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Biochemical and Nanotechnological Studies in Selected Seaweeds of Chennai Coast

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ABSTRACT

Three different seaweeds *Gracilaria corticata* J.Agardh ,*Grateloupia lithophila* Boergesen and *Chaetomorpha antennina*(Bory) kuetz used for the study were subjected for the estimation of carbohydrates, proteins, aminoacids, lipids and pigments such as chlorophyll a, chlorophyll b, carotenoid and phycobilins. They were also used for the nanoparticles synthesis and also checked for the blood glucose level changes by the oral administration of the seaweeds (0.5 g/day) to 6 mice for 20 days and with 3 mice as controls. The *chaetomorpha, grateloupia* and *gracilaria* estimation results showed 18.4%, 5.5%, 3.6% for carbohydrates, 15.8%, 30.5%, 23.7% for proteins, 4.9%, 22.94%, 11.04% for amino acids, 0.3%, 1.8%, 1.2% for lipids, 33.93, 1.35, 2.97 (mg/g fresh sample) for total chlorophyll, 0.2, 0.6, 5.49 (mg/g fresh sample) for carotenoid, 1.75, 2.1, 5.04 (µg/g fresh sample) for phycoerythrin respectively. They were also investigated for the extracellular biosynthesis of silver and gold nanoparticle and have achieved rapid formation of gold nanoparticles using *Chaetomorpha antennina* and *Gracilaria corticata*. It has been confirmed with the surface plasmon resonance peak at 537 and 541 nm respectively.

INTRODUCTION

Seaweeds which are also known as marine macro algae are a habitat of both marine and brackish water environment. They are found in the sub-tidal region deep up to where photosynthetic light of 0.01% prevails and also in the coastal region between high tide and low tide. As the first organism in marine food chain, seaweeds provide nutrients and energy for other living organisms (Cheong-xin chan et al., 2006). They also provide shelter and habitat for many coastal animals. Seaweeds have many direct uses. Seaweeds are traditionally consumed in different part of the world. Recently human consumption of green algae (5%), brown algae (66.5%) & red algae (33%) is high in Asia, mainly in Japan, China & Korea. In Asian countries, seaweeds are often consumed as marine vegetables (Marinho-Soriano et al., 2006).

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Japanese people are the main consumers with an average of 1.6 kg (dryweight) per year per capita (Joel fleurence, 1999). Seaweeds are traditionally used for the production of additives or meal for animal nutrition. Seaweed can be eaten by humans as food and are sources of useful industrial products such as phycocolloids: carrageenan, alginates and agar. Algal phycocolloids find use in the food industry as thickening and emulsifying agents. Some of the algae are used to prepare soil conditioner for horticulture. Other uses include medicine, animal feed, cosmetics, and fish bait (Semesi A.K, 2000). A number of research studies have been conducted to investigate these claims and other effects of seaweed on human health(Lewis J.R. 1964). Bimalendu Ray *et al*., 2002 have worked on the extraction of polysaccharides from *Gracilaria corticata*. They found cold extracted material consist of high molecular weight alkali liable sulphated galactans which exhibits antiviral against herpes simplex virus 1 and 2. Christine Dawezynski *et al*., 2007 reported that most of the edible seaweeds are found to contain all essential amino acid and red algal species are featured uniquely

with high concentration of taurine when compared to brown algal varieties. Sergio O. Lourenco *et al*., 2002 found lower percentage of both aspartic and glutamic acid in green algae when compared to brown and red algae. They also observed higher percentage of lysine and arginine in red algae and methionine in brown algae. Soriano *et al*., 2006 investigated the chemical composition of two tropical seaweeds seasonally and reported that the protein content of red algae *Gracilaria* spp. greater than the brown algae and furthermore they also found higher concentration of protein in red seaweed when compared with some higher plants.

The protein content of seaweed differs according to species. The protein content of brown seaweeds is low (3±15% of the dry weight) compared with that of the green or red seaweeds (10±47% of the dry weight) (Joel fleurence, 1999**).** Lipid extracts of some edible seaweed showed antioxidant activity and synergistic effect with the tocopherol (Le Tutour,1990). Narayan Bhaskar *et al*., 2004 investigated three red species of macro algae along Indian coast and reported that *Gracilaria* species were rich in glycolipids followed by neutral and phospholipids.

Algae of the genus *Gracilaria* as well as *Gracilariopsis* are of particular interest because they contain eicosanoids characteristic of higher plants and human and regarded as beneficial to health (Uki *et al*., 1986 and Orziah and Ching, 2002). Aguilera.J *et al*., 2002 investigated the content of photosynthetic pigments (chlorophyll a, biliproteins, carotenoids) and UV-absorbing mycosporine-like amino acids (MAAs), as well as the activity of reactive oxygen species scavenging enzymes in six macro algal species with respect to the seasonal changes of the solar radiation regime and the macronutrient levels in the seawater of the Kongsfjord and concluded that the seasonal changes in pigments may additionally be related to variations in nutrient levels in the seawater.

Nanotechnology involves synthesis of nanoparticles of size ranging from 1 to 100 nm which can be suitably manipulated for the desired applications. There have been impressive developments in the field of nanotechnology in the recent past, with numerous methodologies formulated to synthesize nanoparticles of particular shape and size depending on specific requirements. Nanoparticles and nanospheres have considerable utility as controlled drug delivery systems .When suitably encapsulated, a pharmaceutical can be delivered to the appropriate size, its concentration can be maintained at proper levels for long periods of time, and it can be prevented from undergoing premature degradation. Nanoparticles have the advantage that they are small enough that they can be injected into the circulatory system (Berkland *et al*., 2008). Singaravelu *et al*., 2002 reported the extracellular synthesis of monodisperse gold nanoparticle size of 8-12 nm using marine algae, *Sargassum wightii* in short duration and proved that the nanoparticle synthesized using marine algae found to be more stable in solution, an very important advantage over other biological methods.

The present study was carried out with three marine seaweed species namely *Chaetomorpha antennina* (Bory) Kuetz belonging to Cladophoraceae family, *Grateloupia lithophila* Boergesen and *Gracilaria corticata* J. Agardh belonging to family Rhodophyceae collected from covalam beach of Chennai coast, Tamil Nadu. Based on the above information the work was planned with the following objectives.(i) Study of biochemical parameters such as carbohydrate, protein, aminoacid, lipid in *Chaetomorpha antennina*, *Grateloupia lithophila* and *Gracilaria corticata* (ii) Analysis of pigments present in the three algal groups. (iii) Study of hyperglycemic effect of seaweeds in mice. (iv) Study of biosynthesis of silver and gold nanoparticle using seaweed species.

MATERIALS AND METHODS

Study Area

The study area of sample collection was covalam or covelong (Fig.1) beach of Chennai coast, situated on the south east coast of India. It lies about 20kms south to the Tamilnadu state capital, Chennai along the east coast.

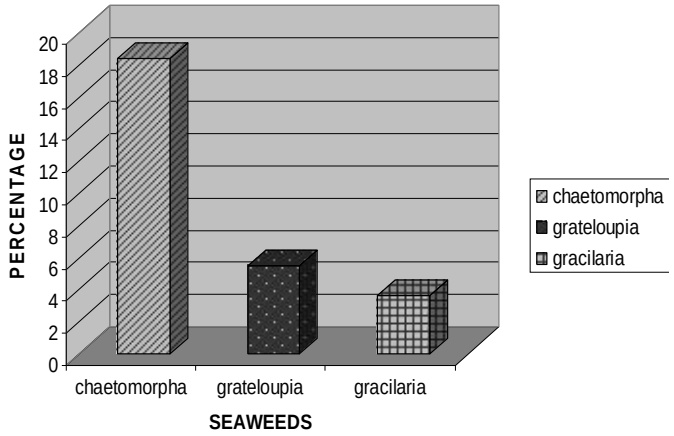

Fig. 1: Total carbohydrate content (% dry weight) of three seaweeds **(***Cheatomorpha antennina, Grateloupia lithophila* and *Gracilaria corticata)*

Collection of Sample

Three seaweed samples (i) *Chaetomorpha antennina (ii) Grateloupia lithophila (iii) Gracilaria corticata* were collected from covalam beach of Chennai coast during the month of December 2007. Samples were rinsed with sea water to remove debris and epiphytes. The entire epiphytes were removed using soft brush. In the laboratory, the seaweeds are once again washed in freshwater and shade dried. The dried seaweeds are finally pulverized in the commercial grinder and the powdered seaweed samples are used for further analysis.

Chemicals

All the chemicals used were of Analytical grade and were purchased from Hi-Media Laboratories Private Limited-Mumbai and Nice Chemicals Private Limited-Cochin.

BIOCHEMICAL STUDIES

Extraction and estimation of total Carbohydrates

The total carbohydrate content of the samples was determined by the method of Dubois *et al*., (1956). The Percentage of carbohydrate present in the sample is calculated as:

Percentage of carbohydrate =

$$\frac{\text{Standard value x OD of sample x vol. of extraction}}{\text{Weight of the sample x vol. of estimation extract}} \times 100$$

Extraction and estimation of Protein

Protein estimation was determined according to Lowry *et al.*, (1951) method. The Percentage of protein present in the sample is calculated as:

Percentage of protein=

$$\frac{\text{Standard value x OD of sample x vol. of extraction}}{\text{Weight of the sample x vol. of estimation extract}} \times 100$$

Extraction and estimation of total Amino acids

The total amino acid content of algal species was determined according to the method of Moore and Stein (1948). The procedure was followed for the standard amino acid (glycine) with the concentration ranging from 10µg to 100µg and the standard graph was prepared. The amount of total amino acids was expressed as percentage of dry weight equivalent to glycine.

$$\text{Percentage of lipid} = \frac{\text{Dry weight of filtrate}}{\text{Weight of the sample}} \times 100$$

Extraction and estimation of Lipids

The method developed by Folch *et al.*, (1957) was followed for total lipid determination of benthic algal species. The Percentage of lipids present in the sample is calculated as:

PIGMENTS

Extraction and estimation of Chlorophyll-a, b

Chlorophyll was estimated spectrophotometrically according to the method of Arnon(1949).

The level of chlorophyll 'a', 'b' and total chlorophyll was calculated using the following formula:

$$\text{Chlorophyll 'a'} = \frac{[12.7(A_{663})-2.69(A_{645})] \text{ x vol. of extraction}}{\text{Weight of the sample}}$$

$$\text{Chlorophyll 'b'} = \frac{[22.9(A_{645})-4.68(A_{663})] \text{ x vol. of extraction}}{\text{Weight of the sample}} \text{ mg/g}$$

$$\text{Total Chlorophyll} = \frac{[20.2(A_{645}) +8.02(A_{663})]\text{xvol. of extraction}}{\text{Weight of the sample}} \text{ mg/g}$$

Where A_{663} = absorbance at 663 nm

A_{645} =absorbance at 645nm

Extraction and estimation of Carotenoids

Carotenoids were extracted and estimated by the method of Ridley (1977). The level of carotenoids was estimated using the following formula and it is expressed as mg of carotenoids present in 1 gm of fresh tissue.

$$\text{Carotenoids} = \frac{4xA_{480}\text{xvol. of extraction}}{\text{Weight of the sample}} \text{ mg/g}$$

Where A_{480} = optical density at 480nm

4 = correction factor

Extraction and estimation of Phycobilins

Phycobilins were extracted and estimated by the method of Padgett and krogman (1987). The phycobilins pigments were calculated using the following formulae.

$$\text{Phycocyanin(PC)} = \frac{[(A_{615}) -0.474(A_{652})] \text{ x vol. of extraction}}{5.34 \text{ x Weight of the sample}} \text{ mg/g}$$

$$\text{Allophycocyanin(APC)} = \frac{[(A_{652}) -0.208(A_{615})] \text{ x vol. of extraction}}{5.09 \text{ x Weight of the sample}}$$

$$\text{Phycoerythrin(PE)} = \frac{[A_{562} -241(PC)-0.849(APC)] \text{ x vol. of extraction}}{9.62 \text{ x Weight of the sample}} \text{ mg/g}$$

Effect of seaweed in the blood sugar level of mice

Experimental Animal

The experiment was carried out with 9 male mice weighing 15 to 20 g obtained from the animal house, karigiri hospital, Vellore, Tamilnadu state. They were housed in polypropylene cages (47x34x20cm) lined with husk, renewed every 24 h under a 12:12 h light dark cycle at around 22˚C. Three mice were kept as control with the administration of normal standard food obtained from the animal house. 0.5% of sample was administered to each mouse along with the normal standard food for mice. The change in the blood sugar level was measured by examining the blood using glucometer(ACCU-CHECK Sensor comfort) every 7days. The whole experiment was carried out for 20 days.

Nanotechnological studies

Silver Nanoparticle Synthesis

Dried seaweed powder of 2g was taken in a 100 ml Erlenmeyer flask with 30ml of sterile distilled water and then boiled the mixture for 2minutes. After boiling, the mixture was filtered in the Whatmann filter paper no.1. 5ml of filtrate or the seaweed broth was added to 45ml of 10^{-3} M aqueous silver nitrate solution and mixed well. Sample of 1ml was withdrawn at different time intervals and the maximum absorbance was measured at a resolution of 1 nm using UV–visible spectrophotometer (8500 II SPECTROPHOTOMETER). (Shiv shankar *et al.*, 2004)

Gold Nanoparticle Synthesis

The gold nanoparticles were synthesized by taking 0.1g of seaweed powder in a 100ml Erlenmeyer flask with 10ml of 10^{-3} M aqueous chloroauric acid solution. The mixture was kept in the rotary shaker.

Aliquots of the reaction solution were removed at regular intervals of time and absorbance were measured using UV-Visible spectrophotometer (8500 II SPECTROPHOTOMETER) operated at a resolution of 1nm. (Singaravelu *et al*., 2007).

RESULT AND DISCUSSION

The detailed biochemical and nanotechnological analyses of *Chaetomorpha antennina, Gracilaria corticata, and Grateloupia lithophila* are given below.

The percentage of total carbohydrates of the selected benthic algae is given in **Table 1**. The carbohydrate content of three macro algae was observed and there was a marked difference among the three samples (Fig.1). The carbohydrate content of *Cheatomorpha antennina* (44µg/0.1g of dry weight) was higher than the red seaweeds. When compared between two red seaweeds, the carbohydrate content of *Grateloupia lithophila* (23µg/0.1g dry weight) was slightly higher than *Gracilaria corticata* (18µg/0.1g dry weight). Francisco *et al*., 2006 have studied more than four green algae and eight red algae from artic region and examined the biochemical composition of seaweeds. The studies have shown that soluble carbohydrates are more in green algae than in red algae which is very similar to the present study. The percentage of protein content determined by Lowry method is given in the **Table 2**. The protein content of the red seaweeds are higher than the green seaweed and the result is very much similar to earlier observation of Wong *et al.,* (2000). Marinho *et al*., (2006) have studied tropical seaweed for their chemical composition and showed that red algae contain more protein when compared to brown algae. The present study also shows that red seaweeds contain more protein when compared to green seaweed (**Fig.2**).

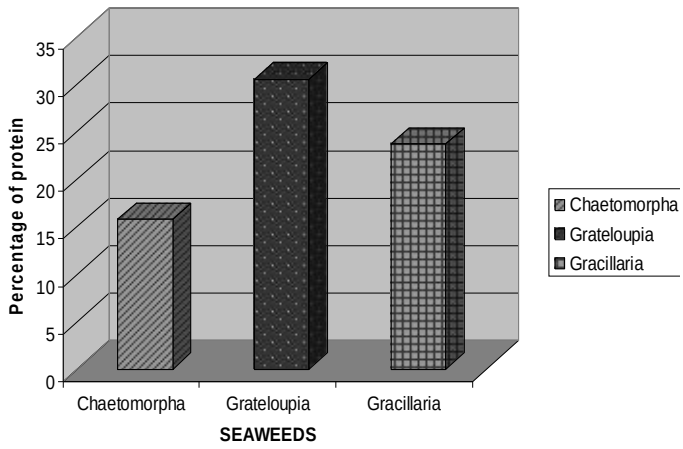

Fig. 2: Protein content (%dry weight) of three seaweeds (*Cheatomorpha antennina Grateloupia lithophila* and *Gracilaria corticata).*

In the same way the protein content of red seaweed *Grateloupia lithophila* showing similar percentage when compared with *Palmaria palmate* (30%) red seaweed (Anne-Vale´rie Galland-Irmouli,1999). The amino acid content of red and green algae is given in the Table 3.

Table. 1: Percentage of Total carbohydrate content in three seaweeds (µg/g dry weight).

Sample	percentage of carbohydrate
Chaetomorpha antennina	18.4%
Grateloupia lithophila	5.52%
Gracilaria corticata	3.6%

Table. 2: Percentage of Protein (% dry weight).

Sample	Percentage of protein
Chaetomorpha antennina	15.8
Grateloupia lithophila	30.5
Gracilaria corticata	23.7

Table. 3: Percentage of amino acid content (µg/g of dry weight).

Sample	Percentage of Aminoacid
Chaetomorpha antennina	4.9%
Grateloupia lithophila	22.94%
Gracilaria corticata	11.04%

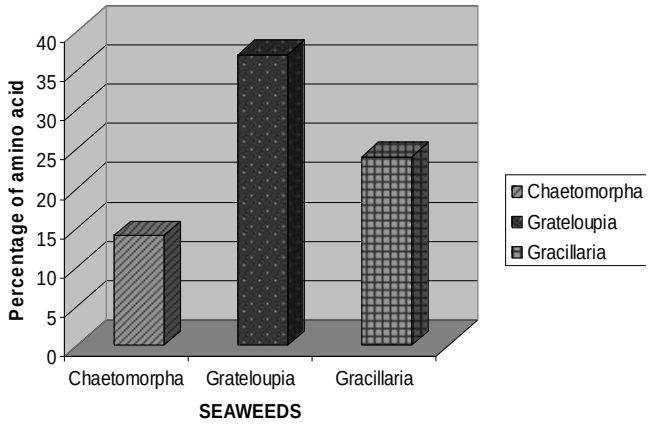

Fig. 3: Amino acid content (% dry weight) of three seaweeds **(***Cheatomorpha antennina, Grateloupia lithophila* and *Gracilaria corticata).*

The determination of total amino acids is of great values from nutritional, chemical and biochemical point of view. The quantitative data of the present study indicated that *Grateloupia lithophila* had higher amino acid content (37µg/0.1g dry weight) when compared to other two macro algae *Gracilaria corticata*(24µg/0.1g dry weight) and Chaetomorpha antennina (14µg/0.1g dry weight). Christine Dawezynski *et al*., 2006 analyzed nutritional composition of four seaweeds and observed that aminoacid content of red seaweed was more when compared to other seaweeds. Similarly the present study also shows maximum amino acid content in red algae than in green algae (**Fig.3**). Total lipid contents of two red and green algae were shown in the **Table 4**. The percentage of lipid content was found to be lower than carbohydrate or protein in general. In keeping with reports that the total lipid contents of seaweeds are always less than 4 %(Lopez-Hernandez J *et al*.,2003) It was observed that the lipid content ranged from 0.3% in *Chaetomorpha antennina* to almost 1.8% in *Gracilaria corticata* and *Grateloupia lithophila* 1.2% indicating that these seaweeds had a very low lipid content (**Fig.4**).

Table. 4: Percentage of lipid (%dry weight).

Sample	Percentage of lipids
Chaetomorpha antennina	0.3%
Grateloupia lithophila	1.8%
Gracilaria corticata	1.2%

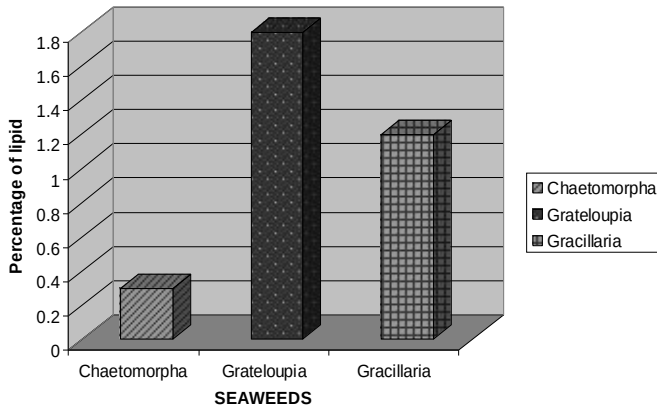

Fig. 4: Lipid content (% dry weight) of three seaweeds (*Cheatomorpha antennina, Grateloupia lithophila* and *Gracilaria corticata).*

Narayan Bhaskar *et al.,* 2003 examined three species of red algae for their lipid composition and revealed that most of the red seaweeds contain lipid percentage ranging from 0.6 to 2%, same way the present study also shows similar results. Lipid content of red algae has been found to have highest lipid content when compared to green algae which shows greater similarity with our present study (Nelson M.M, 2002). Chlorophyll 'a' content measured by Arnon method revealed that the green algae contained considerably high chlorophyll 'a' than the red algae (**Table 5**). *Chaetomorpha antennina* was seen to be containing the highest percentage of chlorophyll 'a' with the maximum of 29.6mg/ g .*Gracilaria corticata* showed low concentration of 2.87mg/g and *Grateloupia lithophila* recorded a poor content of 1.33mg/g. Chlorophyll 'b' also showed alike pattern like chlorophyll'a' in the three algal sample analyzed. Here also the green algae *Chaetomorpha antennina* exhibited higher content of 4.33mg/g and lower content in *Gracilaria corticata* which is 0.5mg/g and least content in *Grateloupia lithophila* 0.1mg/g (**Fig.5**).

Table. 5: Chlorophyll-a, chlorophyll-b and total chlorophyll content (mg/g fresh sample)

Sample	Chlorophyll-a	Chlorophyll-b	Total chlorophyll
Chaetomorpha antennina	29.6	4.33	33.93
Grateloupia lithophila	1.33	0.5	1.35
Gracilaria corticata	2.87	0.1	2.97

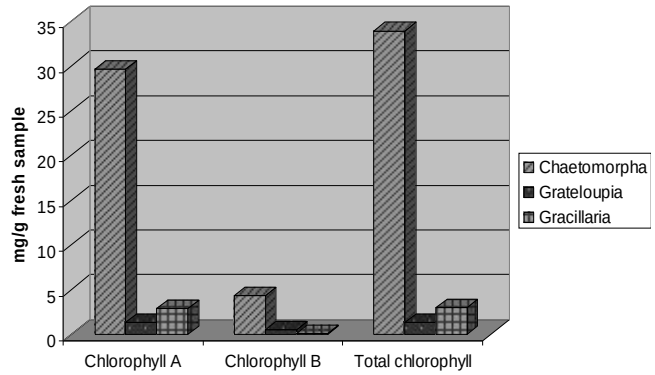

Fig. 5: Chlorophyll content (mg/g fresh sample) of three seaweeds (*Cheatomorpha antennina, Grateloupia lithophila* and *Gracilaria corticata).*

Total chlorophyll content was the summative value of the chlorophyll 'a' and chlorophyll 'b'. Therefore it showed that similar trend and concentration gradient like the constituting two above mentioned parameters. Total chlorophyll content was also recorded highest in green algae when compared to red algae (Francisco J.L.Gordillo *et al.,* 2006). Unlike chlorophyll content here the highest carotenoid content was observed (**Fig.6**) in red algal species and the lowest in the green algae (**Table6**).

Table. 6: Total content of carotenoid (mg /g fresh sample).

Sample	Carotenoid (mg/g fresh sample)
Chaetomorpha antennina	0.2
Grateloupia lithophila	0.6
Gracilaria corticata	5.49

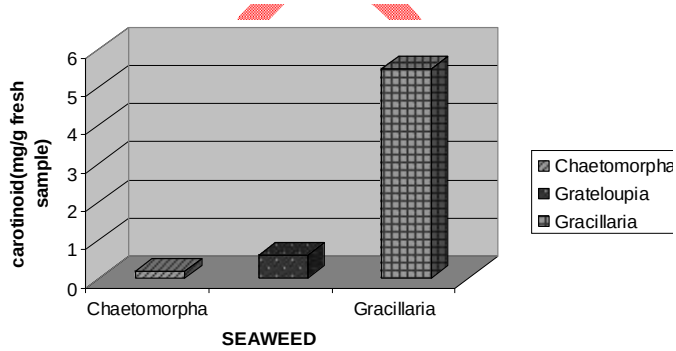

Fig. 6: Total carotenoid content (mg/g fresh sample) of three seaweeds (*Cheatomorpha antennina, Grateloupia lithophila* and *Gracilaria corticata).*

Thus carotenoid concentrations were found to be varied in different algal groups and collaborate with the earlier repots of Fristch (1971). The phycobilin content was observed to be more in red algae than in green algae. Most of the red seaweeds contain higher amount of phycoerythrin in addition to chlorophyll. The variations in the phycobilin content in three seaweeds were shown in the **Fig.7** and their contents were tabulated (**Table 7**).

Table. 7: Phycobilin Content (µg/g fresh sample).

Sample	Phycocyanin	Allophycocyanin	Phycoerythrin
Chaetomorpha antennina	12.8	23.55	1.75
Grateloupia lithophila	15.04	21.84	2.1
Gracilaria corticata	3.45	0.4	5.04

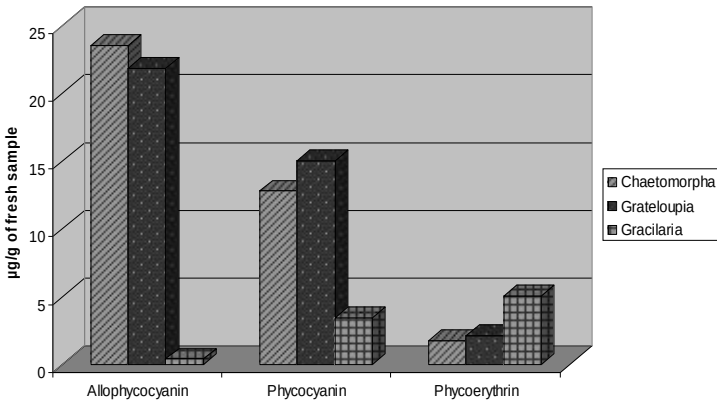

Fig 7: Phycobilins content (µg/g fresh sample) of three seaweeds **(***Cheatomorpha antennina, Grateloupia lithophila* and *Gracilaria corticata).*

Table. 8: Effect of seaweed in the blood glucose level and body weight of mice .

Group	Treatment	Body weight(g)			Blood glucose concentration (mg/dl)		
		Day 1	Day 10	Day 20	Day 1	Day 10	Day 20
I	Normal Control	19.66±0.8	20.62±0.9	21.24±0.25	120.3 ± 16.3	131 ± 20	135.6 ± 14.8
II	Normal+ Gracilaria (0.5g/g)	17.16±0.7	19.88±0.4	20.69±0.3	105.5 ± 25.5	122 ± 15	144 ± 7
III	Normal + Grateloupia (0.5g/g)	17.47±1.0	19.85±1.2	20.1±1.0	99 ± 17	126 ± 17	129 ± 13.5
IV	Normal + Chaetomorpha(0.5/g)	16.3±1.8	18.11±2.25	21.24±1.11	105.5 ±7.9	116.5 ±16.5	120.5 ± 12.5

According to Schreiber.U, 1979 the phycobilin content vary seasonally in different seaweeds and the phycobilin shows some higher variation between red and green seaweeds similarly the present study also reveals more variation. Oral administrations of seaweeds were carried out for 20days. Blood glucose level change in normal and experimental mice was shown in **Table 8.** Treatment of seaweed increased the blood sugar level as well as weight in normal mice. The oral administration of spirulina effectively shows increased blood glucose level in rats (Lyman.A and Reddy. C.L.K., 2006), the result obtained was similar to the present result. Thus the present study shows that these seaweeds have good nutrient value and can be used as a good food source.

Formation of the metal nanoparticles by reduction of the aqueous metal ions during exposure to the seaweed broth may be easily followed by UV-VIS spectrophotometer. The silver should exhibit yellowish-brown color in water and the color arises due to excitation of surface plasmon vibrations in the metal nanoparticles. The silver surface plasmon resonance band occurs at ca. 450nm and steadily increases in intensity as a function of time of the reaction without any shift in the peak wavelength (Absar Ahmad *et al*., 2004). The present study has been made with three different seaweed samples of two group red and green algae. The solution was monitored for the reduction of pure Ag^{+} by measuring the UV-VIS spectra at regular intervals of time. No significant absorbance was measured around 450nm wavelength corresponding to the silver surface plasmon resonance band, thus shows no silver nanoparticle was synthesized in the solution. From this study it has been clear that these three species of seaweed are not capable to synthesis the silver nanoparticle. Maximum absorbance of gold nanoparticle with *chaetomorpha antennina* and *Gracilaria corticata* as a function of time is shown in Fig 8 and 9.

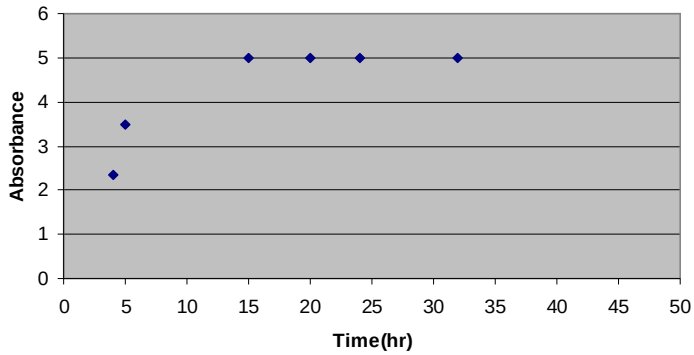

Fig. 8: Maximum absorbance of gold nanoparticle with *chaetomorpha antennina* as a function of time.

The detailed study on the marine algal *(Chaetomorpha antennina, Gracilaria corticata* and *Grateloupia lithophila)* biosynthesis of gold nano particles were carried out in this work.

Fig. 10a, 11a shows the powder of marine algae with gold ions at the beginning of the reaction and **Fig. 10b, 11b** shows the tube after 15 hours of incubation. The color change of the medium was noted by visual observation.

The light absorption pattern of the algal biomass was monitored in the range of 300-800nm. It has been well established that surface plasmon resonance of metallic gold nanoparticles exhibit ruby red color and gives rise to an absorption band at 510-540nm (Absar Ahmad *et al*., 2004) .UV-vis spectra were recorded from the aqueous chloroauric acid and algae reaction medium. In case of gold ions reduction, the bands corresponding to the surface plasmon resonance (SPR) occurred at 537 nm in *chaetomorpha antennina* with the color change of the medium to ruby red after 4 hr of incubation and in case of *Gracilaria corticata* the band corresponding to surface plasmon resonance occurred at 541 nm and no ruby red color change corresponding to the gold nanoparticle synthesis in the medium containing red algal species *Grateloupia lithophil*a , thus no absorbance were observed near the surface plasmon resonance band. On comparing three seaweed species *chaetomorpha antennina* and *Gracilaria corticata* were found to contain the ability to synthesis the gold nanoparticle. Singaravelu *et al*., 2007 reported the extracellular gold nanoparticle synthesis using seaweed, *Sargassum wightii* and proved that nanoparticle synthesis is mainly due to the presence of extracellular polysaccharides in seaweed. In the same method the present study was also conducted and believed that the nanoparticles were synthesized extracellular.

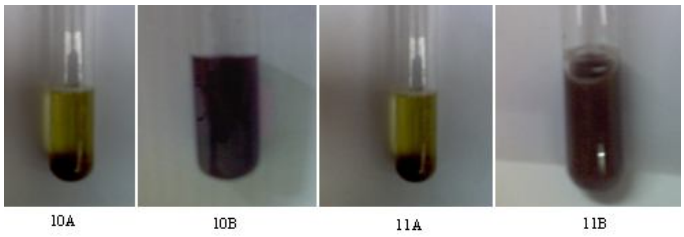

Fig.10a. *Chaetomorpha antennina* powder with gold ions at the beginning of the reaction . **Fig.10b.** Ruby red color indicating formation of gold nanoparticle after incubation. **Fig.11a.** *Gracilaria corticata* powder with gold ions at the beginning of the reaction. **Fig.11b.** Ruby red color indicating the formation of gold nanoparticle after incubation .

SUMMARY AND CONCLUSION

Three species of red and green seaweed were examined for their biochemical parameters and also for their ability to synthesis nanoparticle such as gold and silver. C.*antennina* was found to contain maximum carbohydrate (18.4%) content and minimum percentage of protein (15.8%), aminoacid (4.9%), lipids (0.3%) when compared to red seaweeds *Gracilaria corticata* and

Grateloupia lithophila. Since *Chaetomorpha antennina* is green algae, it contains (33.9 mg/g) total chlorophyll, (0.2 mg/g)carotenoid, (12.8µg/g) phycocyanin and (1.75 µg/g)phycoerythrin. *Chaetomorpha antennina* also shows synthesis of gold nanoparticle at a faster rate when compared to red seaweeds.

The red seaweeds such as *Gracilaria corticata* and *Grateloupia lithophila* show similar percentage of biochemical parameters. They contain lesser percentage of carbohydrate content (3.6% & 5.52%) and more percentage of protein (23.7% & 30.5%), aminoacid (11.04% & 22.94%), and lipid (1.2% & 1.8%) respectively. Since these seaweeds belongs to red algal group, they contain minimum amount of chlorophyll (2.97, 1.35 mg/g), carotenoids (5.49, 0.6 mg/g) and maximum of phycoerythrin (5.04, 2.1µg/g). Compared to *Grateloupia lithophila*, *Gracilaria corticata* has the ability to biosynthesis the gold nanoparticles at a short period of time. Rise in blood glucose level of the experimental mice in the oral administration of seaweeds conclude that these seaweeds can be used as a food product or they can also be used in the production of some foods in food industry. This work concluded that the seaweeds are rich in biochemical components which make them healthy food for human and animal nutrition. Achievement of such rapid time scale for synthesis of metallic nanoparticle contributes to an increase in the efficiency of synthetic procedures using environmentally benign natural resources as an alternative to chemical synthesis protocols. Biosynthesis of gold nanoparticle using marine algae will therefore lead to the development of an easy bioprocess for synthesis of gold nanoparticle. It is suggested that the cultivation of seaweeds at larger scale in the barren long coastal line of our country augment economy and employment opportunities through seaweed based industry.

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