Dust mite ingestion-associated, exercise-induced anaphylaxis: a case report and literature review

Mongkhon Sompornrattanaphan1*, Yanisa Jitvanitchakul2, Nat Malainual3, Chamard Wongsa1, Aree Jameekornrak1, Orathai Theankeaw1 and Torpong Thongngarm1

Abstract
Background: Oral mite anaphylaxis (OMA) is a condition characterized by severe allergic reactions after ingesting food containing dust mite-contaminated flour. Physical exertion is recognized as a common trigger factor inducing anaphylaxis. The association of OMA with exercise-induced anaphylaxis has rarely been reported.

Case presentation: We report a 29-year-old Thai woman who had dust mite ingestion-associated, exercise-induced anaphylaxis who tolerated the same bag of contaminated flour without exercise. A sample of contaminated cooking flour was examined under a light microscope. Living mites, Dermatophagoides farinae, were detected by a medical entomologist based on the morphology. We performed skin test to both mite-contaminated and newly opened Gogi® cooking flour, common aeroallergens, food allergens, and all other ingredients in the fried coconut rice cake 5 weeks after the anaphylactic episode. Specific IgE tests, using ImmunoCAP were also performed.

Conclusions: Dust mite ingestion-associated, exercise-induced anaphylaxis may be misdiagnosed as wheat-dependent exercise-induced anaphylaxis and should be suspected in patients with anaphylaxis linked to food intake and exercise, but who have no apparent evidence to the index food ingredients on allergy workup.

Keywords: Pancake syndrome, Oral mite anaphylaxis, Food allergy, House dust mite, Exercise-induced anaphylaxis

Background
Oral mite anaphylaxis (OMA) is a condition characterized by severe allergic reactions after ingesting food containing dust mite-contaminated flour [1, 2]. Physical exertion is recognized as a common trigger factor inducing anaphylaxis [3, 4]. The association of OMA with exercise-induced anaphylaxis has rarely been reported [5, 6]. It may be misdiagnosed as wheat-dependent exercise-induced anaphylaxis.

Case presentation
We report a 29-year-old Thai woman who had dust mite ingestion-associated, exercise-induced anaphylaxis who tolerated the same bag of contaminated flour without exercise. She had moderate to severe, persistent allergic rhinitis since the age of 5, which was controlled by intranasal corticosteroid. Before the anaphylactic event occurred, she ate 10 pieces of fried coconut rice cake using mixed cooking flour (Gogi®) (Fig. 1a). Sixty minutes later, she began to jog along the road as a daily routine. Twenty minutes after jogging, she developed itchy palms and feet, followed by bilateral nasal congestion. She immediately sought medical attention for these symptoms. She then developed swollen eyelids, eye redness, watery rhinorrhea, chest tightness, and difficulty breathing.
In the emergency room, her vital signs were a blood pressure of 94/62 mmHg, a heart rate of 110 beats per minute, a respiratory rate of 24 times per minute, and an oxygen saturation of 97% on room air. Physical examination revealed angioedema of eyelids as well as generalized wheals and flares. The lungs were clear to auscultation. She was diagnosed with anaphylaxis, and food was suspected as a causative agent. Intramuscular epinephrine was administered. All symptoms improved on the first day. She had a biphasic reaction with mild recurrent eyelid angioedema the next day, which completely recovered within 24 h.

She was generally well the day before the anaphylactic event. She denied taking medications and denied history of drug allergy. She could take ibuprofen and diclofenac without any adverse reaction. One week before the anaphylactic episode, she could tolerate 15 pieces of fried coconut rice cake using the same bag of mixed cooking flour which had been opened and stored at room temperature for 2 months.

A sample of contaminated cooking flour was examined under a light microscope. Living mites, *Dermatophagoides farinae*, were detected by a medical entomologist based on the morphology (Fig. 1b). We performed skin test to both mite-contaminated and newly opened Gogi® cooking flour, common aeroallergens, food allergens, and all other ingredients in the fried coconut rice cake 5 weeks after the anaphylactic episode. Specific IgE tests, using ImmunoCAP (Phadia AB, Uppsala, Sweden), were also performed. The results of allergologic tests are summarized in Table 1.

**Discussion and conclusions**

We report a case of dust mite ingestion-associated, exercise-induced anaphylaxis in a Thai patient. Most reported OMA cases developed symptoms immediately after eating mite-contaminated foods, but they can occur during physical exercise after the oral ingestion of the mites [6]. A recent review included 145 OMA cases from various regions [1]. However, dust mite ingestion-associated, exercise-induced anaphylaxis has only been reported twice [5, 6]. To the best of our knowledge, our report is the third reported case of dust mite ingestion-associated, exercise-induced anaphylaxis. We did not perform mite-contaminated food combined with exercise challenges due to the safety issue. However, 1 week before the anaphylactic event, our patient could tolerate the same bag of mite-infested flour without exercise at home.

An alternative explanation is house dust mite allergen level in the cooking flour could have increased with mite propagation [7]. However, the patient could tolerate 15 pieces of fried coconut rice cake without any reaction 1 week prior to the anaphylactic event compared with the 10 pieces associated with the event with exercise. Both the quantity of the food ingested and the 1-week interval of mite population increase should not have caused a significant increase in mite allergen ingestion associated with the anaphylactic event. This emphasizes the role of exercise as a cofactor to develop anaphylaxis in a patient who ingests mite-infested food. This reaction appears to be caused by heat-stable allergens, as cooking the flour does not seem to make a difference in terms of reactions in our case which is similar to the previous report [1].

OMA is associated with hypersensitivity to aspirin and NSAIDs (Non-steroidal anti-inflammatory drugs). A high prevalence of house dust mite allergic rhinitis...
and/or asthma has been observed in OMA patients [2, 8]. Although our patient had house dust mite allergic rhinitis, she had no NSAIDs hypersensitivity, which is similar to the two previously reported cases (Table 2). Whether NSAIDs could also be a cofactor for anaphylaxis development without exercise after ingesting mite-infested food similar to FDEIA (Food-dependent exercise-induced anaphylaxis) has not been well established [3].

OMA is observed more frequently in geographical locations with high temperatures and relative humidity, favoring mite propagation. A series of OMA cases were reported from Venezuela, Spain, and Japan [1]. OMA is likely to be underreported in many countries with long periods of warm and humid weather, including Thailand. This condition is often overlooked and may be misdiagnosed as idiopathic anaphylaxis. The differential diagnoses include wheat allergy, allergy to hidden food allergens, food additives, and non-food allergens (e.g. drugs) [1]. In the case of suspicion of dust mite ingestion-associated, exercise-induced anaphylaxis, FDEIA should be excluded before making a diagnosis. OMA should be considered in mite allergic patients with food-induced allergic reaction who have no apparent allergy to the index food ingredients [6]. The diagnostic criteria for OMA were recently reviewed [1].

‘Gogi®’ is a well-known brand of cooking flours in Thailand which is composed of 90% wheat, 6% tapioca, 3% baking powder, and 1% of trace component. The previous report demonstrated that dust mite infestation

| Skin prick test* | Specific IgE* |
|------------------|--------------|
| Mite DP 30 x 15 mm | Cow’s milk: negative |
| Mite DF 25 x 10 mm | Egg yolk: negative |
| Mite B. tropicalis 24 x 12 mm | Egg white: negative |
| Contaminated Gogi® flour extract 1/5 w/v in saline 14 x 12 mm | Shrimp: negative |
| Newly opened Gogi® flour extract 1/5 w/v in saline: negative | Crab: negative |
| Kapok 10 x 8 mm | Clam: negative |
| Cat 5 x 4 mm | Oyster: negative |
| Dog 11 x 6 mm | Soybean: negative |
| Mouse epithelium 5 x 4 mm | Peanut: negative |
| American cockroach 5 x 4 mm | Wheat grain: negative |
| German cockroach 4 x 4 mm | Mite DP 16.00 kUA/L |
| Bermuda 5 x 4 mm | Egg yolk: negative |
| Johnson 4 x 3 mm | Mite DF 15.50 kUA/L |
| Carelessweed 15 x 8 mm | Shrimp: negative |
| Acacia 5 x 4 mm | Egg yolk: negative |
| Penicillium: negative | Wheat 0.03 kUA/L |
| Aspergillus: negative | Omega-5 gliadin 0 kUA/L |
| Alternaria: negative | Cow’s milk 0.02 kUA/L |
| Sticky rice flour extract 1/5 w/v in saline: negative | Egg white 0 kUA/L |

B. tropicalis, Blomia tropicalis; DP, Dermatophagoides pteronyssinus; DF, Dermatophagoides farinae; sIgE, specific immunoglobulin E; mm, millimeter; w/v, weight to volume ratio

* Normal saline and histamine (10 mg/mL) were used as negative and positive controls, respectively. We did not perform a latex skin test due to the unavailability of a standard solution

b Prick-to-prick test by using fresh fruit

Solid-phase immunoassay: ImmunoCAP
of flour was dependent on the presence of wheat and a high ambient temperature in tropical regions [9]. It is recommended that cooking flours be kept in the refrigerator using sealed glass containers or plastic bottles. In tropical regions, it is recommended that cooking flour be kept refrigerated for no longer than 6 weeks to prevent significant mite propagation [1].

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Authors' contributions
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Competing interests
The authors declare that they have no competing interests.

Author details
1 Division of Allergy and Clinical Immunology, Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.
2 Division of Hematology, Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.
3 Department of Parasitology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.

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