

Change in Some Chemical Parameters of two Environment Polluting Waste (Fertilizer Factory Effluent and Sweetmeat Factory Waste) Media After Culture of Three Important Microalgae

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Abstract

Some chemical parameters of fertilizer factory effluent (FFE) and sweetmeat factory waste (SFW) were analyzed before and after culture of three important microalgae (*Spirulina platensis*, *Chlorella ellipsoidea* and *Scenedesmus obliquus*) to make the waste environment friendly and to develop their economic use. Among the two wastes significantly ($P < 0.05$) higher phosphate phosphorus (116.09 mg/l), ammonia nitrogen (17.39), total suspended solids (TDS, 949.00 mg/l), total dissolved solids (28924.67 mg/l), total solids (30009.00 mg/l) and chemical oxygen demand (7892.00 mg/l) were in raw SFW. On the other hand significantly higher pH (7.51), nitrite nitrogen (19.65) and dissolved oxygen (0.33) were significantly higher in collected raw FFE. Before culture of *S. platensis* TDS of the prepared media were very high (10200.00 mg/l) due to addition of NaHCO_3 . Before inoculation of *C. ellipsoidea* and *S. obliquus* the highest TS, TSS, TDS and COD were recorded 867.28, 49.67, 771.33 and 1424.33 mg/l, respectively in prepared media. But after the culture of all the three microalgae, the amount of TS, TSS, TDS and COD were significantly ($P < 0.05$) lower in all the media. The cultured microalgae were nutritionally rich.

Key words : Chemical parameters, fertilizer factory effluent, sweetmeat factory waste, microalgae.

Introduction

Bangladesh is an agro-based country. The agro-industrial organic wastes discharged from different types of mill containing high organic and inorganic nutrients, high total dissolved solids due to high carbohydrate and micronutrient which increase both biological oxygen demand (BOD) and chemical oxygen demand (COD) in aquatic environment

(Phang, 1990 and Habib *et al.*, 1998). The organic loads as well as COD are possible to reduce by aerobic and anaerobic digestion of the waste discharge and growing important (beneficial) microalgae (Phang, 1990 and Husain, 2001). The highest COD value 500-980 ppm with either aerobic or anaerobic digestion is not harmful for aquaculture (Phang, 1990).

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In Bangladesh five big fertilizer factories are discharging huge amount of inorganic effluent in nature every year, which polluted aquatic environment. A large number of sweet meat factories have been developed both urban and rural area of Bangladesh, which discharge a lot amount of wastes in aquatic environment. Ultimately all of these wastes cause partial environmental pollution, which may causes partial ecological imbalance in nature and increase both biological oxygen demand (BOD) and chemical oxygen demand (COD) in aquatic environment. Sweetmeat factory waste (SFW) and Fertilizer factory effluent (FFE) are discharging through out the year. The economic uses of these wastes are not yet been developed. However, these wastes are possible to use for the production of microalgae having some modification. In aquaculture system, these wastes might be used to produce commercially important microalgae, which may use as feed for fish fry/fingerlings, shrimp larvae as well as zooplankton in aquaculture system. Due to microalgal activity, harmful and polluting affects of the wastes will be reduced after culture of microalgae and thus the environment will be free from pollution partially. So, it is essential to study the chemical characteristics of these environment polluting wastes before and after culture of microalgae. Keeping this in mind, attempt was made to study the chemical characteristics of sweetmeat factory waste and fertilizer factories effluent before and after culture of three important microalgae, *Chlorella ellipsoidea*, *Spirulina platensis* and *Scenedesmus obliquus*.

Materials and Methods

Two environment polluting waste, fertilizer factory effluent (FFE) and sweetmeat factory waste (SFW), and three important microalgae, *Chlorella ellipsoidea*, *Spirulina platensis* and *Scenedesmus obliquus* were used in this study.

Collection and preparation of fertilizer factory effluent (FFE) medium

Fertilizer factory effluent was collected from Jamuna Fertilizer Factory, Tarakanda, Jamalpur and it was decomposed for a period of 15 days by aeration. It should be noted that before collection, chemical treatment of effluents by H_2SO_4 and $Al_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$ and partial water treatment by flashing and circulating water was done by the factory authority. However, the decomposed solution was filtered and diluted with distilled water to 40, 45, 50, 55 and 60 % concentration levels. For culture of *S. platensis* 6.0 g/l $NaHCO_3$ was added to increase pH level of the media.

Collection and preparation of sweetmeat factory waste (SFW) medium

Sweetmeat waste was collected from Mymensingh town. It was diluted with distilled water to 1.5, 2.0, 2.5 and 3.0 % concentration levels and was decomposed for a period of 30 days by aeration at room temperature. The supernatant of decomposed effluent was for algal culture. Urea (0.2 g/l) was added to the media to increase nitrogen

content for culture of all the three algal species. On the other hand NaHCO_3 (6.0 g/l) was added to the media to increase pH level, only for spirulina culture.

Chemical analysis of raw waste sample

To know the chemical status of collected raw waste sample of FFE and SFW, different chemical parameters such as pH, dissolved oxygen (DO), chemical oxygen demand

(COD), total solids (TS), total suspended solids (TSS), total dissolved solids (TDS), phosphate phosphorus ($\text{PO}_4\text{-P}$), nitrate nitrogen ($\text{NO}_3\text{-N}$), nitrite nitrogen ($\text{NO}_2\text{-N}$) and ammonia nitrogen ($\text{NH}_3\text{-N}$) were analyzed before decomposition.

Prepared FFE and SFW media were sterilized at 120°C for 15 minutes with moist heat autoclave (Express Equipment, Dixon's surgical instrument LTD).

Table I. Composition of bold basal medium (BBM) for *Chlorella ellipsoidea* and *Scenedesmus obliquus* culture

SI. No.	Chemicals/ compounds	Concentration in stock solution (g/l)	Amount in culture medium (ml/l)
1.	NaNO_3	25.00	10.0
2.	$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$	7.50	10.0
3.	NaCl	2.50	10.0
4.	K_2HPO_4	7.50	10.0
5.	KH_2PO_4	17.50	10.0
6.	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$	2.50	10.0
7.	Trace element		1.0
	a) $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$	8.82	
	b) $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$	1.44	
	c) MoO_3	0.71	
	d) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	1.57	
	e) $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	0.94	
8.	H_3BO_3	11.40	1.0
9.	EDTA-KOH solution		1.0
	a) EDTA Na_2		
	b) KOH	50.00	1.0
10.	a) $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	31.00	
	b) Conc. H_2SO_4	4.981.0 ml/l	1.0

- ◆ Was made up to 1 litre with distilled water and
- ◆ Autoclaved at 126°C for 15 minutes

Preparation of control media

Bold Basal Medium (BBM) and Kosaric Medium (KM) were used as the inorganic media. Different composition of inorganic nutrients of BBM, Phang and Chu (1999) is given in Table I. And different composition of inorganic nutrients of Kosaric Medium (KM), modified form of Zarouk (1966), and Phang and Chu (1999) is given in Table II.

Table II. Different composition of inorganic nutrients of Kosaric Medium (KM) for *Spirulina platensis* culture

SI. No.	Chemicals	Amount (g/l)
1.	NaHCO ₃	9.00
2.	K ₃ HPO ₄	0.25
3.	NaNO ₃	1.25
4.	K ₂ SPO ₄	0.50
5.	NaCl	0.50
6.	MgSO ₄	0.10
7.	CaCl ₂	0.02
8.	FeSO ₄ , 2H ₂ O	0.005
9.	As micronutrient solution ^a	0.50 ml/ l
	a) As micronutrient solution	(g/l)
	H ₃ BO ₃	2.86
	MnCl ₂ , 4H ₂ O	1.81
	ZnSO ₄ , 7H ₂ O	0.22
	CuSO ₄ , 5H ₂ O	0.08
	MoO ₃	0.01
	CoCl ₂ , 6H ₂ O	0.01

◆ Was made up to 1 litre with distilled water and

◆ Autoclaved at 126^o C for 15 minutes

Culture of microalgae

Stock culture of *S. platensis*, *C. ellipsoidea* and *S. obliquus* maintained in the Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh was used for this study. The microalgae were inoculated into each 1.0 liter volumetric culture flask from the stock (optical density 620nm=0.20, Habib, *et. al.*, 1998) to get 10 % suspension of algae in different culture media including control. As control kosaric medium (KM) was used for *S. platensis* culture and bold basal medium (BBM) for *C. ellipsoidea* and *S. obliquus* culture. Three replications were used both for culture and control media. All the flasks were kept under fluorescent lights (light: dark = 12 h: 12 h) for 14 days in Live Food Culture Laboratory of the Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh. The culture flasks were continuously aerated using electric aerator. All the glass-wares used in the experiment were sterilized with dry heat in an oven at 70^o C for 12 hrs. Growth parameters of algae viz., cell counts and Chlorophyll *a* content were recorded every alternate day using a compound microscope and UV spectrophotometer, respectively. After successful completion of laboratory culture, the algae were centrifuged at 3000 rpm for 10 minutes to separate the media from microalgae from each other. The chemical properties of separated media were analyzed. After completion of laboratory culture mass culture was per-

formed in better concentrations (50 % FFE and 2.5 % SFWM) of the media. During mass culture microalga was harvested before stationary phase and centrifuged at 3000 rpm for 10 minutes to separate the microalga. The separated microalgae were used for proximate composition analysis.

Before inoculation of microalgae (*C. ellipsoidea*, *S. platensis* and *S. obliquus*) in different concentrations of culture media prepared by FFE and SFW, and control medium (BBM and KM), sub samples were collected. Chemical properties such as pH dissolved oxygen (DO), chemical oxygen demand (COD), total solids (TS), total suspended solids (TSS) and total dissolved solids (TDS) of the collected sub samples were analyzed following standard methods (Clesceri *et al.*, 1989). After laboratory culture, same chemical parameters of the separated media were analyzed.

Results and Discussion

Chemical composition of collected raw FFE and SFW showed that significantly ($p < 0.01$) higher pH, $\text{NO}_2\text{-N}$ and DO was in FFE. On the other hand significantly ($p < 0.01$) higher amount of $\text{PO}_4\text{-P}$, $\text{NH}_3\text{-N}$, TSS, TS and COD was in SFW. Nitrite nitrogen was 29.73 mg/l in FFE and 30.05 mg/l in SFW. The whole results are shown in the Table III. The physico-chemical analysis of the two effluents under the present study indicates that the media are nutrient rich. In a study Wing and Chong (2002) analyzed the chemical composition of palm kernel meal, which is more or less agrees with the present findings. Habib *et al.* (1998) determine the chemical contents of raw latex concentrate rubber effluent, standard Malaysian rubber effluent and palm oil mill effluent which is not similar with the present findings. It may be due to the different source of effluents.

Table III. Mean (\pm SD) chemical composition (mg/l, except pH) of collected raw FFE and SFW sample before decomposition

Composition	FFE	SFW
pH	7.51 \pm 0.04 ^a	4.92 \pm 0.04 ^b
Phosphate phosphorus ($\text{PO}_4\text{-P}$)	11.62 \pm 0.28 ^b	116.09 \pm 2.01 ^a
Nitrate nitrogen ($\text{NO}_3\text{-N}$)	29.73 \pm 0.40 ^a	30.05 \pm 0.62 ^a
Nitrite nitrogen ($\text{NO}_2\text{-N}$)	19.65 \pm 0.09 ^a	1.54 \pm 0.27 ^b
Ammonia nitrogen ($\text{NH}_3\text{-N}$)	12.46 \pm 0.22 ^b	17.39 \pm 0.61 ^a
Total suspended solid (TSS)	37.00 \pm 1.00 ^b	949.00 \pm 30.61 ^a
Total dissolved solid (TDS)	785.00 \pm 3.61 ^b	28924.67 \pm 53.53 ^a
Total solid (TS)	838.33 \pm 4.04 ^b	30009.00 \pm 102.66 ^a
Dissolved oxygen (DO)	0.33 \pm 0.06 ^a	0.00 \pm 0.00 ^b
Chemical oxygen demand (COD)	3686.00 \pm 50.48 ^b	7892.00 \pm 75.50 ^a

Data in a row followed by different letter (s) indicate significant differences at 5 % level

The highest growth of the cultured algae was observed on the 10 th day of culture in both media. The growth performance of the cultured microalgae is shown in Table IV. Among the different concentrations of the

6336.00 mg/l in 40 % FFEM. The range of TSS and was recorded 11.15 to 42.33 mg/l and the highest value was recorded in 3.0 % SFWM and the lowest value was recorded in KM. The highest TDS was recorded

Table IV. Growth performance of *S. platensis*, *C. ellipsoidea* and *S. obliquus* in different concentrations of waste media at 10th day of culture

Media	<i>S. platensis</i>		<i>C. ellipsoidea</i>		<i>S. obliquus</i>	
	Cell wt. mg/l (mg/l)	Chlorophyll <i>a</i> (mg/l)	Cell no. (x10 ⁵)/ml	Chlorophyll <i>a</i> (mg/l)	Cell no. (x10 ⁵)/ml	Chlorophyll <i>a</i> (mg/l)
40 % FFEM	622.67 ± 9.50	5.36 ± 0.12	121.37 ± 4.08	5.85 ± 0.44	82.37 ± 5.00	4.63 ± 0.41
45 % FFEM	715.33 ± 9.46	6.47 ± 0.16	142.34 ± 5.91	7.29 ± 0.29	87.71 ± 5.64	5.11 ± 0.30
50 % FFEM	846.67 ± 9.02	7.52 ± 0.13	182.07 ± 9.70	8.08 ± 0.29	119.10 ± 6.03	6.12 ± 0.39
55 % FFEM	803.33 ± 12.06	7.17 ± 0.25	157.41 ± 6.02	7.06 ± 0.20	93.49 ± 5.81	5.42 ± 0.25
60 % FFEM	692.67 ± 16.8	6.29 ± 0.30	137.57 ± 6.86	6.55 ± 0.32	99.33 ± 6.60	5.62 ± 0.32
KM/BBM	916.00 ± 22.07	7.96 ± 0.30	198.49 ± 6.05	9.39 ± 0.31	135.34 ± 7.92	6.86 ± 0.31
1.5 % SFWM	448.33 ± 4.16	4.16 ± 0.28	75.21 ± 4.96	4.22 ± 0.36	51.21 ± 5.88	2.71 ± 0.28
2.0 % SFWM	546.00 ± 6.24	4.87 ± 0.26	98.50 ± 3.70	5.33 ± 0.43	65.19 ± 7.09	3.61 ± 0.31
2.5 % SFWM	705.00 ± 8.72	6.73 ± 0.23	141.80 ± 7.15	7.47 ± 0.44	97.05 ± 7.01	5.52 ± 0.41
3.0 % SFWM	619.33 ± 8.08	5.41 ± 0.30	110.48 ± 7.99	5.82 ± 0.30	83.21 ± 4.97	4.77 ± 0.29
KM/BBM	933.67 ± 9.61	8.58 ± 0.28	181.54 ± 9.13	9.28 ± 0.38	136.30 ± 9.00	6.14 ± 0.36

media 50 % FFEM and 2.5 % SFWM showed better growth performance than other concentrations for all the three microalgae. On the other hand among these two, 50% FFEM showed the best growth performance for all the three species. Proximate composition showed that the cultured algae were nutritionally rich having 34.56 to 58.38 % protein (Table V).

In the case of before culture of *S. platensis*, the highest average TS was recorded 10216.97 mg/l in KM and the lowest was

10200.00 mg/l in KM and the lowest TDS was observed 6311.0 mg/l in 40 % FFEM. For the culture of *S. platensis*, media were prepared adding 6mg/l NaHCO₃ in each concentration of waste media and for KM it was needed 9 mg/l. That is why more solids were observed in KM and comparatively higher solid were recorded before inoculation in both media. The range of pH and DO were recorded 8.50 (in KM) to 8.67 mg/l (in 45 % FFEM), and 3.20 (in 55 % FFEM) to 3.77 mg/l (in 0.50 g/l KM), respectively. The

Table V. Proximate composition of *S. platensis*, *C. ellipsoidea* and *C. ellipsoidea* grown in 50 % FFEM and 2.5 % SFWM

Composition	<i>S. platensis</i>		<i>C. ellipsoidea</i>		<i>S. obliquus</i>	
	50 % FFEM	2.5 % FWM	50 % FFEM	2.5 % FWM	50 % FFEM	25 % SFWM
Crude protein	58.38± 0.37 ^a	55.13± 0.86 ^b	44.63± 0.11 ^c	42.45± 1.16 ^c	37.21± 0.14 ^d	34.56± 1.12 ^d
Crude lipid	11.41± 1.00 ^d	13.74± 0.53 ^c	11.15± 0.06 ^d	11.15± 0.61 ^d	17.37 ± 0.08 ^a	16.13± 0.85 ^{ab}
Ash	7.33± 0.17 ^d	8.66± 0.63 ^d	10.49± 0.53 ^c	12.24± 0.85 ^b	14.20± 0.13 ^a	12.08± 0.36 ^b
Crude fiber	6.71± 0.42 ^b	7.71± 0.42 ^a	5.26± 0.03 ^c	7.55 ± 0.38 ^a	7.46 ± 0.21 ^a	6.39± 0.18 ^b
Moisture	7.62± 0.44 ^c	8.29± 0.47 ^b	9.73± 0.11 ^a	9.48 ± 0.38 ^a	9.54 ± 0.15 ^a	8.81± 0.31 ^b
NFE	8.76± 0.83 ^d	6.46± 0.22 ^c	18.23± 0.28 ^b	17.34± 0.81 ^{bc}	14.23 ± 0.28 ^c	22.36± 0.79 ^a

Data in a row followed by different letter (s) indicate significant differences at 5 % level

highest average COD was recorded 1899.00 mg/l in 60 % FFEM and the lowest COD was 1163.67 mg/l in 1.5% SFWM. The results are shown in the Table VI.

Table VI. Mean (± SD) Chemical contents (mg/l, except pH) determined in different concentration of FFEM and SFWM KM media before inoculation of *S. platensis*

Media	pH	DO	TS	TSS	TDS	COD
40 % FFEM	8.54 ± 0.05	3.37 ± 0.21	6336.00 ± 4.58	22.00 ± 1.00	6311.00 ± 4.00	1312.00±14.42
45 % FFEM	8.56 ± 0.02	3.43 ± 0.15	6371.00 ± 5.57	24.00 ± 1.00	6344.00 ± 4.58	1444.67 ± 7.02
50 % FFEM	8.50 ± 0.16	3.27 ± 0.21	6421.67 ± 9.07	26.33 ± 0.58	6391.67 ± 6.66	1598.00±12.49
55 % FFEM	8.52 ± 0.02	3.20 ± 0.20	6466.00 ± 7.81	31.00 ± 1.00	6432.00 ± 5.29	1753.33 ± 8.74
60 % FFEM	8.50 ± 0.02	3.33 ± 0.15	6512.00 ± 5.00	34.33 ± 0.58	6475.33 ± 5.03	1899.00±11.79
1.5 % SFWM	8.62 ± 0.06	3.47 ± 0.5	6545.33 ± 6.09	23.33 ± 1.15	6519.00 ± 3.61	1163.67±8.62
2.0% SFWM	8.57 ± 0.09	3.47 ± 0.12	6652.00 ± 8.89	26.33 ± 1.53	6613.33 ± 4.04	1279.00±7.00
2.5% SFWM	8.59 ± 0.04	3.50 ± 0.20	6746.33 ± 8.02	38.00 ± 1.00	6702.67 ± 6.11	1364.33±8.50
3.0% SFWM	8.57 ± 0.09	3.40 ± 0.17	6849.67 ± 6.03	42.33 ± 0.58	6795.33 ± 4.04	1483.00±8.19
KM	8.67 ± 0.03	3.50 ± 0.10	10216.97± 8.70	11.15 ± 0.92	10200.00 ± 8.44	

After the culture of *S. platensis* the highest TS was recorded 1515.67 mg/l in 60 % FFEM and the lowest TS was recorded 967.73 mg/l in KM. On the other hand, the range of TSS and TDS were found 7.67 (in KM) to 38.00 mg/l (in 3.0 % SFWM) and 957.24 (in KM) to 1523.67 mg/l (in 3.0 % SFWM), respectively. The range of pH and DO were recorded 7.62 (in 45 % FFEM) to 8.17 (in KM) and 2.70 (in 2.0% SFWM) to 2.93 mg/l (in 2.5 % SFWM), respectively. The highest average COD was recorded 438.33 mg/l in 60 % FFEM and the lowest COD was recorded 249.33 mg/l in 40 % FFEM. The findings are presented in the Table VII. After the culture of *S. platensis*, the solids like TS, TSS, TDS and COD were found significantly ($P < 0.05$) lower. Here both organic and inorganic loads were mixed

the study of Habib *et al.* (1997) where they studied with palm oil mill effluent in Malaysia.

In case of before culture of *C. ellipsoidea* and *S. obliquus* the range of average pH and DO was observed 7.03 to 7.13 and 2.77 to 3.37 mg/l, respectively, in different concentration of media including BBM. The highest average TS was observed 867.28 mg/l in BBM and the lowest was 332.59 mg/l in 40 % FFEM. The range of TSS was found 2.88 (in BBM) to 22.33 mg/l (in 3.0 % SFWM). The highest TDS was recorded 861.04 mg/l in BBM and the lowest was 316.48 mg/l in 40 % FFEM. The average highest COD was recorded 1238.0 mg/l in 3.0 % SFWM and the lowest was 916.33 mg/l in 40 % FFEM. The findings of the present study are shown in the Table VIII.

Table VII. Mean (\pm SD) Chemical contents (mg/l, except pH) determined in different concentration of FFEM, SFWM and KM media after culture of *S. platensis*

Media	pH	DO	TS	TSS	TDS	COD
40 % FFEM	7.74 \pm 0.05	2.90 \pm 0.10	1377.67 \pm 6.66	15.67 \pm 0.58	1359.85 \pm 7.41	249.33 \pm 7.51
45 % FFEM	7.62 \pm 0.01	2.87 \pm 0.06	1402.00 \pm 4.00	20.00 \pm 1.00	1377.44 \pm 4.55	298.33 \pm 8.74
50 % FFEM	7.84 \pm 0.01	2.72 \pm 0.40	1428.00 \pm 6.56	24.33 \pm 0.58	1396.33 \pm 7.51	354.00 \pm 9.17
55 % FFEM	7.74 \pm 0.02	2.80 \pm 0.10	1495.00 \pm 4.58	27.00 \pm 1.00	1455.00 \pm 6.56	393.00 \pm 4.00
60 % FFEM	7.75 \pm 0.02	2.87 \pm 0.06	1515.67 \pm 8.02	31.67 \pm 0.58	1479.14 \pm 6.37	438.33 \pm 7.09
1.5 % SFWM	7.65 \pm 0.04	2.77 \pm 0.06	1249.00 \pm 7.00	20.33 \pm 1.15	1224.00 \pm 3.00	252.67 \pm 5.51
2.0 % SFWM	7.71 \pm 0.04	2.70 \pm 0.10	1368.00 \pm 7.55	25.33 \pm 0.58	1331.33 \pm 6.43	312.33 \pm 5.51
2.5 % SFWM	7.78 \pm 0.02	2.93 \pm 0.06	1446.33 \pm 7.02	33.67 \pm 1.15	1408.33 \pm 7.09	349.00 \pm 8.19
3.0 % SFWM	7.82 \pm 0.02	2.87 \pm 0.15	1573.00 \pm 8.54	38.00 \pm 1.00	1523.67 \pm 7.51	397.00 \pm 8.54
KM	8.17 \pm 0.02	2.87 \pm 0.06	967.73 \pm 3.42	7.67 \pm 1.15	957.24 \pm 0.96	

up which was used by the microalgae as the source of nutrients. Similarity was found in

After the culture of *C. ellipsoidea* in the different media under the present study, the

Table VIII. Mean (\pm SD) Chemical contents (mg/l, except pH) determined in different concentration of FFEM, SFWM and BBM media before inoculation of *C. ellipsoidea* and *S. obliquus*

Media	pH	DO	TS	TSS	TDS	COD
40 % FFEM	7.08 \pm 0.06	3.17 \pm 0.06	332.59 \pm 2.48	14.44 \pm 1.17	316.48 \pm 2.50	916.33 \pm 5.51
45 % FFEM	7.03 \pm 0.02	3.00 \pm 0.10	373.96 \pm 3.97	16.13 \pm 1.46	356.13 \pm 3.40	1048.67 \pm 7.02
50 % FFEM	7.05 \pm 0.03	3.03 \pm 0.06	416.00 \pm 4.08	17.86 \pm 1.60	395.53 \pm 3.48	1170.33 \pm 6.66
55 % FFEM	7.04 \pm 0.02	3.10 \pm 0.10	457.62 \pm 4.47	19.70 \pm 1.73	435.21 \pm 3.92	1305.33 \pm 9.06
60 % FFEM	7.06 \pm 0.03	2.97 \pm 0.12	503.47 \pm 5.96	21.45 \pm 1.96	475.03 \pm 4.28	1424.33 \pm 6.51
1.5 % SFWM	7.08 \pm 0.05	3.30 \pm 0.10	511.00 \pm 4.58	12.00 \pm 1.00	495.67 \pm 3.21	968.67 \pm 7.02
2.0 % SFWM	7.11 \pm 0.02	3.47 \pm 0.15	603.67 \pm 7.51	15.67 \pm 0.58	582.33 \pm 6.66	1053.67 \pm 6.66
2.5 % SFWM	7.11 \pm 0.03	3.47 \pm 0.12	695.33 \pm 9.07	18.33 \pm 0.58	669.33 \pm 5.69	1142.67 \pm 4.51
3.0 % SFWM	7.13 \pm 0.07	3.33 \pm 0.06	797.33 \pm 9.61	22.33 \pm 1.53	771.33 \pm 7.51	1238.00 \pm 8.19
BBM	7.04 \pm 0.03	3.37 \pm 0.15	867.28 \pm 2.52	2.88 \pm 0.52	861.04 \pm 4.60	

average range of pH and DO was recorded 6.85 (in 50 % FFEM) to 6.97 (in 60 % FFEM) and 2.63 (in 1.5 % SFWM) to 3.93 mg/l (in BBM), respectively. The average TS were recorded 124.33 to 269.67 mg/l in different concentrations of the media including the control BBM. The range of TSS was

recorded 4.55 (in BBM) to 15.67 mg/l (in 3.0 % SFWM) and TDS was recorded 114.33 (1.5 % SFWM) to 341.00 mg/l (55 % FFEM) for all the treatments (Table IX).

After the culture of *S. obliquus* the range of DO and pH was recorded 2.57 (in 2.0 %

Table IX. Mean (\pm SD) Chemical contents (mg/l, except pH) determined in different concentration of FFEM, SFWM, and BBM media after culture of *C. ellipsoidea*

Media	pH	DO	TS	TSS	TDS	COD
40 % FFEM	6.94 \pm 0.03	3.17 \pm 0.15	127.27 \pm 1.97	5.66 \pm 0.52	121.65 \pm 1.52	217.67 \pm 5.51
45 % FFEM	6.91 \pm 0.02	3.63 \pm 0.06	142.29 \pm 2.02	6.35 \pm 1.11	136.25 \pm 2.09	249.33 \pm 6.11
50 % FFEM	6.86 \pm 0.03	3.87 \pm 0.06	158.33 \pm 2.08	7.29 \pm 0.97	155.09 \pm 2.41	292.00 \pm 4.58
55 % FFEM	6.85 \pm 0.03	3.47 \pm 0.06	173.69 \pm 2.52	7.70 \pm 0.61	168.61 \pm 2.56	341.00 \pm 6.56
60 % FFEM	6.97 \pm 0.02	3.43 \pm 0.06	187.89 \pm 3.52	8.27 \pm 0.93	185.35 \pm 2.93	376.33 \pm 5.51
1.5 % SFWM	6.87 \pm 0.06	2.63 \pm 0.12	124.33 \pm 2.08	6.00 \pm 1.00	114.33 \pm 2.52	166.67 \pm 5.51
2.0 % SFWM	6.89 \pm 0.02	2.80 \pm 0.17	166.00 \pm 2.66	9.33 \pm 0.58	153.67 \pm 2.52	195.67 \pm 5.03
2.5 % SFWM	6.84 \pm 0.03	2.77 \pm 0.15	218.00 \pm 3.61	13.33 \pm 1.53	201.67 \pm 4.04	230.67 \pm 4.51
3.0 % SFWM	6.92 \pm 0.03	2.70 \pm 0.17	269.67 \pm 2.52	15.67 \pm 1.15	251.00 \pm 3.00	259.33 \pm 3.51
BBM	6.92 \pm 0.01	3.93 \pm 0.12	124.55 \pm 1.49	4.55 \pm 0.50	117.61 \pm 2.11	

SFWM) to 3.30 mg/l (in 40 % FFEM) and 6.66 (in 2.0 % SFWM) to 6.85 (in BBM), respectively for all the treatments. The highest average COD was recorded 338.67 mg/l in 60 % FFEM and the lowest COD was recorded 131.67 mg/l in 1.5 % SFWM. The highest average TS was found 277.00 mg/l in 3.0 % SFWM and the lowest TS was recorded 147.67 mg/l in 1.5 % SFWM. On the other hand, the range of TSS was recorded 4.67 (in BBM) to 15.67 mg/l (in 3.0 % SFWM) and the range of TDS was recorded 142.00 (in 40 % FFEM) to 262.00 mg/l (in 3.0 % SFWM). The findings are shown in the Table X.

due to the biodegradation of organic and inorganic loads and nutrient released in the system, which was used by the microalgae (Islam *et al.*, 2004). Both pH and DO of the media were in favorable condition (Karmaker *et al.*, 2001). Though the growth performance of the algae were lower than control media but it was at the satisfactory level and the algae were nutritionally rich (Habib, 1998; Karmaker *et al.*, 2001 and Islam *et al.*, 2004). Change in all the chemical parameters of the waste media after culture of microalgae had become more or less environment friendly condition.

Table X. Mean (\pm SD) Chemical contents (mg/l, except pH) determined in different concentration of FFEM, SFWM, and BBM after culture of *S. obliquus*

Media	pH	DO	TS	TSS	TDS	COD
40 % FFEM	6.74 \pm 0.03	3.30 \pm 0.20	153.00 \pm 5.57	7.33 \pm 1.53	142.33 \pm 3.06	171.33 \pm 6.51
45 % FFEM	6.80 \pm 0.04	2.83 \pm 0.12	169.67 \pm 4.16	8.00 \pm 1.00	157.67 \pm 4.04	205.00 \pm 6.56
50 % FFEM	6.80 \pm 0.03	3.13 \pm 0.21	187.00 \pm 4.58	9.00 \pm 1.73	170.00 \pm 2.65	255.00 \pm 7.56
55 % FFEM	6.81 \pm 0.09	3.17 \pm 0.21	205.67 \pm 6.11	9.67 \pm 0.58	193.67 \pm 6.51	302.00 \pm 6.56
60 % FFEM	6.84 \pm 0.04	2.83 \pm 0.12	224.67 \pm 6.11	10.00 \pm 1.00	210.67 \pm 6.51	338.67 \pm 5.03
1.5 % SFWM	6.76 \pm 0.05	2.80 \pm 0.10	147.67 \pm 5.03	7.33 \pm 0.58	142.67 \pm 3.21	131.67 \pm 5.51
2.0 % SFWM	6.66 \pm 0.03	2.57 \pm 0.12	186.33 \pm 5.51	10.67 \pm 1.15	176.67 \pm 2.31	159.00 \pm 7.55
2.5 % SFWM	6.79 \pm 0.06	2.83 \pm 0.12	214.33 \pm 3.51	15.33 \pm 1.15	195.33 \pm 3.06	199.33 \pm 8.74
3.0 % SFWM	6.73 \pm 0.02	2.83 \pm 0.21	277.00 \pm 5.57	15.67 \pm 1.53	262.00 \pm 2.65	228.33 \pm 7.51
BBM	6.85 \pm 0.13	2.63 \pm 0.15	156.67 \pm 1.53	4.67 \pm 0.58	157.00 \pm 2.65	

After the culture of *C. ellipsoidea* and *S. obliquus* the amount of TS, TSS, TDS and COD were recorded very lower ($P < 0.05$) in each media than before culture. It might be

Conclusion

The study proved that both fertilizer factory effluent and sweetmeat factory waste media become environment friendly condition after

culture of microalgae. On the other hand it may possible to use fertilizer factory effluent for commercial culture of *S. platensis*, *C. ellipsoidea* and *S. obliquus* which also may play an important role in aquaculture or as human food and thus the environment will be free from pollution partially.

Acknowledgement

The authors are indebted to the Director, Bangladesh Agricultural University Research System (BAURES), Bangladesh Agricultural University, Mymensingh, Bangladesh for providing the fund for successful completion of the research.

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Received : May 03, 2007;

Accepted : July 01, 2007