Seaweed Res. Utiln., 24 (1) : 73 - 77, 2002

Seasonal changes in growth, biochemical constituents and phycocolloid of some marine algae of Mandapam coast

N. KALIAPERUMAL, J. R. RAMALINGAM, S. KALIMUTHU AND R. EZHILVALAVAN
Regional Centre of Central Marine Fisheries Research Institute
Marine Fisheries - 623 520, Mandapam Camp, India

ABSTRACT

Seasonal variation in growth and biochemical constituents such as protein, carbohydrate and lipid in *Hypnea valentiae, Acanthophora spicifera, Laurencia papillosa, Enteromorpha compressa, Ulva lactuca* and *Caulerpa recemosa* were observed for one year from April, 1995 to March 1996. Carrageenan content was estimated from *H. valentiae, A. spicifera* and *L. papillosa.* In general, peak growth and biomass of these algae occurred during the period June - August and January - March. The maximum values in these algae varied from 12.5 to 13.2% for protein, 13.0 to 13.3% for carbohydrate and 10.3 to 12.0% for lipid. The yield of phycocolloid recorded 11.3%, 6.0% and 8.1% in *H. valentiae, A. spicifera* and *L. papillosa* respectively.

Introduction

Studies on the biochemical constituents such as protein, carbohydrate and lipid in green and brown marine algae have been carried out from different parts of Indian coast (Dave and Parakh 1975; Dhargalkar *et.al.*, 1980; Sumitra Vijayaraghavan *et. al.*, 1980; Dave *et. al.*, 1987; Parekh and Chauhan, 1987; Sobha *et. al.*, 1988 and 1992; Chennubhotla *et. al.*, 1990; Reeta *et. al.*, 1990; Kumar, 1993; Kaliaperumal *et. al.*, 1994; Ganesan and Kannan, 1994). Only very few of these studies were on the seasonal changes of biochemical constituents. The information available on the phycocolloid content of red algae is scanty (Rama Rao, 1970; Rama Rao and Krishnamurthy, 1978; Subba Rao *et. al.*, 1977; Solimabi *et. al.*, 1980; Thomas and Subbaramaiah, 1994). Hence studies were made for one year from April, 1995 to March, 1996 on the seasonal changes in protein, carbohydrate and lipid contents of six economically important seaweeds *Hypnea valentiae, Acanthophora spicifera, Laurencia papillosa, Enteromorpha compressa, Ulva lactuca* and *Caulerpa racemosa* in relation to their growth behaviour. Phycocolloid was estimated in *H. valentiae, A. spicifera* and *L. papillosa.* Data collected on these aspects are presented in this paper.

Materials and Methods

Plants of *Hypnea valentiae* (Turner) Montagne, *Acanthophora spicifera* (Vahl) Boergesen and *Laurencia papillosa* (C. Agardh) Greville from Pudumadam and *Ulva lactuca*

Linnaeus, *Enteromorpha compressa* (Linnaeus) Lees and *Caulerpa racemosa* (Forsskal) J. Agardh from Kilakkarai were collected at fortnightly intervals for one near from April, 1995 to March, 1996. The materials were collected randomly from 10 to 12 quadrats of 1.0 m^2 area in the intertidal and subtidal region upto 0.5 m depth. The wet weight for all these algae were taken whereas the height of 50 plants were taken randomnly for the red algae only. The samples were brought to the laboratory, cleaned thoroughly in fresh water followed by distilled water, dried in oven at 60 - 70°C, pulverised and sieved. The dried powder was used for estimating the protein, carbohydrate and lipid.

The protein was estimated after extraction with NaOH (Lowry *et. al.*, 1951). Carbohydrate was analysed by phenol-sulphuric acid method of Dubois *et. al.* (1956). The lipid was extracted by the method suggested by Folch *et. al.* (1957) and estimated by sulphospho-vanillin method (Barnes *et. al.*, 1973). Materials for each of *H. valentiae, A. spicifera* and *L. papillosa* collected in different months were mixed and phycocolloid was estimated following the method of Ji Ming Hou (1995). In this method 10 g of bleached and dried sample was taken, cut into small pieces and washed with fresh water. Then it was boiled at 60-70°C with 300 ml of 5% KOH solution for one hour. It was filtered wtih 80 mesh bolting silk and the filtrate was neutralised with dilute hydrochloric acid. Then 300 ml distilled water was added and heated at 85°C for 2 hours. Again it was filtered in hot condition using 80 mesh bolting silk cloth. The filtrate was cooled at room temperature, cut into strips and freeze-thawed. The values are expressed as percentage in dry weight basis.

Results

Data collected on the seasonal changes in growth and biomas of *H. valentiae, A. spicifera* and *L. papillosa* are given in Fig. 1and 2. In *H.valentiae,* minimum biomass of

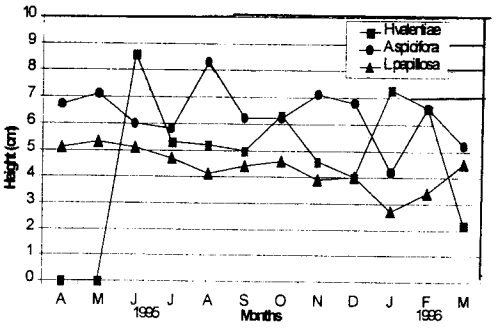


Fig. 1. *Monthly changes in the height of red algae.*

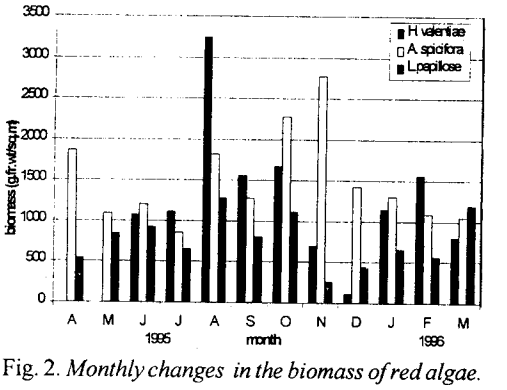
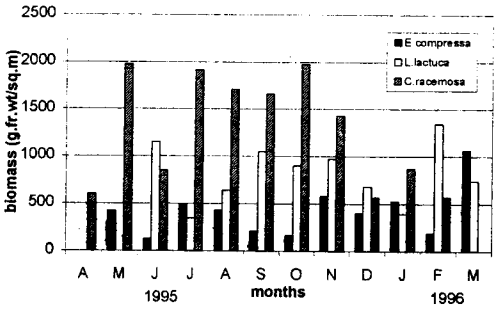


Fig. 2. *Monthly changes in the biomass of red algae.*

408 g fr. wt/m^2 in December and maximum biomass of 3240 g fr. wt/m^2 in August were obtained. Plants with minimum height of 2.2 cm in March and maximum height of 8.6 cm in June were observed. The biomass of *A. spicifera* varied from 856 g fr. wt / m^2 in July to 2272 g fr. wt/m^2 in October. The mean height of plants varied from 4.2 cm in January to 8.3 cm in August. In *L. papillosa,* the biomass ranged from 260 to 1280 g fr. wt/m^2 during November and August respectively. Plants with minimum growth of 2.7 cm in January and maximum growth of 5.3 cm in May were recorded.

Data collected on the seasonal variation in the biomass of *E. compressa, U. lactuca and C. racemosa* are shown in Fig.3.



months

Fig. 3. *Monthly changes in the biomass of green algae*

The biomass of *E. compressa* was low (128 g fr. wt/m2) in June and high (1064 g fr. wt/m^2) in March. In *U. lactuca*, minimum biomass of 346 g fr. wt/m^2 in July and maximum biomass of 1343 g fr. wt/m^2 in February were registered. In *C. racemosa,* the minimum and maximum values for biomass were 566 and 1980 g fr. wt/ m^2 during the month of December and May respectively.

The seasonal variation observed in protein, carbohydrate and lipid contents of the six algae are given in Tables 1 to 3 respectively. In general, there was no much seasonal variations in these biochemical constituents in all the algae. The protein content varied from 11.4% to 13.2%, carbohydrate from 11.6 to 13.3% and lipid from 8.9 to 12.0%. The estimated phycocolloid values were : 11.3% in *H. valentiae,* 6.0% in *A. spicifera* and 8.1% in *L. papillosa.*

Discussion

In the present investigation, maximum stature and biomass of the six algae were recorded during the periods from June to August and January to March. This finding generally agrees with the observations of Umamaheswara Rao (1972) on the growth of

Table 1. *Protein content (% dry wt) in marine algae of Mandapam Coast*

Month	*H valentiae*	*A.spicifera*	*L.papillosa*	*E.compressa*	*U. lactuca*	*C.racemosa*
April'95	-	13.2	12.0	-	-	12.0
May	-	13.2	11.8	13.0	-	12.0
June	11.8	12.4	12.8	12.8	12.6	11.8
July	11.8	12.1	12.6	12.6	11.5	12.3
August	12.0	12.1	12.9	12.4	11.8	12.0
September	12.6	12.7	12.8	12.2	11.5	12.5
October	12.5	12.8	12.9	12.4	11.8	12.5
November	12.5	12.0	11.8	12.2	12.1	12.0
December	12.7	12.5	12.0	12.4	12.0	12.0
January'96	12.0	12.0	12.0	12.0	12.0	12.2
February	12.3	12.6	12.3	12.4	11.6	12.1
March	11.9	13.0	12.1	12.0	11.4	-

Table 2. *Carbohydrate content (% dry wt) in marine algae of Mandapam Coast*

Month	*H.valentiae*	*A.spicifera*	*L.papillosa*	*E.compressa*	*U. lactuca*	*C.racemosa*
April'95	-	13.2	13.0	-	-	12.0
May	-	12.4	12.1	13.0	-	12.6
June	12.4	12.4	12.4	12.4	13.2	12.4
July	12.1	11.8	12.9	12.4	12.1	12.4
August	11.8	11.6	12.8	12.6	12.2	13.0
September	12.0	12.4	12.9	12.4	12.5	12.8
October	11.6	12.3	13.3	12.0	12.0	12.8
November	13.0	11.8	12.0	12.2	11.6	12.8
December	12.4	11.8	12.6	12.0	12.4	12.2
January'96	11.8	11.7	12.8	11.8	12.0	12.4
February	12.0	12.0	12.5	11.6	12.6	12.0
March	12.0	12.1	12.0	12.2	12.4	-

Table 3. *Lipid content (% dry wt) in marine algae of Mandapam Coast*

Month	*H.valentiae*	*A.spicifera*	*L.papillosa*	*E.compressa*	*U. lactuca*	*C.racemosa*
April'95	-	10.4	9.8	-	-	9.0
May	-	10.0	9.6	10.3	-	9.8
June	10.0	10.6	10.8	9.6	10.2	9.0
July	9.6	10.8	10.0	9.8	9.6	9.8
August	9.8	10.8	10.5	9.2	10.0	10.0
September	11.4	10.0	9.6	9.8	9.6	10.0
October	11.6	11.0	9.0	9.0	10.0	10.5
November	10.0	10.2	9.2	9.6	11.4	9.6
December	11.0	10.6	9.0	9.4	10.5	9.8
January'96	11.5	10.4	9.2	9.2	11.2	9.0
February	11.6	10.5	9.4	9.6	10.0	9.0
March	11.4	12.0	8.9	9.0	10.4	-

Enteromorpha compressa, brown and red algae of Gulf of Mannar and Palk Bay. There was no marked seasonal variation in the protein, carbohydrate and lipid contents of the six algae studied. The values obtained for these biochemical constituents in the present study agree with the values obtained for the same species growing at Mandapam area (Parekh and Chauhan 1987; Chennubhotla *et. al.,* 1990; Reeta *et. al.,* 1990), Tuticorin (Kumar, 1993; Ganesan and Kannan, 1994). Goa coast (Sumitra Vijayaraghavan *et. al.,* 1980; Solimabi *et. al.,* 1980), Maharashtra coast (Dhargalkar *et. al.,* 1980), Gujarat coast (Dave and Parekh, 1975; Parekh and Chauhan, 1987; Dave *et. al.,* 1987) and Lakshadweep (Kaliaperumal *et. al.,* 1994). The phycocolloid contents of *H. valentiae, A. spicifiera* and *L. papillosa* growing at Pudumadam were found to be low in the present study when compared with the phycolloid contents of *H. valentiae, A. spicifera* and *L. papillosa* occurring at Mandapam (Subba Rao *et. al.,* 1977; Rama Rao and Krishnamurthy, 1978) and *H. musciformis* of Veraval (Rama Rao and Krishnamurthy, 1978) and Goa coast (Solimabi *et. al.,* 1980). This variation may be due to the habitat of these algae in the surf exposed rocky coast and their stature. It may be also due to the variation in the methods of phycocolloid extraction.

Acknowledgement

The authors are thankful to Dr. M. Devaraj, Former Director, CMFRI, Cochin for encouragement and facilities provided in carrying out this investigation at the Regional Centre of Central Marine Fisheries Research Institute, Mandapam Camp.

Literature cited

Barnes, H. and J. Blackstock 1973. Detailed investigation of the *sulphospho vanillin* method for total lipid. *J. Exp. Mar. Biol. Ecol.,* 12 : 103-118.

Chennubhotla, V. S. K., M. Najmuddin, J.R. Ramalingam and N. Kaliaperumal 1990. Biochemical composition of some marine algae from Mandapam Coast, Tamilnadu. *CMFRI Bulletin,* 44 (Part - 2) : 442 - 446.

Dave, M. J. and R. G. Parekh 1975. Protein content of green seaweeds of Sourashtra coast. *Salt Res. Ind.,* 11 : 41.

Dave,M.J., R.G.Parekh, B.K.Ramavat, Y.A.Doshi and V.D. Chauhan 1987. Protein contents of red seaweeds from Gujarat coast. *Seaweed Res. Utilin.,* 10 (1 & 2) : 17-20.

Dhargalkar, V.K., T.J. Jagtap and A.G. Untawale 1980. Biochemical constituents of seaweeds along the Maharashtra coast. *Indian J. Mar. Sci.,* 9(4) : 297-299.

Dubois,N., K.A. Gills, J. K. Hamilton, P.A. Rober and F. Smith 1956. Colorimetric method of determination of sugars and related substances. *Anal. Chem.,* 28 : 1-350.

Folch, J., M. Less and G. H. Stores-Stanley 1957. A simple method for the isolation and purification of total lipid from animal tissues. *J. biol. Chem.*, 226 : 497-505.

Ganesan, M. and L. Kannan 1994. Seasonal variation in the biochemical constituents of economic seaweeds of Gulf of Mannar. *Phykos*, 33 (1 & 2) : 125-135.

Ji Ming Hou 1995. Laboratory methods for qualification of red seaweeds and their polysaccharides. *Processing /Analysis, SW / REF / 02, Final workshop of the Regional study on the taxonomy, ecology and processing of commercially important red seaweeds.* NAGA, Bangkok, Thailand.

Kaliaperumal, N., V. S. K. Chennubhotla, M. Najmuddin, J. R. Ramalingam and S.Kalimuthu 1994. Biochemical composition of some common seaweeds from Lakshadweep. *J. Mar. Biol. Ass. India*, 36 (1 & 2) : 316 - 319.

Kumar, V. 1993. Lipid content of some algae from Tuticorin. *Seaweed Res. Utiln.*, 16 (1 & 2) : 45-48.

Lowry, O.H., N. J. Rosebrough, A. L. Fan and R. Z. Randell 1951. Protein measurement with Folin-Phenol reagent. *J. Biol. Chem.*, 193 : 265-275.

Parekh, R. G. and V. D. Chauhan 1987. Lipid content of some Indian seaweeds. *Indian J. Mar. Sci.*, 16 : 272-273.

Rama Rao, K. 1970. Studies on growth cycle and phycocolloid content in *Hypnea musciformis* (Wulf.) Lamour. *Bot. Mar.*, 13 : 163-165.

Rama Rao, K. and V. Krishnamurthy 1978. Studies on Indian Hypneaceae. I. Seasonal variation in phycocolloid content in two species of *Hypnea* (Gigartinales, Rhodophyceae). *Bot. Mar.*, 21 : 257-259.

Reeta Jayasankar, J. R. Ramalaingam and N. Kaliaperumal 1990. Biochemical composition of some green algae from Mandapam coast. *Seaweed Res. Utiln.*, 12 (1 & 2) : 37-40.

Sobha, V., K. S. Mayadevi and T. Vasudevan Nair 1988. Proximate composition of certain algae at Kovalam, SW coast of India. *Seaweed Res. Utiln.*, 11 : 31-38.

Sobha, V., Meera Surendran and T. Vasudevan Nair 1992. Heavy metal and biochemical studies of different groups of algae from Cape Comorin and Kovalam. *Seaweed Res. Utiln.*, 15 (1 & 2) : 77-85.

Solimabi, R., Dass, S. Y. Kamat, L. Fernandes and C.V.G. Reddy 1980. Seasonal changes in carrageenan and other biochemical consituents of *Hypnea musciformis*. *Indian J. Mar. Sci.*, 9 : 134-136.

Subba Rao, P. V., K. Rama Rao and K. Subbaramaiah 1977. Screening of certain seaweeds for phycocolloids. *Seaweed Res. Utiln.*, 2(2) : 82-86.

Sumitra Vijayaragahavan, M. D. Rajagopal and M. V. M. Wafar 1980. Variation in biochemical composition of some seaweeds from Goa coast. *Indian J. Mar. Sci.*, 9 : 61-63.

Thomas, P. C. and K. Subbaramaiah 1994. Seasonal variation in growth and phycocolloid content in *Hypnea pannosa* J. Agardh (Gigartinales, Rhodophyta) from Mandapam region. *Proc. Indian Natl. Sci., Acad.*, B 60, No. 1 : 93-98.

Umamaheswara Rao, M. 1972. Ecological observations on some intertidal algae of Mandapam coast. *Proc. Ind. Natl. Sci., Acad.*, 38, B (3& 4) : 298-307.