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Letter to the Editor

A case of oral allergy syndrome due to star fruit sensitized from atopic hands

Dear Editor,

Star fruit (*Averrhoa carambola*), a popular fruit which is widely distributed in tropical areas, is the only edible member of the family Oxalidaceae. We present herein the first case of oral allergy syndrome (OAS) in an atopic dermatitis patient due to star fruit.

A 27-year-old Japanese female presented with severe atopic dermatitis and mild asthma, both of which had their onset in her childhood. The patient's medical history also revealed pollinosis caused by Japanese cedar and Hinoki cypress pollens. In the three years leading up to her most recent hospital visit, the patient had worked as a pastry chef. Three months after her latest visit, she experienced an itching and burning sensation in the lips, mouth, and ear canal within fifteen minutes of consuming star fruit. The patient had experienced similar OAS symptoms previously after consuming kiwi fruit and papaya. Severe erythema, erosion, fissures and lichenification developed particularly on the hands. Her

SCORAD was 64. Laboratory tests showed the following values: total IgE 1510 IU/ml, LDH 178 U/L, and TARC 474 pg/mL. Specific IgE tests were performed for the following, with the obtained values indicated in parentheses: Japanese cedar pollen (62.7 Ua/mL, class 5), Hinoki cypress pollen (4.79 Ua/mL, class 3), birch pollen (0.11 Ua/mL, class 0), alder pollen (0.11 Ua/mL, class 0), orchard grass pollen (0.11 Ua/mL, class 0), kiwi (2.98 Ua/mL, class 2), and Latex (0.11 Ua/mL, class 0). The prick-by-prick test was performed according to the method reported previously using a positive control of 10 mg/ml histamine and a negative control consisting of saline.¹ The results of the prick-by-prick test showed a positive reaction to star fruit (3+), kiwi (3+), papaya (3+), egg (–), peach (–), melon (–) and water melon (–) after fifteen minutes (Fig. 1). Two healthy volunteers showed negative reactions to the same samples.

Star fruit, kiwi, and papaya proteins were extracted from whole fruit (including rinds, etc.) using phosphate-buffered saline (pH 8) at 200 mg/ml. Japanese cedar and Hinoki cypress pollens (ITEA[®],

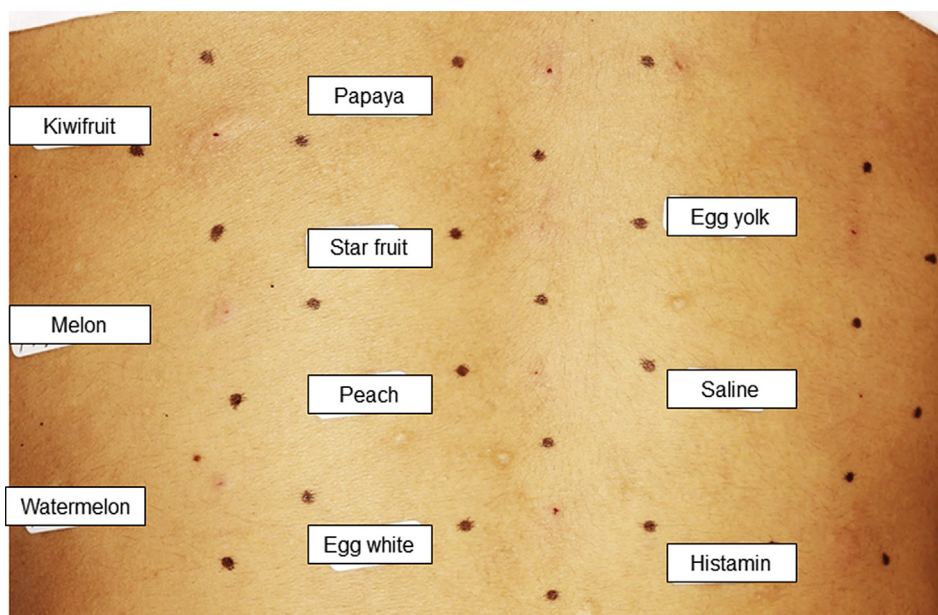


Fig. 1. The prick-by-prick test of star fruit, kiwi, and papaya after fifteen minutes.

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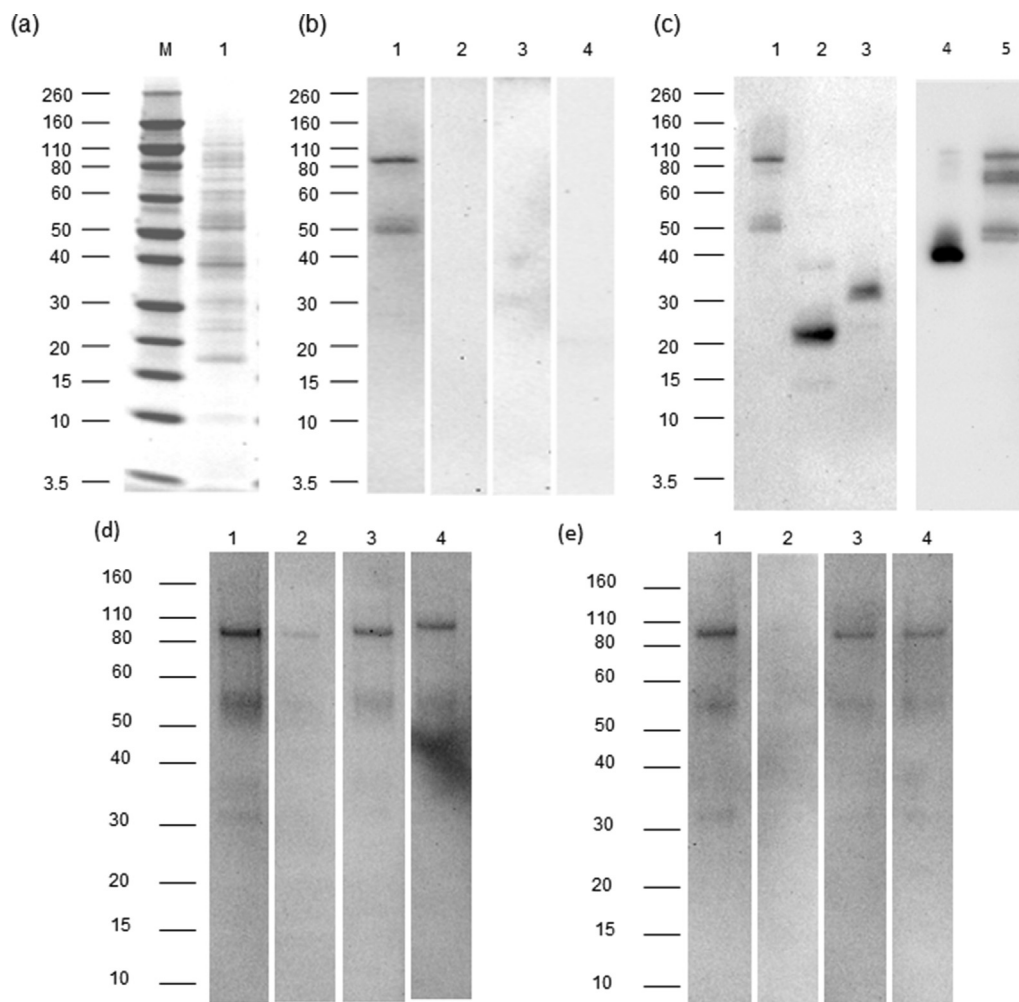


Fig. 2. (a) SDS-polyacrylamide gel electrophoresis (SDS-PAGE). Gel stained with Colloidal Blue Coomassie. M, marker; Lane1, star fruit. (b) Immunoglobulin E (IgE) immunoblotting. Lane 1, patients' serum; Lane 2–4, sera from three healthy volunteers. (c) Immunoglobulin E (IgE) immunoblotting. Lane1, star fruit; Lane2, kiwi; Lane3, papaya; Lane 4, Japanese cedar pollen; Lane 5, Hinoki cypress pollen. (d) Inhibition assay of immunoglobulin E immunoblotting. Transferred star fruit proteins were reacted with 10% serum from the patient containing each extract as inhibitors. Lane 1, PBS; Lane 2, 400 µg star fruit; Lane3, 20 µg Japanese cedar pollen; Lane 4, 20 µg Hinoki cypress pollen. (e) Inhibition assay of immunoglobulin E immunoblotting. Transferred star fruit proteins were reacted with 10% serum from the patient containing each extract as inhibitors. Lane 1, PBS; Lane 2, 600 µg star fruit; Lane 3, 600 µg kiwi; Lane 4, 600 µg papaya.

Japan) were extracted (1:20 w/v) using 0.125 M NaHCO₃ at 4 °C under rotation overnight. Extracts were centrifuged at 12 000 g for 10 min at 4 °C and the supernatants were collected. The supernatant proteins were measured and treated by NuPAGE[®] LDS sample buffer and NuPAGE[®] reducing Agent (Life Science[®], Zurich, Switzerland). SDS-polyacrylamide gel electrophoresis (SDS-PAGE) was performed with 4–12% NuPAGE[®] Bis-Tris Precast Gel (Life Technologies[®] Carlsbad, CA, USA) and fractionated protein bands weighing variously from 10 kDa to 110 kDa were visualized using Colloidal Blue Coomassie (Sigma–Aldrich) (Fig. 2a). Proteins were transferred to nitrocellulose membrane by diffusion. For IgE immunodetection, membranes were incubated 24 h in a 10% solution of the patient's serum or the three healthy control sera. Alkaline phosphatase-conjugated mouse monoclonal B3102E8 anti-human IgE mAbs (Abcam[®], Cambridge, UK) was then added after dilution to 1/500. Finally streptavidin–alkaline phosphatase conjugate was used for the detection of the molecules. As the result of immunoblotting, two bands for the star fruit proteins, 52 kDa and 92 kDa, were detected in the patient's serum. None of the target proteins were detected in the sera from the three healthy control subjects (Fig. 2b). The patient also presented kiwi, papaya, cedar pollen, and Hinoki cypress pollens allergies. As a result of the IgE

immunoblotting 25 kDa, 30 kDa, 42 kDa, and 45/50/70/95 kDa binding proteins were respectively detected in the patient's serum, pointing to kiwi,² papaya³ cedar pollen,⁴ and Hinoki cypress pollen as the chief allergens⁵ (Fig. 2c). To identify the star fruit antigen and confirm its cross-reactivity with pollen, each 400 µg/ml aliquant of star fruit protein, 20 µg aliquant of Japanese cedar pollen, and 20 µg aliquant of Hinoki cypress pollen protein were reacted with the patient's serum for 1 h at 37 °C. In the inhibition assay, 10% serum from the patient was cross-reacted for 24 h with the protein transferred to the membranes. In the IgE immunoblotting of the inhibition assay, 52 kDa and 92 kDa bands of star fruit protein were suppressed by the protein within the starfruit itself. However, the Japanese cedar and Hinoki cypress pollens proteins were not suppressed at all (Fig. 2d). Furthermore, the protein inhibition assay using star fruit protein with the patient's serum after the serum was reacted with 600 µg of kiwi or papaya proteins failed to decrease the star fruit protein (Fig. 2e). On the basis of the clinical symptoms, the prick-by-prick testing results, and the IgE-immunoblotting including inhibition assay, OAS resulting from the consumption of star fruit was diagnosed. Star fruit did not demonstrate any cross-reactivity with Japanese cedar, Hinoki cypress pollen, kiwi and papaya.

Discussion

Oxalidaceae consists of eight genera. While star fruit (*A. carambola*) is a popular food item in wide areas of the tropics, the fact remains that little is known about its chemistry. In some reports star fruit was found to have a prophylactic effect against hepatocellular carcinoma.⁶ On the other hand, two other reports found that star fruit induced toxic encephalopathy.^{7,8}

In the present case, although the patient suffered from atopic dermatitis with severe eczema on the hands, she worked as a pastry chef, and may have come into contact with star fruit on multiple occasions. A previous report demonstrated a higher frequency of OAS among atopic dermatitis patients than non-allergic controls.⁹ We speculate that due to her hand eczema and work environment, the patient's skin was sensitized to the star fruit antigen. An analogous case was reported previously on a case of sensitization to kiwi fruit through contact with atopic skin.¹⁰ The patient in the present case also presented OAS in response to kiwi and papaya. However, our data showed that star fruit antigen behaved differently from the kiwi and papaya antigens. Incidentally, the patient suffered from pollinosis of Japanese cedar and Hinoki cypress pollens. The results of the IgE-immunoblotting suggest that the binding proteins detected at 52 kDa and 92 kDa point to important antigens for IgE mediated reactions. This report is the first to document OAS resulting from consumption of star fruit.

Conflict of interest

The authors have no conflict of interest to declare.

Takafumi Numata, Tomonobu Ito *, Chizu Egusa, Yuko Kobayashi, Tatsuo Maeda, Ryoji Tsuboi

Department of Dermatology, Tokyo Medical University, Tokyo, Japan

* Corresponding author. Department of Dermatology, Tokyo Medical University, 6-7-1 Nishi-Shinjuku, Shinjuku-ku, Tokyo 160-0023, Japan.
E-mail address: tomonobu@tokyo-med.ac.jp (T. Ito).

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