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Mutagenicity of Tama River Sediments

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The existence of mutagens in an aquatic environment has become an important problem (Pelen et al.,1977; Van Hoff, 1981; Sato et al., 1983). But amounts of mutagens in water are very small and very variable. Many chemicals are concentrated in river sediment from water by adsorption and sedimentation. Several chemicals are degradated physically or biologically and return to river water. But the components of the sediment are relatively stable. So analyses of the amounts of chemicals included in the sediments may show the pollution indices of the river water.

Bacterial mutagenicity test of crude extract of river sediments may be one of the most sensitive, economic and simple methods for estimation of pollution or toxicity of river environment.

Tama River is located at the boundary between Tokyo Metropolis and Kanagawa Prefecture, and one of the most polluted urban rivers in Japan. We examined the mutagenicity of lipophilic extracts of Tama River sediments as an estimation method of a "complex pollution".

MATERIALS AND METHODS

Sediments were collected from the middle to lower reaches of Tama River (June to August, 1983). Sampling stations are shown in Fig. 1. The collected sediments were lyophillized and 300 g of dry sediments were extracted twice with 600 ml of n-hexane. The extracts were dried under reduced pressure and 40 C. Residual materials were dissolved in dimethylsulfoxide (DMSO). The final concentration of the extracts in DMSO solution contained 0.6 g dry sediment/0.1 ml.
The mutagenicity assay was carried out with the Ames test and the pre-incubation assay (Ames et al.,1975;

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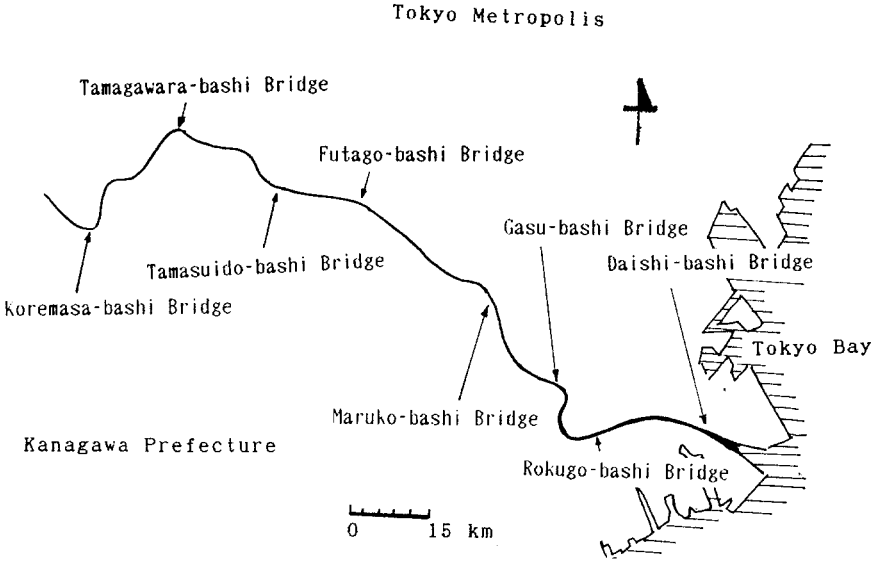

Figure 1. Sampling stations of Tama River sediments.

Yahagi et al., 1977). The test strains were Salmonella typhimurium TA1535, TA1537 and TA1538. S9 fraction was purchased from Oriental Yeast Co., Tokyo.
0.1 ml of sample, 0.5 ml of S9 mix (+S9) or phosphate buffer (-S9) and 0.3 ml of bacterial culture were mixed and pre-incubated at 37 C for 20 min. The mixture was poured onto minimal-agar plate. The plates were incubated at 37 C for 48 hr and revertant colonies were counted. Three plates were prepared for same sample and the mean was calculated. For the control, 0.1 ml DMSO containing evaporated residue of 1200 ml of n-hexane was used instead of 0.1 ml of test solutions.

RESULTS AND DISCUSSION

Mutagenicity of n-hexane extracts of the sediments is shown in Table 1. The sediments collected from many stations showed mutagenicity, and mutagenic intensity was enhanced by metabolic activation (addition of S9 mix) except for 3 sampling stations (Maruko-bashi Bridge, Tamasuido-bashi Bridge and Tamagawara-bashi Bridge). The extracts from these sampling stations showed killing effect to TA1535 and the killing effect was decreased by addition of S9 mix.

The sample of Rokugo-bashi Bridge was revealed the highest mutagenicity in TA1535 and especially TA1537. This sampling station located at Keihin Industrial Zone and mutagenic factory waste might flow in this sampling area. The concentration of polyaromatic hydrocarbons (PAH) in sediments has been the highest

Table 1. Mutagenicity of Tama River sediments in Salmonella typhimurium TA1535, TA1537 and TA1538

Sampling point	TA1535		TA1537		TA1538	
	-S9	+S9	-S9	+S9	-S9	+S9
Control	100	100	100	100	100	100
Daishi-bashi Bridge	87	136	100	514	197	268
Rokugo-bashi Bridge	160	450	>20000	>35000	94	409
Gasu-bashi Bridge	100	132	181	246	116	181
Maruko-bashi Bridge	92	70	156	105	90	367
Futago-bashi Bridge	67	80	100	190	165	>3000
Tamasuido-bashi Bridge	83	41	158	243	129	101
Tamagawara-bashi Bridge	229	283	122	285	161	172
Koremasa-bashi Bridge	113	167	162	345	137	341

Values are expressed as the percent of the control.

at Rokugo-bashi Bridge. Benzo(a)pyrene concentration in sediment collected at Rokugo-bashi Bridge was 200ng/g dry weight and total PAH was 1300 ng/g (Ariga et al, 1984). The mutagenic activity in our system calculated from this value was far low to compared to the present results. In addition, benzo(a)pyrene was a frame-shift type mutagen and it should be not reveal the mutagenicity in TA1535 tester. The present results suggest that the sediment of Rokugo-bashi Bridge may contain strongly unknown mutagen(s).

The sample of Daishi-bashi Bridge, the lowest sampling stations, was slightly weaker mutagenic activity than Rokugo-bashi Bridge. This reason may be elucidate the location of Daishi-bashi Bridge; Daishi bashi bridge locates the mouth of Tama River and this area belong to tidal compartment of Tokyo Bay. So the mutagenic substances may be diluted by massive sea water. In fact, the analytical value of PAH in the sediment of Daishi-bashi Bridge has been lower than that of the Rokugo-bashi Bridge (Ariga et al.,1984). In TA1538 tester, the Futago-bashi Bridge sediment was very highly mutagenic activity after metabolic activation. Hirayama et al (1981) reported that the water extract of the sediment of this sampling station show also highly mutagenic activity. These results suggest that the sediment of the Futago-bashi Bridge contained both lipophilic and hydrophilic mutagens.

The sediments of Tama River, typical urban river in Japan, contained the relatively strong mutagens. Almost of those mutagens may come from human (industrial) products. So the method described this paper is useful to estimate the total environmental risk survey.

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