

EAACI/DGAI Symposium Reviews

Mite species of allergologic importance in Europe

Fernández-Caldas E. Mite species of allergologic importance in Europe. Allergy 1997; 52: 383–387. © Munksgaard 1997.

E. Fernández-Caldas

Research & Development C.B.F. LETI, SA,
Tres Cantos, Madrid, Spain

Key words: allergic diseases; asthma; mites.

Enrique Fernández-Caldas, PhD
Director, Research & Development
C.B.F. LETI, SA
Calle Sol #5
Tres Cantos,
28760 Madrid
Spain

Accepted for publication 27 January 1997

The recovery of mites of various species in house dust in Europe has been the subject of numerous reports. In 1939, Oboussier described the presence of several storage mites in Hamburg, Germany (1). In his work, he cited earlier work with similar findings. In 1964, the Dutch investigators Voorhorst, Spieksma-Boezeman, and Spieksma were the first to describe the allergenic role of mites belonging to the genus *Dermatophagoides* (2). The identification of the species was done by Fain in Belgium, who identified it as *D. pteronyssinus* (3). It is now clear that storage mites can also occur in house dust, produce potent allergens, and sensitize individuals. The term "domestic mites" has been adopted to describe mite species that can be found in the indoor environment and elicit an IgE response. This group includes house-dust as well as storage mites.

The purpose of this review is to acquaint the medical community with the clinical implications that sensitization to other nonpyroglyphid mites may have in Europe. Information is presented on the most common house-dust and storage-mite species that may elicit sensitization and/or symptoms and the various degrees of cross-reactivity that may be encountered between these species.

Storage mites and occupational sensitivities

Storage mites belong to a wide range of families, genera, and species. The most commonly found in the indoor environment belong to the

genera *Tyrophagus*, *Glycyphagus*, *Acarus*, *Lepidoglyphus*, *Chortoglyphus*, *Blomia*, *Carpoglyphus*, *Aleuroglyphus*, and *Tarsonemus*. These mites are usually found in stored grain, grain transfer facilities, barns, hay, and straw, but exposure to these mites and their allergens can also occur in homes.

Several species of storage mites have been identified in barns, granaries, and stored hay, straw, grains, and flour in Europe. A few examples follow. In Scotland, Jeffrey (4) analyzed hay samples from 31 farms and identified *Lepidoglyphus destructor*, *Acarus farris*, *A. siro*, *Tyrophagus longior*, and *T. palmarum* as the most common. In Iceland, Hallas & Gudmundsson (5) reported that the most common species in hay samples were *L. destructor* and *A. farris*. In Finland, Terho et al. (6) identified *T. longior*, followed by *A. siro* and *A. farris*, as the most common. In Ireland, Cusack et al. (7) reported that the predominant species in stored grain were *A. siro* and *Glycyphagus domesticus*, followed by *T. longior*, and *A. immobilis*; *Tyrophagus putrescentiae* was also present in small numbers. In England and Wales, Griffiths et al. identified in grain samples *A. farris*, and *T. putrescentiae* (8). In Denmark, Iversen et al. (9) reported that *L. destructor* and *A. siro* were the predominant mite species in grain, straw, and hay samples. *Tyrophagus* spp. were also found. In Sweden, Hillerdahl et al. reported that the most common species in hay are *L. destructor* and *A. siro* (10).

L. destructor seems to be an important source of storage mite allergens in farms. A study by Campbell et al. also suggested that *L. destructor* is very common in North American barns (11). Sensitization to storage mites, especially *L. destructor*, is also common in the Wisconsin farming population (12). Tee et al. reported similar results in Europe. The authors compared the allergic responses to dust mites in English bakery workers and Swedish farmers and concluded that the most important difference in specific IgE levels between the two groups was the higher response to *D. pteronyssinus* in the English bakers vs a higher response to *L. destructor* in the Swedish farmers (13).

The mite fauna in German barns has also been investigated and is currently under further examination. A study by Franz et al. (14) identified 35 Astigmata species (storage and house-dust mites), 13 of which may be of allergenic importance. The analysis of the farm dust samples revealed the presence of large numbers of *L. destructor* and of other species with a still unknown allergologic importance, such as *Blomia tjobodas* and *Euroglyphus longior*. Ensuing studies demonstrated significant cross-reactivity between *B. tjobodas* and *B. tropicalis* (15).

Allergic symptoms produced by the inhalation of storage-mite allergens may vary from mild irritation to severe bronchoconstriction or incapacitating occupational disease. There are several reports of asthma epidemics and individual cases caused by the inhalation of mite allergens, including *Pyemotes ventricosus*, *A. siro*, *Glycyphagus* spp., *Tetranychus urticae*, and *Panonychus ulmi* (16–19). The relationship between storage-mite sensitivity and allergic symptoms such as asthma, rhinitis, and conjunctivitis was first studied among a group of farmers in Scotland (20, 21). Their symptoms were related to the presence of large numbers of storage mites in the hay and grain used for feeding cattle in the winter. Allergy to storage mites is also very common in Scandinavia, where many farmers who develop allergic symptoms have a positive skin test and RAST to storage-mite extracts. In this farming population, mite allergy is more important than sensitivity to allergens derived from plants and animals, as a cause of allergic disease (22–26). A lack of cross-reactivity between storage and house-dust mites was also suggested (27). Mite sensitivity in occupationally exposed patient populations has been confirmed by nasal and bronchial provocation tests (22, 28, 29). To the best of our knowledge, there have been only two published reports on immunotherapy using storage-mite extracts (30, 31). Both studies showed significant clinical benefit. More studies are needed to confirm these findings.

Storage-mite sensitivity in urban dwellers

The role of storage mites as environmental allergens in homes has not been extensively studied, although allergic rhinitis, contact dermatitis, urticaria, and asthma have been associated with storage mites. In recent years, there has been increasing interest in the study of storage mites as triggers of allergic reactions. Storage mites have been identified in urban dwellings, suggesting that they can also be regarded as causative agents of allergic diseases in people who are not exposed occupationally. These mites are found most frequently in humid environments and people living in damp houses seem to be particularly at risk of sensitization (32).

The presence of storage mites in European homes has been demonstrated for many years, from pioneer studies several centuries ago, to more recent reports. For many years, scientists considered *G. domesticus*, *T. putrescentiae*, and *A. siro* the most frequent species in house dust in Europe. It is noteworthy that these mites, which occupied the first place in prevalence years ago, are now only second behind *D. pteronyssinus*. The reasons for this shift may be due to the changes that have occurred in the indoor environment related to cleaning habits, storage of food, introduction of wall-to-wall carpets, and to a greater tendency to live in cities. This variation in frequency could also be explained by the different technologies that are currently used to isolate mites from house dust (17), although the most probable reason remains the changes incorporated in human dwellings. Tarsonemid mites have also been described in abundant quantities in house dust in Denmark. These species, for which there are no commercial extracts, could also be of clinical significance (33).

Sensitization to storage mites in urban dwellers seems to be more common than previously thought. Several authors have demonstrated high rates of sensitization to storage mites in *Dermatophagoides* spp.-allergic urban individuals. These rates are similar to those obtained by other investigators in tropical regions. In the subtropical Canary Islands of Spain, various mite species have also been described, and sensitization to various species is very common (34–36). In Germany, Mücken et al. (37) studied 103 patients with allergic rhinitis and/or asthma; 77 were urban and 26 rural dwellers. The entry criterion was a positive intracutaneous test to *A. siro*, *L. destructor*, and/or *T. putrescentiae*. Specific IgE to *D. pteronyssinus*, *L. destructor*, *B. tjobodas*, *B. tropicalis*, and *E. maynei* was measured by direct ELISA. Specific IgE to several storage and house-dust mites was detected in urban and rural allergic patients with a positive skin test to

storage mites. Sensitization to *L. destructor* was more frequent in rural, occupationally exposed individuals; sensitization to *E. maynei* was the most frequent in both groups. Sensitization to *B. tjiobodas*, *B. tropicalis*, and *E. maynei* was documented for the first time in Germany (37). Sensitization to *B. tropicalis* could be due to its cross-reactivity with *B. tjiobodas*. The authors concluded that sensitization to storage mites is common in patients with or without occupational exposure. Other authors have shown similar results (38–43).

It has been demonstrated that the most common inhabitant of house dust in Europe is *D. pteronyssinus*, which has been found in all European countries where it has been sought; *D. farinae* and *E. maynei* are highly prevalent and allergenic as well (44–46). Other species that seem to be fairly common are *Cheyletus* spp., predator mites for which no commercial extracts are available, *Chortoglyphus arcuatus*, *Goheria fusca*, *T. putrescentiae*, *A. siro*, and *G. domesticus*.

Cross-reactivity between house-dust and storage mites

The allergenicity of the house-dust mites *D. pteronyssinus*, *D. farinae*, and *E. maynei* is well documented in Europe, but the extent to which their allergens are unique or cross-react with mite allergens of other genera has not been completely elucidated. Table 1 shows the number of common antigens in *D. pteronyssinus*, *D. farinae*, *B. tropicalis*, and *T. putrescentiae*. It has also been demonstrated by CRIE that *E. maynei* is the source of at least 15 allergens, sharing six with *D. pteronyssinus*, four with *D. farinae*, and six with *B. tropicalis* (47, 48). The clinical significance of this cross-reactivity remains to be established.

In general, it can be assumed that the cross-reactivity between pyroglyphid mites is greater than between pyroglyphid and nonpyroglyphid mites. The nonpyroglyphid mite species that have been studied in greater detail are *L. destructor* and *T. putrescentiae* (49). By immunoblot inhibition, it has been demonstrated that *L. destructor* shares at least one allergenic determinant with *D. pteronyssinus*. *L. destructor* was able to inhibit IgE binding to a 25-kDa protein in a *D. pteronyssinus* extract. Der p 2 was also slightly inhibited. Minimal cross-reactivity between Lep d 1 (now designated as Lep d 2) and *D. pteronyssinus* has also been demonstrated (50). Monoclonal antibodies have been prepared against two allergens (39 and 14 kDa) of this mite and it is possible to detect the presence of this mite in dust by a combination of monoclonal antibodies (51–53). An ELISA inhibition method that allows mite detection in dust samples has been

Table 1. Cross-reacting antigens between four mite species by two-dimensional CIE

Mite extract	Df _b	Df _f	Dp _b	Dp _f	Tp _b	Tp _{sc}
Bt _b	3	3	2	1	4	1
Bt _{sc}	1	3	1	1	2	1
Df _b	35	15	19	12	2	2
Df _f	15	20	12	13	0	0
Dp _b	21	5	33 ⁺	6	2	1
Dp _f	3	9 ⁺	9	13 ⁺	0	0
Tp _b	2	1	0	0	20	5
Tp _{sc}	1	1	—	—	0	18

Adapted from Arlian LG, Vyszynski-Moher DL, Fernández-Caldas E. J Allergy Clin Immunol 1993;91(5):1042-50.

Dp: *D. pteronyssinus*, Df: *D. farinae*, Bt: *B. tropicalis*, Tp: *T. putrescentiae*; b: body, sc: spent culture, f: feces.

developed with monoclonal antibody 42B6 against the 39-kDa allergen. This antibody recognizes common epitopes in *G. domesticus*, *A. siro*, and *T. putrescentiae*, thus providing a rapid method of "mite" detection (54). The amino acid composition of Lep d 1 does not show any homology with other cloned or purified mite allergens (52). However, a recently cloned allergen of the mite species *B. tropicalis* shows a certain homology with Der p 5 (55), suggesting some cross-reactivity between these two mites at the molecular level. It has also been suggested that specific IgE may bind predominantly to cross-reactive determinants on mite allergens (56). We expect that future studies using molecular biology techniques will shed some light on the complex problem of mite-allergen cross-reactivity.

Conclusions

It is accepted that domestic mites have unique as well as cross-reactive allergens, the extent of which has not been fully delineated. Therefore, any mite species present in the human environment in large enough quantities (i.e., more than 100–200 mites per gram of dust) could be considered a potential allergen with sensitizing capabilities. It is not clear whether this sensitizing capability is due to the fact that mites contain several potent proteolytic enzymes that could be implicated in the sensitization process through their action as adjuvants. More studies are needed to clarify the complex spectrum of mite-allergen cross-reactivity at the molecular level.

Although sensitivity to storage mites is common in Europe, to the best of our knowledge only two immunotherapy studies have been published. Both studies showed a clear clinical benefit. There is an emerging need for standardized extracts of the

most important mite species for the diagnosis of allergic respiratory diseases. Standardized extracts are needed to obtain standardized skin test responses and compare epidemiologic data. More studies are needed to evaluate sensitization to storage mites in urban dwellers and the clinical significance of these findings should be tested by controlled nasal and/or bronchial provocation studies. Double-blind-controlled immunotherapy studies will determine the clinical benefit of using more mite extracts in clinical practice.

References

- Oboussier H. Beiträge zur Biologie und Anatomie der Wohnungsmilben. Z Angew Ent Berlin 1939;26:253-96.
- Voorhorst R, Spieksma-Boezeman MIA, Spieksma FThM. Is a mite (*Dermatophagoides* sp.) the producer of the house dust allergen? Allergy Asthma 1964;10:329.
- Fain A. Nouvelle description de *Dermatophagoides pteronyssinus* (Trouessart, 1897). Importance de cette acarien en pathologie humaine. Acarologia 1966;8:302-27.
- Jeffrey IG. A survey of the mite fauna of Scottish farms. J Stored Prod Res 1976;12:149-56.
- Hallas TE, Gudmundsson B. Storage mites in hay in Iceland. Eur J Res Dis 1987;154 Suppl:60-4.
- Terho EO, Leskinen L, Husman K, Klärenlampi L. Occurrence of storage mites in Finnish farming environments. Allergy 1982;37:15-19.
- Cusack PD, Evans GO, Brennan PA. The origin and sources of mite infection of stored grain and related products in the Republic of Ireland. Ann Appl Biol 1976;82:178-9.
- Griffiths DA, Wilkin DR, Southgate BJ, Lynch SM. A survey of mites in bulk grain stored on farms in England and Wales. Proc Ass Appl Biol 1994;180:4.
- Iversen M, Korsgaard J, Hallas T, Dahl R. Mite allergy and exposure to storage mites and house dust mites in farmers. Clin Exp Allergy 1990;20:211-19.
- Hillerdahl G, Zetterström O, Johansson SGO, Engström B, Wiren A. Mites living in hay: an important allergen source? Allergy 1982;37:475-9.
- Campbell AR, Swanson MC, Fernández-Caldas et al. Aeroallergens in dairy barns near Cooperstown, New York and Rochester, Minnesota. Am Rev Respir Dis 1989;140:317-20.
- Marx JJ, Twigg JT, Ault BJ, Merchant JA, Fernández-Caldas E. Inhaled aeroallergen and storage mite reactivity in a Wisconsin farmer-tested case-control study. Am Rev Respir Dis 1993;147:354-8.
- Tee RD, Gordon DJ, van Hage-Hamsten M, et al. Comparison of allergenic responses to dust mites in UK bakery workers and Swedish farmers. Clin Exp Allergy 1992;22:233-9.
- Franz J-TH, Masuch G, Müsken H, Bergmann K-CH. Untersuchungen zur Vorratmilbenfauna von Bauernhöfen in Nordrhein-Westfalen: Ostwestfalen. Allergologie 1995; 18 (1):25-30.
- Fernández-Caldas E, Müsken H, Marañón F, Franz J-Th, Masuch G, Bergman K-Ch. Sensibilisierung durch die Milbengattung *Blomia* in Deutschland und Untersuchungen zur Kreuzallergenität. Allergo J 1996; 5(SA1):44.
- Ancona G. Asma epidemico da *Pediculoides ventricosus*. Pliclinico (Sez Med) 1923;30:45.
- Voorhorst R, Spieksma FThM, Varekamp H. House dust atopy and the house-dust mite *Dermatophagoides pteronyssinus*. Leiden: Stafleu's Scientific Publishing, 1969.
- Delgado J, Gómez E, Palma JL, et al. Occupational rhinoconjunctivitis and asthma caused by *Tetranychus urticae* (red spider mite). A case report. Clin Exp Allergy 1994;4: 477-80.
- Kroidl R, Maasch HJ, Wahl R. Respiratory allergies (bronchial asthma and rhinitis) due to sensitization of type I allergy to red spider mite (Koch). Clin Exp Allergy 1992;22:958-62.
- Cuthbert OD, Brostoff J, Wraith DG, Brighton WD. Barn allergy: asthma and rhinitis due to storage mites. Clin Allergy 1979;9:229-36.
- Ingram CG, Jeffrey IG, Symington IS, Cuthbert OD. Bronchial provocation studies in farmers allergic to storage mites. Lancet 1979;2:1330.
- Terho EO, Husman K, Vohlonen I, Rautalahti M, Tukiainen H. Allergy to storage mites or cow dander as a cause of rhinitis among Finnish dairy farmers. Allergy 1985;40:23-6.
- Terho EO, Leskinen L, Husman K, et al. Occurrence of storage mites in farming environments. Allergy 1982;37: 15-19.
- van Hage-Hamsten M, Johansson SGO, Zetterström O. Predominance of mite allergy to pollens and animal danders in a farming population. Clin Allergy 1987;17:417-21.
- van Hage-Hamsten M, Johansson SGO, Hoglund S, Tull P, Wiren A, Zetterström O. Storage mite allergy is common in a farming population. Clin Allergy 1985;15:555-64.
- van Hage-Hamsten M, Johansson SGO. Clinical significance and allergenic cross-reactivity of *Euroglyphus maynei* and other nonpyroglyphid mites. J Allergy Clin Immunol 1989; 83:581-9.
- van Hage-Hamsten M, Johansson SGO, Wiren A. Lack of allergenic cross-reactivity between storage mites and *Dermatophagoides pteronyssinus*. Clin Allergy 1987;17: 23-31.
- Armentia A, Tapias J, Barber D, Martin J, et al. Sensitization to the storage mite *Lepidoglyphus destructor* in wheat flour respiratory allergy. Ann Allergy 1992;68: 398-403.
- van Hage-Hamsten M, Ihre E, Zetterström O, Johansson SGO. Bronchial provocation studies in farmers with positive RAST to the storage mite *Lepidoglyphus destructor*. Allergy 1988;43:545-51.
- Armentia A, Tapias JA, Martin JF, Ventas P, Fernández A. Immunotherapy with the storage mite *Lepidoglyphus destructor*. Allergol Immunopathol (Madr) 1995;23(5): 211-23.
- Cuthbert OD, Brighton WD, Ayuso R, Trivino E, Carreira J. Controlled activity mite vaccines for "barn" allergy. Ann Allergy 1986;56:261-6.
- Iversen M, Dahl R. Allergy to storage mites in asthmatic patients and its relation to damp housing conditions. Allergy 1990;45:81-5.
- Korsgaard J, Hallas TE. Tarsonemid mites in Danish house dust. Allergy 1979;34:225.
- Fernández-Caldas E, Botella HG, López-Román R. House dust mites (HDM) in Tenerife, Canary Islands, Spain. New Engl Reg Allergy Proc 1988;9(4):283.
- García Robaina JC, Torre Morín F, Bonnet Moreno CG, Antolín Arias J, Pérez Santos C, Sánchez Covisa A. House dust mites and Der p 1 in Tenerife (Canary Islands, Spain): the relative importance of other non-*Dermatophagoides* spp. mites. Allergol Immunopathol (Madr) 1996;24(4):135-8.
- Sánchez Palacios A, García Marrero JA, Limiñana Cañal JM, Schaman F, Alonso Bordón J, Gutierrez Pérez AT. Skin cross-reactivity between *Dermatophagoides pteronyssinus* and storage mites in atopic children. J Invest Allergol Clin Immunol 1991;1(3):179-84.

37. Msken H, Fernndez-Caldas E, Marann F, Franz JTh. Storage mites: sensitization in urban and rural dwellers. *Eur Respir J* 1996;9(23):393s.
38. Luzynska C, Griffin R, Davies RJ, Topping MD. Prevalence of specific IgE to storage mites (*A. siro*, *L. destructor* and *T. longior*) in an urban population and cross-reactivity with the house dust mite (*D. pteronyssinus*). *Clin Exp Allergy* 1990;2:403-6.
39. Ebner C, Feldner H, Ebner H, Kraft D. Sensitization to storage mites in house dust mite (*Dermatophagoides pteronyssinus*) allergic patients. Comparison of a rural and an urban population. *Clin Exp Allergy* 1994;24:347-52.
40. Boner AL, Richelli C, Vallone G, et al. Skin and serum reactivity to some storage mites in children sensitive to *Dermatophagoides pteronyssinus*. *Ann Allergy* 1989;63:82-5.
41. Korsgaard J, Dahl R, Iversen M, Hallas T. Storage mites as a cause of bronchial asthma in Denmark. *Allergol Immunopathol (Madr)* 1985;13:143-9.
42. Griffin P, Ford AW, Alterman L, et al. Allergenic and antigenic relationship between three species of storage mites and the house dust mite *D. pteronyssinus*. *J Allergy Clin Immunol* 1989;84:108-17.
43. Angrisano A, Di Berardino L, Fregoso A, et al. *Dermatophagoides* and storage mites: a statistical analysis of RAST results. *Ann Allergy* 1990;64:358-61.
44. Hart BJ, Whitehead L. Ecology of dust mites in Oxfordshire. *Clin Exp Allergy* 1990;20:203-9.
45. Hart BJ, Fain A. Morphological and biological studies of medically important house dust mites. *Acarologia* 1988; 29:285-95.
46. Colloff MJ, Howe CV, McSharry C, Smith HV. Characterization of IgE antibody binding profiles of sera from patients with atopic dermatitis to allergens of the domestic mites *Dermatophagoides pteronyssinus* and *Euroglyphus maynei*, using enhanced chemiluminescent immunoblotting. *Int Arch Allergy Immunol* 1992;97:44-9.
47. Arlian LG, Rapp CM, Fernndez-Caldas E. Allergenicity of *Euroglyphus maynei* and its cross-reactivity with *Dermatophagoides* spp. *J Allergy Clin Immunol* 1993;91: 1051-8.
48. Morgan MS, Arlian LG, Fernndez-Caldas E. Cross-allergenicity of the house dust mites *Euroglyphus maynei* and *Blomia tropicalis*. *Ann Allergy Asthma Immunol* 1996;77:1-7.
49. Arlian LG, Geis DP, Vyszynski-Moher DL, Bernstein IL, Gallagher JS. Antigenic and allergenic properties of the storage mite *Tyrophagus putrescentiae*. *J Allergy Clin Immunol* 1984;74(2):166-72.
50. Johansson E, Borg Å, Johansson SGO, van Hage-Hamsten M. Immunoblot multiallergen inhibition studies of allergenic cross-reactivity of the dust mites *Lepidoglyphus destructor* and *Dermatophagoides pteronyssinus*. *Clin Exp Allergy* 1991;21:511-18.
51. Ansotegui IJ, Hrfast B, Jeddi Tehrani M, et al. Identification of a new major allergen of 39 kilodaltons of the storage mite *Lepidoglyphus destructor*. *Immunol Lett* 1991; 27:127-30.
52. Ventas P, Carreira J, Polo J. Purification and characterization of Lep d 1, a major allergen from the mite *Lepidoglyphus destructor*. *Clin Exp Allergy* 1992;22: 454-60.
53. Ventas P, Carreira J, Polo J. Identification of IgE binding proteins from *Lepidoglyphus destructor* and the production of monoclonal antibodies to a major allergen. *Immunol Lett* 1991;29:229-34.
54. Hrfast B, Johansson E, Johansson SGO, van Hage-Hamsten M. ELISA method for detection of mite allergens in barn dust: comparison with mite counts. *Allergy* 1996; 51:257-61.
55. Arruda LK, Fernndez-Caldas E, Naspitz CK, Montealegre F, Vailes LD, Chapman MD. Identification of *Blomia tropicalis* allergen Blo t 5 by cDNA cloning. *Int Arch Allergy Immunol* 1995;456-7.
56. Hill MR, Newton MR, Hart BJ. Comparative IgE responses to extracts of 5 species of house dust mite using Western blotting. *Clin Exp Allergy* 1993;23:110-16.

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.