Anaphylaxis Due to Oat Ingestion

Prados-Castaño M[1], Piñero-Saavedra M[2], Leguisamo-Milla S[1], Pastor C[3], Cuesta J[3], Bartolomé B[4]
[1]*Allergy Unit, Virgen del Rocio University Hospital, Sevilla, Spain*
[2]*Allergy Section, Dr Jose Molina Orosa Hospital, Las Palmas, Spain*
[3]*Jiménez Díaz Foundation, Madrid, Spain*
[4]*Bial-Aristegui, R&D Department, Bilbao, Spain*

J Investig Allergol Clin Immunol 2016; Vol. 26(1): 68-69
doi: 10.18176/jiaci.0016

Key words: Anaphylaxis. Oat. IgE-mediated hypersensitivity. SDS-PAGE immunoblotting. 48 kDa protein.

Palabras clave: Anafilaxia. Avena. Hipersensibilidad IgE mediada. SDS-PAGE immunoblotting. Proteína de 48 kDa.

Common oat (*Avena sativa*) is a cereal grain widely used due to its high nutritional value. It belongs to the *Poaceae* family, together with wheat, rice, barley, rye, and maize. Most patients with celiac disease can tolerate moderate amounts of pure oats, but they are advised to undergo both initial and long-term assessments by a health professional [1].

The allergic response to the inhalation of proteins from oat and cereal flour and dust (generally know as bakers' asthma and rhinitis) has been known since ancient times. Nowadays, this response is well characterized and constitutes one of the most important occupational allergies in many countries [2,3]. Contact allergy and urticaria by cutaneous sensitization due to the use of emollients/moisturizers containing oat extracts have been also described [4,5]. Patients with bakers' asthma, urticaria, and contact allergy due to oat or wheat protein usually tolerate the ingestion of oat and wheat. In the case of wheat allergy in adults, the allergen most frequently related to anaphylaxis is ω-5 gliadin [6]. However, no allergens have been described in anaphylaxis due to oat ingestion only.

We report a case of an anaphylactic reaction following oat consumption by an adult probably caused by a 48-kDa serpin protein; no allergy symptoms were observed with the ingestion of any other cereals.

The patient was a 70-year-old man with a history of essential hypertension and rheumatoid arthritis who was evaluated in our allergy unit following an acute episode of palmoplantar pruritus, generalized exanthema, nausea, vomiting, dysphonia, thoracic and laryngeal oppression, and hypotension 10 minutes after the ingestion of oat milk (200 mL). He was evaluated within an hour of the onset of symptoms. In the physical examination, the patient was conscious and oriented; he had a generalized pruritic rash, a blood pressure of 100/70 mm Hg, and a heart rate of 120 beats per minute. He was treated initially with epinephrine (1 mg/mL), dexchlorpheniramine (5 mg), and hydrocortisone (100 mg). Due to the persistence of symptoms, a new dose of epinephrine was required 20 minutes later. The patient was taken to the emergency room and stayed there until he recovered (12 hours). He had previously tolerated oat meals and no cofactors were identified in the anaphylactic episode.

Blood cell count, biochemistry, and coagulation values were in normal ranges. Skin prick tests (SPTs) performed with the most common aeroallergens in our area and common food allergen extracts (milk, egg white and yolk, shellfish, fish, apple, nuts, tomato, garlic, and *Anisakis simplex*) were all negative.

Prick by prick tests with oat milk (8 mm) and oat seed (10 mm) were both positive. Oat seed and oat milk extracts were prepared by homogenization in phosphate buffer saline, dialyzation, and lyophilization. SPTs with oat seed extract (9 mm) and oat milk extract (8 mm) were positive; the same tests were negative in control individuals. SPTs with wheat, rice, barley, rye, and maize flour were negative.

Specific IgE determination (ImmunoCAP) to oat, barley, rye, and grass pollen were all negative (<0.35 kU/L). Serum specific IgE levels against oat seed and oat milk extracts were measured by means of the enzyme allergosorbent test (EAST method) following the manufacturer´s instructions (specific IgE EIA kit HYTEC, HYCOR BioMedical Ltd). The values obtained were 0.4 kU/L and less than 0.35 kU/L, respectively. An allergen microarray immunoassay with 112 allergens (including rTri a 14, rTri a 19, and nTri a aA_TI) (ImmunoCAP ISAC, Phadia, Thermo Fisher Scientific) was performed, with negative results in all cases.

The protein profiles of oat seed and oat milk extracts were analyzed by SDS-PAGE immunoblotting, as described by Laemmli [7]. The results showed proteins in the range of 90

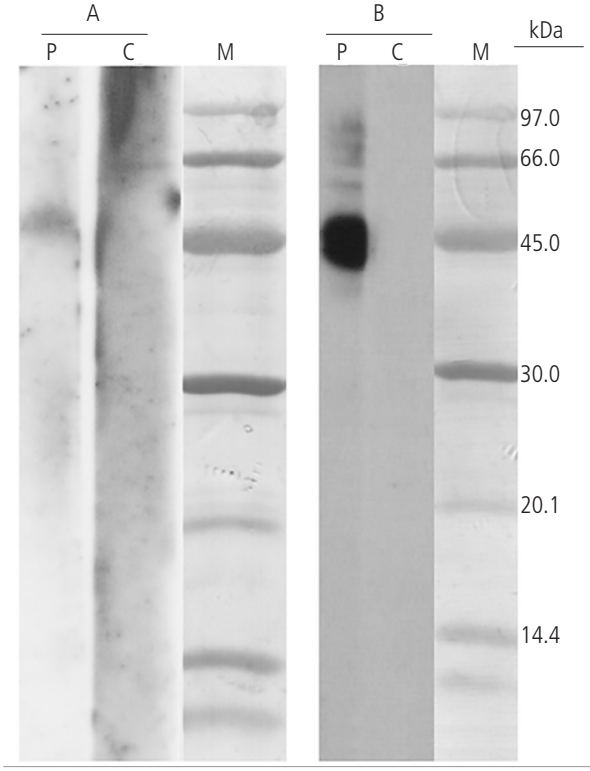

Figure. SDS-PAGE immunoblotting results in nonreducing conditions (without 2-mercaptoethanol). A, Oat milk extract. B, Oat seed extract. Lane P, patient serum; Lane C, control serum; Lane M, molecular mass marker.

to 14 kDa. SDS-PAGE IgE immunoblotting was carried out in nonreducing conditions and revealed a 48-kDa binding band in both the oat seed and oat milk extracts (Figure). The band was not detected when the assay was performed in reducing conditions (with 2-mercaptoethanol) (results not shown), suggesting the presence of disulphide bridges maintaining the 3-dimensional structure of this protein.

The 48-kDa-IgE-binding band from oat seed extract was extracted from the gel, digested with trypsin, and the protein was identified by mass spectrometry (MS) using LC-ESI-IT (LC-MS/MS), as previously described [8]. Sequence analysis of several internal peptides was carried out using the following sequences: DGSSVSGEEAEGLHANAEQVVQVVLADASAAGGPR, DGVFVDASLPLQSFPR, and LTTPATDVSLPLANQTR. Research conducted with protein databases identified the IgE-binding band detected as a serpin, as the protein peptide sequence yielded a strong match with serpins from related species, such as *Triticum aestivum, Triticum urartu, Oryza sativa*, and many others.

We have presented a case of anaphylaxis due to oat milk ingestion in an adult, with demonstration of an IgE-mediated mechanism and absence of cross-sensitization to other cereal antigens. The positive skin test results, as well as the positive serum specific IgE values against oat seed, demonstrated the involvement of an IgE-mediated mechanism. The results of the proteomic study pointed to a 48-kDa serpin protein from oat seed as the probable cause of the anaphylactic reaction after oat milk ingestion. The low concentration of this protein in the oat seed extract could be the cause of the low specific IgE value detected against this extract using the EAST method, and the negative result obtained in ImmunoCAP.

In one case of anaphylaxis due to oat ingestion in a child previously described by Inuo et al [9], positive results were detected against oat and wheat seed extracts in prick tests, serum specific IgE, and IgE immunoblotting. In our case, skin tests and serum specific IgE to other cereals were negative. None of the molecular masses of the IgE binding bands detected in the case described by Inuo et al were similar to the one detected by us. Furthermore, the episode of anaphylaxis occurred the first time the child consumed oat. The above facts lead us to think that the primary sensitization could be due to a cereal other than oat, unlike in our case, in which sensitization was exclusive to oat.

To our knowledge, this is the first report of anaphylaxis after the ingestion of oat with no concomitant allergy to other cereals. The results suggest that a 48-kDa serpin protein was the probable cause of this episode.

Funding

The authors declare that no funding was received for the present study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Previous Presentation

This case report was presented as a poster at the 2013 World Allergy & Asthma Congress, EAACI & WAO, in Milan, Italy.

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Manuscript received March 6 2015; accepted for publication September 23, 2015.

Macarena Piñero-Saavedra
Sección de Alergia
Hospital Dr Jose Molina Orosa
Crta. Arrecife-San Bartolomé, Km 1,3,
35500 Arrecife, Las Palmas (Spain)
E-mail: macpisa@gmail.com