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USF INTERNAL MEDICINE & PEDIATRIC DIVISIONS OF ALLERGY AND IMMUNOLOGY

Continuing with key historical articles of scientific importance in the medical literature, Enrique Fernandez Caldas, PhD, a past faculty member for many years in the Internal Medicine Division of Allergy and Immuology and now an affiliate faculty member, would like to highlight the early work done with *Blomia tropicalis* in Tampa and the clinical impact of these findings.

From Enrique Fernandez-Caldas, PhD

Richard F. Lockey, MD, Director, Division of Allergy and Immunology, Department of Internal Medicine, always had a great interest in analyzing the house dust mite fauna in the Tampa Bay area. He had the clinical impression and opinion that something was missing, since many patients had a clear clinical history of "house dust allergy" but the skin tests were negative. I first came to Tampa in 1986 and presented the data of the projects I had been doing at the Mayo Clinic and also the results of my doctoral thesis about the mite fauna in the Canary Islands. He was very impressed with the data and we started this first project in Tampa. We analyzed these samples collected in homes of mite allergic individuals, concluded that the *Blomia tropicalis* was an important mite species in Tampa, and described it for the first time in the USA. We were also very lucky to be able to culture this species and take these nice Scanning Electron Microscopy pictures at the USF Department of Pathology with Ed Haller. The predator mite *Cheytleus* spp. was also photographed. Once the *B. tropicalis* cultures were established, we produced allergen extracts which were used to diagnose patients using *in vivo* and *in vitro* tests. Most of these projects resulted in high impact publications with several fellows as primary authors. The attached is the first one of such publications.

With warm regards,

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House Dust Mite Allergy in Florida. Mite Survey in Households of Mite-Sensitive Individuals in Tampa, Florida

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ABSTRACT

This study evaluated the prevalence of positive house dust mite skin tests in a population of atopic individuals and identified the mite species present in mattress and house dust samples in homes of the Tampa Bay area. Four hundred consecutive individuals were evaluated for respiratory complaints and skin tested with standardized extracts of Dermatophagoides pteronyssinus (Dp) *and* Dermatophagoides farinae (Df). *Two hundred forty individuals (60%) had a positive skin test to the mite extracts. Dust samples were collected in 40 homes of mite-allergic individuals and analyzed by light microscopy. Mite species were found in 53 of the 60 dust samples (20 mattresses and 40 carpets). Mite numbers ranged from 110–6200 mites/g of mattress dust and from 120–5500 mites/g of carpet dust. Eleven different mite species were identified and* Blomia tropicalis (Bt), *not previously identified in the United States, was found in 30% of the samples.* Dp *and* Df *were the predominant species. These observations suggest that house dust mite allergy is common in the Tampa Bay area and that the house dust mite fauna comprises several mite species besides* Dp *and* Df. *Prospective studies in progress are designed to confirm the role of different mite species in house dust mite allergy.*

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Kern and Cooke[1,2] were the first authors to relate the pathogenesis of house dust asthma to an immunological process. In 1964, Voorhorst et al.[3] demonstrated that microscopic Arachnida, specifically *Dermatophagoides* spp., of the subclass Acari, are an important cause of respiratory allergies and the main source of house dust allergen. Two species of the genus *Dermatophagoides, Dp* and *Df*, are found primarily in the indoor environment.

Information on the house dust mite fauna in the United States is scarce. Several reports indicate that there is a higher incidence of *Df* in the Midwest[4] and Texas,[5] of *Dp* in Georgia,[6] while both species are found frequently in California with *Dp* predominating in the coastal areas.[7,8] A study of the prevalence of house dust mite (HDM) in homes of 224 mite-allergic patients in seven geographical regions of the United States revealed that *Df, Dp, Euroglyphus maynei* (*Em*), and *Blomia* spp. were the most common mites and that their prevalence varied geographically.[9]

The allergenicity of storage mites has also been established.[10–13] Storage mites have a wide range of families, genera, and species. The species most commonly found in the indoor environment belong to the genera *Tyrophagus, Glycyphagus, Acarus, Suidasia, Lepidoglyphus, Chortoglyphus, Blomia* and *Tarsonemus.* These are most frequently found in stored grain, grain transfer facilities, barns, hay, and straw. Exposure to these mites and their by-products also occurs in homes, and they

have been found in dust of occupied dwellings throughout the world.[14-17] The role of storage mites as environmental indoor allergens has not been adequately studied although allergic rhinitis, asthma, contact dermatitis, and urticaria have been described as associated with mites present in stored grain, straw, hay dust, and barns.[18-21] Indeed, mite allergy has been described as a more frequent cause of allergic diseases in the farming population in Sweden than allergens derived from plants and animals.[22]

Although the allergenicity of *Dermatophagoides* spp. is documented, the extent of its uniqueness and/or cross-reactivity with mite allergens of other genera has not been completely studied; there is some evidence that *Dp* and *Df* do not cross-react with various storage mites.[16,23]

The purpose of this study was to establish the prevalence of positive skin test reactions to *Dp* and *Df* in the allergic population and to perform a qualitative and quantitative survey of the house dust mite fauna in the Tampa Bay area. Other studies are in progress to study the allergenicity of different mite species.

MATERIALS AND METHODS

Skin Testing

Four hundred consecutive patients, referred to the authors for evaluation of respiratory (upper and/or lower airways) complaints, were skin tested with a battery of aeroallergens of the Tampa Bay area and with extracts of *Dp* and *Df* (Berkeley Biologicals, Berkeley, CA). Pollen extracts (Greer Laboratories, Lenoir, NC) were used at 1:20 w/v concentration and mite extracts at 1:50 w/v (10,000 A.U.) for prick tests and all extracts at 1:500 w/v for intradermal skin tests. A positive skin test was defined as a wheal of a diameter ≥3 mm with erythema on prick or a wheal ≥8 mm on intradermal testing.

Collection of Dust Samples

Dust samples were collected in the homes of 40 mite skin test positive individuals who had clinical symptoms of allergic rhinitis and/or asthma. Twenty mattress and 40 living room carpet dust samples were collected using a 1.7 peak horse power vacuum cleaner. This hand-held vacuum cleaner incorporates a polytetrafluoroethylene filter membrane that retains particles larger than 0.3 μ and has an air flow of 10 L/sec. After collecting dust, the filters were folded, transported to the laboratory in sealed plastic containers, and stored at 5°C. All the dust samples were sieved under a ventilation hood using a mesh size 20 copper sieve. The fine fraction, which contained the mites, was used for further studies; the coarse sample was discarded.

Identification of Different Mite Species

A 100-mg sample of each fine dust sample was suspended in 50 ml of saline and 5 drops of liquid soap in a graduate cylinder. The cylinder was inverted three times and the contents allowed to settle for 5 min. Five-milliliter aliquots of the supernatant were placed into small Petri dishes (5 × 1.5 cm). Under a dissecting microscope, each mite present in every aliquot was collected with a fine needle and mounted in Hoyer's medium on microscope slides for species identification and counting. Mites were identified using mite reference slides and taxonomic keys.[24,25] The number of mites in each sample was recorded as mites per gram of dust. Selected specimens of each species were sent to Dr. Alex Fain at the Natural Science Museum in Brussel and to Dr. Hallas in Denmark for the verification.

RESULTS

Of the 400 subjects evaluated for respiratory (upper and/or lower airways) complaints, 240 (60%) had positive skin test reactions to *Dp* and *Df*. Skin test reactivity to mite allergens was two to three times more frequent than to other common aeroallergens, such as Bahia grass, white oak, short ragweed, cat, and cockroach. Twenty percent of the subjects tested did not have any positive skin tests to the battery of common aeroallergens (Table I).

Eleven different HDMs were identified under light microscopy (Table II), and two or more species were found in 53 of the 60 dust samples analyzed. Mites were not found in 4 of the 40 carpet and 3 of the 20 mattress dust samples. The predominant species were

TABLE I

Skin Test Results in 400 Consecutive Subjects Evaluated for Respiratory Complaints*

Outdoor Allergens	%	Indoor Allergens	%
Live oak	20	*Dp*	60
Cypress	11	*Df*	60
Bayberry	15	Cat	24
Bahia grass	23	Dog	14
Bermuda grass	22	American cockroach	25
Rye grass	18		
Short ragweed	26		
Dog fennel	18		
Alternaria	24		

* *Skin test results were negative in 20% of subjects.*

TABLE II

Mite Species in Mattress and Carpet Dust Samples

Mite Species	Mattress: 20 Samples (mites/g dust)	Carpet: 40 Samples (mites/g dust)
Dp	14 (110–3000)	34 (90–2200)
Df	8 (50–1500)	18 (60–800)
Euroglyphus maynei	1 (1100)	3 (60–200)
Bt	6 (1300–3800)	12 (50–210)
Cm	10 (50–300)	23 (50–90)
Tarsonemus floricolus	5 (40–320)	15 (40–800)
Typhlodromus spp.	NF*	4 (80–200)
Tyrophagus putrescentiae	NF	6 (60–90)
Chortoglyphus arcuatus	NF	1 (250)
Mesostigmata†	3 (50–60)	4 (10–40)
Cryptostigmata†	2 (110–140)	4 (10–50)
Unidentified	1 (50)	3 (100)
Mean ± SE	1512.5 ± 469.3	746.5 ± 169.2

* *NF, not found.*
† *Orders.*

Dp and *Df*. Ten carpet dust samples contained more than 1000 mites/g of dust and 10 samples contained more than 300 mites/g of dust. *Em* was the predominant species (more than 50% of the total mites) in one mattress sample. Mite numbers in carpets ranged from 120 to 5500 mites/g of dust (746.5 ± 169.2).

Blomia tropicalis (*Bt*), not previously identified in the United States, was found in 12 carpet dust samples. A predator mite, *Cheyletus malaccensis* (*Cm*), was identified in 23 carpet and 10 mattress dust samples. Figure 1 is a scanning electron microscopic photo of *Cm*. *Typhlodromus* spp. were identified in 4 carpet dust samples, *Tarsonemus floricolus* in 15 carpet dust and 5 mattress dust samples, *Tyrophagus putrescentiae* in 6 carpet samples, *Chortoglyphus arcuatus* in one carpet dust sample, *Mesostigmata* mites in 3 mattress and 4 carpet dust samples, *Cryptostigmata* in 2 mattress and 4 carpet dust samples and unidentified mites in 1 mattress and 3 carpet dust samples.

The 17 positive mattress dust samples contained from 110 to 6200 mites/g of dust (1512.5 ± 469.3). Although the predominant species was *Dp*, *Bt* was the predominant species in 3 mattress dust samples and was also found in large numbers in 3 more mattress dust samples. Figure 2 shows a scanning electron microscopic photo of *Bt*.

DISCUSSION

Tampa, Florida, with its subtropical climate, mean temperature of 72.2°F and average rainfall of 48.6 inches, provides a perfect environment for the growth of HDM, the survival of which depends directly upon the absolute humidity. House dust mite skin test sensitivity is prevalent in the Tampa Bay area as revealed by *Dp* and *Df* skin test results. This correlates with the discovery of a rich HDM fauna in occupied dwellings of mite skin test-sensitive subjects. *Dp* and *Df* were the predominant mite species, but storage and predator mites were also found in several dust samples.

Figures defining the significance of mite counts have not been completely established. Data from Denmark, Holland, London, Sidney, and New Guinea suggest that pyroglyphid mite counts over 100 mites/g of dust may be associated with sensitization and symptoms.[26,27] In our study, mite counts were higher in mattresses than in carpets and, in general, greater than 100 mites/g of dust. These results are comparable with mite numbers and species found in other tropical and subtropical environments.[16,28,29] Storage mites were also present in concentrations greater than 100 mites/g of dust. The clinical implications of this finding remain unclear, since no figures have been accepted for the number of storage mites responsible for sensitization.

The storage mite, *Bt*, was the predominant species in 3 mattress dust samples and was identified in 30% of the dust samples. *Bt*, a glycyphagid mite, is commonly found in house dust samples in tropical and subtropical regions of the world. Investigators from Japan,[16] Venezuela,[17] Spain,[28–30,31] and Nigeria[32,33] have detected these mites in house dust. In the Tampa Bay area, *Bt*

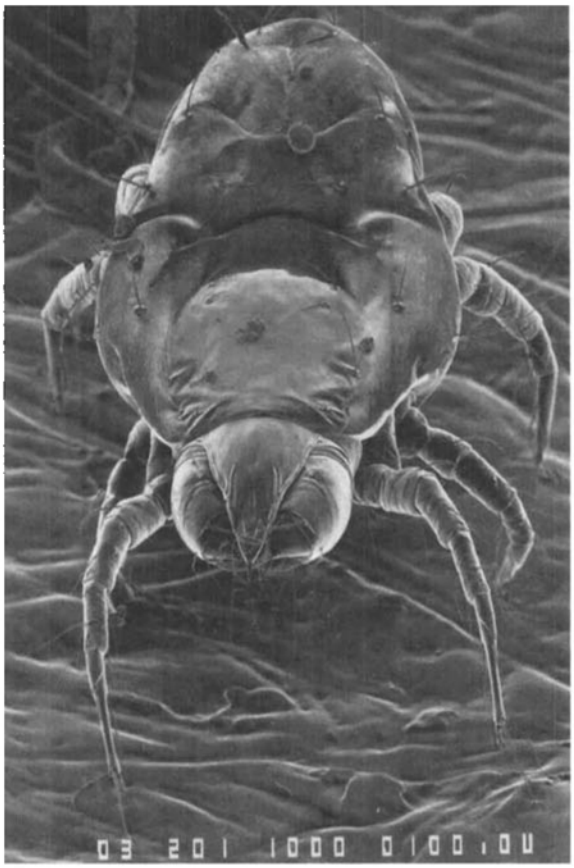

Figure 1. *Scanning electron microscopic picture of* Cheyletus malaccensis *(× 200).*

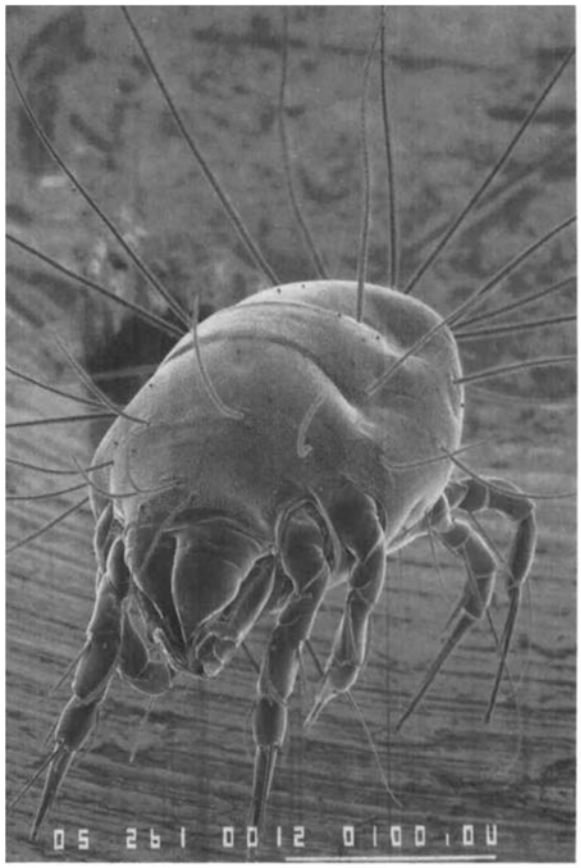

Figure 2. *Scanning electron microscopic picture of* Blomia tropicalis *(× 260).*

was found in larger numbers in mattresses than in carpets. Preliminary data suggest that *Bt* is a mite of allergenic importance and that specific IgE to *Bt* can be detected in mite-allergic individuals in Tampa, FL.[13] *Cm* was found in 33 samples, generally associated with large colonies of *Dp* and/or *Df*. The presence of *Cm*, a predator mite, in house dust may be of clinical importance since these mites have been identified as causing papular urticaria.[34,35] However, there are no data available on their antigenic composition or allergenicity.

Currently, commercial extracts are not available for skin testing to mite species other than *Dp* and *Df*. Therefore, *in vivo* or *in vitro* mite allergy tests to evaluate perennial sensitivity may be negative or equivocal, and an incorrect diagnosis of nonallergic rhinitis or asthma could be made in a subject with perennial allergic symptoms due to sensitivity to a mite for which tests are not yet available. Detection of mite species, other than *Dp* and *Df*, in a representative house dust sample may provide the only evidence that it could be causing symptoms, particularly when *Dp* and *Df* skin tests are negative. House dust analysis may also reveal an infestation of storage mites, such as *Bt*. Diagnostic capabilities may be greatly enhanced by house dust analysis of selected subjects until extracts of the various species of mites are commercially available for skin testing. Ultimately, immunochemical quantitation of samples using monoclonal antibodies or serum pools containing high titers of IgE to specific mites will provide a method to determine mite allergen content of dust. This type of house dust test will eventually replace the labor intensive counting of mites.

Physicians should be aware that many species of mites may infest homes, particularly in the humid and hot regions of the world, where a high prevalence of mites contributes to perennial allergic symptoms. Residential factors, such as high indoor absolute humidity, wall-to-wall carpeting overlying a concrete slab, the presence of pets, old overstuffed furniture and bedding, and an ample food supply of skin scales and mold spores promote the growth of mite species. Mite species, besides *Dermatophagoides* spp., are found in many Tampa Bay homes and may represent previously unrecognized sources of indoor environmental allergens. Extracts of these newly identified mites for allergy testing would enhance the allergists' abilities to survey

for sensitivities to potentially important house dust allergens. Indoor environmental management strategies should also incorporate immunochemical analysis of house dust samples for these mite antigens.

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