Cadmium Test Kit Using Immunochromatography
− Examination of Rapid Pretreatment Method −

Background

Cadmium is considered an increasingly important environmental pollutant in many countries. It is a cumulative poison associated with a variety of syndromes and effects, including renal dysfunction, reproductive toxicity and bone defects. The main source of cadmium exposure is dietary via contaminated water and crops grown on polluted soil, resulting in a need for methods for detecting cadmium in both environmental and food samples. We previously reported a test kit for cadmium in rice grain using immunochromatography. For commercial use, however, the kit needed some speeding-up in Cd isolation step.

Objectives

The purpose of this study is to evaluate new cadmium separation column for immunochromatography using rice grain, leaves and stems

Principal Results

1. Rapid pretreatment column

(1) To save time for isolation of cadmium from inhibitors in sample, we optimized beads of cadmium binding column (Fig. 1). The new column consumed about 10 minutes and it was 4 times quicker than previous one. A multiple column system was also developed and it allowed simultaneous sample treatment.

2. Evaluation of new column system

(1) Rice grain: Fifty rice grains were applied to the new column system and successively analyzed by immunochromatography. The estimated cadmium concentrations from the assay were evaluated by the comparison with the results of nitrate treatment and ICP-AES analysis. Two measurements were highly correlated, with $R^2 = 0.94$ (Fig. 2A).

(2) Rice leaves and stems: In future, the test kit will be applied to vegetables, so that we tried treatment of leaves and stems of rice using the column system. Recovery of cadmium from the column was validated by comparison of cadmium concentration of column eluent and degradation solution of the sample, and the results showed almost all cadmium in the sample was recovered from the column (Fig. 3A). On the other hand, metals which inhibit the immunochromatography could be removed by the column (Fig. 3B). The estimated cadmium concentrations from the immunochromatography were evaluated by the ICP-AES analysis. And then two measurements showed highly correlation, with $R^2 = 0.95$ (Fig. 2B).

The development of the cadmium test kit was carried out in joint research with Kansai Electric Power Co., and Sumika Chemical Analysis Service, Ltd.

Future Developments

Biosensor for lead and chromium will be developed for measurement of environmental samples.

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Reference

K. Sasaki, et al, 2008, “A simple method to reduce interference from excess magnesium in cadmium immunoassays”, J Agric. Food Chem., 56: 7613-6
K. Sasaki, et al, 2008, “Screening method for cadmium in rice grain using immunochromatography”, Bunseki Kagaku, 57: 105-112 (in Japanese with English abstract and figure legend)

Fig.1 Contents of the cadmium test kit (left and middle) and result of the immunochromatography (right)

In the right photograph, the arrow points to the red band showing concentration of cadmium.

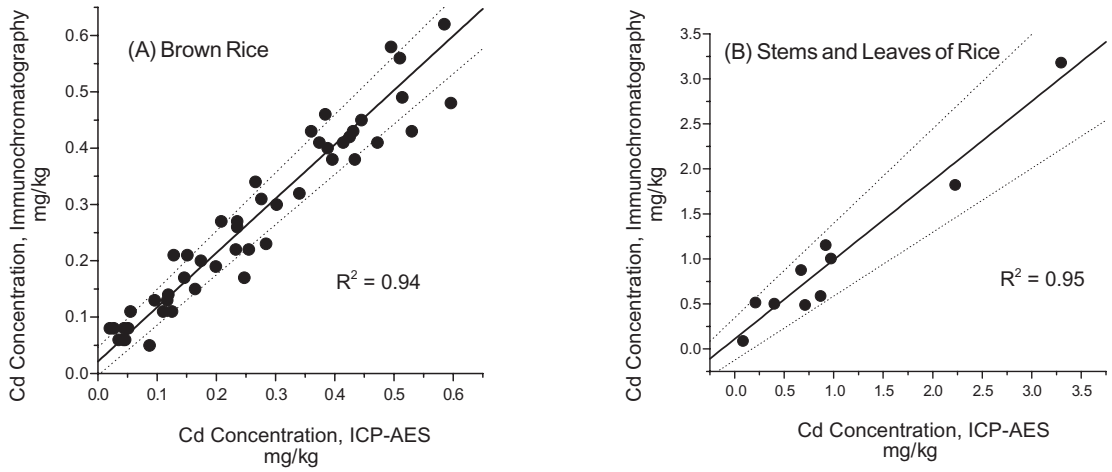

Fig.2 Immunochromatography vs. instrumental analysis (ICP-AES)

The estimated cadmium concentrations from two measurements were plotted. Dotted lines show 95% confidence intervals.

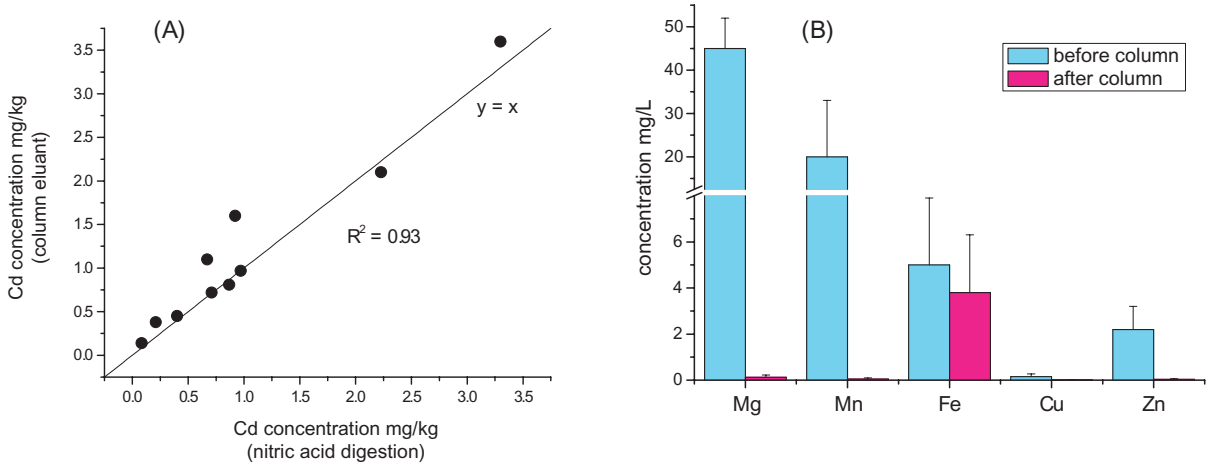

Fig.3 Pretreatment of rice leaves and stems

(A) Cadmium concentrations in column eluent and degradation solution from same sample were plotted. (B) Metal concentrations in sample solution before and after column treatment. Fe does not affect the immunochromatography at this concentration.