Development of Immunochromatography for Low-Level Cadmium Rapid Test – Application for Rice –

Background

Cadmium (Cd) is a general environmental pollutant of increasing global concern. The joint FAO/WHO Codex Alimentarius Commission will propose new international food legislation for low-level Cd contaminants. We are developing new assay system for low-level Cd using immunological techniques with antibodies that bind Cd specifically. Immunochromatography (IC) has been developed for clinical diagnosis uses and has a number of advantages over conventional immunological assay methods, including ease of performance and relatively low cost. Using anti-Cd antibody, IC is expected as on-site screening device that allows quick testing for Cd-contaminated foods, crops, water and soil.

Objectives

To develop IC device and sample pretreatment system for Cd-testing

Principal Results

1. A novel antibody for cadmium

An antibody that has highly specific affinity to cadmium was prepared in joint research with Kansai Electric Power Co., Inc. The cloned cells producing this antibody were screened by using developed methodology that increases chance to get high performance antibodies. This antibody showed 50-fold higher affinity than the previous prepared antibody that could not be used for low -level Cd-testing (Fig.1).

2. IC device for Cd-testing

An IC device based on the novel anti-Cd antibody was developed in joint research with the Kansai Electric Power Co., Inc. and EmBio Tec Laboratories Co., Ltd (Fig.2). Immobilized Cd-chelator EDTA could capture Cd on the test strip, which allowed detecting small molecules like Cd that had been hardly targeted for conventional ICs. Our IC device could detect 0.01 mg kg-1 (10ppb) Cd.

3. Pretreatment of rice for the IC kit

Isolation of Cd from extract of rice was need for the IC testing because zinc, magnesium and manganese in rice extract prevented reaction of the antibody and Cd. In joint research with Kansai Electric Power Co., we developed a novel pretreatment system, which separates Cd and other metals. To examine the IC kit consisting of the pretreatment system and the IC device, we tested rice samples consisting of broad range Cd content. The results were evaluated by comparing with results of instrumental analysis from the same samples (Fig.3). The IC kit showed good performance giving correct judgment for almost samples.

Future Developments

We will improve pretreatment system to apply IC kit for other food samples and environmental samples.

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Reference

K. Sasaki, et.al., 2005, “Validation of accuracy of enzyme-linked immunosorbent assay in hybridoma screening and proposal of an improved screening method”, Anal Chem, 77: 1933.
K. Sasaki, 2003, “Development of a Convenient Immunoassay for the Detection of Heavy Metals”, CRIEPI’s Annual Research Reports.

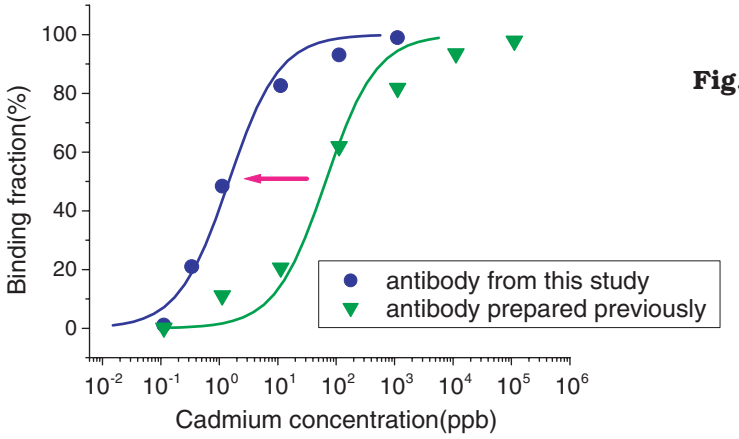

Fig.1 Comparison of binding affinities of anti-cadmium antibodies

The novel antibody had 50-fold stronger affinity to cadmium than the previous one.

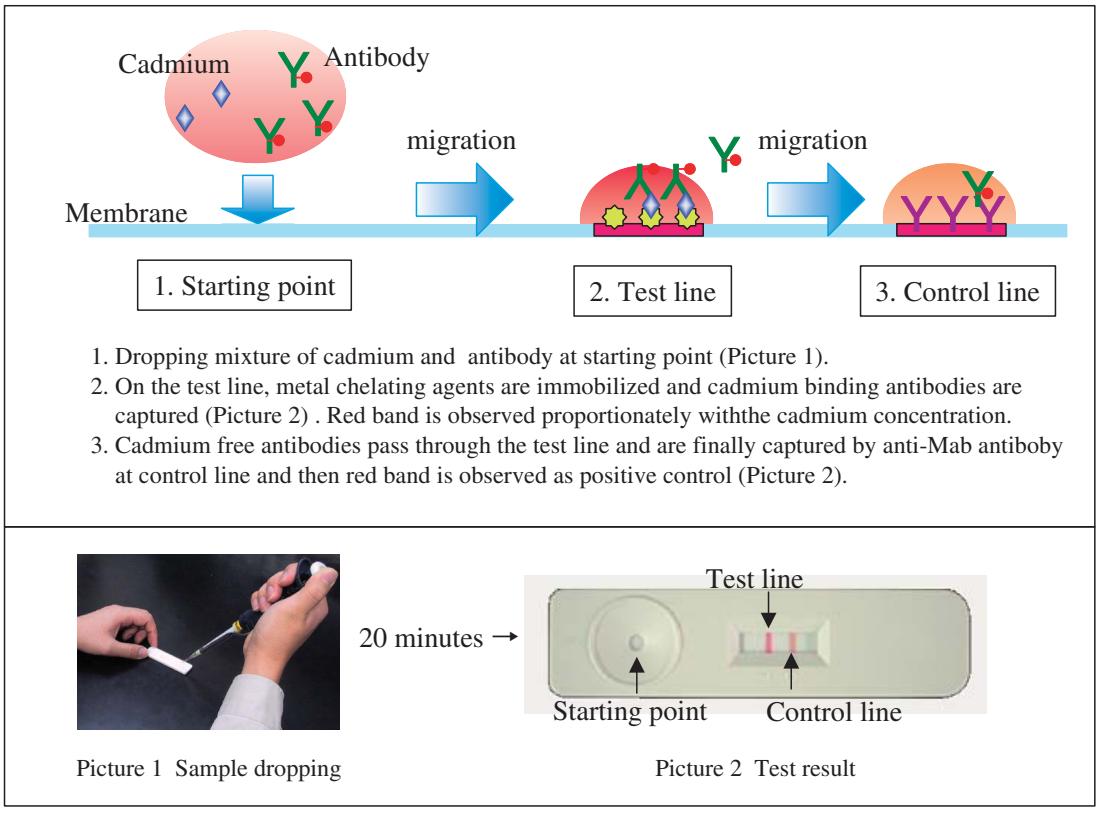

Fig.2 Principle of the IC

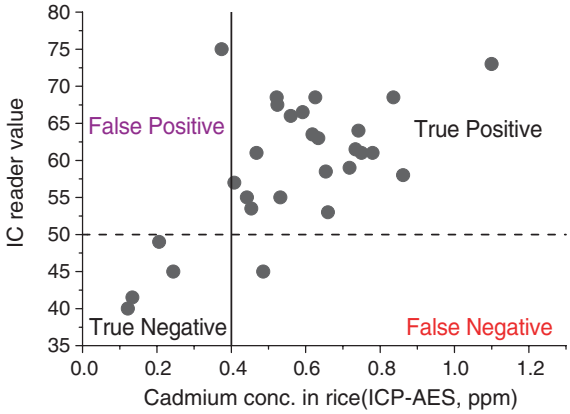

Fig.3 Results generated by the IC kit when applied to pretreated extract from 29 types of brown rice, compared with results of the ICP-AES instrumental analysis

Japan has set the maximum limit for Cd in rice at 0.4 mg kg^{-1}. In the IC kit test, Cd contamination was determined by the value of IC reader upper than 50. Only one Cd-contaminated (real positive) sample was judged as negative by the IC kit.