

Prevalence of specific IgE to storage mites (*A. siro*, *L. destructor* and *T. longior*) in an urban population and crossreactivity with the house dust mite (*D. pteronyssinus*)

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Summary

The role of pyroglyphid mites in house dust allergy is well established and the major allergens from the common house dust mites (*Dermatophagoides* species) have been characterized. There is, however, relatively little progress in the understanding of the human IgE response to non-pyroglyphid storage mites, allergenic crossreactivity with other mite species and extent of environmental exposure. We studied 196 individuals from an urban environment who were not occupationally exposed to storage mites and found a 24% prevalence of specific IgE antibody to *Dermatophagoides pteronyssinus* and a 14% prevalence of RAST positivity to at least one of three storage mites, *Acarus siro*, *Lepidoglyphus destructor* and *Tyrophagus longior*. All individuals with a positive RAST to storage mites had specific IgE to *D. pteronyssinus*. RAST inhibition studies with the eight sera with greater than 2% RAST binding to both families of mites showed considerable crossreactivity between *D. pteronyssinus* and the storage mites *A. siro* and *T. longior* and limited crossreactivity between *D. pteronyssinus* and *L. destructor*. This suggests that at least some of the response to storage mites observed by direct RAST is a consequence of crossreactivity with the more abundant *D. pteronyssinus*.

Clinical and Experimental Allergy, Vol. 20, pp. 403–406. Submitted 25 July 1989; revised 5 February 1990; accepted 7 February 1990.

Introduction

The importance of pyroglyphid mites of the order Acaridae in house dust asthma and the close correlation between the allergenicity of house dust and these mites has been known for over 20 years [1,2]. The pyroglyphid mites have been extensively studied and two groups of allergens, *Der I* and *Der II*, have been purified from each of the three *Dermatophagoides* species, *D. pteronyssinus*, *D. farinae* and *D. microceras* and their cross-allergenicity and cross-antigenicity examined [3].

In addition to the house dust mites, there are a number of anatomically different mites of the tyroglyphid family (storage mites) that are found in large numbers in stored hay and cereal products but may also be found in house dust, predominant species include *Acarus siro*, *Lepidogly-*

phus destructor and *Tyrophagus longior* [4,5]. Occupational asthma and specific IgE to storage mites has been demonstrated in workers exposed to stored grain and hay [6–8] and their similarly exposed families [9]. However, the allergenic crossreactivity between storage mites and mites of the *Dermatophagoides* species, and the relative importance of storage mites in causing allergic disease in different environments is not clear [10–12]. Tee *et al.* [13] found that the prevalence of specific IgE to storage mites was similar in bakers and a non-exposed control population of salt packers (9% and 12%, respectively), but there was no evidence of occupational exposure to storage mites in the control group. Immunological crossreactivity between *Dermatophagoides* species and grain storage mites has been suggested [14] and, recently, Griffin *et al.* [15] demonstrated significant allergenic crossreactivity between *D. pteronyssinus* and three species of storage mite using CRIE, RAST inhibition, and affinity absorption, which could explain RAST and skin-test positivity to

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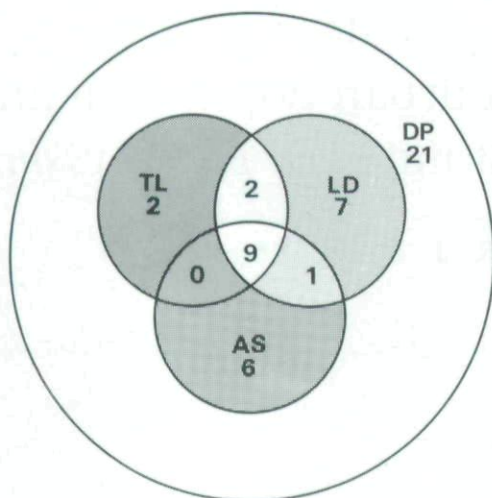


Fig. 1. Distribution of RAST responses to *D. pteronyssinus* (DP) and the three storage mite species, *L. destructor* (LD), *A. siro* (AS) and *T. longior* (TL). Out of the study group of 196 sera, 48 were positive to one or more mite extracts.

storage mites in non-exposed individuals. We present here further data that corroborate previous findings that immunological reactivity to storage mites exists in non-exposed populations, but that this is probably due to allergenic crossreactivity between the two families of Acaridae mites rather than environmental exposure to storage mites.

Materials and methods

Serum samples

Sera were collected from 196 workers living in a typical urban environment and employed in a cocoa and coffee bean processing factory. Microscopic examination of dust from the factory was performed; mites and mite faecal pellets were not found.

Immunological studies

The mite cultures used in this investigation were as previously described [15]. Mite extracts were prepared as 20% (w/v) crude extracts in phosphate-buffered saline (PBS), centrifuged at $30\,000 \times g$ for 30 mins and dialysed against PBS overnight at 4°C. The protein content of the extracts, measured by absorbance at 280 nm, were: *D. pteronyssinus*, 7.3 mg/ml; *A. siro*, 14.1 mg/ml; *L. destructor*, 6.6 mg/ml; *T. longior*, 11.0 mg/ml. One millilitre aliquots of mite extract were each coupled to 600 mg cyanogen bromide-activated paper discs, then used for RAST and RAST inhibition, as described previously [15]. A mixed allergen disc of *A. siro*, *L. destructor* and

Table 1. RAST percentage binding to *D. pteronyssinus* and storage mites and percentage inhibition and allergen discs by *D. pteronyssinus* and storage mite extracts

Serum no.	Binding (%)	Inhibition (%)	Binding (%)	Inhibition (%)
DP discs				
		DP*	LD*	
1	10.7	59	10	
2	5.1	100	22	
3	7.5	91	30	
4	13.5	89	0	
LD discs				
				LD*
1				50
2				94
3				96
4				93
AS discs				
		DP*	AS*	DP*
5	2.9	100	90	
6	3.1	100	80	
7	3.9	100	38	
TL discs				
		DP*	TL*	DP*
8	2.6	90	75	

DP, *D. pteronyssinus*; AS, *A. siro*; LD, *L. destructor*; TL, *T. longior*.

DP*, LD*, AS* and TL* indicate inhibitor used.

Amount of inhibitor added estimated as total protein: DP 0.73 mg; LD 0.66 mg; AS 1.41 mg; TL 1.1 mg. Inhibitors used at 1/10 for sera nos 1, 5, 6 and 8.

T. longior using 300 µl of each mite extract was used for initial screening of the sera for specific IgE to storage mites. Assays were performed in duplicate and the results expressed as RAST percentage binding of total added c.p.m. or percentage inhibition.

Results

Specific IgE to *D. pteronyssinus* and storage mites

All 196 sera were examined for specific IgE with a *D. pteronyssinus* allergen disc. The distribution of log binding to *D. pteronyssinus* was, as expected, bimodal, with the lower mode due to non-specific binding to the disc and the upper to specific binding to the allergen. A cut-off between specific and non-specific binding, such that there would be no more than 1% false positives, was determined by a Newton-Raphson procedure [16]. This gave a cut-off value of 0.6% binding. Using this criteria, 48 out of 196 (24%) individuals had specific IgE antibody to *D. pteronyssinus*.

Specific IgE response to one or more of the 3 storage

mites, *L. destructor*, *T. longior* and *A. siro*, was present in 27 (14%) of the sera. All the sera RAST-positive to storage mites were also positive to *D. pteronyssinus*, none had specific IgE exclusively to storage mites. Examination of the pattern of reactivity to the storage mites showed that reactions occurred most frequently to all three mites or to either *L. destructor* or *A. siro* alone (Fig. 1).

Crossreactivity studies

Eight sera with >2% binding to *D. pteronyssinus* and at least one storage mite were used in RAST inhibition experiments. For each sera the RAST binding to *D. pteronyssinus* and the storage mite with the highest binding were inhibited with *D. pteronyssinus* and the storage mite extract. Table 1 shows that for each serum, except no. 1, the homologous inhibitor gave at least 90% inhibition. For the sera with storage mite response primarily to *A. siro* (sera 5–7) and *T. longior* (sera 8), *D. pteronyssinus* was as an effective inhibitor of RAST binding as the storage mite, while inhibition of *D. pteronyssinus* by storage mites ranged from 38 to 90%. These results suggest considerable crossreactivity between *D. pteronyssinus* and the two storage mites, *A. siro* and *T. longior*. In contrast, there was only limited crossreactivity between *L. destructor* and *D. pteronyssinus* (sera 1–4; Table 1).

Discussion

Pyroglyphid mites are important indoor domestic allergens [3], however, tyroglyphid or storage mites are also found in very damp houses in the U.K. [12] and in very large numbers in stored hay, grain and other cereal products [4,5]. We investigated the prevalence of specific IgE to *D. pteronyssinus* and storage mites in an urban population working in a coffee bean processing factory who were not occupationally exposed to storage mites, and the extent of reactions to storage mites could be attributed to crossreactivity with *D. pteronyssinus*. Statistical analysis of the log normal bimodal distribution of the RAST binding data gave a RAST cut-off of 0.6% binding. Using this criteria we found a 24% prevalence of specific IgE antibody to *D. pteronyssinus* and a 14% prevalence to storage mites. Tee *et al.* [13] using a cut-off of 1% binding for RAST positivity found 12% of an occupationally unexposed population positive to storage mites; applying their criteria to our data we find 8% positive.

The finding that all the sera positive to storage mites were also positive to *D. pteronyssinus* suggests considerable crossreactivity between these two families of Acari-dae mites. RAST inhibition studies with the eight sera

with greater than 2% RAST binding to both families of mites showed considerable crossreactivity between *D. pteronyssinus* and the storage mites *A. siro* and *T. longior*, but only limited crossreactivity between *D. pteronyssinus* and *L. destructor*. As *D. pteronyssinus* is the mite normally found in greatest numbers in domestic dwellings [3] it seems likely that in sera where crossreactivity occurs *D. pteronyssinus* is the sensitizing allergen. This indicates that the true prevalence of sensitization to storage mites in a typical urban population is probably lower than the 14% value found by direct RAST.

These findings are in contrast to those of Hage-Hamsten and colleagues [11] who found no crossreactivity between four species of storage mites and *D. pteronyssinus*. However, we have previously shown [15] that storage mites and *D. pteronyssinus* possess common as well as distinct allergenic determinants. It is possible that in this urban population responses to *D. pteronyssinus* will include, in some subjects, these common allergenic determinants. In farming communities, where there is considerable storage mite exposure, responses to the distinct allergenic determinants are perhaps more likely to dominate.

Future work on the relevance of storage mites to allergic disease will involve the identification and purification of major storage mite allergens and the production of monoclonal antibodies for epitope-mapping studies.

Acknowledgment

We would like to thank Mr C. Chalmers, Department of Statistics, Birkbeck College, University of London, for the statistical analyses.

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