphytes. They were shade dried and then ground in a mixer grinder and the powder was stored until use.

Total phenol was measured following folin – ciocalteau method<sup>11</sup> and expressed as mg gallic acid equivalent per gram (mg GAE/g) DW. The total flavonoid content was quantified according to<sup>12</sup> and expressed as quercetin equivalents (QEs)/g. Total condensed tannin content was determined according to<sup>13</sup> and expressed as catechin equivalents (CE)/g extract. Total proline content was determined following the method of<sup>14</sup>. Total vitamin – C was estimated by<sup>15</sup> using ascorbic acid as standard and the values are expressed as mg/g DW. Tocopherol was estimated in the samples by Emmerie-Engel reaction<sup>16</sup>. The free radical scavenging activity was measured by 2, 2 -Diphenyl-1- picrylhydrazyl (DPPH) according to the method of<sup>17</sup> and ascorbic acid was used as positive control.

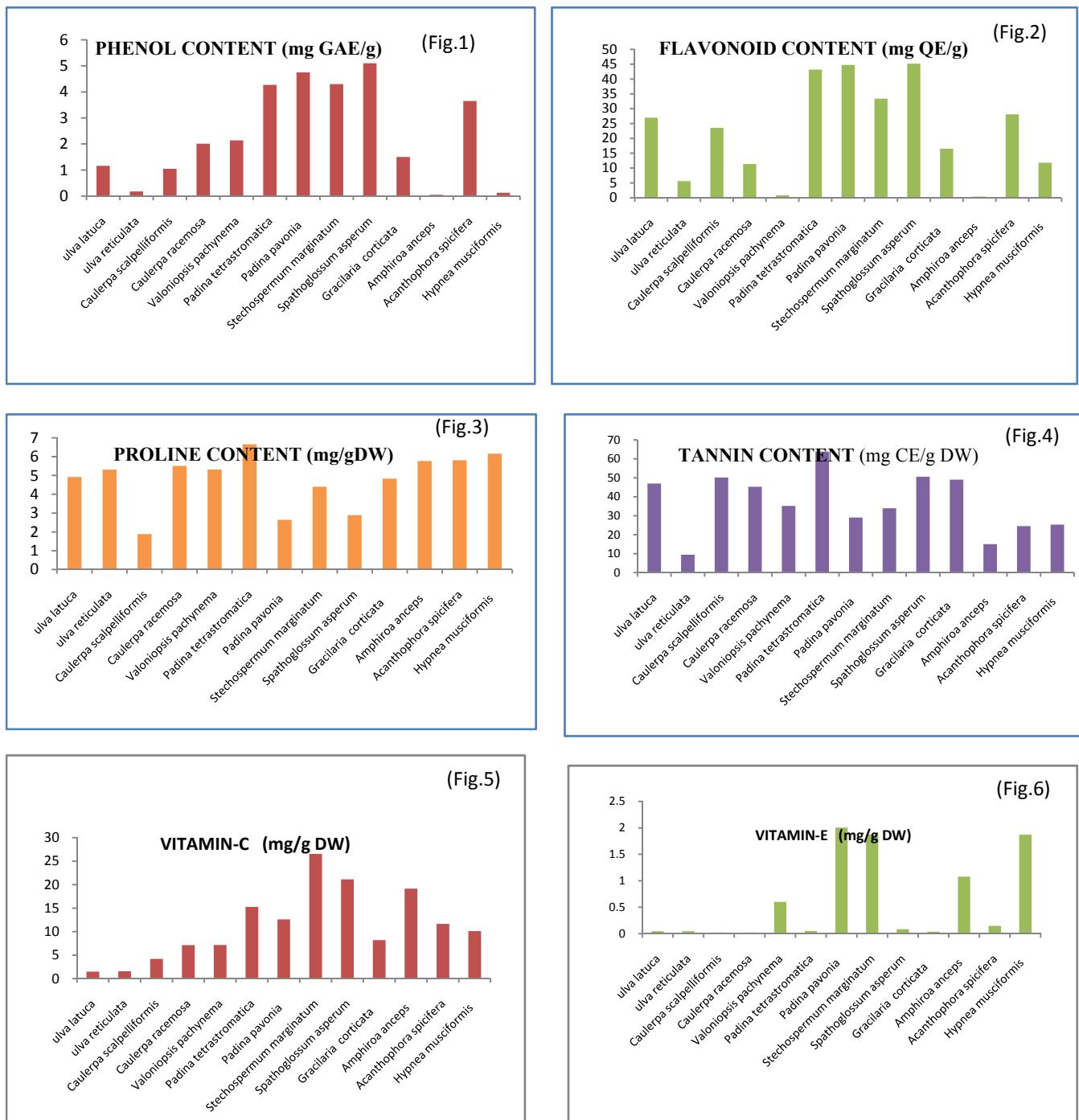
**Preparation of seaweed extract:** Crude extract was prepared under cold condition by mixing 100 ml of distilled water with 10g of each seaweed powder separately in the ratio of 10:1 (v/w). After 24 hours, of constant agitation the mixture was filtered through what man No.1 filter paper. Crude (aqueous) extracts of all the samples were further analysed for antioxidants and antioxidant activity.

## RESULT AND DISCUSSION

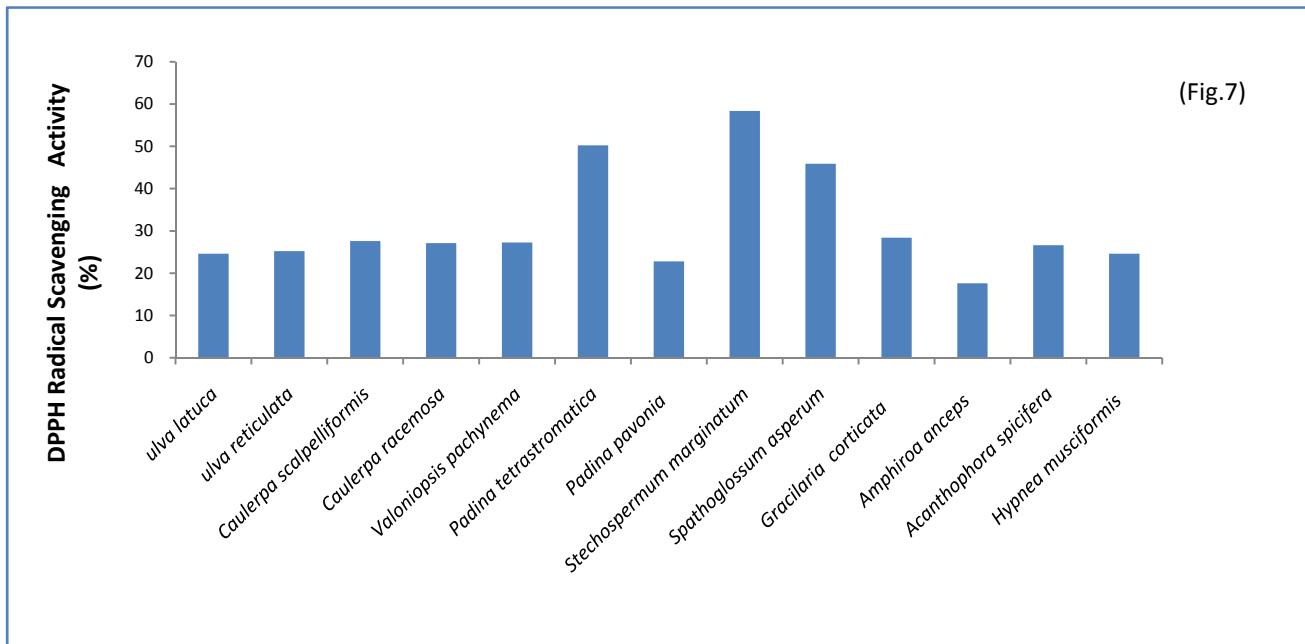
**Figure1 to 6** shows the phenol, flavonoid, proline, tannin, Vitamin C and Vitamin E content of thirteen seaweeds belonging to Chlorophyceae, Phaeophyceae and Rhodophyceae. Amount of phenol is ranged between (0.13-5.10 mg GAE/g) DW. Maximum amount of phenol was noted in *S. asperum*( $5.10 \pm 0.10$  mg GAE/g DW). Phenol level was low in *H. musciformis*( $0.13 \pm 0.02$  mg GAE /g DW). *S. asperum*, *P. pavonia* and *P. tetrastromatica* were also noted for high phenol level. Phenolic compounds act as free radical scavengers, reducing agents and metal chelators, and thus effectively inhibit lipid oxidation. <sup>18</sup> reported that phenolic compounds are one of the most effective antioxidants in brown algae. Amount of flavonoid varied between 0.83 - 45.20 mg QE/g DW. Highest amount was recorded in *S. asperum*( $45.20 \pm 0.01$  mg QE/g DW). *P. pavonia* ranked second in the flavonoid level. *V. pachynema* and *A. anceps* contained lowest amount of flavonoid when compared to other species. Flavonoids, the largest groups of phenolic compounds are known to contain a broad spectrum of chemical and biological activities including antioxidant and free radical scavenging properties<sup>19</sup>. Flavonoids include flavonols, flavones, catechins, proanthocyanidins, anthocyanidins and isoflavonoids<sup>20</sup>. Flavonoids are one of non-nutritive chemicals in seaweeds exhibit several biological effects such as anti-inflammatory, anti-hepatotoxic and anti-ulcer actions. Flavonoids have potent, anti-allergic, and anti-viral and have free radical scavenging abilities and also provide protection against cardio vascular mortality. They also exhibited anti-coagulant, anti-hyperlipidase, anti-nephritic, vasodilative effects and human immuno deficiency virus (HIV type 1 integrate inhibition). The study revealed that the amount of proline content was more in *P. tetrastromatica*( $6.66 \pm 1.28$  mg/g DW) and *H. musciformis*( $6.16 \pm 0.507$  mg/g DW) and less in *P. pavonia*( $2.6 \pm 0.081$  mg/g DW) and *C. scalpelliformis*( $1.88 \pm 0.665$  mg/g DW). The total tannin content was more in the *S. asperum* ( $50.6 \pm 7.88$  mg CE/g) and less in *U. reticulata*( $9.42 \pm 1.50$  mg CE/g). Among the green algae *C. scalpelliformis* showed higher tannin content ( $50.20 \pm 0.55$  mg CE/g). Tannin content was high in *P. pavonia* ( $29.05 \pm 2.45$  mg CE/g) < *S. marginatum*( $33.96 \pm 4.41$  mg CE/g) < *S. asperum* ( $50.6 \pm 7.88$  mg CE/g) < *P. tetrastromatica*( $63.77 \pm 3.96$  mg CE/g). Among the red algae *G. corticata* ( $49.01 \pm 5.24$  mg CE/g) had more tannin content than the other species studied. Phlorotannins are tannin compounds which have been found only in marine algae. Phlorotannins purified from several brown algae have been reported to possess strong antioxidant activity which may be associated with their unique molecular skeleton<sup>21</sup>. Phlorotannins from brown algae have up to eight interconnected rings. They are therefore more potent free radical scavenger than other polyphenols derived from terrestrial plants, including green tea catechins, which only have three to four rings<sup>22</sup>.

Vitamin C is non – enzymatic antioxidant necessary for regulating cell metabolism and growth. *P. tetrastromatica*, *S. asperum*, *S. marginatum* were noted for their high Vitamin C level. Higher concentration was recorded in most of the species of Phaeophyceae followed by Rhodophyceae and Chlorophyceae. Maximum amount of Vitamin C was estimated in Phaeophyceae ( $26.56 \pm 1.56$  mg/g DW), and less in Chlorophyceae ( $1.48 \pm 0.01$  mg/g DW). Among Rhodophyceae, the Vit- C content was higher in *A. anceps* ( $19.14 \pm 2.11$  mg/g DW) and lower in *G. corticata* ( $8.2 \pm 0.05$  mg/g DW). Among Chlorophyceae, it was found to be more in *V. pachynema*( $7.16 \pm 0.07$  mg/g DW) and less in *U. latusca*( $1.48 \pm 0.01$  mg/g DW). Higher Vitamin C content also reported in members of Phaeophyceae, Rhodophyceae and Chlorophyceae. Formulation of these algal species into palatable products containing intrinsic antioxidants protect from oxidative stress, and forming the first line of defense<sup>23</sup>. In the present study, the Vitamin E of seaweeds varied from 0.021 to 1.872 mg/g DW. Maximum vitamin E was noted in phaeophyceae, *S. marginatum* ( $1.872 \pm 0.331$  mg/g DW) followed by Rhodophyceae *H. musciformis* ( $1.871 \pm 1.235$  mg/g DW) and chlorophyceae *U. latusca* ( $0.047$  mg/g Dw). Present study revealed that brown seaweeds contain higher levels of vitamin E than green and

red seaweeds. Brown algae contain alpha, beta and gamma tocopherol while the green and red algae contain the alpha tocopherol. It was shown that the gamma and alpha tocopherols increase the production of nitric oxide and nitric oxide synthase activity and also play an important role in the prevention of cardio vascular disease<sup>24</sup>. Fig-7 indicated the DPPH radical scavenging activity. *S. marginatum*(58.37%) was found to have high infree radical scavenging activity. Although the algal extracts showed lower scavenging activity in the red algae *A. anceps*(17.6%). Among green algae *C. scalpelliformis* (27.58%) showed higher scavenging activity.



**Fig. 1- 6:** Total Phenol, Flavonoid, Proline, Tannin, vitamin C and Vitamin E level in different seaweeds of Hare Island, Gulf of Mannar



**Fig. 7:** Shows the DPPH scavenging activity of different seaweeds

## CONCLUSION

The results of the study indicated that *P. tetrastromatica*, *S. asperum*, *S. marginatum*, *P. pavonia* are endowed with high amount of antioxidants. These species could be processed suitably into acceptable form and consumed as natural antioxidants for prevention and protection from degenerative diseases.

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