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Exploration and Isolation of rare marine macro-algae from, East Coast, Odisha, India

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Abstract

The East coast of Odisha, India, provides a unique environment for different algal species. The perennial rivers like Mahanadi, Rushikulya, Brahmani, Subarnarekha, and Baitarani open into the Bay of Bengal. Marine algae plays very important role for the health of Bay of Bengal, production of value added products such as polysaccharides, pigments, proteins, pharmaceuticals and various other products. But on the east coast region research and commercial activities on macro and micro algae are limited. In the present scenario twelve different strains of macro algae were isolated, from Odisha coast of Gopalpur, Paradeep and Chandipur. The isolated species belongs to the genus *Ulva, Grateloupia, Cladophora, Gracilaria, Ceramium Chaetomorpha, and Enteromorpha.* The economical uses of these isolated algae's were evaluated on the basis of their biochemical analysis. Isolated algae were rich in fatty acid (8-20%), protein (0.6mg/gm-1.06mg/gm), carbohydrate (8-14%) and pigment (0.3mg/gm-0.9mg/gm). At present macro-algae from east coast of Odisha are not exploited for commercial uses. Based on this brief study, it's concluded that these marine algae can be useful to make bio-fuel, bio-ethanol, bio-butanol and protein rich feed etc.

Keywords: Marine algae, Odisha coast, biochemical characteristics, fatty acid, carbohydrate.

Introduction

Marine algae provide important ecosystem services globally. These organisms are responsible for the production of about half of the atmospheric oxygen generated each year. Most of the macro-algae maintain their habitat in salty, saline and shallow water at the sides of different sea (Kandale et. al, 2011). Marine algae commonly, come in all shapes and sizes. Marine algae offer a wide range of therapeutic possibilities both internally and externally. Marine algae also refer to macrophytic marine algae, both wild and cultivated growing in saltwater. Rocky beaches, mudflats, estuaries and coral reefs along the Indian coast provide ideal habitats for the growth of seaweeds. India (08.04–37.06 N and 68.07–97.25 E), a tropical South Asian country with a coastline of more than 750km harbor diverse marine algal species (Subha Rao, 2006). Jnanendra Rath studied eastern coast of India which covers 470km of coastline and surveyed for marine algal diversity. The coast is characterized by mixed tides and generally with narrow intertidal regions. However, due to the geographical, climatic and physiographic influences, the coast harbors predominantly sub-tidal algal community. Several rivers flow eastwards in this region of India which fall to the sea Bay of Bengal, such as Mahanadi, Brahmani, Baitarani, Rushikulya, Subarnarekha. Macro-algal resources of the oceans and estuaries are found attached to the rocks, corals and other submerged strata in the intertidal and shallow sub tidal zones (Mcclanahan et al.,2002). They are clearly sighted during low tide condition on the sea shores (Wilson et al., 2002). In marine ecosystems, macro-algae are ecologically and biologically important and provide nutrition and unaccommodating environment for other living organisms. Because of these properties, macro algae are considered as one of the most important biotic components maintaining the ecosystem's stability (Dalkiran et al., 2003). The different macro algae are partially beneficial in mariculture as food species, fatty acid, proteins, chlorophyll have different biochemical composition and economical application in certain area (Costard, et al., 2012). Best selection of algal species is important to help different oil based industries, food sector for the improvement of nutritional quality (Cordilea, et al., 2013). Carbohydrate, protein and fatty acid composition varies from species to species and the difference can be a major advantage for researcher to extract the exact percentage and there economical use in that locality (Formuzul, et al., 2009). The industrial applications of macro-algae are also varied. Their polysaccharides are used in food, cosmetics and paint, crop, textile, paper, rubber and building industries. In addition, they are used in medicine and in pharmacology for their antimicrobial, antiviral, antitumor, anticoagulant and brinolytic properties (Fleurence et al., 1999). Moreira-Da-Silva et al., (1982) studied the possibilities of using marine algae as a substrate for biogas generation. Based on the above sited facts, most of the macro-algae from east coast of Odisha are not

identified and characterized for its commercial applications. The present study carried out at three different sites in east coast of Odisha for identifying marine macro algae with high economical values.

Materials and methods

Isolation of marine macro algae

Macro-algae were isolated from Paradeep port side Odisha, where the environment and habitat is suitable for marine algal sample collection. The algal samples were collected by the method of scrapping with the help of a scrapper, from the attached beach rock, pebbles or mud flats. Marine water samples were also collected from the same sampling site using water sterile container. The salinity, temperature and pH of the sampling sites were analyzed as per the method of Strickland and Parsons (Strickland et al., 1972).

Description of studied site

The sampling sites were classified sequentially as the Paradeep port side (N20º 17' 34.0", E86º 42' 59.3"), Gopalpur on sea (N19º 18' 11.7", E84º 57' 57.8") and Chandipur (N21º 27' 07.1", E87º 02' 26.6") which have many river outlets into it such as Baitarani, Brahamani, Mahanadi, etc. Most of the environmental conditions in and around the sampling sites have sandy with rocky surfaces, mud flat and hard rock assembles in these regions. The samples were collected on different days in between February and March 2015, respectively. Temperature, pH and physical parameters such as total dissolved solid, total suspended solid, calcium hardness, magnesium hardness and total water hardness of the marine environment were analyzed.

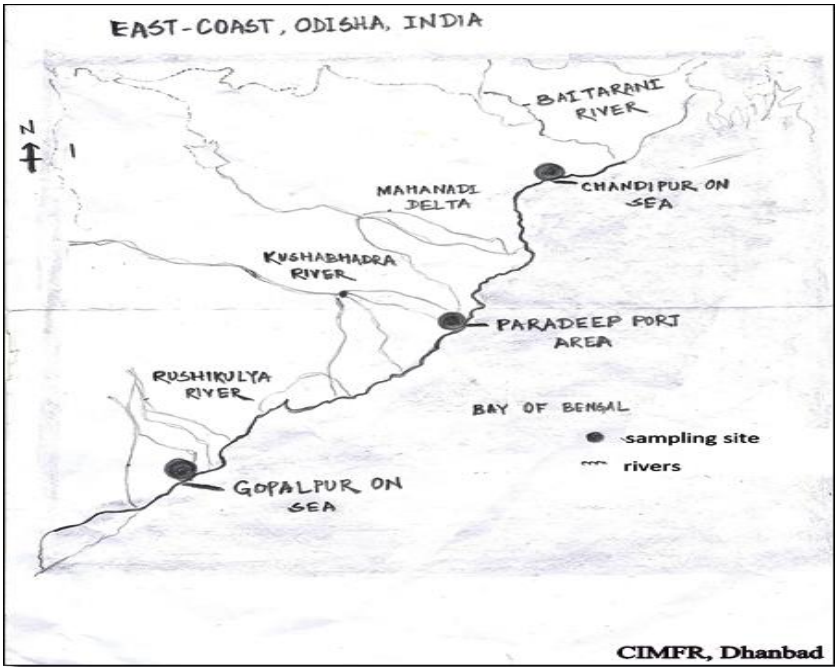

Figure 1. Map of sampling site

Macro algal culturing and identification

For the storage of these samples, zip locked air tight sterile pouches were used. After collecting the samples these were preserved in marine medium which was initially prepared in lab and kept under minimum effect of sunlight at optimum temperature. For further analysis, a segment of each sample was preserved at 4ºC. All the isolated algae were analyzed and the morphological studies were observed in microscope. The isolated macro-algae were sub cultured in artificial Basic Bold's algal medium. For the identification of isolated marine macro algae Olymbus BX53 microscope was used.

Biochemical Characteristics

Different biochemical parameters such as pigment, fatty acid, protein content, and carbohydrate were analyzed. The Chlorophyll a, Chlorophyll b and Total Chlorophyll were calculated by Arnon (1949). Hence the pigment extraction by using spectrophotometer gave the total value of Chlorophyll a, Chlorophyll b and total Chlorophyll as explained by Lorenzen (1967). The protein was estimated by Lowry method Lowry et al., (1951). Carbohydrate estimation was carried out by Anthrone Method by Good et al., (1933). Fatty acid was quantified by Soxhlet method as described by Folch et al., (1957).

Result and Discussion

In the present study, eight different macro marine algae species were isolated. The selected sampling sites were Paradeep port area, Gopalpur on sea and Chandipur on sea. These sites exhibited different ecological habitats like sharp and rocky (Paradeep port area, 29ºC), sandy and rocky (Gopalpur on sea, 30ºC) and mud flat (Chandipur on sea, 30ºC). The species identified from Paradeep port area were *Ceramiun diphanum* (Red in color, branched), *Gracilaria verrucosa* (Grey in color, repeatedly branched), and *Cladophora sericea* (dark green in color, filamentous), species from Gopalpur on sea were *Ulva lactuca* (Green in color, fully branched), *Grateloupia eithophila* (Green in color, densely branched) and *Enteromorpha compressa* (deep green in color, thread like), species from Chandipur on sea were Enteromorpha linza (deep green in color, thin thread like) and *Chaetomorpha linum* (Green in color, unbranched).

The protein, lipid, carbohydrate and fatty acid content of eight different algal species were estimated. Among the eight algal species, *Ulva lactuca* (1.098mg/gm) showed high content of chlorophyll, followed by *Grateloupia eithophila* and Enteromorpha *compressa*, as shown in Figure 2 , but in case of *Ceramiun diphanum* there was less pigment content observed.

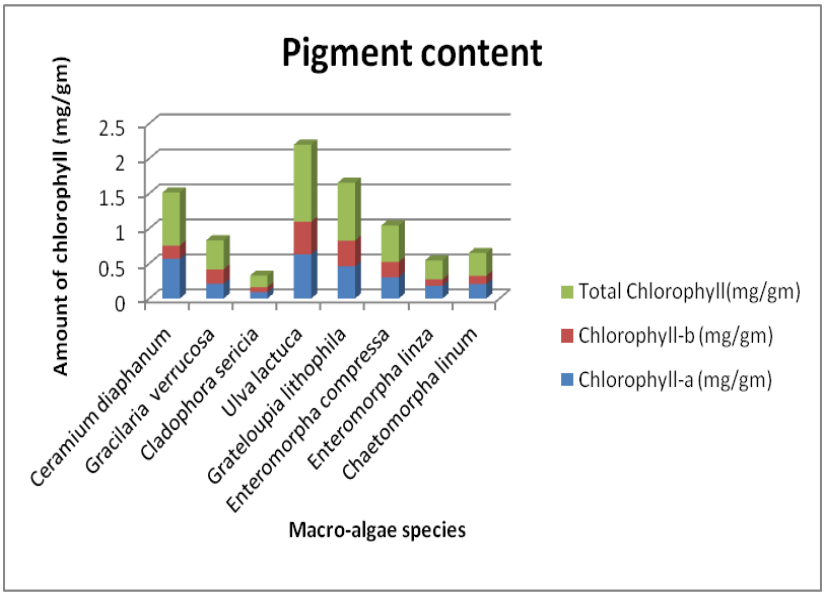

Figure 2: Total pigment content of isolated macro algae from East coast of India.

Cladophora sericea showed the highest amount of protein content (1.053602mg/gm) followed by *Ceramium diaphanum* and *Grateloupia eithophila* as shown in Figure 3. *Enteromorpha Linza* showed high content of carbohydrate (16%FW), followed by *Chaetomorpha linum* (12%FW), *Gracilaria verrucosa* (11%FW) and *Ulva lactuca* (10%FW) respectively as shown in Figure 4. The above results are similar to the findings of John Peter Paul J (2014) which showed high content of carbohydrate in *Enteromorpha linza* (33.8%).

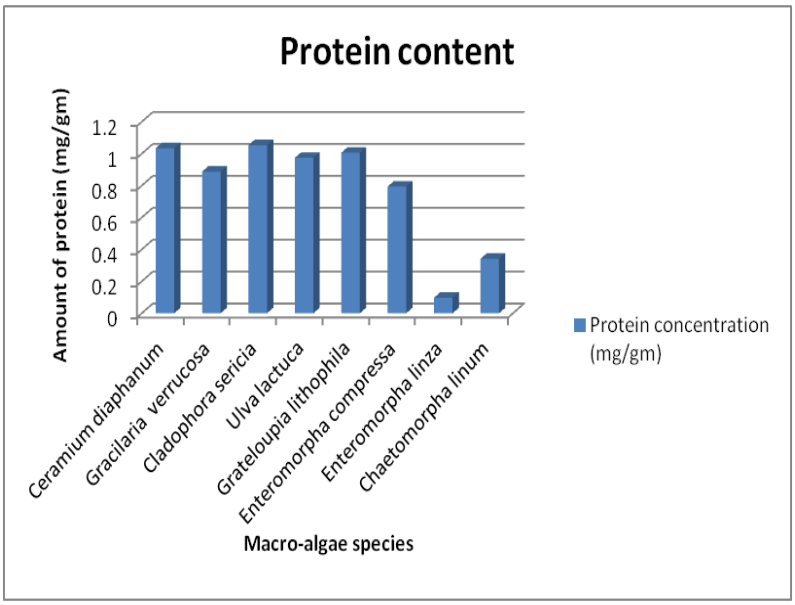

Figure 3: Protein content of isolated macro algae from East coast of India.

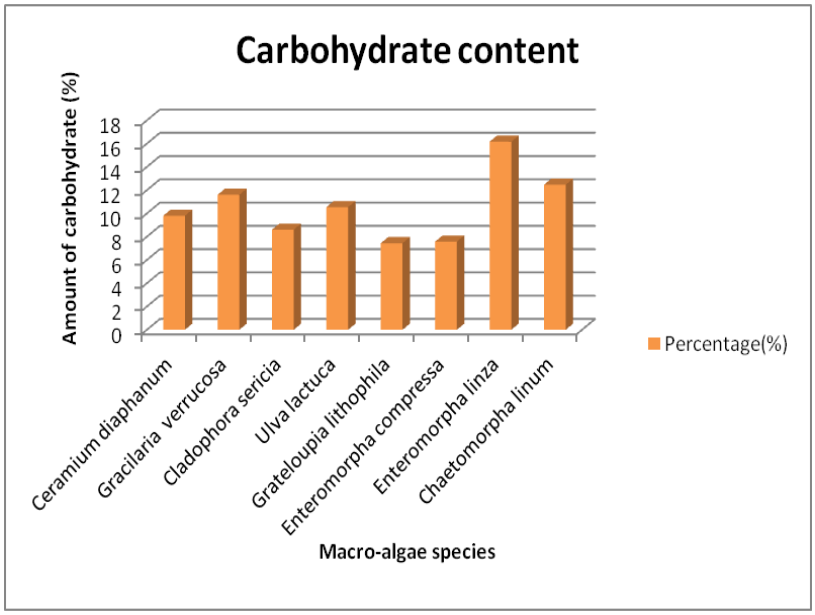

Figure 4: Carbohydrate content of isolated macro algae from East coast of India.

The lipid content of *Enteromorpha compressa* (39%FW) was recorded to be the highest followed by *Gracilaria verrucosa* (27%FW) as listed below in Figure 5.

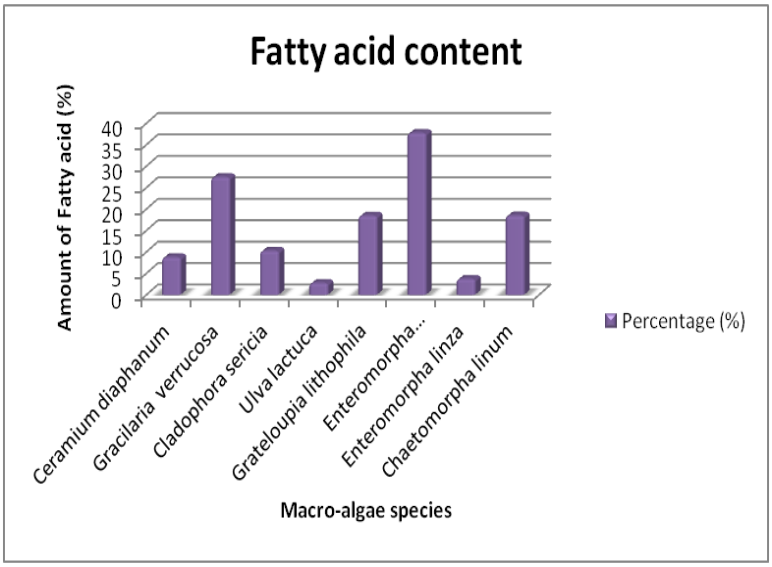

Figure 5: Fatty acid content of isolated macro algae from East coast of India

Conclusion

The study reveals that macro algal species are nutritional rich species in terms of Protein, Carbohydrate, Fatty acid and Pigment content. The east coast of Odisha is unique in terms of bio-diversity and hydrological parameters. Thus, our findings will have an immediate and actful bearing on food sectors, primary productivity, commercial importance and coastal development activities.

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Table 1. Isolation and Identification details of marine macro-algae from east coast of Odisha

S.No.	Sampling site	Date of Collection	Habitat &water collecting temperature (º c)	Sample Code	Species Identified	Species Morphology
1	Paradeep Port Area	14/02/ 2015	Sharp Rocky (Marine) 29ºC	MA/CIMFR/PR-1	*Ceramiun diphanum*	Red in color ,1-5 cm length, branched
				MA/CIMFR/PR-2	*Gracilaria verrucosa*	Gray and green ,1- 3cm length repeatedly branched
				MA/CIMFR/PR-3	*Cladophora sericea*	Dark Green, 2-18cm length , filamentous
2	Gopalpur on Sea	15/02/2015	Sandy and Rocky (Marine) 30ºC	MA/CIMFR/GP-1	*Ulva lactuca*	Green, 1- 20cm length, Elongated
				MA/CIMFR/GP-2	*Grateloupia eithophila*	Green,2-6cm length, fully branched
				MA/CIMFR/GP-3	*Enteromorpha compressa*	Deep green 18cm length , leafy like
3	Chandipur on Sea	08/03/2015	Mud Flat 30ºC	MA/CIMFR/CP-1	*Enteromorpha linza*	Deep green,10-30 cm length, thread like
				MA/CIMFR/CP-2	*Chaetomorpha linum*	Green,2-10cm length, unbranched