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REVIEW

Allergenic mites in habitats associated with man in Poland

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Abstract: Mites are ubiquitous and thrive in many diverse environments, so humans contact many species of mites and products of their activity. Many mite species are the sources of potent allergens that sensitize and induce IgE-mediated allergic reactions in humans. The house dust mites, especially several species from the family Pyroglyphidae, may cause atopic diseases in humans. The diseases are: atopic asthma, atopic dermatitis (eczema) and allergic rhinitis, keratoconjunctivitis or oculorhinitis. Besides, humans may contact or be exposed to predaceous mites and parasitic mites of plants and animals, which are also the sources of allergens that induce allergic diseases. This paper gives a literature review of the allergenic mites that are pathogenic for humans and a faunistic review of house dust mites that have actually been recorded in various dwellings in Poland. Mites were found in 365 of the 650 samples examined (56.15%). A total of 8479 mites were isolated, including 7017 of the family Pyroglyphidae (82.8%). *Dermatophagoides farinae* [DF] was predominant (approximately 52% of the total count) followed by *D. pteronyssinus* [DP] (29.7%) and *Chortoglyphus arcuatus* [ChA] (11.6%). Numbers of house dust mites varied among cities examined, among dwellings in the same town, and localities within the same dwelling. The domination of *D. farinae* in dwellings appeared to be a characteristic tendency in many urban localities in Poland, whereas single-family houses of agricultural and/or suburban settlements are dominated by *D. pteronyssinus*.

Key words: Acari, Acaridida, acarofauna, allergenic mites, storage mites, house dust mites, occupational biohazards, environmental biohazards

INTRODUCTION

Allergic disease is a common disorder affecting 40% of the world population (ARLIAN 2002). Many species of mites are the sources of potent allergens that sensitize and induce IgE-mediated allergic reactions in humans. Most of the mite allergens are proteins, and the allergic response mechanism to these allergens is the same as it is for allergens from other biological sources, such as plant pollens, moulds, and foods (ARLIAN 2001). VOORHORST et al. (1964) reported for the first time that house dust contained mites of the genus *Dermatophagoides* Bogdanov, 1864 and

suggested that these were the source of the house dust allergen. This discovery was one of the most important events in the history of allergic disease. Besides, humans may contact or be exposed to predatory mites and parasitic mites of plants and animals, which are also sources of allergens that induce allergic disease.

House dust mites

The house dust mites, especially several species from the family Pyroglyphidae (Acari: Astigmata), may cause atopic diseases in humans. The diseases are: atopic asthma, atopic dermatitis (eczema) and allergic rhinitis, keratoconjunctivitis or oculorhinitis (FAIN et al. 1990, ARLIAN 2001, 2002). Three pyroglyphid mite species, *Dermatophagoides pteronyssinus* (Trouessart, 1897), *Dermatophagoides farinae* Hughes, 1961 and *Euroglyphus maynei* (Cooreman, 1950), are primarily involved as cosmopolitan inhabitants of human dwellings in many parts of the world (FAIN et al. 1990, SOLARZ 2004). These mites are the major sources of indoor inhalant allergens facilitating both the sensitization of atopic subjects and asthmatic attacks in patients (FAIN et al. 1990, PLATTS-MILLS et al. 1992, ARLIAN 2001, ARLIAN et al. 2002). Most often they are found in habitats intimately associated with man, such as beds, couches, sofas, other upholstery furniture, clothing, floors and carpets (VAN BRONSWIJK 1981, FAIN et al. 1990, SOLARZ 2004). The house dust mites have been reported from human dwellings and a wide variety of other habitats associated with man and his environment, both indoors and outdoors, e.g. in hospitals, libraries, cinemas, schools, nursery schools, hotels, hostels, offices, military barracks, workplaces and other public places, recreation facilities, farmsteads, passenger aircraft and trains, automobile seats, naval ships, ocean-going ships, birds' nests, city pavements (COLLOFF 1987, KING et al. 1989, FAIN et al. 1990, FRIEDMAN et al. 1992, GREEN et al. 1992, BABE et al. 1995, ZOCK & BRUNEKREEF 1995, JANKO et al. 1996, RACEWICZ 2001, NEAL et al. 2002). Prevalent dust mite species and allergens differ geographically, between homes within a geographical region, and among areas within a dwelling (FAIN et al. 1990, ARLIAN 2001, 2002, ARLIAN et al. 2002, SOLARZ 2004). Therefore, it is important to know what mite species are dominant in a geographical area when diagnostic testing is performed and immunotherapy is prescribed.

Storage mites

The storage mites, especially several species from the families Acaridae, Glycyphagidae and Chortoglyphidae (Acari: Astigmata), are commonly found in various stored food products, hay, straw, granaries, barns and other farming and occupational environments, as well as in samples of house dust. The most abundant and most often reported are as follows: *Acarus siro* L., 1758, *Acarus farris* (Oudemans, 1905) and *Tyrophagus putrescentiae* (Schrank, 1781) from the family Acaridae; *Lepidoglyphus destructor* (Schrank, 1781), *Glycyphagus domesticus* (De Geer, 1778) and *Gohieria fusca* (Oudemans, 1902) from the Glycyphagidae; and *Chortoglyphus arcuatus* (Troupeau, 1879) from the Chortoglyphidae (BOSTRÖM et al. 1997, FRANZ et al. 1997, MEHL 1998). The greatest exposure to storage mites usually occurs in an occupational and/or rural setting, where allergies to these mites are of major importance (DUTKIEWICZ et al. 1988, VAN HAGE-HAMSTEN & JOHANSSON 1998).

Other mites inducing allergic reactions

Beside the house dust mites or storage mites, also many other mite species with which humans come in contact with, can induce allergic reactions. This group includes some species of spider mites, e.g. the 2-spotted spider mite *Tetranychus urticae* C. L. Koch, 1836, the citrus red mite *Panonychus citri* (Mc Gregor, 1916) and the European red mite *Panonychus ulmi* (Koch, 1835), which are common pests in orchards, greenhouses, and gardens. Spider mites were recently proved to induce IgE-mediated reactions (KIM et al. 1999, LEE et al. 2000, ARLIAN 2001, 2002). It should

Table 1. Species list, and summarized data on dominance and frequency of mites found in the examined house dust samples from dwellings in Poland [based on own previous surveys from 1989–2001 (SOLARZ 2004) and recent, unpublished results from 2001–2005]

Mite taxa	Dominance		Frequency		
	N	%	n	%[1]	%[2]
Pyroglyphidae					
Dermatohagoides farinae	4418	52.11	251	38.62	68.77
D. pteronyssinus	2520	29.72	151	23.23	41.37
Dermatophagoides sp.	7	0.08	5	0.77	1.37
Euroglyphus maynei	67	0.79	9	1.38	2.47
Gymnoglyphus longior	1	0.01	1	0.15	0.27
Hirstia chelidonis	4	0.05	4	0.62	1.10
Chortoglyphidae					
Chortoglyphus arcuatus	981	11.57	14	2.15	3.84
Glycyphagidae					
Lepidoglyphus destructor	84	0.99	13	2.00	3.56
L. fustifer	1	0.01	1	0.15	0.27
Glycyphagus domesticus	39	0.46	4	0.62	1.10
G. privatus	4	0.05	2	0.31	0.55
Gohieria fusca	127	1.50	19	2.92	5.21
Acaridae					
Acarus siro complex	7	0.08	6	0.92	1.64
Tyrophagus putrescentiae	36	0.42	20	3.08	5.48
T. neiswanderi	2	0.02	1	0.15	0.27
Tyrolichus casei	4	0.05	1	0.15	0.27
Caloglyphus sp.	2	0.02	2	0.31	0.55
Thyreophagus sp.	1	0.01	1	0.15	0.27
Acaridae – unident.	6	0.07	4	0.62	1.10
TARSONEMIDA	17	0.21	10	1.54	2.74
CHEYLETIDAE	109	1.29	40	6.15	10.96
Other ACTINEDIDA	4	0.05	4	0.62	1.10
ORIBATIDA	19	0.22	10	1.54	2.74
GAMASIDA	19	0.22	13	2.00	3.56
Total mites	**8479**	**100.0**	**365**	**56.15**	**100.00**

N – number of specimens; n – number of positive samples; [1] in relation to all samples examined (n = 650); [2] in relation to samples positive for mites (n = 365)

Table 2. Mean density of mites per 1 g of dust in samples from sleeping accommodations, floors and carpets, and upholstery furniture from the examined dwellings in some localities of Upper Silesia

Sampling sites	Katowice mean±SD	Bytom mean±SD	Gliwice mean±SD	Sosnowiec mean±SD
Sleeping accommodations	509.8±1632.1 [n = 44]	206.9±255.3 [n = 22]	216.7±396.9 [n = 9]	41.2±78.6 [n = 48]
Floors and carpets	13.0±40.4 [n = 30]	101.9±205.3 [n = 26]	61.3±135.6 [n = 36]	2.9±10.8 [n = 45]
Upholstery furniture	163.3±394.4 [n = 8]	125.0±176.8 [n = 2]	94.2±124.4 [n = 9]	43.1±54.5 [n = 20]

n – number of samples

Table 3. Mean densities of dust mite species (per 1 g of dust) in samples from beds in the examined flats in Katowice and Gliwice (Upper Silesia, SW Poland) and Kraków (S Poland)

Mites	Katowice (n = 84) mean ± SD	Gliwice (n = 54) mean ± SD	Kraków (n = 74) mean ± SD
Dermatophagoides farinae	485.6 ± 1575.7	210.0 ± 395.9	110.3 ± 296.7
Dermatophagoides pteronyssinus	11.9 ± 52.4	9.8 ± 19.5	145.6 ± 249.3
Euroglyphus maynei	3.2 ± 14.1	NF	NF

NF – not found; n – number of samples examined

come as no surprise to learn that chigger mites (Trombiculidae), ticks (Ixodida) and other species of ectoparasitic mites, for instance Gamasida, feed on fowl, pigeons, other birds, mice, guinea pigs, and other mammals, as well as some predaceous mites, sensitize and induce allergic reactions in human (ARLIAN & PLATTS-MILLS 2001). The role of these parasitic mites in causing allergic disease is not known yet. *Hemisarcoptes cooremani* (Thomas, 1961), which feeds on scale insects that parasitize trees and shrubs in orchards, yards, and gardens, can induce allergic diseases. Immunoblotting of extracts of this mite has shown that they contain 16-kDa and 19-kDa proteins that bind IgE in the serum of an exposed and symptomatic individual (ARLIAN et al. 1999). Predaceous mites, such as *Phytoseiulus persimilis* Athias-Henriot, 1957 and *Neoseiulus cucumeris* (Oudemans, 1930), which feed on spider mites and larvae of thrips, respectively, can sensitize greenhouse workers (HOMMA et al. 1994). This raises the possibility that predaceous mites, used for biological control of pest spe-

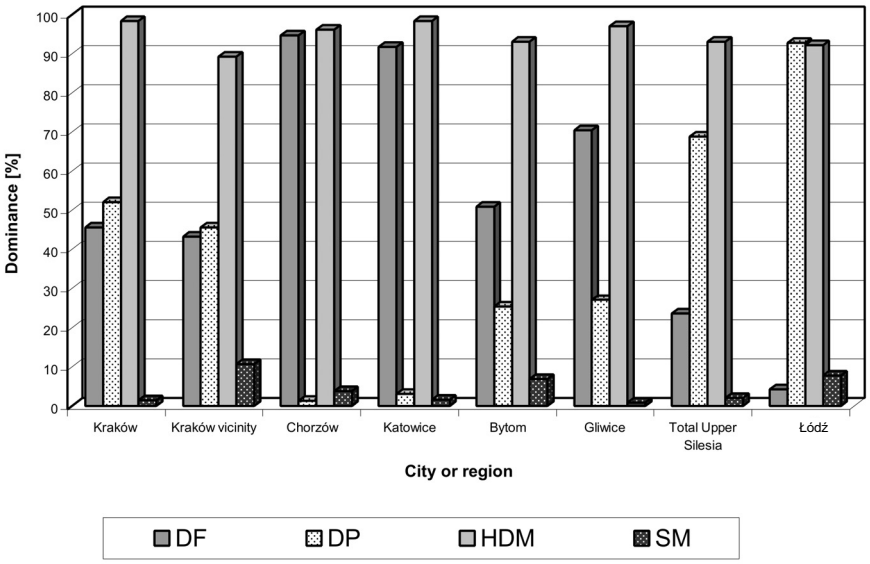

Figure 1. Dominance of domestic mites in dust samples from dwellings in particular localities examined in Poland in 1989-2005. DF – *Dermatophagoides farinae*; DP – *Dermatophagoides pteronyssinus*; HDM – house dust mites; SM – storage mites

cies in fields and orchards, may also be important sources of allergens for gardeners, farmers, and people living around fields and orchards (ARLIAN 2002). Capability of other parasitic mites, such as follicle mites *Demodex folliculorum* (Simon, 1842) and *D. brevis* Akbulatova, 1963, red chicken mites *Dermanyssus gallinae* (De Geer, 1778), rat mites *Ornithonyssus bacoti* (Hirst, 1913) and sheep scab mites *Psoroptes ovis* Hering, 1838, inducing IgE reactions in humans, needs to be investigated (ARLIAN 2002). Multiple erythematous papules accompanied by severe pruritus were observed in humans bitten by the mites *Pyemotes tritici* (Labreze-Fossat et Montagne, 1851) (Pyemotidae), *D. gallinae*, *O. bacoti* and *Androlaelaps casalis* (Berlese, 1887) in Israel (ROSEN et al. 2002). Allergens of the human itch mite *Sarcoptes scabiei var. hominis* (L., 1758), which burrows in the stratum corneum of the skin, induce IgE production and an IgE-mediated reaction in some infested patients (MORGAN et al. 1997, ARLIAN & PLATTS-MILLS 2001, ARLIAN 2002). Many of these immunogens are cross-reactive with antigens of the house dust mites *Dermatophagoides farinae* and *D. pteronyssinus*. The saliva of ticks (Ixodida) contains immunogenic proteins that can induce IgE-mediated reactions while they feed. Some cases of anaphylactic reactions from a tick bite have been reported, too (ARLIAN 2002).

House dust mites in dwellings in Poland (data from 1989–2005)

The study was carried out from January 1989 to April 2005. A total of 650 dust samples from dwellings were examined. The samples were collected with portable vacuum cleaners, equipped with a specially constructed dust trap filter attached

to the end of the hose. A new filter was used for each sample, and each sample was kept separately. A surface area of 1 m^2 at each sampling site was vacuumed (for 2 minutes). The samples were weighed in a 150-ml beaker and analysed for mites as described by ARLIAN et al. (1983), with some modifications (SOLARZ 2001a, b). Mite density was calculated as the number of specimens per 1 g of dust. Mite abundance was also calculated as the number of specimens per 1 sample (= per 1 m^2).

Mites were found in 365 of 650 samples examined (56.15%). A total of 8479 mites were isolated, including 7017 of the family Pyroglyphidae (82.8%) (Table 1). The majority of mites were collected from beds and other sleeping accommodations. Numbers of dust mites varied from one town to another, from one dwelling to another in the same town, and from one locus to another within the same dwelling (Tables 2–3, Fig. 1). *D. farinae* was the predominant species in the examined dwellings (52.1% of the total catch), followed by *D. pteronyssinus* (29.7%) (Table 1). The former species was predominant in Katowice, Sosnowiec, Chorzów, Bytom, Gliwice, and generally in Upper Silesia, whereas the latter dominated in Łódź, Kraków and its vicinity (Table 3, Fig. 1). *D. farinae* was the most abundant species per 1 g of dust in all main types of indoor places examined (Table 2). *D. farinae* was more abundant (per 1 g of dust) in samples from couches and sofas, whereas *D. pteronyssinus* in bed mattresses (SOLARZ 2001a). Single-family houses (suburban settlement) were dominated by the chortoglyphid mite *Chortoglyphus arcuatus* and by *D. pteronyssinu*s, whereas flats (urban and industrial area) by *D. farinae*; the main habitats for the occurrence of both pyroglyphid species (especially *D. pteronyssinu*s) are sleeping accommodations, whereas *Ch. arcuatus* prefers carpets (SOLARZ 2001b). Sensitivity to non-pyroglyphid domestic mites found in house dust is generally unimportant in the examined localities in Poland because exposure to these species is minimal, with the exception of single-family houses in agricultural (or suburban) settlements, where the abundance of chortoglyphid mites may be of clinical importance (Table 1, Fig. 1).

It should be stressed that the domination of *D. farinae* in dwellings appears to be a characteristic tendency in many urban localities in Poland, whereas single-family houses of agricultural and/or suburban settlements are dominated by *D. pteronyssinu*s (SOLARZ 2001b).

In summary, all mites should be regarded as a potential source of mite allergens in various environments associated with human activity, not only in dwellings. So far, many groups of mites have not been reported as occupational biohazards for humans. Our studies suggest that the allergenic mites belonging to Acaridae, Glycyphagidae, Pyroglyphidae and Tetranychidae should be considered as occupational risk factors contributing to the occurrence of respiratory and skin diseases among workers of zoological gardens, coal-miners and farmers in Poland (SOLARZ 2004). As the occurrence and densities of mites in samples from various sites may vary to a considerable extent, further studies are highly desirable.

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