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Water and sediment parameters at the algae culture area of Salimpur coast Chittagong

Abstract

Macro-benthic algae *Catenella nipae* was cultured from November '06 to August '07 at the Salimpur planted mangrove area. Some physico-chemical parameters of the study area were recorded during the culture period and found as water temperature ranges from 24.0 to 31.5˚C, salinity from 6.0 to 21.0‰, dissolved oxygen (DO) from 3.8 to 5.8ml/l, water pH from 7.2 to 8.4, total dissolved solids (TDS) from 410 to 598mg/l, total suspended solids (TSS) from 50 to 118mg/l, Total alkalinity from 95 to118 ppm, NO_2-N from 0.18 to 0.47mg/l, NO_3-N from 0.56 to 0.69mg/l, PO_4-P from 0.90 to1.10mg/l, HCO_3 from 69.88 to 93.80mg/l. The soil texture of the study area was sandy clay loam. Soil organic carbon, soil organic matter, soil PO_4-P, soil pH were ranges from 2.22-2.37%, 4.22-4.51%, 1.10-1.39mg/100g and 5.9-6.7 respectively. Physico-chemical parameters of both water and soil revealed that the coastal area of Salimpur could be a significant place for *C. nipae* cultivation.

Volume 4 Issue 1 - 2019

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Received: February 11, 2019 | **Published:** February 22, 2019

Introduction

Seaweeds are sedentary organisms, growing on the rocky or hard substratum of intertidal water of World Ocean.[1] They belong to the group of plants known as algae containing some of the most primitive members of the plant kingdom.[2] Okazaki stated,[3] "Seaweeds as the name implies covers the macroscopic plant life of the sea except the flowering plants". It has immense importance both for human and faunal communities. Prehistorically, people have been consuming seaweed either raw or cooked condition. Novaczek[4] reported that seaweeds have large amount of protein, amino acids, lipids, vitamins and minerals, polysaccharides and dietary fibers. Some compounds of seaweeds control high blood pressure, level of cholesterol, and prevent strokes. These can also be used as remedy for rheumatism, diarrhea, and for controlling the growth of tumors.

These culture systems have lot of advantages; components are locally available and cheap, organic and environmental friendly, and easy-to-setup. Generally, seaweed cultivation, as such, is more economically viable for stakeholders over other aqua-species. Given the large coastal water bodies and naturally available seeds, it is by and large accessible to farmers. With the initiation of seaweed culture, coastal people can diversify their income opportunities and change their pattern of livelihood. Other than using seaweed as their dietary items (to meet their nutritional requirements), farmers would be able to export it to foreign markets.

The study is first experiment of *Catenella nipae* culture on bamboo poles in the intertidal waters of Salimpur coast in Bangladesh where plenty of *C. nipae* grows naturally and remains unutilized. To grow interest on algae the present investigation was carried out.

Materials and method

Study area

The investigation was carried out on November 2006 to August 2007 at Salimpur mangrove area. The geographical position of the lower portion of Salimpur mangrove area was latitude 22˚15" N and longitude 91˚49" E. The bottom is sandy-clay. This area is almost fertile to grow algae especially *Catenella nipae.* It was available on the pneumatophores and other hard substrate of this mangrove area. Salimpur mangrove area about 15km off from Chittagong Port City and is one of the planted mangrove area of Bangladesh.[5] Tidal condition was semidiurnal type observed in the study area.

Sample collection

Water samples were collected during low tide. Samples were collected with clean plastic bottles. Soil sample were collected from the intertidal mangrove areas and taken to plastic bag.

Analysis

Dissolved Oxygen was determined as following as Winkler's method, APHA (1976).[6] Total Dissolve Solids was determined following the method of APHA (1976).[6] Total suspended solid was detected by following procedure described by APHA (1976).[6] Total alkalinity was determined by following the Titrimetric method according to APHA (1976).[6] Nitrite was determined according to the method of Strickland and Parson, 1965.[7] Nitrate was determined by Strickland and Parson, 1965.[7] Phosphate was determined by the method of Murphy and Riley, 1961.[8] HCO_3 was determined by following APHA (1976).[6] BOD was determined by following APHA (1976).[6]

In the laboratory soil Organic Carbon was determined according to the method of Jackson (1958).[9] Organic Matter content in soil was obtained by multiplying the volume of organic carbon with 1.72. Phosphate that remains as total inorganic phosphate nutrient in soil was determined by a modified single solution method of Murphy and Riley, 1961.[8] Hydrogen ion concentration (pH) is measured by using digital soil pH meter. Soil texture was detected following the procedure described by APHA (1976).[6]

Results

Water parameters

The average water temperature was recorded as (29.05±2.45˚C) in the overall sampling period whereas the highest water temperature (31.5˚C) was recorded on June 2007 and the lowest water temperature (24˚C) on February 2007 (Table 1). Mean water salinity was observed

as (14.30±5.35‰). Highest salinity was found 21‰ on March 2007 and lowest value was recorded as 6‰ on August 2007 (Table 1). The average D.O was recorded (4.95±0.62ml/l). Concentration of dissolved oxygen was highest 5.80ml/l on July 2007 and lowest value 3.80ml/l on December 2007 (Table 1). The average water pH was (7.78±0.37). Maximum water pH 8.4 on February 2007 and minimum value was recorded 7.2 on August 2007(Table 1). The average TDS was recorded as (541.10±59.35mg/l), the highest water TDS value 598.00mg/l was recorded on July 2007 and the lowest TDS value 410.00mg/l on February 2007 (Table 1). The average TSS was recorded as (76.30±22.01mg/l), the highest water TSS value 118.00mg/l was recorded on Augus 2007 and the lowest TSS value 50.00mg/l on April 2007 (Table 1). The average total alkalinity was recorded as (107.40±6.92 ppm), the highest value 118.00ppm was recorded on February 2007 and the lowest value 95ppm on August 2007 (Table 1). Mean NO_2-N was observed as 0.34±0.09mg/l. Highest NO_2-N value was found 0.47mg/l on June 2007 and lowest value 0.18mg/l was recorded on February 2007 (Table 1). Mean NO_3-N was observed as 0.65±0.05mg/l. Highest NO_3-N value was found 0.69mg/l on May 2007 and lowest value 0.56mg/l was recorded on January 2007 (Table 1). Mean PO_4-P was observed as 0.99±0.06mg/l. Highest PO_4-P value was found 1.10mg/l on January 2007 and lowest value 0.90mg/l was recorded on June 2007 (Table 1). Mean HCO_3 was observed as 81.33±4.50mg/l. Highest HCO_3 value was found 93.80mg/l on June 2007 and lowest value 69.88mg/l was recorded on February 2007 (Table 1). The average BOD was recorded 1.86±0.17ml/l. Highest value was 2.16ml/l on November 2006 and lowest value 1.56ml/l on June 2007(Table 1).

Table 1 Physico-chemical parameters of tidal water in the culture site of C. nipae (November 06 to August 07)

Month	Water Temp. ˚C	Salinity ppt	D.O ml/l	Water pH	T.D.S mg/l	T.S.S mg/l	T.A ppm	NO_2-N mg/l	NO_3-N mg/l	PO_4-p mg/l	HCO_3 mg/l	BOD ml/l
November	26	10	4.5	7.5	585	78	115	0.38	0.69	1.01	70.8	2.16
December	28	18	3.8	7.7	547	65	110	0.36	0.66	1.09	75.33	2.05
January	30	20	4.2	7.9	498	69	102	0.25	0.56	1.1	73.25	2
February	24	16	5.3	8.4	410	58	118	0.18	0.65	0.99	69.88	1.98
March	31	21	5.8	8.2	467	57	113	0.22	0.61	0.96	71.8	1.92
April	30	20	5.2	7.9	563	50	111	0.37	0.58	0.97	85.05	1.88
May	30	15	4.8	8.1	578	67	107	0.35	0.69	0.99	92.98	1.78
June	31.5	10	4.9	7.4	593	89	103	0.47	0.68	0.9	93.8	1.56
July	30.27	7	5.8	7.5	598	112	100	0.42	0.69	0.93	91.87	1.63
August	29.75	6	5.2	7.2	572	118	95	0.4	0.69	0.95	88.56	1.67

DO, dissolved oxygen; TDS, total dissolved solid; TSS, total suspended solid; TA, total alkalinity; BOD, biological oxygen demand; COD, chemical oxygen demand

Soil parameters

The average organic matter was recorded as 4.39±0.10%, the highest value was 4.51% was recorded on January 2007 and the lowest value 4.22% on July 2007 (Table 2). The average organic carbon was recorded as 2.31±0.05%, the highest value was 2.37% was recorded on November 2006 and January 2007 respectively and the lowest value 2.22% on July 2007 (Table 2). Average PO_4-P was observed as 1.28±0.10mg/100g. Highest PO_4-P value was found 1.39mg/100g on August 2007 and lowest value 1.10mg/100g was recorded on March 2007 (Table 2). The average soil pH was 6.30±0.28. Maximum soil pH 6.7 on January 2007 and minimum value was recorded 5.9 on August 2007 (Table 2). The soil texture of the study area was sandy clay loam. Sand ranges from 67.00% to 72.68%, Clay ranges from 23.69% to 29.60%, Silt ranges from 2.50% to 5.11% during the whole study period (Table 2).

Table 2 The physico-chemical parameters of soil in the culture site of C. nipae (November 06 to August 07)

Month	% of Organic carbon	% of Organic matter	PO4-P mg/100g	Soil pH	Soil texture			Classification of soil
					% of Sand	% of Clay	% of Silt	
November	2.37	4.5	1.16	6.1	67.58	27.85	4.57	Sandy Clay loam
December	2.35	4.48	1.27	6	68	29.12	2.88	
January	2.37	4.51	1.38	6.7	67.95	28.86	3.19	
February	2.34	4.46	1.26	6.5	67	29.6	3.4	
March	2.31	4.4	1.1	6.6	69.55	26.9	3.55	
April	2.27	4.33	1.15	6.5	70	24.88	5.11	
May	2.24	4.26	1.33	6.5	72.68	23.69	3.63	
June	2.26	4.3	1.36	6.2	71.9	25.6	2.5	
July	2.22	4.22	1.35	6	70.55	26.53	2.92	
August	2.34	4.45	1.39	5.9	69.88	26.95	3.17	

Citation: Uddin MR. Water and sediment parameters at the algae culture area of Salimpur coast Chittagong. *MOJ Eco Environ Sci.* 2019;4(1):39–42. DOI: 10.15406/mojes.2019.04.00130

Discussion

The growth of seaweeds is governed by various factors like temperature, salinity, pH, dissolved oxygen, water transparency; nutrients Lunning (1990).[10] His studies found that for the growth of tropical seaweeds the optimum water temperature ranges between 15-30˚C. The findings of the present investigation are exclusively agreed with the above mentioned report. Meade[11] recommended standard water quality for aquaculture as water pH 6.5-8, DO 5mg/l, and alkalinity 10-400ppm. The mean D.O value was found (4.95±0.62) ml/l in the present investigation which is quite satisfactory for normal growth and functioning of aquatic organisms. While the standard values of D.O of the coastal water of Bangladesh is 6ml/l.[12] So the present findings are exclusively agreed with the above information. The environmental quality standard value of pH of coastal water of Bangladesh is 6-9. Zafar[13] found, the water temperature, salinity, pH, DO ranged from (30-33˚C), (6-16ppt), (6.9-7), (2.95-5.77ml/l) at the Fauzdarhat planted mangrove area. The present study also showed similar trend of results. Hossain[14] recorded water temperature, salinity, water pH, DO ranged from (20-29˚C), (6.5-16ppt), (6.8-7.4), (3.77-5.50ml/l) at the Fauzdarhat mangrove area. In the present investigation recorded water temperature, salinity, DO, water and soil pH were more or less similar to the above mentioned report. Talukder[5] recorded water temperature ranged between 11.65-31.40˚C, water pH 6.27- 7.75, dissolved oxygen 2.34-5.71ml/l, salinity ranges from 6.51-16.30ppt, total suspended solids ranges between 112.03mg/l to 343.34mg/l, total dissolved solids 377.16mg/l to 573.32mg/l, PO_4-P ranges from 1.01-4.68ml/l, NO_3-N varied from 1.15-3.34ml/l, BOD 2.95-6.63ml/l, soil pH 5.30-7.70 in a study on macrobenthic algae of the Fauzdarhat coast, chittagong. The findings of the present investigation are apparently similar to the above mentioned report. Chowdhury[15] reported the micronutrients of the coastal water of Cox's Bazar and recorded maximum (NO_2-N=1.520µ-g at/l, PO_4-P=1.804µ-g at/l and SiO_3-Si=46.62µ-g at/l) during July to August and minimum (NO_2-N=0.084µ-g at/l, PO_4-P=0.224µ-g at/l and SiO_3-Si=3.28µ-g at/l) during November to December respectively. Noori[16] reported the micronutrients concentration of the coastal water of southeast coast of Bangladesh and recorded maximum (NO_2-N=1.198µ-g at/l, PO_4-P=2.330µ-g at/l and SiO_3-Si=63.31µ-g at/l) during May to August and minimum (NO_2-N=0.020µ-g at/l, PO_4-P=0.075µ-g at/l and SiO_3-Si=0.673µ-g at/l) during September to December respectively. The findings of the present investigation are apparently similar to the above mentioned report.

Grant[17] recoded the inter-tidal soil pH ranged from 7.6 to 8.1 from the inter-tidal sand flat of North Inlet, South Carolina, U.S.A. Islam (2004) recorded pH values ranged from 6.35 to 6.85 in bottom sediment collected from lower Meghna river estury during premonsoon. Present findings are more or less similar to these above mentioned report. Within the marine sediments there is generally a decrease in organic content with depth in the deposit. Correns,[18] Revelle & Shepard[19] have all reported this characteristics distribution. Connell,[20] obtained a linear relationship between organic matter and calcium carbonate and concluded that calcareous material contained about 0.2% organic matter and having no calcareous material contained a constant proportion of organic matter. Kondalarao & Murty[21] reported that organic matter of intertidal zone of the Kinda bay, east coast of India was 0.70% to 2.17% which is closely similar with the present observation where organic matter varied from 4.22% to 4.51%. Vizakat et al.[22] expressed that the texture of sediment as silty clay'sand silts; silty sand of the subtidal soft sediment of the west coast of India. Alam[23] recorded the seasonal variation of sediment percentage in the Halishahar coast; Chittagong and he found maximum sand percentage in monsoon and minimum in winter, which is similar with the present investigation.

Conclusion

This study shows that water and sediment of Salimpur mangrove area possesses environmentally friendly condition for growth and culture of algae. Therefore, commercial culture may be introduced in the coastal Salimpur of Bangladesh.

Acknowledgments

None.

Conflicts of interest

The authors declare that there is no conflicts of interest regarding the publication of this article.

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Citation: Uddin MR. Water and sediment parameters at the algae culture area of Salimpur coast Chittagong. *MOJ Eco Environ Sci.* 2019;4(1):39–42. DOI: 10.15406/mojes.2019.04.00130