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Fluctuations of Dissolved Organic Carbon in the Karnaphuli River near BSCIC Industrial Estate, Chittagong, Bangladesh

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Abstract: Dissolved Organic Carbon (DOC) fluctuations were studied in the surface water of Karnaphuli River near BSCIC industrial estate from May 2001 to October 2001, at monthly intervals. Concentration of DOC varied from 0.120 mg L⁻¹. A minimum was recorded in May 2001, while an increase was observed during October 2001. The DOC concentration seems to be closely related to the growth of phytoplankton and other primary and secondary producers which in turn are affected by water chemistry. So the relationship between temperature and pH with DOC is likely indirect. The fluctuations during the observation period showed a relationship with temperature and pH.

Key words: Dissolved Organic Carbon, concentration, fluctuation correlation, Karnaphuli river, Chittagong

INTRODUCTION

Dissolved Organic carbon (DOC) is generally the dominant form of organic carbon in following waters and determining its fate is important for an understanding of the energy flow in aquatic ecosystems^[1,2].

According to Ogura *et al.*^[3] the dissolved organic matter is mainly derived from the excretions or decay of phytoplankton. Studies of Fisher and Likens^[1], McDowell and Fisher^[4] indicate that most of the DOC in streams is allochthonous in origin. Although the microbes readily use some of the DOC from allochthonous sources, some of it is slowly degraded biologically^[5]. DOC is converted to POC (Particulate Organic Carbon) by microorganisms to be used by filter feeders.

Recently a lot of mills and industries have been set up on the bank of the Karnaphuli River. Some of such industries are paper mills, textile industries, paint industries, Asbestos industries, etc. These kind of industries use carbon and carbon derivatives as important chemicals at different stages. They discharge their effluent through the drainage system, which ultimately falls into Karnaphuli River. Among other wastes or effluents they also discharge a huge amount of carbon which in later decomposed by microorganisms and converted into dissolved organic carbon.

The present observation attempted to study the fluctuations in DOC concentrations in the Karnaphuli River along with temperature and pH.

MATERIALS AND METHODS

Sampling was done according to Menzel and Vaccaro^[6], Szekiolda and Krey^[7], Merks and Vlasblam, Wetzel and Rich^[9].

Surface water samples were taken from predetermined sites in all the stations of the Karnaphuli River at monthly intervals. Temperature was recorded during the collection of the samples and the pH was also determined simultaneously in the field itself.

Collection of water sample: Water was collected in plastic bottles, refrigerated in hard glass bottles for several weeks and transferred to the Bangladesh Forest Research Institute Laboratory, Chittagong for the determination of dissolved organic carbon.

Preservation of sample: Each sample was filtered at room temperature through glass fiber filter papers (0.5 µm porosity 9.84 HD Reeve Angel) which were precombusted at 500°C. The filtrate was analyzed for Dissolved Organic Carbon (DOC) by chromic acid oxidation and conductometric methods.

RESULTS AND DISCUSSION

The concentration of DOC varied between 0.120 to 0.250 mg L⁻¹. Minimum concentration observed in May at station 1 (0.120 mg L⁻¹) and there after it started to

increase up to October at station 3. The highest value was observed in October 2001 (0.250 mg L^{-1}) at station 3 (Table 1).

The water temperature varied between 24.50 to 31.50°C . Water temperature showed gradual decrease from May in all the stations and reached its least 24.50°C in October at station 2 (Table 1).

The pH value ranged between 6.00 to 7.20 . The minimum value was observed in October at station 2 (6.00) and there after it started to increase up to May in all the stations. Then it decreased once with subsequent increase and attaining the maximum value (7.20) in July, 2001. From maximum it showed decreasing tendency (Table 1).

Dissolved Organic Carbon (DOC) concentration ranged from 0.120 to 0.250 mg L^{-1} . The value were low through out the experiment except for the month of October (Table 1), when a part of DOC, might have originated from the breakdown of cells of organisms during freezing and storage as has been reported earlier by Ogura *et al.*^[3].

During the period of study there was a kind of lateral shift in the seasonality mainly as a result of an unexpected early rain during April-May months followed by a rise in temperature, as a result of which the vegetation and other life got damaged and died earlier than expected. This evidently might have resulted in the setting of decomposition process by bacteria earlier than expected and the consequent release of dissolved organic carbon in winter, instead of the usual seasons of spring or summer. Thus the main driving force for bringing back the nutrients to the photic zone seems to be the autumnal rather than the winter turnover as reported by Serruya *et al.*^[10].

Fluctuations in DOC levels have also been reported by Holmes *et al.*^[11], according to whom the maximum values for the DOC prevailed from spring to summer off Scripps, California. On the other hand, Duursma^[12] observed the maximum DOC in the North Sea after a sharp spring increase in the phytoplankton growth, followed by a general decrease during summer to winter, while as Ogura *et al.*^[3] observed a high concentration of DOC during the months of summer. Similarly, the highest concentration of DOC was recorded in June against the lowest in March.

The pH 6.00 to 7.20 (Table 2) fell in the alkaline range throughout the year. This alkaline range of pH values throughout is ascribed to the geological features of the catchments, comprising a mud bed, composed to calcium compounds and some other salts in high proportions. The considerable extension of pH range in limestone regions

Table 1: Monthly concentration of DOC, temperature and pH in the Kamaphuli River

Station	Months	Components		
		Dissolved Organic Carbon (mg L^{-1})	Water temperature ($^\circ\text{C}$)	pH
1	May	0.120	31.50	6.70
	June	0.140	30.00	7.00
	July	0.140	28.00	7.20
	August	0.140	27.20	6.80
	September	0.140	27.20	6.70
	October	0.150	25.00	6.30
2	May	0.140	31.40	7.20
	June	0.150	29.50	7.10
	July	0.150	28.30	7.00
	August	0.170	27.50	7.20
	September	0.170	28.50	6.90
	October	0.190	24.50	6.00
3	May	0.180	31.00	7.20
	June	0.190	29.00	7.20
	July	0.230	27.00	7.10
	August	0.200	27.60	7.00
	September	0.180	28.50	6.80
	October	0.250	25.00	6.20

Table 2: Average value of DOC, temperature and pH in the Kamaphuli River

Months	Components		
	Dissolved Organic Carbon (mg L^{-1})	Water temperature ($^\circ\text{C}$)	pH
May	0.146	31.30	7.03
June	0.160	29.50	7.10
July	0.173	27.75	7.10
August	0.170	27.45	7.00
September	0.163	28.10	6.80
October	0.196	24.80	6.16

due to dissolved carbonates has also been reported by Reid^[13].

Water temperature varied from 24.50 to 31.50°C (Table 1) with the lowest prevailing during the month of October. The present study clearly brings out the relationship between pH and temperature on one hand and in turn the effects on the DOC concentration on the other.

Statistically relationship was observed which exist between pH and DOC on one hand; DOC and temperature on the other (Fig. 1 and 2) with correlation coefficients of -0.223 and -0.485 respectively, which is in agreement with the results of Carpenter *et al.*^[14].

Thus the study supports the conception that DOC concentration pattern is not a generalized one and varies from place to place as has been opined by Ogura *et al.*^[3]. The DOC concentration seems to be closely related to the growth of phytoplankton and other primary and secondary producers which in turn are affected by water chemistry, water temperature and a milieu of other factors characterizing such habitats. So the relationship between temperature and pH with DOC is likely indirect.

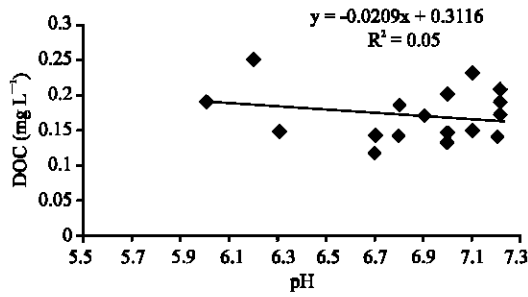


Fig. 1: Scatter diagram depicting relationship between pH and dissolved organic carbon

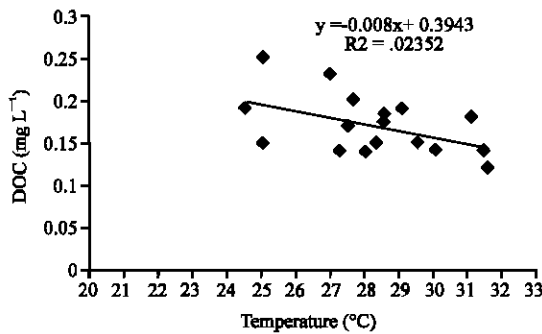


Fig. 2: Scatter diagram showing relationship between temperature and dissolved organic carbon

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