High-Performance Liquid Chromatographic Analysis of Polycyclic Aromatic Hydrocarbons Extracted by Blue-Cotton from River Waters

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The polycyclic aromatic hydrocarbons (PAHs) are widely distributed pollutants in our environment, being generated from a number of industrial processes, vehicles and the incineration of waste matter. Some PAHs, such as benzo [a] pyrene, are potent carcinogens in a variety of biological systems. The World Health Organization has set a standard for the amount of PAHs in drinking water (max. 200 ng/l for total PAHs). However, no regulation against water pollution by PAHs has yet been issued in Japan.

Recently, much work has been carried out to develop a method of determination of PAHs in the aqueous environment. Not only the extraction procedure, involving liquid-liquid partitions or a column system, but also the subsequent clean-up using thin-layer or column chromatography required considerable effort and time. In the present study, blue-cotton bearing covalently bound trisulfo-copper-phthalocyanine, which can adsorb multicyclic compounds in a selective manner, was used to concentrate PAHs from river water. Then ten PAHs in the extract were analyzed by reversed-phase high-performance liquid chromatography (HPLC) with a spectrofluorometric detector.

Kanzaki River, an affluent of Yodo River in Osaka Prefecture, showed more serious water pollution in terms of BOD, DO, SS and number of E. coli, compared with Kako River in Hyogo Prefecture. Blue-cotton (0.25–2.00 g) wrapped with vinyl netting was immersed in the surface waters of these two rivers for 24 h. Blue-cotton extracts were obtained according to the method of Hayatsu et al. (Mutat. Res., 119, 233, 1983). Mutagenic activities of the extracts were assayed by means of the Ames test in Salmonella typhimurium TA98 and TA100. Blue-cotton-adsorbed materials showed potent mutagenicity in TA98 with S9 mix. The mutagenic activity of the extract from Kanzaki River was much higher than that from Kako River. On the other hand, little mutagenicity in TA100 was observed, indicating that frame-shift type mutagens existed in the river waters.

Ten PAH standards (anthracene, fluoranthene, pyrene, chrysene, benz [a] anthracene, benzo [e] pyrene, benzo [b] fluoranthene, benzo [k] fluoranthene, benzo [a] pyrene and benzo [ghi] perylene) were well separated by the reversed-phase HPLC. PAH in the extract was identified from the retention time in the HPLC and also from the fluorescence spectrum. Six PAHs were found in water from Kako River, all of which increased in proportion to the weight of blue-cotton immersed. In Kanzaki River, eight PAHs were detected. The total amount of PAHs in Kako River and Kanzaki River were estimated to be 30 and 101 ng/g blue-cotton, respectively.

These results showed that total PAHs and mutagens derived from these compounds increased with the aggravation of water pollution in the river waters. To further investigate the status of these contaminants in the aqueous environment, including drinking water, is of great importance.