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SEASONAL VARIATIONS IN THE BIOCHEMICAL COMPOSITION OF SOME COMMON SEAWEED SPECIES FROM THE SOUTHWEST COAST OF KANYAKUMARI DISTRICT, INDIA.

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ABSTRACT

The biochemical composition like carbohydrate, protein and lipid in six selected seaweeds (marine macroalgae) species such as *Padinafraseri*, *Caulerpalentillifera*, *Palmariapalmata*, *Sargassamwightii*, *Dictyotadichotoma* and *Janiarubens* from Leepuram and Vattakottai coasts of Kanyakumari district was determined. The samples were collected in two seasons, pre monsoon (Sep.2015) and post monsoon (Dec.2015). The estimation of total carbohydrate was done by using Anthrone reagent, protein by using the Folin phenol reagent and lipid was done by extraction using the chloroform-methanol mixture. The optical density was measured using Jasco UV-Visible spectrophotometer. The carbohydrate content of the selected six seaweeds varied from 30.7 ± 0.48 % dw to 58.9 ± 0.92 % dw, the protein content of the selected six seaweeds ranged from10.7 ± 0.30 % dw to 19.7 ± 0.55 % dw, the level of lipid of the selected six seaweeds varied from 0.6 ± 0.03 % dw to 3.8 ± 0.18% dw. Among the six seaweeds, *C. lentillifera* contained higher amount of carbohydrate (58.9 ± 0.92% dw), *P. fraseri*possessed higher amount of protein (19.7 ± 0.55%dw) however *D. dichotoma* possessed maximum lipid (3.8 ± 0.18%dw). The study of seasonal variation showed that the best season for harvesting seaweeds for food is post monsoon season. The carbohydrate and protein content are found maximum in the samples from Leepuram coast and lipid content is found maximum in the samples from Vattakottai coast.

KEYWORDS: *P. fraseri, C. lentillifera, P. palmata, S. wightii, D. dichotoma, J. rubens.*

INTRODUCTION

Seaweed refers to several species of macroscopic, multi-cellular, marine algae that live near the sea bed. The largest and most complex marine algae are called seaweeds.[1] Most of them are the red (6000 species), brown (2000 species) or green (1200 species) kinds and most are attached by holdfasts, which just have an anchorage function. The long history of seaweed utilization for a variety of purposes has led to the gradual realization that some of their constituents are more superior and valuable in comparison to their counterparts on land.[2] Surveys conducted in Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhrapradesh, West Bengal, Andaman and Nicobar Islands, etc. brought to light the huge quantity of seaweed resources available on Indian coast.[2] About 700 species of marine algae have been reported from different parts of Indian coast. Of these, nearly 60 species are commercially important and can be utilized as raw material for agar, algin, carrageenan production and for food, manure and pharmaceuticals.[3]

Seaweeds are of ecological importance because they assist in supplying oxygen to the sea and act as one of the primary producers in the marine food chain.[4] The knowledge of changes in the chemical composition is of importance for understanding the algal vital activity, growth regulation and alga adaptation to varying environment.[5] Seaweed is an important component of the marine ecosystem along with the mangrove and coral reefs and can be viewed in two perspectives, from its ecological value as well as its economic uses.

Seaweed is an ingredient in toothpaste, cosmetics and paints. Alginates enjoy many of the same uses as carrageenan and are used in industrial products such as paper coatings, adhesives, dyes, gels, explosives and in processes such as paper sizing, textile printing and drilling. Algae rich in iodine such as *Asparagopsis taxiforms, Sarconema spp.* can be used for controlling goiter disease caused by enlargement of thyroid glands. The seaweed mineral content is higher than that of land plants and animal products.[6] Banu (2012) reported that a good source of trace minerals such as chromium and iodine are present in seaweeds.[7] Seaweeds can also be used to prepare seaweed meals as supplementary to the daily ration of the cattle, poultry and other farm animals.[8] John and Anisha (2011) showed that the fermentation of carbohydrates obtained from macroalgal biomass can be used for the production of bioethanol.[9] Seaweed collections are mainly centered along the southeastern coast of India from Rameswaram to Kanyakumari.[2] Certain seaweeds contain significant quantities of proteins, lipids, minerals and vitamins[10] while nutrient contents can vary with

species, geographical location, season and temperature.[11] Seaweeds are exposed to seasonal variations of abiotic factors that influence their metabolicresponses (photosynthesis and growth rates) and levels of proximate constituents.[12]

Seasonal variation in biochemical constitutions of *Sargassum wightii* with special reference to yield in alginic acid content from Pudumandapam has been reported.[13] Seasonal variation in growth and biochemical constitutions such as protein, carbohydrate and lipid in *Hypneavalentiae, Acanthophoraspicifera, Laurenciapapillosa, Enteromorphacompressa, Ulvalactuca*and *Caulerparacemosa*were observed for one year from Mandapam coast.[14] Seasonal variation of carbohydrate, protein and lipid in seaweeds has been carried out from different localities of southeast coast of India.[15,16] Most studies on biochemical composition of seaweeds were determined from all parts of the world. Hence, the present study is carried out to estimate the proximate biochemical composition of some seaweed on the coast of Kanyakumari District, India and to investigate the impact of season and location on the biochemical composition.

MATERIALS AND METHODS

a) Area of study

In the present study, the selected nearby coastal villages namely Leepuram and Vattakottai are located in the south west coast of Kanyakumari district. Vattakottai Fort (Circular Fort) is built as *coastal* defence with granite blocks. It is a popular tourist spot famous for black sand beach iIlmenite sand exposed between Leepuram and Vattakottai along the west coast for a distance of about 2.4 km. The district of Kanyakumari is the southern most districts in the state of Tamil Nadu, India. It is situated between 77°15' and 77°36' east latitude and 8°03' and 8°35' north longitude. The district has borders with Tirunelveli district, the Gulf of Mannar, the Indian Ocean, the Arabian Sea and the state of Kerala.

b) Collection and Processing of Samples

Six selected seaweeds (marine macroalgae) species such as *P. fraseri* (brown), *C. lentillifera*(green), *P. palmata* (red) from Leepuram, *S. wightii* (brown), *D. dichotoma*(brown) and *J. rubens* (red) from Vattakottai coasts of Kanyakumari district were collected during two seasons, pre monsoon (September 2015) and post monsoon season (December 2015). Exactly 100g (wet weight) of each species were taken and the sample was thoroughly washed with seawater to remove epiphytes and dirt particles, followed by shade-drying at 70°C to obtain a constant weight and pulverized in the grinder (size 2mm). The ground samples were sieved to

get uniform particle size, then kept in air tight container and stored in a freezer until further analysis.

c) Estimation of Carbohydrate, Protein and Lipid

The estimation of total carbohydrate was done by using Anthrone reagent on following the procedure Seifter *et al*., 1950.[17] The protein was estimated by using the Folin phenol reagent on following the procedure Lowry *et al*., 1957.[18] The extraction of lipid was done by the chloroform-methanol mixture and estimated by the method suggested by Folch *et al*., 1957.[19] The optical density was measured using Jasco UV-Visible spectrophotometer.

RESULTS AND DISCUSSION

a) Estimation of Carbohydrate

The seasonal variation of carbohydrate content in the selected seaweed samples from Leepuram coast is presented in Table 1 and Vattakottai coast in Table II. Carbohydrate content of the selected seaweeds collected from Leepuram coast ranges from 32.6 ± 0.51%dw to58.9 ± 0.92%dw (Table I) and for the samples collected on the Vattakottai coast shows the range form 30.7 ± 0.48 to54.4 ± 0.85%dw (Table II). The carbohydrate content in *P. fraseri* is found to be 41.6 ± 0.65 % dw during pre-monsoon season and 54.5 ± 0.85 % dw in post monsoon season. Similarly for *C. lentillifera*, it is recorded as 43.5 ± 0.68 % dw in pre-monsoon season and 58.9 ± 0.92 % dw in post-monsoon season. The observed carbohydrate content in *P. palmata* is 32.6 ± 0.51 % dw during pre-monsoon season and 45.5 ± 0.71 % dw in post monsoon season. These data show that the carbohydrate content is found to be slightly higher in the samples from Leepuram coast than Vattakottai coast. This spatial variation may be attributed to the different environmental features prevailed in both the locations. The maximum carbohydrate content is recorded in the green seaweed *C. lentillifera* from Leepuram coast and the brown seaweed *D. dichotoma* from Vattakottai coast. Similarly Chakraborthy and Santra (2008) recorded higher carbohydrate in the green seaweeds *Ulvalactuca* and *E. intestinalis* [20]. In general, the carbohydrate content is higher during post monsoon season for all the samples collected from both the locations than the pre monsoon season.

Table 1: Carbohydrate, Protein, Lipid content (%dw) of selected seaweeds from Leepuram coast during the study period September (pre monsoon season) and December (post monsoon season) 2015.

Species	Seasons	Carbohydrate (%dw)	Protein (%dw)	Lipid (%dw)
P.fraseri	Pre monsoon	41.6 ± 0.65	13.3 ± 0.37	2.3 ± 0.11
	Post monsoon	54.4 ± 0.85	19.7 ± 0.55	2.7 ± 0.13
C.lentillifera	Pre monsoon	43.5 ± 0.68	13.6 ± 0.38	0.8 ± 0.04
	Post monsoon	58.9 ± 0.92	11.5 ± 0.32	1.0 ± 0.05
P.palmata	Pre monsoon	32.6 ± 0.51	14.7 ± 0.41	3.1 ± 0.15
	Post monsoon	45.5 ± 0.71	16.5 ± 0.46	3.6 ± 0.17

dw: dry weight

Table II: Carbohydrate, Protein, Lipid content (%dw) of selected seaweeds from Vattakottai coast the during the study period September (pre monsoon season) and December (post monsoon season) 2015.

Species	Seasons	Carbohydrate (%dw)	Protein (%dw)	Lipid (%dw)
S.wightii	Pre monsoon	40.3 ± 0.63	11.8 ± 0.33	2.5 ± 0.12
	Post monsoon	51.2 ± 0.80	17.9 ± 0.50	2.9 ± 0.14
D.dichotoma	Pre monsoon	41.6 ± 0.65	12.5 ± 0.35	3.4 ± 0.16
	Post monsoon	54.4 ± 0.85	10.7 ± 0.30	3.8 ± 0.18
J.rubens	Pre monsoon	30.7 ± 0.48	13.6 ± 0.38	0.6 ± 0.03
	Post monsoon	42.9 ± 0.67	15.1 ± 0.42	1.2 ± 0.06

The level of carbohydrate in the selected seaweeds from Vattakottai coast is ranging from 30.7 ± 0.48 to 54.4 ± 0.85 % dw. The carbohydrate content in *S. wightii* is found to be 40.3 ± 0.63 % dw during pre-monsoon season and 51.2 ± 0.80 % dw in the post monsoon season. Similarly for *D. dichotoma*, it is registered 41.6 ± 0.65 % dw in the pre monsoon season and 54.4 ± 0.85 % dw in the post monsoon season. The carbohydrate content in *J. rubens* is found to be 30.7 ± 0.48 % dw during pre-monsoon season and 42.9 ± 0.67 % dw in the post monsoon season. The selected seaweeds in terms of carbohydrate content lie in the order *C. lentillifera> P. fraseri>D. dichotoma> S. wightii> P. palmata> J. rubens.* Among the two selected locations, the samples from Leepuram coast possessed higher amount of carbohydrate. The level of carbohydrate in the selected seaweed samples follows the order green > brown > red. This result coincides with Nirmal Kumar *et al*. (2010) [21] who stated that the concentration of carbohydrate is higher in the most of the species of chlorophyta (green) followed by phaeophyta (brown) and rhodophyta (red).

Estimation of Protein

The data on the seasonal variation of protein content of three selected seaweeds namely *P. fraseri*, *C. lentillifera* and *P. palmata*, collected from Leepuram coast are given in Table 1 and *S. wightii*, *D. dichotoma* and *J. rubens* collected from Vattakottai coast in TableII. The protein content available in certain seaweeds has attracted the attention of food industries that produce food products both for human consumption and also for animal feeds. The protein content of the three selected seaweeds from Leepuram coast is ranging from 11.5 ± 0.32%dw to 19.7 ± 0.55%dw. The level of protein in *P. fraseri*is 13.3 ± 0.37%dw in pre monsoon season and 19.7 ± 0.55 %dw in post monsoon season. Similarly for *C. lentillifera*, the protein content is 13.6 ± 0.38%dw during pre-monsoon season and 11.5 ± 0.32%dw in post monsoon season. In *P. palmata*, the protein content is registered as 14.7 ± 0.41%dw during pre-monsoon season and 16.5 ± 0.46%dw in post monsoon season. The protein content of *P. fraseri* and *P. palmata*is found to be higher during post monsoon season than in pre monsoon season. The measured protein content is ranging from 10.7 ± 0.30%dw to 17.9 ± 0.50%dw for the selected seaweeds from Vattakottai coast (Table I). The maximum protein content is observed for the *S. wightii* species. The minimum protein content is found in *D. dichotoma* species. For *S. wightii*, the protein content is 11.8 ± 0.33%dw in pre monsoon season and 17.9 ± 0.50%dw in post monsoon season. Similarly for *D. dichotoma*, the protein content is 12.5 ± 0.35%dw during pre- monsoon season and 10.7 ± 0.30%dw in post monsoon season. In *J. rubens*, the protein content is observed to be 13.6 ± 0.38%dw during pre-monsoon season and 15.1 ± 0.42%dw in post monsoon season. Except *C. lentillifera*from Leepuram coast and *D. dichotoma* from Vattakottai coast, other selected seaweeds possessed higher amount of protein during post monsoon season.

In the present study it has been noted that the brown seaweed possessed higher concentration of protein and green seaweed contained lesser content of protein. The protein content of seaweeds can vary according to species, seasonal period and geographic area.[22, 23]

Estimation of Lipid

The seasonal variation of lipid content in the selected seaweeds from Leepuram coast during the study period is provided in Table 1 and Vattakottai coast in Table II. In the present study, the estimated lipid is found to be low when compared to carbohydrate and protein. The lipid content is varied for each species. The concentration of lipid in the selected seaweeds is varying from 0.6 ± 0.03%dw to 3.6 ± 0.17%dw.This range of lipid is in coincidence with the

general lipid level in most of the seaweeds. Typically, seaweeds are not considered a good source of lipids [23] and the total lipid content has always been found to be <4% [24].The level of lipid in *P. fraseri* 2.3 ± 0.11%dw during pre-monsoon season and 2.7 ± 0.13%dw in post monsoon season. Similarly for *C. lentillifera*, the lipid content is 0.8 ± 0.04%dw during pre-monsoon season and 1.0 ± 0.05%dw in post monsoon season. In *P. palmata*, the lipid content is 3.1 ± 0.15%dw during pre-monsoon season and 3.6 ± 0.17%dw in post monsoon season. The seasonal variation of lipid content in the selected seaweeds from Vattakottai coast during the study period is presented in Table II. The maximum lipid content 3.8 ± 0.18%dw is observed for *D. dichotoma* during post monsoon season. Similarly *J. rubens* possessed higher lipid content 1.2 ± 0.06%dw in post monsoon season and lesser lipid content 0.6 ± 0.03%dw in pre monsoon season. The seaweed species *C. lentillifera* and *J. rubens* are containing more or less same lipid level (Table I and II). The lipid level of all the selected seaweeds is found to be higher during post monsoon season than pre monsoon season just like carbohydrate content. As the lipid level of seaweeds is found low, they are not a good source of lipid but they form suitable diet for people who need low fat diet.

CONCLUSION

The biochemical composition like carbohydrate, protein and lipid in six selected seaweeds (marine macroalgae) species such as *P. fraseri*, *C. lentillifera*, *P. palmata*, *S. wightii*, *D. dichotoma* and *J. rubens* from Leepuram and Vattakottai coasts of Kanyakumari district was determined. The samples were collected in two seasons, pre monsoon (Sep.2015) and post monsoon (Dec.2015). The carbohydrate content of the selected six seaweeds varied from 30.7 ± 0.48 % dw to 58.9 ± 0.92 % dw, the protein content of the selected six seaweeds ranged from10.7 ± 0.30 % dw to 19.7 ± 0.55 % dw, the level of lipid of the selected six seaweeds varied from 0.6 ± 0.03 % dw to 3.8 ± 0.18% dw. Among the six seaweeds, *C. lentillifera* contained higher amount of carbohydrate (58.9 ± 0.92% dw), *P. fraseri*possessed higher amount of protein (19.7 ± 0.55%dw) however *D. dichotoma* possessed maximum lipid (3.8 ± 0.18%dw). The study of seasonal variation showed that the best season for harvesting seaweeds for food is post monsoon season. The carbohydrate and protein content are found maximum in the samples from Leepuram coast and lipid content is found maximum in the samples from Vattakottai coast.

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