

REVIEW

Domestic mites: their role in respiratory allergy

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Introduction

The first documented observation that mites can be a cause of respiratory problems in man dates back little less than 70 years [1]. This description of an asthma epidemic resulting from inhalatory contact with dust of grain infested with the so-called grain-itch mite (which is in fact a parasite of storage insects and mites) was soon followed by other reports on the probably allergic nature of the causative relation between exposure to mites or mite infested materials and asthma [2,3]. However, during almost 30 years following these first observations, no real progress was made in the investigation of the relation between mites and respiratory allergy.

In the early 1960s, interest was revived when Voorhorst [4] confirmed the allergenic potency of some storage mites in an initially unsuccessful attempt to find the source of the house-dust allergen. A few years later another mite of the genus *Dermatophagoides* was found to occur in household dust and was accused of being the producer of the house-dust allergen [5,6]. In a great number of confirming studies, the significance of *Dermatophagoides*, soon called the 'house-dust mite', for the origin of the allergenicity of household and mattress dust, was described and documented further [7-13]. And although storage mites were not completely forgotten [14,15], almost all attention was given to house-dust mites [16,17].

House-dust mites

The evidence that mites of a particular genus *Dermatophagoides* are the main source of the allergenicity of house dust meant a breakthrough in the thinking about ecological allergology. Surprisingly enough, nobody had noticed the almost ubiquitous presence of these mites in floor dust, upholstered furniture and mattresses. Today, we have come to realize that house-dust mites are a normal element in our environment and they are to be considered as useful inhabitants of the 'human nest'. Their usefulness lies in the role they play in the biological recycling process, whereby human waste products, e.g. shed epithelial scales, are broken down.

Taxonomically, the genus *Dermatophagoides* belongs

to the mite family Pyroglyphidae [18], which comprises 13 genera, which have been found in house or mattress dust (Table 1), the best known of the species being *D. pteronyssinus*, *D. farinae*, *D. microceras*, and *Euroglyphus maynei*. The best definition of house-dust mites would be: those species of pyroglyphid mites occurring in houses more than incidentally.

During the first years of the house-dust mite research, allergists were thinking in terms of the house-dust mite allergen. When, soon after the discovery of *D. pteronyssinus*, *D. farinae* was reported from North American dust [19], the question of the cross-allergenicity between the two species was raised [20]. The first simple experiment, carried out using the skin-test technique, showed that allergenic extracts from these two species could not be distinguished from one another [21]. Interest in cross-allergenicity or species-specificity, even after another species had been described [22,23] as *D. microceras*, a

Table 1. The 10 species of house-dust mites, and their place in the family Pyroglyphidae

Sub-families	Nest dwelling genera	House-dust mite species
Pyroglyphinae	<i>Pyroglyphus</i>	
	<i>Bontella</i>	
	<i>Weelawadja</i>	
	<i>Campephiloptes</i>	
	<i>Euroglyphus</i>	<i>E. maynei</i>
Dermatophagoidinae	<i>Malayoglyphus</i>	<i>M. intermedius</i> <i>M. carmelitus</i>
	<i>Pottocola</i>	
	<i>Hirstia</i>	<i>H. domicola</i>
	<i>Hullia</i>	
	<i>Sturnophagoides</i>	<i>S. brasiliensis</i>
	<i>Guatemalichus</i>	
	<i>Capitonoecius</i>	
	<i>Dermatophagoides</i>	<i>D. pteronyssinus</i>
		<i>D. neotropicalis</i>
		<i>D. siboney</i>
		<i>D. farinae</i>
		<i>D. microceras</i>

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sibling species to *D. farinae*, was not rekindled until the 1980s, when advanced techniques of purification and characterization of allergens became available [24–28]. It also became clear that the allergenic product of one mite species consists of several major allergens, the best known of which are indicated as Group I and Group II allergens [29]. Today, the progress in immunochemical studies has lead to cloning and sequencing of several house-dust mite allergens [30–33], demonstrating in great detail both the similarities and the differences of the allergens from different species.

Yet, from a clinical point of view it is of great interest to note that many allergic people apparently can become sensitive to allergens from both *D. pteronyssinus* and *D. farinae* or *D. microceras* by exposure to *D. pteronyssinus* only [21,34]. However, whether this is also true for the hyposensitization process in a therapeutic regime remains highly questionable.

Storage mites

As discussed in the Introduction, the first cases of respiratory allergy due to contact with mites were related to storage mites [1–3]. The significance of storage-mite allergy in occupational situations, particularly in farmers, has been shown in a number of European studies with farming communities [35–38]. A striking phenomenon in these farming populations is the low prevalence of allergy to pollen. The selection of mite species investigated in these and other studies is rather limited to, for example, *Acarus siro*, *Tyrophagus putrescentiae*, *Glycyphagus domesticus*, and *Lepidoglyphus destructor*. The selection of the species is probably determined by the availability of allergenic extract more than by the extreme variability of the mite fauna in barns and stored products [39]. The taxonomic position of some of these mites is shown in Table 2. Yet the number of this kind of study on storage-mite allergy in farming communities remains small, and it seems as if in technologically advanced agricultural societies allergy to storage mites is seen only occasionally [21].

Conversely, there are still a growing number of reports about the relatively high prevalence of sensitivity to storage mites in non-farming communities, almost always in combination with allergy to house-dust mites [14,15,21,40–49]. These observations have greatly stimulated the discussion about the cause or origin of sensitization. The findings have also led to speculation on the allergenic relation between storage mites and house-dust mites, as indicated below.

Relation between house-dust mites and storage mites

The problem of the relation between house-dust mites and storage mites is often simplified into two questions:

- 1 Is there cross-allergenicity between house-dust mites and storage mites?
- 2 Is there, in spite of the non-farming environment, simultaneous exposure to house-dust mites and storage mites in the house?

Evidence so far gives inconclusive answers to both questions.

The great majority of studies indicate that there are allergenic differences between house-dust mites and storage mites. However, a certain degree of cross-allergenicity is often reported. Although the results of these studies are not identical, there is agreement in the suggestion that the closer the taxonomic relationship between the mites is, the greater the level of cross-allergenicity [28,50–58]. In many reports, the formulation of the conclusions depends on the previous opinion of the authors. As an illustration, there follows some quotations given by authors describing the degree of similarity of the allergenic products of species of *Dermatophagoides* and *Tyrophagus*. 'It is clear that each mite species and its faeces contains antigens and allergens specific to each in addition to some common antigens and allergens' [52]. 'These results suggest considerable cross-reactivity between *D. pteronyssinus* and the two storage mites, *A. siro* and *T. longior*' [58]. Probably, the situation is best characterized by a third quotation: 'These findings demonstrate the complexity of the immunologic responses to the different mite species' [55]. This complexity is very well shown in the finding by Van Hage-Hamsten [59] that the results of RAST-inhibition studies with two species of the mite family Glycyphagidae, viz. *Lepidoglyphus destructor* and *Blomia kulagini* were different using sera from geographically remote human populations.

The occurrence of mites in house dust primarily known from stored food has been reported repeatedly [3,7,15,40–49,60–63]. The numbers of storage mites in house dust are mostly much lower than those of the pyroglyphid house-dust mites. Therefore, their significance for allergic sensitivity in the non-farming population was often supposed to be comparably small. It remains unclear, however, whether these relatively low numbers of storage mites in house dust may have sensitizing effects, particularly in people who are being sensitized simultaneously to the more abundant pyroglyphid house-dust mites. Moreover, records of mite numbers in dust reflect only the situation at one moment in time, but do not necessarily give representative information about possible mite exposure in the past.

In wet tropical regions it should be noted that non-pyroglyphid storage mites are more abundant in dust than pyroglyphid house-dust mites [42,64,65]. In these situations, where the distinction between pyroglyphid

Table 2. Simplified taxonomical scheme of astigmatic mites, presenting the best known allergenic mites

Sub-order	Families	Genera	Species
Metastigmata (ticks)			
Mesostigmata (poultry mites)	Carpoglyphidae	<i>Carpoglyphus</i>	<i>C. lactis</i>
	Chortoglyphidae	<i>Chortoglyphus</i>	<i>C. arcuatus</i>
Prostigmata (spider mite, chiggers cheyl., tarson., grain itch mite)	Acaridae	<i>Acarus</i>	<i>A. siro</i> <i>A. farris</i>
		<i>Aleuroglyphus</i>	<i>A. ovatus</i>
		<i>Tyrophagus</i>	<i>T. putrescentiae</i> <i>T. longior</i>
		<i>Suidasia</i>	<i>S. nesbitti</i>
Cryptostigmata (moss mites)			
Astigmata (Storage mites, house-dust mites, itch/mange mites)	Glycyphagidae	<i>Glycyphagus</i>	<i>G. domesticus</i> <i>G. privatus</i>
		<i>Lepidoglyphus</i>	<i>L. destructor</i>
		<i>Blomia</i>	<i>B. tropicalis</i> <i>B. kulagini</i>
		<i>Gohieria</i>	<i>G. fusca</i>
	Pyroglyphidae	<i>Euroglyphus</i>	<i>E. maynei</i>
		<i>Dermatophagoides</i>	<i>D. pteronyssinus</i> <i>D. farinae</i> <i>D. microceras</i>
	Psoroptidae	<i>Otodectes</i>	<i>O. cynotis</i>
		<i>Psoroptes</i>	<i>P. cuniculi</i> <i>P. ovis</i>
	Sarcoptidae	<i>Sarcoptes</i>	<i>S. scabiei</i>

and non-pyroglyphid mites is irrelevant for their occurrence in house dust, the term house-dust mite may lead to confusion. Therefore, during the Second International Workshop Dust Mite Allergens and Asthma [66] held in September 1990 at Minister Lovell, it was proposed to introduce the term 'Domestic Mites' to indicate all free-living (non-parasitic) mite species which are found regularly in the bedding, furniture and dust of houses.

Other mites

Apart from domestic mites, like pyroglyphid house-dust mites and non-pyroglyphid storage mites, man can also come in contact with mites belonging to other ecological and taxonomical groups, some of which are indicated in Table 2. It should suffice to mention them here briefly, particularly with reference to reports related to allergenic aspects: ticks [28,67], poultry mites [68], cheyletids [69], spider mites [70–72]. In some of these reports a concurrent

sensitivity to house-dust mites is described in spite of their remote taxonomic position. Studies with parasitic mites, like the itch mite *Sarcoptes scabiei*, which are taxonomically related to pyroglyphid mites, have shown quite high degrees of cross-reactivity [73,74], even if the host for the parasite is not human [75,76].

Conclusion

Domestic mites are free-living mites found regularly in the home environment and belonging to two ecologically defined groups: house-dust mite and storage mites, together with their parasitic and predatory mites. In the moderate climate zones of the world pyroglyphid house-dust mites are the most abundant among the domestic mites. In wet tropical regions non-pyroglyphid mites, commonly known from stored food, may be the more abundant types of domestic mites.

Respiratory allergy to domestic mite products is one of the most common allergic diseases. Particularly house-dust mites are very often the cause of allergic rhinitis and asthma in sensitive people.

Although the allergen molecules show clear species specificity, cross-allergenicity between species of the same family can be relatively strong. Cross-allergenicity between families is less outspoken, but not completely absent. Whether the relatively widespread sensitivity to storage mites in non-farming, rural or even urban house-dust allergies is due to cross-allergenic sensitization to house-dust mites or to unnoticed simultaneous exposure to storage mites is not clear.

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