

## CASE REPORT

# Anaphylaxis Following the Ingestion of Flour Contaminated by House Dust Mites - A Report of Two Cases from Singapore

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**SUMMARY** This study presents two patients who developed anaphylaxis after eating mite-contaminated food, and also contains a survey of dust-mites contamination in flour samples from Singapore households. The clinical records of each patient was studied. Patient A developed anaphylaxis twenty minutes following the ingestion of home-made fried fish coated with Japanese flour, while Patient B developed similar life-threatening symptoms one hour after the ingestion of home baked scones. Both patients were NSAID-intolerant and had a history of allergic rhinitis. Skin prick tests showed a strong positive result for dust-mites and for extracts prepared from the ingested flour. Flour samples were also examined microscopically which revealed large numbers of live *Dermatophagoides farinae* dust-mites. A survey of 57 flour samples showed that 4 samples (7%) were contaminated with dust mites. The findings in the present study confirm that mite-contamination of flour exists in Singaporean households, and it may trigger anaphylaxis in susceptible individuals.

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Anaphylaxis is potentially a life-threatening allergic reaction, and is caused by the IgE-mediated release of inflammatory cytokines. It occurs in 30 out of 100,000 people annually within the United States, and the reported mortality rate is 1-2%.<sup>1</sup> Anaphylaxis caused by the ingestion of wheat flour contaminated with dust or with storage mites such as *Dermatophagoides farinae* appears to be a rare event. It is an unlikely trigger for anaphylaxis, and its documentation has been restricted mainly to case

reports.<sup>2-6</sup> Thus, it should be regarded with a high degree of suspicion.

The phenomenon typically arises in tropical and subtropical countries where hot and humid cli-

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mates are particularly conducive to mite propagation. Previous cases have arisen in regions such as Spain and Venezuela. Indeed, Singapore has a tropical climate with annual temperatures ranging between 24–32°C, which is highly suitable for dust mites. There is a high prevalence (> 90%) of positive sensitization to dust mites among individuals with atopic diseases such as asthma and/or allergic rhinitis in Singapore. Dust mite allergy is also an important asthma risk factor in Singaporean children.<sup>7</sup> Although inhaled dust mite allergens can trigger severe asthma and rhinitis, it has rarely been implicated as a trigger of life-threatening anaphylaxis symptoms<sup>8</sup> or death.<sup>9</sup> Broom and Fitzharris<sup>8</sup> raised the possibility of inhaled allergens as being a common cause of recurrent idiopathic anaphylaxis when other recognized causes have been excluded.

Our study presents the clinical observations and diagnostic approaches of two patients who had developed acute anaphylaxis after eating food contaminated with dust mites. Additionally, examinations of flour samples kept in Singapore households for dust mite infestations were also conducted.

## PATIENTS AND METHODS

Clinical reports were obtained at a Singapore hospital for two patients treated for systemic anaphylaxis as a consequence of ingesting mite-contaminated food.

### Skin prick allergy tests

House dust mite sensitivities for both patients were determined using skin prick test evaluations with *D. pteronyssinus* and *D. farinae* commercial extracts (Greer Laboratories, Lenior, North Carolina, USA) as well as with our in-house *Blomia tropicalis* extracts. Custom-made extracts were also isolated from flour provided by the subjects and from fresh flour purchased from a supermarket. The extracts were prepared by mixing 0.5 g of flour with 5 ml of normal saline (1:10 w/v) with agitation for 3 hours at 26°C. Samples were then centrifuged at 10,000 × g for 30 minutes. Supernatants were passed through 0.22 μm pore size filters and stored at 4°C in sterile containers until required. The extracts from freshly purchased flour were prepared from the same

brand of flour that had been consumed by each patient.

### Examination of flour samples for dust mites

The flour samples were viewed separately under a dissecting microscope. For species identification, mites were picked individually from flour samples and added to 5–10 ml of 80% (v/v) aqueous lactic acid. Following 15 minutes of boiling, they were mounted onto glass slides using DAKO® Faramount Aqueous mounting medium (DAKO Corporation, Carpinteria, CA, USA). Identifications were carried out with a light microscope by examining slides at 150-fold magnification.

### Screening of flour samples from Singapore households

Flour samples were collected from the homes of volunteers. A questionnaire was used to gather information on the location, temperature and method of flour storage, as well as light exposure, type and brand name of the flour and the length of flour storage since opening. All samples were examined under a dissecting microscope.

## RESULTS

### Case 1

A 15-year-old girl (Patient A) developed urticaria, throat discomfort, acute dyspnea and severe wheezing 20 minutes after ingestion of home-cooked fried fish and prawns coated with Japanese tempura flour. Her oxygen saturation level dropped to 77% and she was resuscitated at the emergency department in a local private hospital. The patient's mother stated that no new ingredients had been used in the preparation of the meal and that the patient had consumed these foods on all prior occasions without incident. However, the tempura flour had been stored on a shelf in a plastic container at 26°C for two months since the last time it was used for cooking. The ingredients in the tempura powder listed on the package label were starch, egg-yolk powder, baking powder and wheat flour. Each of these individual ingredients had been previously consumed by the patient without complaint.

The patient had a history of early childhood asthma and allergic rhinitis as well as intolerances to aspirin, NSAIDs and paracetamol. She also suffered from a similar but somewhat milder attack previously when she developed itchiness around her mouth after consuming large prawns. However, the patient tolerates other shellfish, including smaller shrimps. When examined, there were many small areas of light brown discoloration in the self-raising flour, indicative of mite infestation. Skin prick tests revealed strong positive responses (wheals > 10 mm) with pseudopodia to the house dust mites *B. tropicalis*, *D. pteronyssinus* and *D. farinae*. Responses were also positive when custom-made extracts prepared from flour samples obtained from the patient were used in the tests. In contrast, negative responses were obtained when identical, freshly-purchased flour extracts were tested, as were shrimp and crab extracts. Flour samples were inspected under the dissecting microscope which confirmed the presence of large numbers of live dust mites. The species *D. farinae* (Fig. 1) was subsequently identified in these samples by morphological examinations.

## Case 2

A 30-year-old female (Patient B) developed bilateral peri-orbital angioedema, wheezing and a feeling of impending doom one hour after ingestion of home baked scones. She required treatment at the hospital emergency department. A detailed history of the ingredients used for the ingested scones revealed that self-raising flour, baking powder, preserved apricots, butter and cow's milk were used. All ingredients had been consumed by the patient previously without any adverse reactions. However, of particular concern was the self-raising flour which had been used for the first time after storage in plastic-ware at 26°C for at least six months.

This patient had required two previous hospitalizations due to systemic anaphylaxis resulting from an unidentified trigger related to food. On the first occasion she had consumed porridge containing sesame oil from a restaurant, and then developed abdominal pain, severe wheezing and angioedema. The second episode arose 15 to 30 minutes after the consumption of home-made pasta and gravy, whereupon she complained of breathlessness, wheezing and body aches. She also had a history of persistent

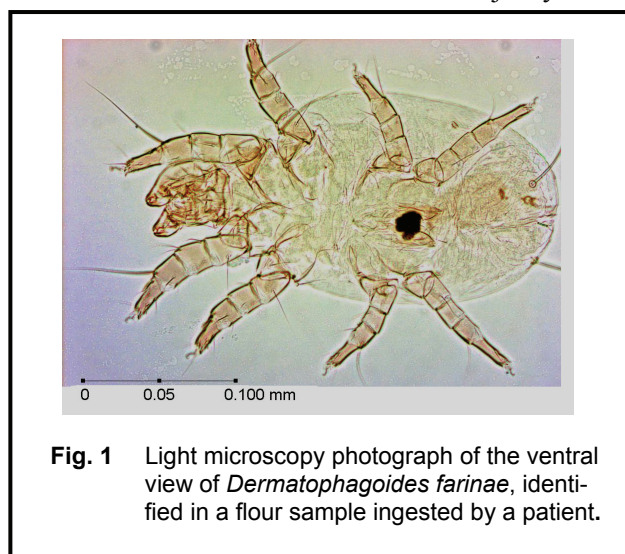
rhinitis since adolescence, but had not been evaluated for allergies. She was intolerant towards aspirin, and the ingestion of 324 mg of salicylates led to the development of periorbital edema.

Skin prick tests were performed with the house dust mites *D. pteronyssinus*, *D. farinae* and *B. tropicalis*. These tests showed positive responses (wheal > 5 mm) for all three of these dust mites tested, as did the extracts of self-raising flour and the baked scone. However, they were negative towards all other ingredients. Close inspection of the self-raising flour revealed that there were many small areas of light brown discoloration which were likely to be colonies containing mites. Microscopic examination of the self-raising flour confirmed large numbers of live dust mites. However, the contaminating mites could not be identified.

Both patients fully recovered and were discharged several days later with a MEDIK AWAS card and an emergency kit containing an Epipen (Adrenaline-auto-injector), Ventolin MDI and Piriton (chlorpheniramine). Advice on the proper storage of flour (e.g. refrigeration) was also provided.

## Screening of flour samples from Singapore households

In order to determine the frequency of flour dust mite infestations in Singapore, 57 flour samples were collected from 36 volunteer households from various locations and examined. The majority of the



**Fig. 1** Light microscopy photograph of the ventral view of *Dermatophagoides farinae*, identified in a flour sample ingested by a patient.

flour donors resided in public housing apartments (21/36, 58.3%). The average duration of storage after the flour package was opened was 9.1 months (range: 0.25-36 months). These samples were mostly wheat flour (30/57, 53.6%). House dust mites were found in only 4 samples (4/57, 7.01%), and all of these were wheat flour obtained from a single household. The duration of storage since the time of purchase was one month for these samples. Throughout storage, there had been no direct exposure to light and the flour was kept in its original packet, fastened with a rubber band and stored in the kitchen cupboard.

## DISCUSSION

House dust mites, mainly pyroglyphids from the genus *Dermatophagoides*, are the most prevalent source of indoor inhalant allergens worldwide.<sup>10-12</sup> Mites are known to infest stored food<sup>13</sup> and cause rhinitis or asthma as food-related inhalant allergies. Anaphylaxis that is triggered by inhalation of dust mites is uncommon, however, it has been implicated in cases where the trigger for the condition cannot be identified. Similarly, in our local cohort of patients, anaphylaxis resulting from jumping on mattresses and playing with blankets had been reported.<sup>14</sup> Hidden food allergens are becoming increasingly recognized as a cause for the condition.<sup>15</sup> There have been very few studies on allergies arising from the ingestion of antigens from insects or arthropods, and mites are not regarded as sources of ingestant allergens. A review article by Phillips and Burkholder<sup>16</sup> concludes that further information linking arthropods to food-related illnesses and injuries are necessary.

The two cases in the present study emphasize the problems caused by dust mite infestation of wheat flour which can lead to severe anaphylactic reactions following consumption. There have been several other case reports of individuals suffering from anaphylaxis after unintentional ingestion of food infested with dust mites.<sup>2-6,9,17,18</sup> All of the patients studied were known to be sensitive to mite allergens, and anaphylaxis occurred soon after the ingestion of mite-contaminated foods which typically consisted of flour. Although food challenges using the contaminated flour were not carried out for the two subjects described because of the seriousness of their reactions, it can be concluded that the ingested

mites caused anaphylaxis, since the subjects had tolerated these foods on prior occasions. Furthermore, they were sensitive to the contaminated flour but not newly-purchased, fresh flour samples.

Ingestion of mite-infested foods may produce varying degrees of allergic reaction severities in mite-sensitive consumers.<sup>4</sup> In such cases, the ingestion of mite-contaminated foods generally involve high levels of mite-exposure (> 1,000 mites per gram of food). The foodstuffs in these reports were typically stored improperly in the home after opening, thereby allowing mites to proliferate and reach very high levels. Symptoms ranged from mild skin reactions to severe life-threatening laryngeal obstruction and cyanosis. The most severe reactions were generally caused by the ingestion of foods with extremely high levels of mite contamination (> 5,000 mites per g of food).<sup>2-5,18-20</sup> The underlying anaphylactic immune mechanisms induced by the ingestion of dust mite allergens as opposed to inhalation is also still not understood. Whether the route of exposure or the dose of allergen contributes to the anaphylactic response requires further investigation.

Salicylate intolerance is also often reported among these patients. A syndrome consisting of a triad of sensitivity to aspirin, allergic rhinitis, and severe allergic reactions to ingested aeroallergens has been proposed<sup>21</sup>, although the pathophysiological link is not clearly defined. Therefore, patients who suffer from NSAID intolerance, allergic rhinitis and anaphylaxis after the consumption of food prepared from flour may also be predisposed to acquiring anaphylaxis from ingested dust mites. Both patients described in the present manuscript also exhibit the features of this clinical triad.

It is possible that this phenomenon occurs in tropical environments more often than what is reported, however only a percentage of these patients are being referred to the appropriate allergists for further diagnostic study and treatment. Patients are frequently diagnosed as suffering from "idiopathic anaphylaxis" or are misdiagnosed with wheat allergies. Klein and Yocum<sup>5</sup> observed that in approximately 50% of unexplained anaphylaxis cases, patients are not referred to an allergist for study and follow-up treatment.

A diagnosis of allergy to ingested house dust mites for patients who develop anaphylaxis after a meal, particularly after the consumption of flour-based food, should be treated with caution. The appropriate diagnostic investigative procedures, such as skin prick tests using extracts from flour contaminated with house dust mites, must be undertaken. Unnecessary testing of multiple allergens should also be avoided. Furthermore, examinations of contaminated flour samples can provide crucial evidence to substantiate the diagnosis. Separating patients who are sensitive to ingested mites from those without an identified allergy trigger assists in avoiding the development of a second anaphylactic attack which might be life-threatening. It also prevents the misdiagnosis of allergies towards wheat or patient unnecessarily avoiding eating certain foodstuffs. Additionally, it may help eliminate anxiety from the accidental ingestion of foods or, in extreme cases, the development of food allergy neuroses.

The findings from our case studies strongly suggest that the mite allergens responsible for anaphylaxis are very heat-resistant, since the ingredients in both cases were baked and fried. This has also been reported previously for other mite species.<sup>6</sup> The heat-stability of the house dust mites persists despite factory-sterilization of the flour prior to shipping, infestation may still occur due to the desiccation-resistant, protonymph-stage mites that can survive dry, adverse conditions. Matsumoto *et al.*<sup>22</sup> reported that mite contamination usually occurs within the home environment after flour packages are opened. These mites then proliferate under more favorable climate conditions, thus producing a substantial population.

Our survey of flour samples from households in Singapore showed that mite infestation was present in approximately 7% of the households. In contrast, a survey conducted in Caracas, Venezuela revealed that 37% of household flour samples were contaminated with dust mites. It is difficult to explain this difference in the prevalence between the regions which have very similar climates. All but one sample in our survey were not refrigerated (data not shown). We speculate that packaging of flour may be different and contamination may occur more easily in Venezuela. This notion, however, requires further evaluation.

In conclusion, we advise that mite-sensitive individuals should store flour products in well-sealed containers in the refrigerator where conditions are far less favorable for mite invasion and proliferation.<sup>2-5</sup> Allergic individuals should also be aware that baking or cooking food at high temperature is unlikely to prevent the ingestion of house dust mites in contaminated foodstuffs.

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