

【Workshop 1】 Development of Phyto-technology for Decreasing Heavy Metal in Food
Simple Measurement of Cadmium Concentrations in Spinach and Soil
by Immunochromatography

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The behavior of cadmium in ecosystems needs to be monitored because of the human toxicity of this heavy metal. The need recently arose for a simple and quick on-site test for trace levels of Cd in food and environmental samples. In response, an immunochromatographic assay kit for detecting Cd was manufactured by Kansai Electric Power Co. of Japan. This kit uses the antigen-antibody complex reaction between the Cd-EDTA complex and an anti-Cd-EDTA antibody and shows the results in terms of the degree of color developed on a test paper. We previously reported the successful use of this kit to determine Cd concentrations in brown rice. Here, we applied the kit to the determination of Cd concentrations in spinach and soil.

Cadmium in the samples was extracted with HCl solution. The extract was purified on a chelate column to remove other metals. Then the pretreated solution is tested by immunochromatographic assay. Color intensity of the test line of the chromatography paper was measured by chromatoreader. In the Cd concentration range 0.01 to 0.1 mg L⁻¹, a good linear relationship is observed between the logarithm values of Cd concentration and the color readings. Cadmium concentrations in the pretreated solution from the samples were estimated from the analytical curve obtained by an exponential approximation for Cd concentrations in the range 0.01 to 0.1 mg L⁻¹.

Cadmium in dried spinach was not extracted successfully by the method used for brown rice. However, it was successfully extracted by 0.1 mol L⁻¹ HCl solution at dried spinach to HCl ratio of 1:50, and co-existing metals were removed sufficiently by the column treatment. We also found that cadmium in raw spinach was successfully extracted by 0.1 mol L⁻¹ HCl solution at raw spinach to HCl ratio of 1:5. The Cd concentrations determined by immunochromatographic assay were well correlated with the values obtained by acid decomposition and inductively coupled plasma mass spectrometry. Furthermore the 0.1-mol L⁻¹ HCl-extractable Cd concentration in soil was also determined successfully with the kit.

Approximate Cd concentrations in spinach and 0.1-mol L⁻¹ HCl-extractable Cd concentrations in soil can be monitored easily and quickly by this method at locations where facilities for acid digestion and precision analysis are not available.