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Chemical and Biological Impact of Effluent from Edible Bamboo Shoot Canning Factory on a Stream

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The Kitakyushu district is known as one of the most famous cultivation centers of bamboo shoot in Japan and there are many canning factories beside the upstream of the Murasaki River. In these factories, bamboo shoots are barked, boiled, canned, and then the effluent which contains much of organic substances and nutrients is discharged in the process of boiling mainly. These factories are operated and discharge the effluent during a limited term, from the middle in April to early in May. The factory investigated in this study discharged the effluent into the Ouma River, which is a branch of the Murasaki River. The water quality of the Ouma River is very clean and categorized as A rank in Environmental Water Quality Standards(Japan Environmental Agency 1981) which is listed in Table 1. We fear the impact of the organic pollutant on the water quality and aquatic community because this river is less-polluted usually. The purpose of this investigation was to estimate the short-term influence of the effluent on chemical parameter and epilithic diatoms as the biological indicator.

MATERIALS AND METHODS

Sampling of the water for chemical analyses and epilithic diatoms was performed six times from October in 1981 to August in 1982 in the Ouma River, which was 4300 m long. Location of sampling station was shown in Figure 1. Four stations were selected. Station 1 (control) was situated in upstream from the factory. Station 2 was situated beside the factory. Stations 3 and 4 were situated in 600 and 1900 m downstream from the factory, respectively.

Water temperature, flow rate(measured with a Riken model SC200-10 flow meter),flow quantity(calculated from the cross-sectional area and the flow rate), pH, dissolved oxygen(DO), biochemical oxygen demand(BOD), chemical

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Table 1. Standard of each parameter in category A which is stipulated in Environmental Water Quality Standards(Japan Environmental Agency 1981).

pH	BOD	Suspended solid(SS)	DO	Number of coliform groups
6.5-8.5	2mg/L or less	25mg/L or less	7.5mg/L or more	1000MPN/100mL or less

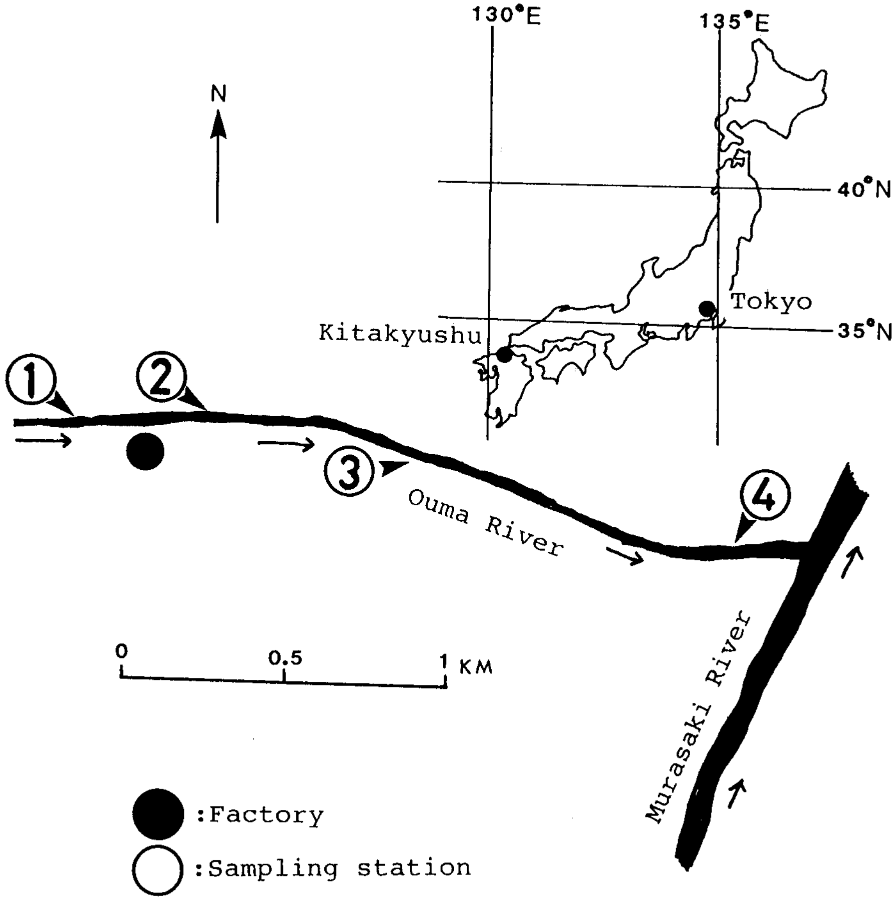

Figure 1. Location of sampling stations and bamboo shoot canning factory.

oxygen demand(COD)(Japan Industrial Standards Committee 1981), chlorine ion(Japan Society of Water Supply 1978), total phosphorus(T-P)(APHA-AWWA-WPDF 1980) and total nitrogen(T-N) were measured as physico-chemical parameters. Total nitrogen was measured with a Yanako

Table 2. Effluent quality and ratio of contribution for each parameter.

	Effluent (mg/L)	Station 1 (mg/L)	Station 2 (mg/L)	ratio of * contribution (%)
BOD	190	0.3	1.8	83
COD	99.5	1.3	2.1	38
T-N	27.3	0.87	1.1	21
T-P	6.02	0.03	0.08	63
Cl^-	33.0	7.7	8.4	8.3

*[(Concentration at station 2 - concentration at station 1)/ concentration at station 2]x 100

model TN-7 micro nitrogen analyzer. Epilithic diatoms were sampled over an area of 25 cm^2 on the surface of stones in the river bed at each station. Epilithic diatoms were immediately preserved in 10% formalin solution after sampling. They were treated with sulfuric acid and potassium permanganate(Japan Society of Water Supply 1978). Then their species were identified, the number of species was counted and the densities were determined with a differential interference contrast microscope(Pascher 1930; Ueno 1974; Hirose 1977).

RESULTS AND DISCUSSION

The effluent quality on May 6, 1982, when the river water had been heavily polluted, was shown in Table 2. The pH value of the effluent was almost the same level as that of the river water. The effluent contained much organic substances and nutrients. Water qualities at stations 1 and 2 on that day and ratio of contribution for each parameter were shown in Table 2. Ratio of contribution for BOD and T-P were high. However the effluent volume was 2L/sec(measured with a measuring cylinder), which was equivalent to less than 1/150 of the flow quantity of the Ouma River(0.3m^3/sec) and the actual concentration of each parameter at station 2 was not so high because of dilution effect. The changes of each parameter during this investigation at stations 1 and 2 were shown in Figure 2. When the effluent was discharged into the river, the difference of concentration between station 1 and 2 was not almost appeared for Cl^- and T-N and a slight increase was appeared for COD, BOD and T-P. On the other hand, for epilithic diatoms, we could recognize that their densities at stations 2, 3 and 4 had obviously increased(Figure 2 and 3). When the factory stopped

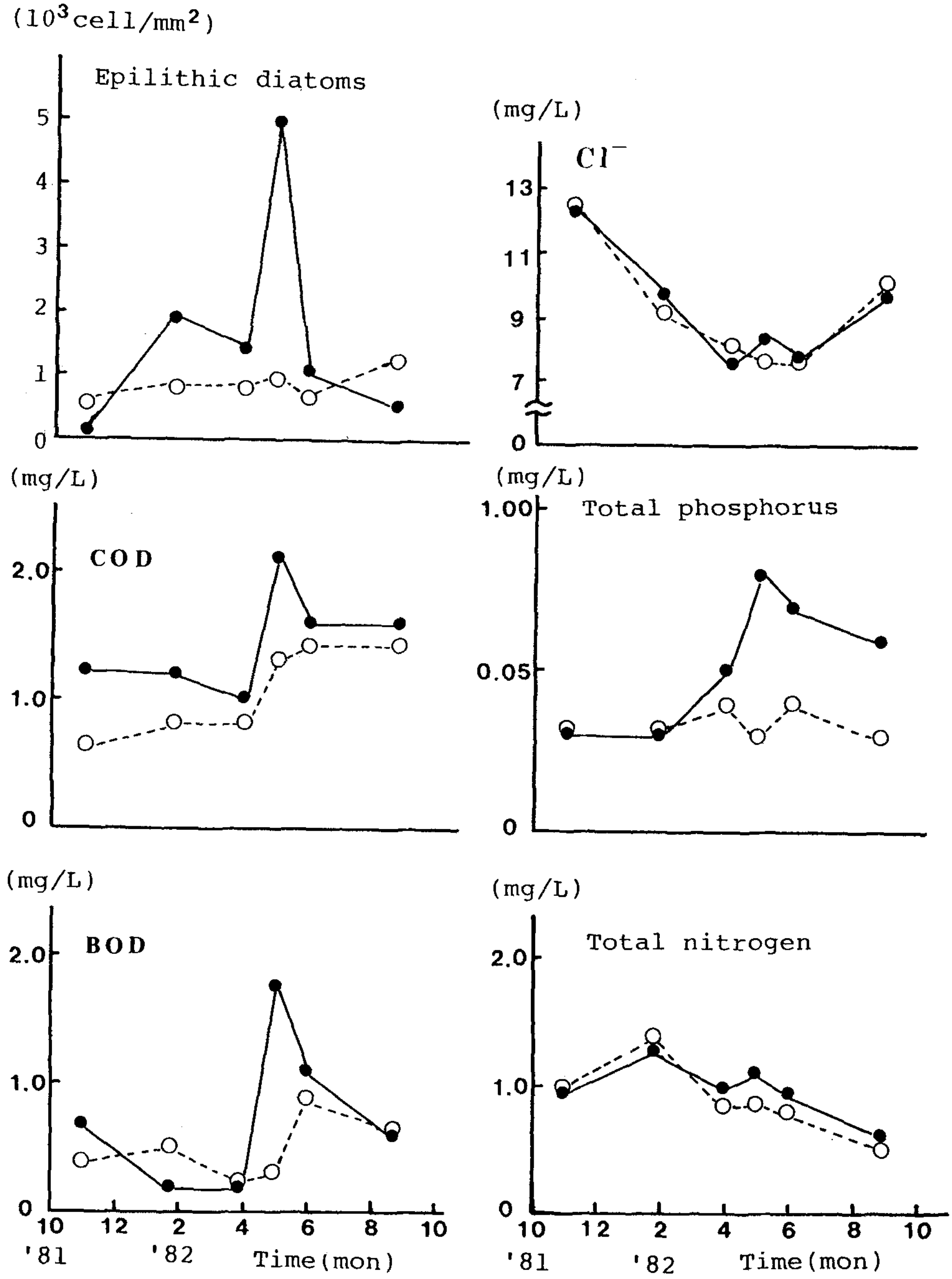

Figure 2. Changes of concentration of each chemical parameter and density of epilithic diatoms. O:station 1, ●:station 2.

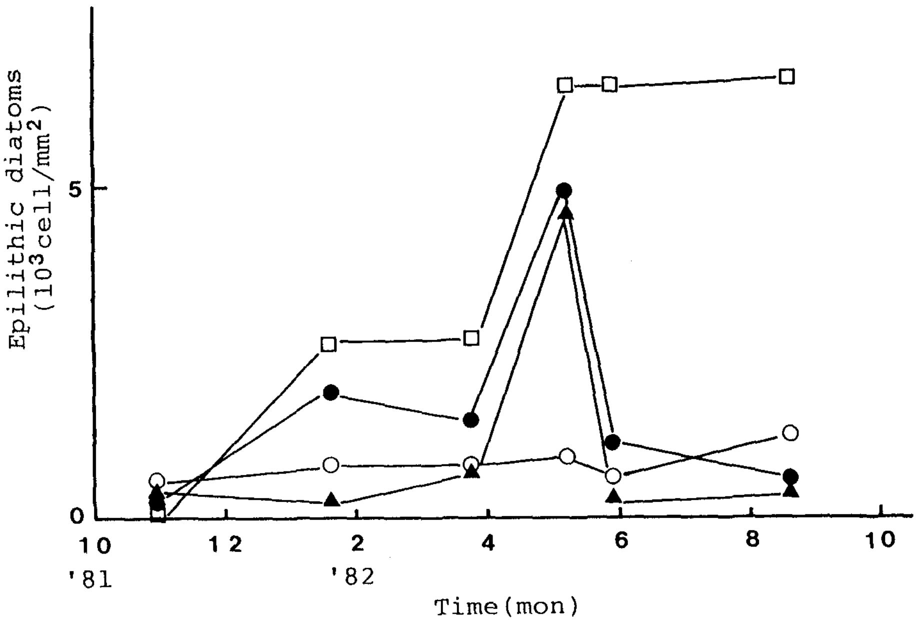

Figure 3. Density of epilithic diatoms at stations 1-4. ○:station 1, ●:station 2, ▲:station 3, □:station 4.

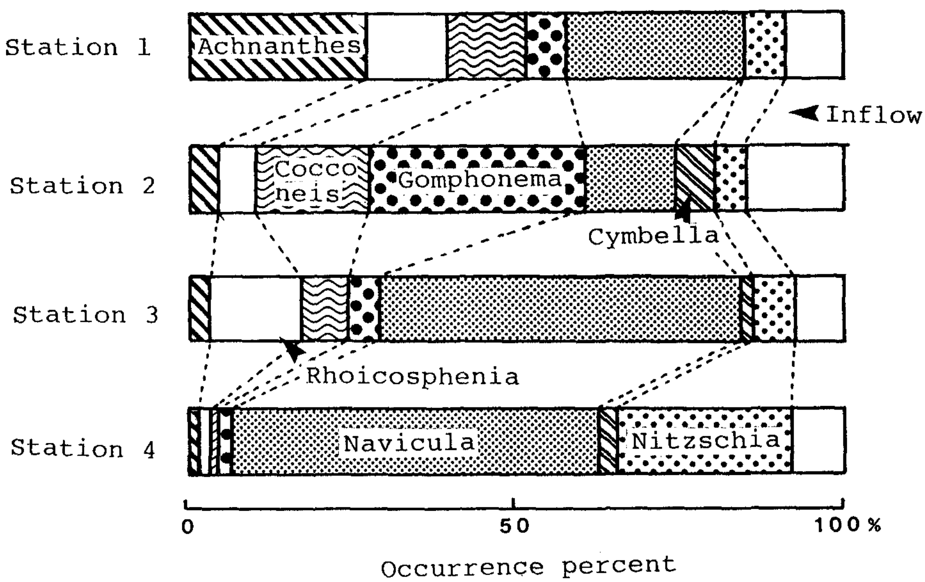

Figure 4. Changes of occurrence percent of each species at stations 1-4 after the inflow of the effluent.

operating, the densities of epilithic diatoms at stations 2 and 3 quickly decreased to the same level as the density at station 1. This fact suggest that these increases of densities were caused by the inflow of the factory effluent. At station 4, the influence of pollution sources except for the factory effluent, such as domestic waste water and inflow from the paddy field, is considered because the same density level continued afterwards. In regard to species, the changes of occurrence percent in each species at stations 1-4 were shown in Figure 4. At station 2, 3 and 4, the ratio of tolerant species, such as Gomphonema, Cymbella, Navicula and Nitzschia, increased after the inflow of the effluent. At station 2, we could observe a large amount of Sphaerotilus in addition to the increase of epilithic diatoms. From these results, it could be said that epilithic diatoms living in the river reflected the pollution degree more sensitively than chemical parameter where the pollution was not so heavy(Sumita and Watanabe 1984). This suggests that the method using epilithic diatoms is more useful for estimating the water quality of the less-polluted river which cannot be estimated by chemical parameter. In future, this method will be frequently used as a more effective method when the public sewerage is well-equipped and the water quality in urban river become more clean.

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