

Anaphylaxis to oats after cutaneous sensitization by oatmeal in skin products used for the treatment of atopic dermatitis



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Clinical Implications

- We report anaphylaxis to oat-containing food after cutaneous sensitization with skin products that contain oatmeal used for the treatment of atopic dermatitis, confirmed by specific *in vitro* basophil activation and inhibition serum IgE immunoblotting.

TO THE EDITOR:

Current state-of-the-art treatment for eczema includes corticosteroid ointments or calcineurin inhibitor creams applied topically to inflamed skin for exacerbations, and regular use of moisturizers to optimally hydrate noninflamed skin. Despite evidence for cutaneous allergen sensitization, application of “natural products” that contain food allergens (eg., goat's milk, cow's milk, peanut oil, almond oil, and oatmeal) to the skin is becoming more popular. There are reports of anaphylaxis and atopic dermatitis after ingestion of foods that contain allergens that patients had previously applied to barrier-compromised skin.¹⁻⁵ Given the global increase in food allergy, we considered whether this natural product fad could be causing anaphylaxis that may be avoidable with appropriate public health messages.

A 30-year-old woman had anaphylaxis 20 minutes after eating homemade apple crumble with a thick oat crust. Progressive subcostal pain, dyspnea, and generalized urticaria required 3 doses of intramuscular adrenaline by paramedics and at a hospital emergency department. Until she was 24, she usually ate porridge and sometimes had muesli for breakfast without problem. She discontinued porridge after that time for convenience. From its onset at age 23, her eczema was generalized and resistant to topical emollients and steroid preparations (methylprednisolone and mometasone). She had a good response to a 3-month course of cyclosporine A. Over the next few years, she had 2 children and her eczema deteriorated. About 6 weeks after the delivery of her second child, she started a moisturizer containing oatmeal. She attributed the consequent burning sensation to broken skin but continued the product until the allergy consultation after the anaphylaxis. When she bathed her sons in an oatmeal-containing bath product, she experienced dyspnea on 2 occasions requiring a salbutamol inhaler. Soon afterward, she used the same product for her own bath (for the first time) but had to get out within minutes and call paramedics because of more serious dyspnea but no new rash, swelling, or faintness. She improved without specific treatment and did not use the bath

treatment again. Later that year she had vomiting and cramps 5 hours after eating a muesli bar. The apple crumble anaphylaxis episode occurred after a further several months. On subsequent allergy consultation, skin prick tests were positive to ryegrass pollen and house dust mite and negative to wheat. No extract was available for oats or apple. Serum-specific IgE was strongly positive for oat (84.2 kU/L) (ImmunoCAP, Phadia, Uppsala, Sweden) and negative for apple (0.36 kU/L). Now she continues to avoid oat products but tolerates apples and wheat. We hypothesized that IgE-mediated sensitization to oat was achieved via exposure of her eczematous skin to the oatmeal-based products with subsequent allergic reactions after ingestion of oats.

The basophil activation test is a quantitative *in vitro* assay for functional IgE. IgE-mediated basophil activation is revealed by flow-cytometric detection of CD63 on the basophil surface after allergen stimulation.⁶ Results correlate highly with symptoms of clinical allergy.⁷ Basophil activation tests were performed using patient whole blood stimulated with several oat-based body products (3 bath products and 1 skin cream moisturizer) and a control oat commercial extract (Greer Laboratories, Lenoir, NC) over a concentration range. Figure 1 demonstrates dose-dependent basophil activation to both the control oat extract and one of the oatmeal-based bath products (product 1; same brand used by the patient), but no activation by peanut extract (Greer Laboratories) to which the patient was not clinically allergic. Similar dose-dependent basophil activation was shown by the other oatmeal-based products (data not shown). Basophils from a nonallergic donor failed to activate in response to any of the antigens (data not shown). Positive controls (bacterial peptide formyl-methionyl-leucyl-phenylalanine and anti-IgE antibody) induced activation.

Serum IgE immunoblotting was performed as described previously⁸ using 2 of the oatmeal-based products (bath product 1 and the moisturizer) and negative control peanut extract. When the oat content of a product was unknown, it was estimated based on comparable basophil activation to a known concentration of oat allergen. Antigen preparations (6 µg/lane) were resolved by 4%-12% gradient sodium dodecyl sulfate polyacrylamide gel electrophoresis under reducing conditions, transferred to nitrocellulose and probed with the patient's serum at 1:20 dilution. IgE immunoblotting revealed serum IgE binding to components in both oatmeal-based products and oat, but not peanut (data not shown), consistent with the ImmunoCAP and basophil activation results. To test our hypothesis that use of the bath product had led to sensitization, we performed IgE inhibition immunoblotting.⁸ For this, before probing the nitrocellulose, the patient's serum was incubated with increasing concentrations of oat, bath product (product 1), or controls (peanut and ryegrass) for 1 hour. Figure 2 shows IgE binding to oat (lane 3) that is clearly inhibited in a dose-dependent manner by preincubation with oat (lanes 4-6) or with bath product (lanes 7-9). Similarly, IgE binding to proteins in the bath product was dose-dependently inhibited by preincubation of the serum with oat (data not shown). This confirms that the IgE target proteins within the bath product contain B-cell epitopes present in oat. Control inhibitors for the IgE inhibition immunoblotting included peanut and ryegrass (lanes 10 and 11), which did not cause any nonspecific inhibition of IgE binding to oat or bath product even at high concentration. A peanut

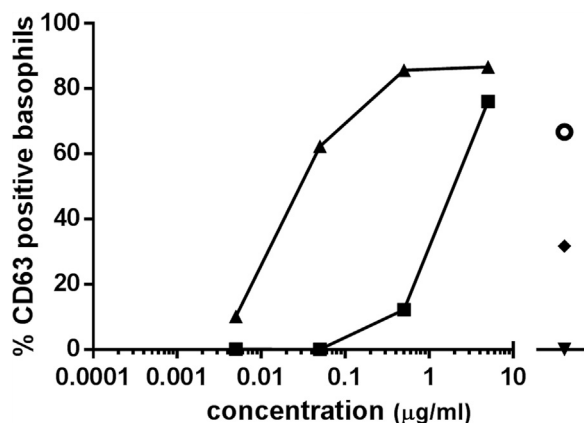


FIGURE 1. Basophil activation test. Dose-dependent basophil activation induced by oat and bath product (product 1). (▲) oat (μg/mL), (■) bath product (μg/mL), (○) anti-IgE, (◆) formyl-methionyl-leucyl-phenylalanine, (▼) no antigen.

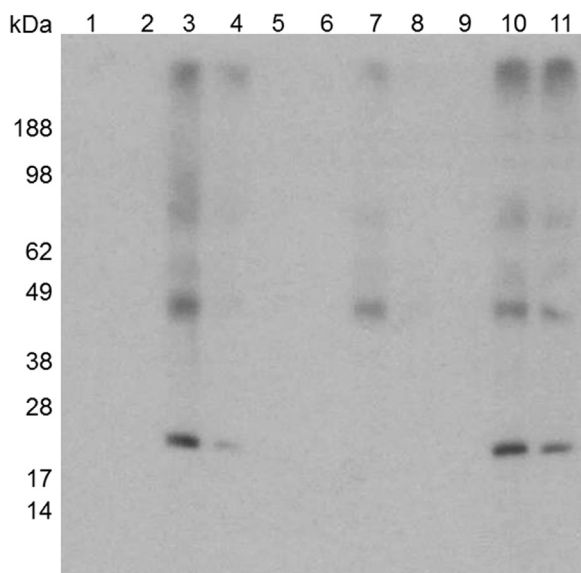


FIGURE 2. Inhibition IgE immunoblotting. Inhibition of patient serum IgE binding to oat with oat and bath product 1. Lane 1: nonallergic control serum. Lane 2: no serum. Lanes 3-11: patient serum, with no inhibitor (lane 3), 0.1, 1, and 10 μg/mL oat (lanes 4-6), 1/200, 1/20, and 1/2 dilution bath product (lanes 7-9), peanut extract (100 μg/mL) (lane 10), ryegrass pollen extract (100 μg/mL) (lane 11).

immunoblot with serum from a peanut-allergic donor did not show any nonspecific inhibition of IgE binding by the bath product or oat (data not shown). Together, these results support the conclusion that the bath product had induced an allergic immune response, and this response could be attributed to the

oatmeal within the product. The immunoblot results show strong IgE reactivity to proteins of approximately 23 and 46 kDa with weaker reactivity to 2 higher MW proteins. Similar IgE-reactive protein bands have been reported for oat using sera from patients with atopic dermatitis,⁹ but to date no oat allergens have been sequenced and characterized for the International Union of Immunological Societies (IUIS) allergen database.

The clinical history and *in vitro* immunological data indicate sensitization after contact of oatmeal allergen with barrier-compromised skin and subsequent anaphylaxis to ingested oat-containing food. These data add substantially to the growing body of evidence for cutaneous sensitization from “natural product” food allergens, in this case oat. Experimental murine studies have also confirmed systemic sensitization after allergen exposure to the skin.¹⁰ These clinical and mechanistic findings should remind clinicians and patients that cosmetics should be bland and not contain food allergens.

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Conflicts of interest: The authors declare that they have no relevant conflicts.

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