



Letter

Anaphylactic reaction to dietary oats

Introduction

Cereals are the seeds obtained from grasses such as wheat, rice, barley, oat, rye, and maize. They are commonly consumed as part of the daily diet. Common oat (*Avena sativa*) is acceptable for most patients with celiac disease, who are intolerant to gluten in cereals.¹ Dietary oats have been reported to cause non-immunoglobulin E (IgE)-mediated reactions, but no reports of anaphylaxis have been made.² Oats are considered to be a suitable cereal for children.

A 7-year-old boy was brought to the pediatric clinic with cough, pruritus, and wheezing that developed within 30 minutes after he ingested cereal containing wheat and oats. This was the first time he had consumed oats. He was treated immediately with beta-2 agonist inhalation and an antihistamine tablet. The symptoms disappeared within an hour. He had never previously reacted to any other food. He had never been diagnosed with allergies.

For diagnosis, he was referred to Kanagawa Children's Medical Center. His serum specific IgE antibody levels for cereals were determined using the CAP system (ImmunoCAP; Phadia, Uppsala, Sweden) and were found to be 150 UA/mL and 10.5 UA/ml against oat and wheat, respectively. Commercially available oat grains were milled to produce flour. The flour was suspended in 0.9% NaCl at a 1:5 wt/vol ratio for 1 hour to obtain the skin prick test suspension. The results were positive for samples of oat (wheal, 4 mm; flare, 14 mm). The negative control with 0.9% NaCl elicited a 0-mm reaction. Two healthy control subjects showed no reactions.

To identify immunoreactive oat proteins, we first homogenized oat flour (1:5 wt/vol) in 10 mM phosphate buffer (pH 7.0.) containing 1 M NaCl and incubated it at 4°C for 3 hours. The homogenate was then centrifuged at 15,000 g for 60 minutes. The protein concentrations of the oat extract were determined according to the Lowry method.³

Isolated proteins were separated by electrophoresis in 7.5% sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) under reducing conditions, using NuPage Bis-Tris Gels and MES buffer, as per the manufacturer's instructions (Invitrogen, Paisley, United Kingdom). After electrophoresis, proteins were transferred to polyvinylidene fluoride membranes (FluorotransR; Nihon Genetics Inc, Tokyo, Japan). Oat proteins that bind human IgE were detected by anti-Human IgE (Kirkegaard & Perry Laboratories, Gaithersburg, Maryland) and the ECL Plus Western Blotting Detection System (GE Healthcare Bio-Sciences, Little Chalfont, United Kingdom), and were then visualized on an X-ray film. Serum from a healthy patient was used as a negative control.

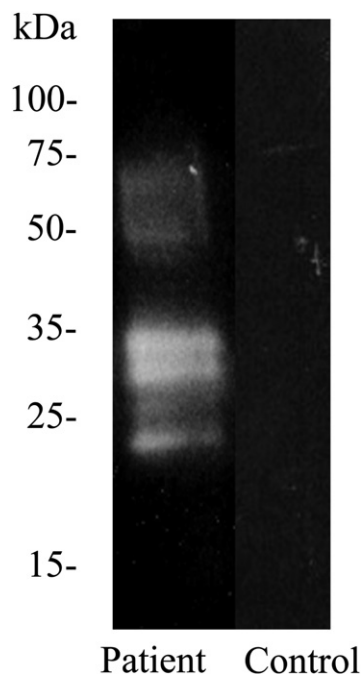


Figure 1. IgE immunoblots with oat after preincubation of patient's serum and normal serum (negative control).

The patient's IgE showed binding to three bands of proteins—23, 30, and 35 kDa (Fig 1).

The isolated oat proteins were electrophoresed on sodium dodecyl sulfate polyacrylamide gel electrophoresis and transferred onto polyvinylidene fluoride membranes (Immobilon, Millipore). Two bands of proteins (23 and 35 kDa) were stained in a solution containing amido black; the 30-kDa band was not. The N-terminal amino acid sequence of these 2 bands was analyzed using the Procise 494 HT protein sequencing system at the Apro Life Science Institute Inc (Tokushima, Japan). N-terminal amino acid analysis of the 23-kDa protein band showed that it had 100% identity with the amino acid sequence of 12S seed storage globulin 1 basic chain (Swiss-Prot: P12615.1) and 12S seed storage globulin 2 basic chain (Swiss-Prot: P14812.1) from *A. sativa*. The N-terminal amino acid sequence of the 35-kDa band could not be determined because the N-terminal was blocked.

Our patient could have been allergic to cereal other than commercial oats, so we tried to determine which allergen had caused the reaction. High oat-specific IgE levels, strong reactivity of his serum IgE to oat proteins according to immunoblot results, and no previous food allergy episodes suggested that the patient had a food allergy to oat.

Disclosures: Authors have nothing to disclose.

Wheat, barley, and rye contain homologous prolamins (seed storage proteins).⁴ These prolamins are less similar to those in oat. His serum recognized several wheat proteins, from the results of immunoblotting (data not shown). However, he could eat other cereals containing wheat; therefore, we ruled out allergic reaction to wheat proteins. Food challenge test to oat carried a risk of anaphylaxis for him, so we did not perform it.

We determined by immunoblotting that the 23-, 30-, and 35-kDa proteins might be candidates for anaphylactic response to oat ingestion. We could not identify the 30- and 35-kDa proteins. If a similar case is reported, it could be studied to determine the responsible proteins for oat-induced anaphylaxis.

To the best of our knowledge, this may be the first case report of anaphylaxis induced by consumption of oats. We observed several proteins that reacted with human IgE and identified 1 of them as an oat 12S seed storage protein. These proteins may contribute to oat-induced anaphylaxis.

Chisato Inuo, MD^{*,†}
 Yasuto Kondo, MD, PhD^{*}
 Yasuharu Itagaki, PhD[‡]
 Kazuyuki Kurihara, MD, PhD[‡]
 Ikuya Tsuge, MD, PhD^{*}
 Tetsushi Yoshikawa, MD, PhD^{*}
 Atsuo Urisu, MD, PhD[§]

^{*}Department of Pediatrics
 Fujita Health University
 Aichi, Japan

[†]Department of Allergy
 Kanagawa Children's Medical Center
 Kanagawa, Japan

[‡]Department of Food Safety and Reliability Project
 Kanagawa Academy of Science and Technology
 Kanagawa, Japan

[§]Department of Pediatrics
 Fujita Health University
 The Second Teaching Hospital
 Aichi, Japan

inuo@mbh.nifty.com

References

- [1] Kupper C. Dietary guidelines and implementation for celiac disease. *Gastroenterology*. 2005;128:S121–S127.
- [2] Mehr S, Kakakios A, Frith K, Kemp AS. Food protein-induced enterocolitis syndrome: 16-year experience. *Pediatrics*. 2009;123:e459–e464.
- [3] Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin phenol reagent. *J Biol Chem*. 1951;193:265–275.
- [4] Tatham AS, Shewry PR. Allergens to wheat and related cereals. *Clin Exp Allergy*. 2008;38:1712–1726.