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Analysis of algal cell elements collected from temple tanks, rock ponds and seashore in Kovalam and Mahabalipuram, Tamil Nadu, India

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Abstract

Four species of micro and macroalgae collected from Mahabalipuram and Kovalam were analyzed for their elemental composition with the help of Perkin Elmer Optima DV Inductively Couple Plasma – Optical Emission Spectroscopy. Several significant elements e.g., Calcium, Magnesium, Sodium, Potassium and Iron were detected quantitatively. Calcium, Potassium, Magnesium were found in large amounts (22.461 – 626.385 ppm), Iron and Sodium were present in small quantities (2.391 – 6.167 ppm). The average quantity of Potassium was found to be highest among these algae (626.385 ppm), followed by Calcium (65.253 ppm) and Magnesium (22.461 ppm) and low quantity of Sodium (6.167 ppm) and Iron (2.391 ppm).

Keywords: micro algae, macro algae, elements, temple tanks, rock ponds, seashore

INTRODUCTION

Algae concentrate minerals and trace elements from both fresh and marine water which are in an organic form (Chapman & Chapman, 1980). Seaweeds grow in a mineral rich medium. The numerous elements coming from the sea are Ca, Cl, Cu, I, Mg, Mn, Na, P, S and Zn (Javis, 1976). The green algae have relatively high mineral contents of Ca, K, Mg, Na and trace elements upto 38.9% (Marderosian, 1972). It seems that the tropical seaweeds tend to accumulate more Fe than Cu, Mn and Zn (Ganesan *et al.,* 1991). The variation of elements is attributed to environmental fluctuation in the form of availability of Ca, K, Mg and Na in seawater, rock ponds, and temple tanks or it may be a function of metabolic activity within the cellular matrix of the seaweeds and fresh water algae (Ilyas & Sukan, 1994). Kovalam and Mahabalipuram, being the coastline of about 25 km includes beaches. The Kovalm around beach and temple tank & Mahabalipuram around beach, temple tank and rock ponds. In their Kovalm and Mahabalipuram side lot of work has been done on their taxonomy, distribution, morphoecological studies, phycochemistry and pharmacology but not much data related to their elemental composition is available. Studies were therefore carried out to examine the distribution of elements in micro and macroalgae on the Kovalm and Mahabalipuram.

MATERIALS AND METHODS

Collection of micro and macroalgae

The healthy and mature specimen of different species of micro and macroalgae were collected from sandy bays, large and shallow sand bottom flats, small and large pools or sandy bottom, temple tanks, rock ponds on various areas of Kovalam beach , Kovalam temple tanks, Mahabalipuram rock ponds and Mahabalipuram temple tanks point during September 2010 and February 2011. The microalgae were collected airtight bottle and kept in ice box containing slush ice and macroalgae were picked up as drift material. The collected microalgae immediately transported to the laboratory, the coarser material was removed by filtration through a mesh net. The algal samples were preserved in 4% formalin (aqueous solution of formaldehyde) and the macroalgae were brought to the laboratory where they were washed immediately with running water to remove foreign particles, sand, epiphytes and attached debris and later by distilled water.

The temperature, rainfall and soil pH for the duration of September 2010 to February 2011, the values for the mentioned factors are given in the result and discussion. The values are confirmed and refereed by India Meteorological Department, Nungambakkam, Chennai

Acid digestion of the micro and macroalgae

The microalgal material after centrifuge was dried under shade at room temperature and later on in an oven at 30˚C for 5 min and macroalgae material was dried under shade at room temperature and later on in an oven at 60˚C - 80˚C for one hour. It was powdered through pestle and mortar. The algal powder sample 15 – 20mg taken for acid digestion. The sample was dissolved in the acid solution of aquas regia. After microdigestion for 15 min, the solution was then diluted to final volume with 25ml of distilled water, mixed well and made ready for ICP – OES reading.

Elemental Assay

Inductively coupled plasma – Optical emission spectroscopy (ICP – OES, Model Perkin Elmer Optima 5300 DV, IIT Chennai) was used for estimating Calcium, Iron, Potassium, Sodium and Magnesium. The assay for specific elements were strictly followed as laid down in the operational manual (Rizvi *et al.,* 2000).

RESULT AND DISCUSSION

The abiotic factors variations in the major and minor constituents of green algae like soil pH, temperature, and monthly rainfall on various areas of kovalam and mahabalipuram during September

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2010 to February 2011 are as following.

Maximum and Minimum level of temperature during September 2010 to February 2011 as, Sep - 28˚C max / 19˚C mini, Octo - 28˚C max / 19˚C mini, Nov - 27˚C max / 17.5˚C mini, Dec - 26˚C max / 16˚C mini, Jan - 26˚C max / 15˚C mini and Feb - 30˚C max / 18˚C mini.

Monthly rains fall during September 2010 to February 2011 are, Sep – 110mm, Oct – 280mm, Nov – 350mm, Dec – 140mm, Jan – 20mm and Feb – 5mm.

Soil pH of the micro and macroalgae present in the collection areas are from Kovalam and Mahabalipuram. The collected Micro and Macro algae are *Enteromorpha flexuosa* collected from Kovalam pH – 6.70, *Tetraselmis suecica* collected from Kovalam temple tank pH – 6.74, *Dunaliella tertiolecta* collected from Mahabalipuram temple tank pH – 5.77 and *Chlorella vulgaris* collected from Mahabalipuram rock ponds pH – 6.97. The present investigation only concentrates on element composition of algae in species level.

Four algae species of micro and macroalgae were investigated, four algae belonged to Chlorophyta. The amounts of all the elements detected in these species have been presented in Table 1. Among these elements Calcium, Potassium, Magnesium was found in large amounts (average between 22.461 – 626.385 ppm). *Dunaliella tertiolecta* was observed to be rich in Potassium showing a maximum in September (808.213 ppm). Iron was found in highest concentration among the trace elements without any correlation with season, the maximum value (5.128 ppm) was found in September and minimum (0.120 ppm) in December (Ilyas & Sukan, 1994). The trace metal distribution in seaweeds of Indian Ocean has been reported to be Iron n128.09 – 1796.22 ppm (Agadi *et al.,* 1978). Potassium was also found in large quantity, Magnesium in Medium quantity and Iron in small amount in green algae. In the present study the average quantity of Potassium was found to be the highest among these algae (626.385 ppm), followed by Calcium (65.253 ppm) with an average amount of Magensium (22.461 ppm). Sodium was detected in the lowest quantity (6.167 ppm) followed by Iron (2.391 ppm) (Rizvi *et al.,* 2001).

The Calcium content was observed the highest level from green algae *Enteromorpha flexuosa* (80.17 ppm) and the lowest level were obtained from the same green alga *chlorella vulgaris* (50.297 ppm). The middle level of Calcium content was observed from *Dunaliella tertiolecta* (60.277 ppm) and *Tetraselmis suecica* (70.271 ppm) Fig. 2. The Iron concentration was ranged from (0.120-5.128 ppm); here the highest level of Iron element concentration was observed from green alga *Dunaliella tertiolecta* (5.128 ppm) and minimum level was attained at green alga *Tetraselmis suecica* (1.128 ppm) and *Chlorella vulgaris* (3.190 ppm) Fig. 3.

Potassium level was varied from (480.917-808.213 ppm); in that the maximum level was recorded (808.213 ppm) from green alga member *Dunaliella tertiolecta* and the minimum level was observed at the same green alga member *Chlorella vulgaris* (480.917 ppm). The maximum level followed by *Enteromorpha flexuosa* (688.2 ppm) and *Tetraselmis suecica* (528.210 ppm). Fig. 4. Sodium element concentration was recorded maximum from green alga *Dunaliella tertiolecta* (9.120 ppm) and the minimum level was observed at the same green alga *Enteromorpha flexuosa* (0.180 ppm). Fig. 5. (Devi *et al.,* 2009).

The Magnesium was attained the maximum level from green alga *Chlorella vulgaris* (30.128 ppm) and the lowest level were observed from the green alga *Enteromorpha flexuosa* (13.28 ppm). Then comparing other elements concentration of green alga both *Dunaliella tertiolecta* and *Tetraselmis suecica* having same level of Magnesium level (23.218 ppm). Fig. 6.

Table 1. Distribution of elements in Micro and Macroalgae of Kovalam and Mahabalipuram.

Algae		Calcium (ppm)	Iron (ppm)	Potassium (ppm)	Sodium (ppm)	Magnesium (ppm)
Enteromorpha flexuosa (Wulfen)	J. Agardh	80.17	0.120	688.2	0.180	13.28
Chlorella vulgaris (Beijering)		50.297	3.190	480.917	8.250	30.128
Dunaliella tertiolecta (Butcher)		60.277	5.128	808.213	9.120	23.218
Tetraselmis suecica (kylin) Butcher		70.271	1.128	528.210	7.120	23.218
Average		65.253	2.391	626.385	6.167	22.461

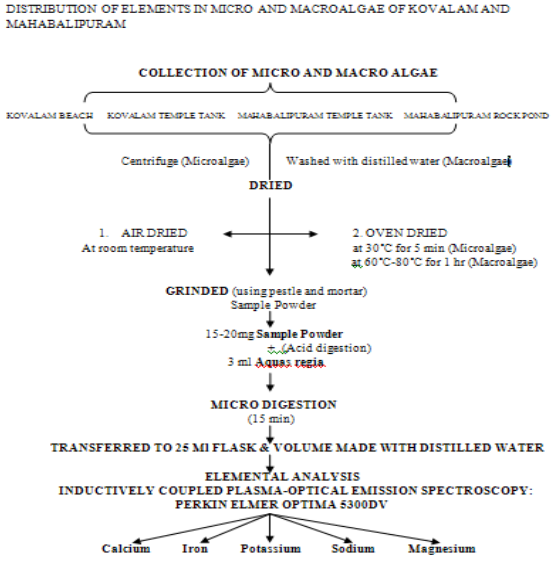

Fig 1. Scheme for the elemental composition of Micro and Macroalgae of the Kovalam and Mahabalipuram

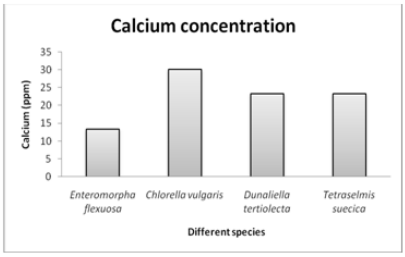

Fig. 2. Shows the Calcium concentration of different micro and macroalgae

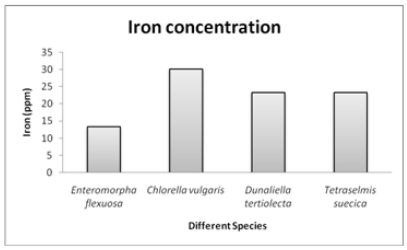

Fig. 3. Shows the Iron concentration of different micro and macroalgae

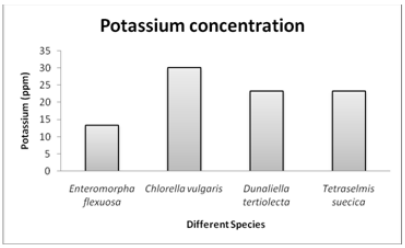

Fig. 4. Shows the Potassium concentration of different micro and macroalgae

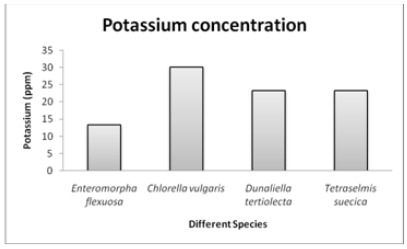

Fig. 5. Shows the Sodium concentration of different micro and macroalgae

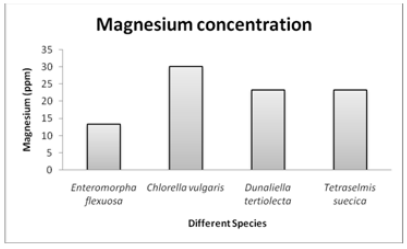

Fig. 6. Shows the Magnesium concentration of different micro and macroalgae

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