
CME review article

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An update on oral anaphylaxis from mite ingestion

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Objective: To review systemic reactions due to the oral ingestion of mites.

Data Sources: We performed a MEDLINE search of peer-reviewed research articles published between 1993 and 2004 relevant to the subject of anaphylactic reactions to mite-contaminated foods.

Study Selection: Recent studies that emphasized the potentially life-threatening nature of anaphylactic reactions, responsible foodstuffs and mites, populations at risk, and pathogenesis were selected for inclusion in this review.

Results: Although relatively few new cases of oral mite anaphylaxis are reported in the literature, we speculate that this clinical condition is occurring more frequently than realized in many geographic locations, and only the suspicion of an informed physician can contribute to its diagnosis and prevention. Oral anaphylaxis from mite-contaminated foods may be lethal if not promptly recognized and treated, and some preventive measures may be helpful for individuals at risk. Frequent cross-reactions among domestic, storage, and phytophagous mites explain the increased risk of oral mite anaphylaxis in sensitive patients living in both urban and rural areas. The enzymatic activity of some mite allergens contributes to the pathogenesis of this syndrome by means of mucosal damage and enhanced allergen absorption through the oral route.

Conclusions: Oral mite anaphylaxis is a severe, potentially lethal allergic condition that occurs in many countries and is frequently undiagnosed. Early recognition may lead to the implementation of simple prophylactic measures in at-risk populations of allergic patients.

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INTRODUCTION

In 1993, Erben et al¹ observed the first case of systemic anaphylaxis to mite-contaminated foods. A few years later, in 1995, we reported on a group of patients who developed severe generalized allergic reactions following the ingestion of foodstuffs that contained high quantities of mites.² Since

these patients were atopic, had a previous history of rhinitis and/or asthma, and frequently were sensitive to aspirin,³ we proposed a new aspirin triad that consisted of aspirin sensitivity, allergic rhinitis, and severe allergic reactions to ingested aeroallergens.⁴

Taking into account that most of our patients developed this clinical picture from mite-contaminated wheat flour pancakes, we also designated it the "pancake syndrome."⁵ Our first patient was diagnosed as having the "pancake syndrome" in 1982, and we have continued to observe new cases of this frequently occurring syndrome, which is mostly found in tropical and subtropical regions with known climatic conditions that facilitate mite reproduction.⁵ We have also received

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requests from colleagues around the world asking for details about our study of patients with suspected oral anaphylaxis from mite ingestion.

We speculate that more of these reactions may be occurring in other countries but that patients are not obtaining the proper medical advice due to the lack of an etiologic diagnosis. Therefore, this article reviews systemic reactions due to the oral ingestion of mites and updates the available information about this syndrome to increase physician awareness on this potentially lethal acute disease. We performed a MEDLINE search of peer-reviewed research articles published between 1993 and 2004 relevant to the subject of anaphylactic reactions to mite-contaminated foods. Recent studies that emphasized the potentially life-threatening nature of anaphylactic reactions, responsible foodstuffs and mites, populations at risk, and pathogenesis were selected for inclusion in this review.

RECENT REPORTS OF NEW CASES OF ORAL MITE ANAPHYLAXIS

Originally, cases from Detroit, MI, Philadelphia, PA, Birmingham, AL, Caracas, Venezuela, Canary Islands, and Kumamoto, Japan, were published.^{4,6-9} Unpublished cases from the Dominican Republic, Israel, and Africa have also been called to our attention. More recent case reports include 1 patient from Brazil with anaphylaxis from corn flour contaminated with mites¹⁰ and 2 additional patients from southern Japan who developed anaphylaxis from "okonomi-yaki" (fried flour that contained dried scallop, bonito, and mackerel) contaminated with *Tyrophagus putrescentiae* or *Dermatophagoides farinae*.¹¹

CAN THIS SYNDROME BE LETHAL?

Oral anaphylaxis from mite ingestion is a life-threatening condition. In our article published in 1997,³ 2 patients were treated in the intensive care unit because of acute respiratory failure due to laryngeal edema. Recently, Edston and van Hage-Hamsten¹² described a 47-year-old farmer sensitive to mites who was found dead at home. Postmortem analysis showed increased levels of serum tryptase and anti-*Dermatophagoides pteronyssinus* and anti-*D farinae* IgE antibodies and high levels of mite allergen in his mattress. Authors concluded that this patient died from anaphylactic shock probably due to the intake of mite-contaminated food, although they did not examine foodstuffs eaten by the patient before his death. From clinical experience, it would be unlikely that inhalation of mite allergens would induce a fatal allergic reaction in this patient. Anecdotal reports on other lethal cases in the Caribbean region have also been called to our attention.

Since there are a number of articles that describe a high prevalence of mite sensitization in people living in rural areas, together with the presence of cross-reactions among different mite species, we have speculated that the population at risk for oral mite anaphylaxis is increasing. For example, in Kenya and other African countries, an increase of asthma

incidence accompanying urbanization has been reported¹³⁻¹⁵; furthermore, IgE-mediated allergies, especially to house dust mite and Bermuda grass, are common in Central Africa,¹⁶ and inhalant allergy is common in Zimbabwe.¹⁷

CROSS-REACTIONS BETWEEN DOMESTIC AND STORAGE MITES

Since some of our patients previously known to have rhinitis and/or asthma and positive skin test results to *Dermatophagoides* spp had anaphylaxis triggered by foods contaminated with other mites, such as *Suidasia* and *Aleuroglyphus*, which are members of the storage mite group, we suspected that these mites cross-reacted with domestic mites. It has been demonstrated that allergy to storage mites is associated with occupational exposure and damp housing conditions.¹⁸⁻²⁰ It is also known that allergies to house dust and storage mites are common among farming populations,^{21,22} and sensitization is associated with asthma and rhinoconjunctivitis. Miyamoto et al²³ showed evidence of cross-reactivity between *D farinae* and several storage mite species, whereas van Hage-Hamsten et al,²⁴ using radioallergosorbent testing inhibition, could not find any significant allergenic cross-reactivity between *D pteronyssinus* and 4 storage mites: *Lepidoglyphus destructor*, *T putrescentiae*, *Glycyphagus domesticus*, and *Acarus siro*.

T putrescentiae is an important storage mite in rural regions and is the third most common indoor mite in Korea.²⁵ Some controversy exists about the level of cross-reactivity between *T putrescentiae* and *D pteronyssinus*. Some authors postulate a minimal degree of cross-reactivity,^{24,26,27} whereas others state it is moderate to high.²⁸⁻³¹ *Dermatophagoides* spp contain species-specific allergens and allergens cross-reactive with *T putrescentiae*, but *T putrescentiae*-derived extracts do not have sufficient species-specific allergens.³² Using enzyme-linked immunosorbent assay inhibition techniques, Munhbayarlah et al³³ showed strong cross-reactivity between the major allergens of *T putrescentiae* and *D pteronyssinus*, but the major allergens of *D pteronyssinus* extracts exhibited less cross-reactivity with *T putrescentiae* allergens.

Regarding cross-reactions with *A siro*, Blainey et al used skin prick tests and radioallergosorbent testing to demonstrate a significant correlation between *D pteronyssinus* specific IgE and *A siro* specific IgE and between *D pteronyssinus* and *T putrescentiae* in atopic patients.^{19,34}

MITES CONTAMINATION OF FOODSTUFFS

In North America, current standards permit up to 75 "insect fragments" per 50 g of grain. An important study published in Brazil by Franzolin and Baggio³⁵ investigated mite contamination of rice and beans in samples from 9 municipal markets (25 rice samples and 53 bean samples). Samples were negative for mites on the first day of analysis, and mites were detected after incubation at 25°C and 75% relative humidity in 31.7% vs 6.9% of samples incubated at room temperature (1,845 vs 45 mites). Increased amounts of mites were present when the samples were maintained at 21.5°C to 22.5°C and humidity kept between 73.5% and 74.5%, with rice being

more contaminated than beans. Increased mite growth occurred from December to April (end of spring, summer, and the beginning of autumn). The predominant mite was *T putrescentiae*, which grows more efficiently between 10°C and 34°C and 65% to 90% relative humidity.³⁶ Other mites were present, including *Blomia tropicalis*, *Cheyletus* spp, and *Blattisocius tarsalis*. These authors also reported that different grains, flours, dried meats and fish, dried fruits, cheese, powdered chocolate, and seeds are often contaminated with mites. To prevent mite contamination of foodstuffs, Franzolin and Baggio recommended the following: (1) store grains for fewer than 6 months, (2) use waterproof receptacles, (3) keep the food in dry and cool places, (4) keep temperature at 0°C to 7°C, (5) keep humidity less than 12%, and (6) wash the grains with running water to eliminate mites.

Zaher et al³⁷ investigated the presence of mites in samples of lupine and camomile in Upper Egypt, with negative results, whereas Codina et al³⁸ showed cockroach allergen (Bla g 2) in wheat flour and cornmeal. In Venezuela, together with Dr Suárez-Chacón, we had the opportunity to observe microscopically a commercial package of tea leaves contaminated with mites. This finding might be extremely important for allergic patients who live in countries where tea is routinely consumed and patients could be at risk for allergic manifestations and anaphylaxis from these products (Sánchez-Borges et al, unpublished data, 1998).

Another issue worthy of discussion in the context of oral mite anaphylaxis is the contamination of plants with phytophage mites. The most studied mites are from the Tetranychidae family (spider mites), including *Tetranychus urticae*, *Panonychus ulmi*, and *Panonychus citri*. There are 1,200 species of spider mites. *P citri* (citrus red mite) is the most important allergen source in citrus fruit farmers with asthma and rhinitis and a common sensitizing allergen in children who live near citrus orchards.^{39–41} The European red mite (*P ulmi*) infests apple farms, and the two-spotted spider mite (*T urticae*) infests pear farms, greenhouses, and herbaceous plants.⁴² Both *T urticae*– and *P ulmi*–derived extracts contain genus- and/or species-specific allergens in addition to common shared allergens with the domestic mites. *T urticae* has 7 dominant allergens (17, 27, 33, 37, 41, 56, and 75 kDa). *T urticae* specific IgE binding was completely inhibited by *T urticae* (99.7%) but only partially inhibited by *P citri* (83.0%), *P ulmi* (71.6%), *T putrescentiae* (69.7%), and *D pteronyssinus* (60.1%). *P ulmi* has 3 dominant allergens (33, 41, and 51 kDa), and *P ulmi* specific IgE binding was completely inhibited by additions of *P citri* (92.3%) and *P ulmi* (91.2%) but only partially inhibited by *T urticae* (61.5%), *T putrescentiae* (57.7%), and *D pteronyssinus* (54.4%).³²

ADVANCES ON THE PATHOGENESIS OF ORAL MITE ANAPHYLAXIS

The clinical picture, previous history of atopic disease (rhinitis and/or asthma), and positivity of immediate-type skin hypersensitivity test results with mite allergens and mite-contaminated food extract led us to propose the hypothesis

that oral mite anaphylactic reactions are mediated by mite specific IgE antibodies. The recent discovery that some mite allergens are enzymes (cysteine proteases, serine proteases) that induce direct damage to airway and gastrointestinal mucosa may help to explain the rapid initiation of symptoms from immediate absorption of large amounts of allergen present in food.⁴³

Different substances with biological activities are produced by mites (Table 1), including hydrolytic and nonhydrolytic enzymes, enzyme inhibitors, proteins involved in storage or transport, and regulatory proteins. For Der p 1 (cysteine protease), the following pathogenetic mechanisms have been proposed⁴⁴: (1) acting as a potent allergen able to induce a T_H2-mediated immune response; (2) cleavage of CD23, which may increase IgE synthesis through inhibition of negative feedback; (3) cleavage of CD25 (interleukin 2 receptor), inducing a bias toward T_H2 pathway through inhibition of T_H1 cell proliferation and decreased production of γ -interferon; (4) direct damage to airway epithelium; (5) inhibition of α_1 -antitrypsin, resulting in reduced defense against epithelial tissue damage; (6) disruption of tight intercellular junctions⁴⁵; (7) release of proinflammatory mediators from eosinophils⁴³; and (8) up-regulation of inducible nitric oxide synthase expression and stimulation of nitric oxide release.⁴⁶

The observation that mite-contaminated foods induce reactions even though the food has been heated and cooked has suggested the participation of group 2 mite allergens, which are thermoresistant, in the production of the clinical picture, since group 1 allergens are heat labile.⁴⁷ Another issue worth further investigation is related to the possible effects of mite allergen introduction through the gastrointestinal mucosa. In tropical environments, the possibility exists of inducing immunologic tolerance from this allergenic contact. On the other hand, long-term exposure to low amounts of allergen by ingestion might result in enhanced sensitization and increased prevalence of allergic disease. In sensitized individuals, the ingestion of high quantities of allergen induces a systemic allergic reaction as observed in oral mite anaphylaxis.

Table 1. Biological Activities of Mite Allergens

Group	Molecular weight, kDa	Function
1	25	Cysteine protease
2	14	Unknown
3	30	Trypsin
4	56	α -Amylase
5	14	Unknown
6	25	Chymotrypsin
7	22–28	Unknown
8	26	Glutathion-s-transferase
9	24	Serine protease
10	36	Tropomyosin
11	102	Paramyosin
13	15	Fatty acid binding protein
19	...	Antimicrobial peptide

Another intriguing fact is the increased incidence of oral mite anaphylaxis in patients with a previous history of aspirin and other nonsteroidal anti-inflammatory drug cutaneous hypersensitivity (urticaria and angioedema), which has been observed in the 2 largest series of cases published until now.^{3,8} In the study by Blanco et al,⁸ the presence of acetylsalicylic acid in the problem flour extracts was investigated by means of spectrophotometric assay, with negative results.

Since enzymes and enzyme inhibitors are present in mite extracts, we have looked for the presence of substances able to inhibit cyclooxygenases 1 and 2 in these extracts, which could contribute to the severity of systemic reactions observed in patients with oral mite anaphylaxis. *D pteronyssinus* and *D farinae* extracts at concentrations up to 220 AU/mL did not show detectable inhibition of either cyclooxygenase 1 or cyclooxygenase 2 enzyme activities, whereas control compounds gave their normal values (M. Ouellet and M. D. Percival, unpublished data, 2004). Since patients with anaphylaxis triggered by mite ingestion had reactions after taking very large amounts of allergen, which we calculated as approximately 165,000 mites per pancake, equivalent to 3,300 µg of group 1 allergen, we intend to test higher allergen concentrations in cyclooxygenase inhibition assays.

CONCLUSION

Anaphylactic reactions to mites hidden in foods are being increasingly recognized, especially in certain parts of the world where climatic conditions (temperature and relative humidity) are favorable for mite proliferation. Recognition of generalized allergic symptoms that occur immediately after the ingestion of mite-contaminated foodstuffs, especially those prepared with wheat flour, constitutes a key factor in establishing the right etiologic diagnosis and proper patient counseling aimed at the prevention of repeated episodes.

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CME Examination

1–5, Sánchez-Borges et al. 2005;94:216–221.

CME Test Questions

1. Oral mite anaphylaxis

a. is observed more frequently in desert areas of the world

b. usually has symptoms that begin approximately 8 hours after inhalation of freeze-dried powdered food

c. occurs more often with foods prepared with wheat flour

-
- d. is observed predominantly in nonatopic patients
 - e. is due to the presence of natural salicylates cross-reacting with mite allergens in the foods
2. Mites that cause oral anaphylaxis are
- a. domestic and storage mites
 - b. storage mites exclusively
 - c. phytophagous mites
 - d. spider mites
 - e. house dust mites
3. Ways to prevent mite contamination of foods include
- a. high-temperature cooking
 - b. microwave cooking food stored for more than 6 months
 - c. keeping the food in waterproof containers in cool and dry places
 - d. adding food grade metabisulfite monthly to powdered foods
4. Mite allergens
- a. are exclusively high-molecular-weight enzymes
 - b. bind to the C1q component of the complement system
 - c. activate coagulation and fibrinolytic systems
 - d. are thermolabile and thermoresistant proteins
 - e. are a minor trigger compared with endotoxin
5. Which of the following mites are house dust mites?
- a. *Dermatophagoides farinae* and *Tyrophagus putrescentiae*
 - b. *Aleuroglyphus ovatus* and *Lepidoglyphus destructor*
 - c. *Glycyphagus domesticus* and *Acarus siro*
 - d. *Euroglyphus maynei* and *Dermatophagoides pteronyssinus*
 - e. *Panonychus ulmi* and *Suidasia* spp
- Answers found on page 306.**
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