

Ecology of house dust mites in Oxfordshire

B. J. HART and L. WHITEHEAD

University of Oxford, Department of Zoology, Oxford, U.K.

Summary

In a survey of the mite fauna in 30 homes in Oxfordshire, *Dermatophagoides pteronyssinus* and *Euroglyphus maynei* were found to be the most abundant species but *D. farinae* was absent. Of a total of 14 parameters investigated for their influence on mite numbers, relative humidity was apparently the most important factor. Bedrooms with humidities above 64% contained significantly more mites in mattresses than those with lower humidities. Bedroom humidity and thus mattress mite numbers were apparently related and were influenced by the bedroom minimum temperature, the age of the house and the use of central heating. These trends were not seen in the numbers of mites found in living-room carpets. Atopic and non-atopic participants involved in this study did not differ significantly in the numbers of mites found in their homes.

Clinical and Experimental Allergy, Vol. 20, pp. 203–209. Submitted 5 July 1989; revised 5 October 1989; accepted 10 October 1989.

Introduction

House dust mites of the family Pyroglyphidae are amongst the most important sources of asthma-provoking allergens. The faeces of these mites are highly allergenic [1] and when inhaled can cause allergic reactions such as asthma, perennial rhinitis and atopic dermatitis. These mites are generally found in highest numbers in mattresses and upholstered furniture, but also in smaller numbers in carpets and rugs. Human skin scales, the main constituent of the diet of these mites, accumulate in the mattresses of regularly occupied beds and therefore mattresses provide an excellent source of food for Pyroglyphid house dust mites [2].

The major ecological factor reported to affect mite numbers in the mattresses is indoor humidity of the home [3–5]. Mites require a high humidity for survival because they osmoregulate through the cuticle. In addition, fungi of the genus *Aspergillus* are thought to be of nutritional significance to *Dermatophagoides pteronyssinus* [6] and consequently, conditions for mite survival must also be suitable for fungi, i.e. above 65% relative humidity.

Ecological studies on these mites in previously unstudied geographical areas are relevant to clinical practice in providing information on levels of allergen exposure in those areas, namely the species and numbers of mites patients are exposed to, and also the conditions in homes influencing mite species and thus allergen levels. Such

details are invaluable in diagnosis and treatment of house dust allergy and also in formulating control measures against mites in the home.

As part of a larger clinical investigation into the influence of mite exposure on patient sensitization to mites, the present study was undertaken to examine in detail for the first time the mite fauna of Oxfordshire and to determine what conditions in houses in this area influence mite species and number.

Subjects and methods

Subjects

A total of 60 dust samples were collected in January 1988 from the homes of 30 participants living in the Oxfordshire area. Ten of these participants were atopic asthmatics (all with severe asthma) with positive skin tests to *D. pteronyssinus*, 10 were non-asthmatic atopic patients with positive skin tests to *D. pteronyssinus* and 10 were non-atopic, skin-test negative controls. The atopic asthmatics (aged 14–24 yr) were all patients attending the Osler Chest Unit of the Churchill Hospital, Oxford, the non-asthmatic atopics (aged 12–27 yr) were patients attending the Research Allergy Clinic of the Churchill Hospital and the controls (aged 20–50 yr) were randomly selected from GPs' lists in Oxfordshire. Participants were defined as atopic if they had a history of symptoms suggestive of allergic disease and any one of the following; a RAST score of 1 or more to any of a range of antigens including *D. pteronyssinus*, mixed grasses, cat dander, dog dander,

Correspondence: Dr B. J. Hart, University of Oxford, Department of Zoology, South Parks Road, Oxford OX1 3PS, U.K.

mixed trees, *Alternaria*, *Cladosporium* and *Aspergillus*, or an elevated total IgE. An individual was designated skin-test positive to *D. pteronyssinus* if they had a skin weal of 2 mm or more than control to an antigen extract of this species.

Dust samples

Participants sampled their living room carpet and bedroom mattress (1m² for 2 min) using their own vacuum cleaners. Maximum–minimum temperature recordings and single humidity readings (using a whirling hygrometer) of the living room and bedroom were taken on the day of sampling. Participants were also asked to respond to a questionnaire which was designed to determine various parameters in the household which may influence mite species and numbers. These included questions on: the situation of the house, pets' beds and dining area; use of central heating, electric blankets and nightclothes; age of the house, carpet and mattress; number of occupants and pets in the house; signs of humidity; mattress material; and control measures used against dust mites.

Mite counts

Mites were extracted from the dust samples according to the flotation technique of Hart and Fain [7]. The extraction efficiency of this technique has been found to average 97% (range 94–100%) [7]. A technique of mass transfer of mites to slides [8] was used when mite numbers were > 30. Slide preparations of mites were made with Hoyer's mountant [9] and the mites (including damaged mites) were counted and identified using the keys of Hart and Fain [10] and Hughes [11]. As the sampling technique introduced errors in the total quantity of dust collected, mite counts were expressed per 0.1 g of dust, rather than per m².

Statistical analysis

Results were analysed using simple regression, Chi-square test, Student's *t*-tests and analysis of variance. Analysis used total Pyroglyphid mite counts for each house and from each sample area to test for factors affecting mite numbers in general. *D. pteronyssinus* and *Euroglyphus maynei* found in each sample area were also analysed separately to investigate factors affecting these medically important species.

Results

Table 1 lists all mite species found, their abundance and occurrence. Over 95% of all mites found comprised

Table 1. Mite fauna found in 0.1 g dust samples from 30 homes in Oxfordshire

	Total mites	Percentage of total	Occurrence (percentage of houses)
Astigmata			
Pyroglyphidae	2071	95.36	89.7
<i>D. pteronyssinus</i>	1589	75.05	89.7
<i>E. maynei</i>	482	20.31	24.1
Glycyphagidae	15	0.80	13.8
<i>Glycyphagus domesticus</i>	15	0.63	10.3
Acaridae	34	1.73	31.0
<i>Acarus siro</i>	21	1.22	10.3
<i>Tyrophagus putrescentiae</i>	12	0.50	20.7
<i>Caloglyphus sp.</i>	1	0.04	3.4
Anoetidae	1	0.04	3.4
Unidentified species	1	0.04	3.4
Hemisarcoptidae	1	0.04	3.4
Unidentified species	1	0.04	3.4
Prostigmata			
Tarsonemidae	10	0.42	3.4
<i>Tarsonemus granarius</i>	10	0.42	3.4
Cheyletidae	21	1.26	31.0
<i>Cheyletus eruditus</i>	20	1.10	27.6
<i>C. malaccensis</i>	1	0.13	6.9
Cryptostigmata			
Unidentified species	3	0.13	6.9
Mesostigmata			
Eulaelaps	1	0.04	3.4
Laelapidae	2	0.08	6.9
Unidentified species	1	0.04	3.4

D. pteronyssinus and *E. maynei*. The other common Pyroglyphid house dust mites, *D. farinae* and *D. microceras*, were not found in this survey. *Glycyphagus domesticus*, *Tarsonemus granarius*, *Acarus siro* and *Tyrophagus putrescentiae* were all found in low numbers. These species have all been implicated in respiratory or contact allergies [12,13], however, at such low levels are unlikely to be a significant source of dust allergens.

As seen in Table 2, mattress dust samples contained, on average, three times as many Pyroglyphid mites as those from living room carpets ($P < 0.01$). Both *D. pteronyssinus* and *E. maynei* occurred in similar numbers of mattress and carpet samples, however, *E. maynei* made up a significantly lower proportion of the total mites found in mattresses ($P < 0.01$) and carpets ($P < 0.01$).

Table 2. The proportion of *D. pteronyssinus* and *E. maynei* in 0.1 g dust samples from mattresses and carpets of 30 homes in Oxfordshire

	Occurrence in mattresses* (%)	Proportion total mites in mattresses† (%)	Occurrence in carpets* (%)	Proportion total mites in carpets† (%)
<i>D. pteronyssinus</i>	96.0	1104/1614 (68.4)	95.7	485/546 (88.8)
<i>E. maynei</i>	23.0	439/1614 (27.2)	21.7	43/546 (7.9)

* The figures shown represent the percentage of the mattresses or carpets sampled in which each mite species was found.

† The figures on the left of the oblique represent the total number of each mite species found in mattresses or carpets; the figures on the right of the oblique represent the total number of mites found in mattresses or carpets. The figures in parentheses are the percentage of mites found in mattresses or carpets which were *D. pteronyssinus* or *E. maynei*.

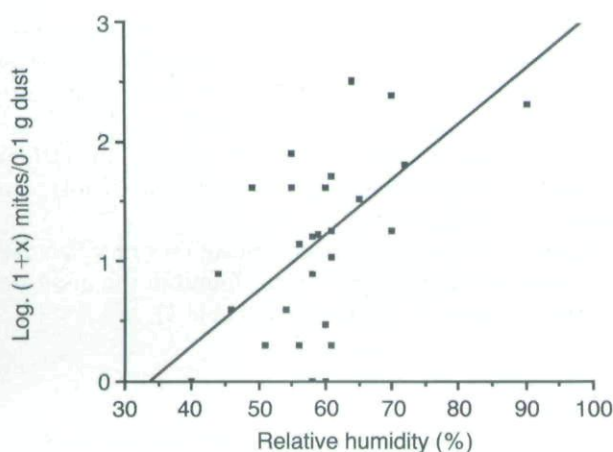


Fig. 1. Number of Pyroglyphid mattress mites found at different bedroom humidities.

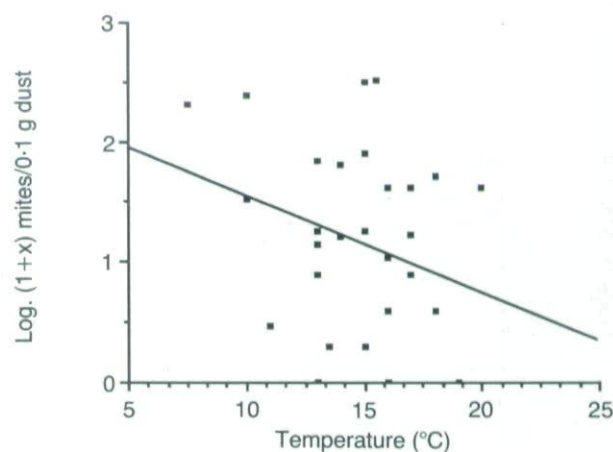


Fig. 2. Number of Pyroglyphid mattress mites found at different bedroom minimum temperatures.

Mattresses

Regression analysis revealed a strong positive relationship between the humidity of the bedroom and the total number of Pyroglyphidae ($P < 0.01$; Fig. 1). Similar analysis also showed a negative relationship between the minimum temperature in the bedroom and the number of mites, although this was not significant ($P = 0.11$; Fig. 2). Comparing heated and unheated bedrooms, *t*-tests indicated that unheated bedrooms had a significantly higher number of mites (157.25 ± 64.45 ; mean $\pm$ s.e.) in the mattress than did heated rooms (37.88 ± 14.85) ($P < 0.05$). A large difference, although not significant, was also found between those mattresses that were vacuumed (35.81 ± 15.23) and those that were not, unvacuumed

mattresses containing greater numbers of mites (95.78 ± 41.27) ($P = 0.10$). No significant relationship was found between total mite numbers and any of the other household factors investigated in the questionnaire.

Numbers of *D. pteronyssinus* and *E. maynei* were analysed separately to investigate any factors which may be influencing each species. This revealed no significant results with *E. maynei*. *D. pteronyssinus*, however, showed a strong positive relationship between the number of this species in mattresses and the humidity of the bedroom ($P < 0.01$; Fig. 3), and there was also a strong negative relationship between the number of *D. pteronyssinus* in mattresses and the minimum temperature of the bedroom ($P < 0.01$; Fig. 4).

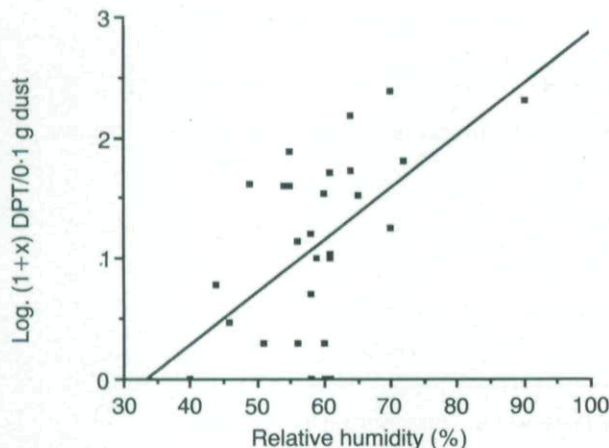


Fig. 3. Number of mattress *D. pteronyssinus* (DPT) mites found at different bedroom humidities.

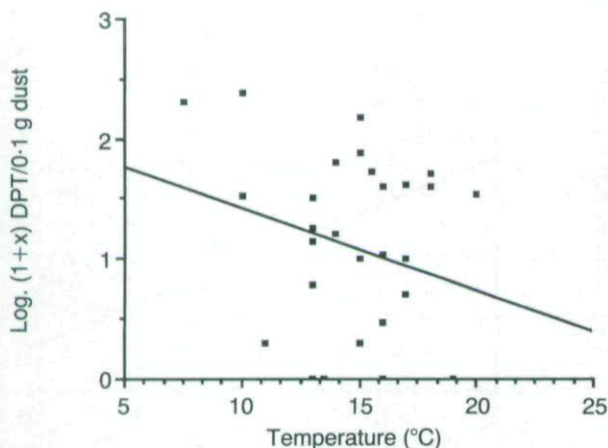


Fig. 4. Number of mattress *D. pteronyssinus* (DPT) mites found at different bedroom minimum temperatures.

Living-room carpets

No significant relationships were found between total Pyroglyphid mite numbers in carpets and any of the factors investigated. When *D. pteronyssinus* and *E. maynei* were analysed separately again no significant results were found.

Whole house

The total number of Pyroglyphid mites from both sampling areas were summed to provide a total for the whole house. There was an indication ($P=0.12$) that houses showing signs of humidity contained larger total numbers of Pyroglyphid mites (95.95 ± 31.27) than houses without signs of humidity (21.22 ± 7.4).

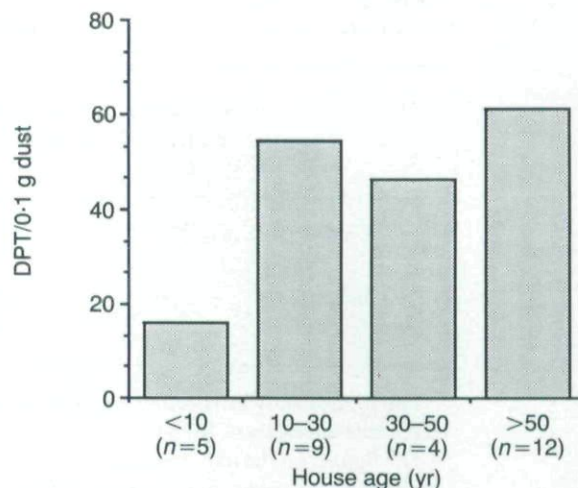


Fig. 5. Average numbers of *D. pteronyssinus* (DPT) found in houses of increasing age.

Statistical analysis demonstrated a significant relationship between total *D. pteronyssinus* found in the house and house age ($P<0.05$; Fig. 5), and also significantly more *D. pteronyssinus* ($P<0.05$) were found in houses showing signs of humidity (68.85 ± 18.97) than those without (18.44 ± 6.51). Again no significant results were obtained with *E. maynei*.

Analysis of variance revealed no significant differences in numbers of Pyroglyphid mites found in the homes of the three groups of participants (Table 3).

Discussion

The numbers and species of mites recorded in this survey of Oxfordshire are similar to those reported in other studies in the U.K. [14]. The family Pyroglyphidae were found in the majority of samples and made up the largest proportion of individual mites. *D. pteronyssinus* and *E. maynei* comprised 75% and 20% of the total mites respectively. However, *D. farinae*, another allergenic Pyroglyphid mite which is common in certain parts of the world (e.g. U.S.A.), was not observed in this survey. These findings are also consistent with other British dust surveys [14–18]. It has been suggested that *D. farinae* thrives in drier, hotter conditions than *D. pteronyssinus* and is thus distributed in inland areas rather than coastal areas where *D. pteronyssinus* predominates [19,20]. Britain, surrounded by water and renowned for its damp climate, is probably too cool and damp for efficient survival of *D. farinae*.

The influence of microclimate on house dust mites has been studied in some detail and the major limiting factor is thought to be indoor air humidity of the house [3,21].

Table 3. Number (mean $\pm$ s.e.) of Pyroglyphid mites per 0.1 g dust from mattresses and carpets of atopic and non-atopic subjects

	Group 1	Group 2	Group 3
Pyroglyphidae in mattresses	57.1 $\pm$ 30.58	18.7 $\pm$ 6.63	85.6 $\pm$ 38.29
Pyroglyphidae in carpets	41.4 $\pm$ 21.69	6.0 $\pm$ 3.01	8.0 $\pm$ 2.61
Total Pyroglyphidae in house	97.5 $\pm$ 51.39	24.7 $\pm$ 8.42	92.8 $\pm$ 38.47
<i>D. pteronyssinus</i> in mattresses	26.0 $\pm$ 8.23	16.9 $\pm$ 6.50	67.5 $\pm$ 29.80
<i>D. pteronyssinus</i> in carpets	36.9 $\pm$ 18.12	5.5 $\pm$ 2.87	6.7 $\pm$ 2.45
Total <i>D. pteronyssinus</i> in house	62.9 $\pm$ 24.09	22.4 $\pm$ 7.91	76.2 $\pm$ 33.83
<i>E. maynei</i> in mattresses	28.7 $\pm$ 25.54	0.8 $\pm$ 0.61	14.5 $\pm$ 14.17
<i>E. maynei</i> in carpets	3.7 $\pm$ 3.70	0.1 $\pm$ 0.10	0.5 $\pm$ 0.34
Total <i>E. maynei</i> in house	32.4 $\pm$ 29.22	0.9 $\pm$ 0.71	16.7 $\pm$ 15.80

Group 1 = atopic asthmatics, skin-test positive to *D. pteronyssinus*; Group 2 = non-asthmatic atopic subjects, skin-test positive to *D. pteronyssinus*; Group 3 = non-atopic controls, skin-test negative to *D. pteronyssinus*.

Our results are in accordance with these studies. In this survey 86% of the houses had central heating regularly in use at the time of sampling and of a total of fourteen household parameters investigated, only humidity, minimum temperature and use of central heating appeared to strongly influence total Pyroglyphid mite numbers, and more obviously, numbers of *D. pteronyssinus* in mattresses. We found significantly more mites in mattresses when the relative humidity of the bedroom was greater than 64%. Our strong negative correlation between bedroom minimum temperature, within the limits of observations, and numbers of *D. pteronyssinus* in the mattress was probably due to the strong correlation found between minimum temperature and humidity. In turn, a low minimum temperature is most likely to be related to less use of central heating. Indeed, we found higher numbers of mites in unheated bedrooms. We also had evidence to suggest that houses showing signs of humidity contained higher numbers of Pyroglyphid mites.

Our findings also indicated that older homes contained higher total numbers of mites or numbers of *D. pteronyssinus* than houses less than 10 years old. It is possible that efficient insulation and central heating in new houses result in conditions (particularly when heating is in use during winter) which are drier and warmer than old houses and therefore detrimental to mite survival. The results of Koekkoek and Bronswijk [22] and Haarlov and Alani [23] are consistent with these suggestions, however, Korsgaard [24] has suggested that insulated homes are more airtight than ordinary homes and that the resultant reduced air flow raises the indoor humidity. Korsgaard

does not mention the influence of central heating in this context, which may explain this discrepancy.

Walshaw and Evans [25], in a study in Liverpool found no correlation between the numbers of *E. maynei* in mattresses and the use of central heating or house age, and only a weak correlation with relative humidity of the bedroom. Despite our correlations between numbers of *D. pteronyssinus* and these factors, our results with *E. maynei* showed no correlations and thus were in accordance with those of the aforementioned authors. The significant numbers of *E. maynei* found here and in similar studies [17,25], the lack of knowledge of its biology and ecology and also the suggested allergenicity of this species [26] emphasize the need for further research on this potentially important house dust mite.

Bronswijk [3], in a study of mite population dynamics in mattresses and living room carpets, reported a constant but fluctuating population in mattresses, but found live mites in living room carpets only during the summer months. Unlike mattresses that are occupied daily, carpets do not have a regular increase in humidity and are therefore much more severely affected by the drying effects of central heating during the winter months. Mites are likely to be transported around the house by the occupants, but only during the more humid summer months can a population establish on the living room carpet. When the mites here are exposed to a drier atmosphere caused by winter central heating they will quickly die out. Our living room carpet results confirm the findings of Bronswijk [3] and imply that the carpet is not the ideal habitat for dust mites, but is only suitable for temporary populations during the summer months.

During the approximately 8 hr when the mattress is occupied, the temperature tends to rise to between 25 and 30°C regardless of the ambient temperature, and the relative humidity also increases by 5–8% [22,27]. Thus for up to 8 hr a day mites in the mattress are experiencing favourable conditions. Furthermore, if the bed is made immediately upon rising it can take up to 16 hr for the temperature, and perhaps humidity, to drop to ambient [28]. Nevertheless, whatever the level of humidity during occupation, the minimum humidity of the bedroom while the mattress is unoccupied will be the limiting factor on the mite population. Each house has its own level of humidity which will create between-house differences in numbers of mites present. Seasonal effects also play a role. In summer, windows and doors are open for prolonged periods and normally no heating is used, thus indoor humidity equilibrates with the high outdoor humidity. In winter, however, windows are opened less frequently and together with central heating this leads to a very dry atmosphere (30–50% relative humidity) which is detrimental to mite survival and development [22,23]. Thus in winter, populations of house dust mites decrease, but the temporary increase in humidity of mattresses when occupied, enables mites in mattresses to survive these detrimental conditions better than mites in carpets.

The effects of using an electric blanket were recently investigated by Mosbech *et al.* [29]. They found that within a month of using an electric blanket every day for 8 hr, the number of mites in mattresses were reduced by one-half in comparison with control mattresses. The authors attribute this to the finding that within 3 hr of the blanket being turned on, the mattress temperature rose by 26°C and the relative humidity fell by 24%. We found no difference between the numbers of mites in mattresses with or without electric blankets; in normal circumstances electric blankets are not left on for the prolonged periods used in the study of Mosbech *et al.*

Bronswijk [27] suggested that the age of the house furnishings may affect the mite numbers. The findings of the present study, in which no significant differences were found between the age of the carpet or mattress and the number of mites, do not support this suggestion. Indeed in an extreme case a 6-month-old mattress was found to contain 318 mites/0.1 g dust, whereas a 25-year-old mattress was found to contain 1 mite/0.1 g dust.

Carswell *et al.* [18] found significantly more mites in the mattresses of bedrooms occupied by more than one person. The results of the present survey, in which the number of occupants of the house were compared to the number of mites in the living-room carpet, do not agree with these findings, perhaps due to regular vacuuming of the living-room carpet.

Atopic and non-atopic participants involved in this

study did not differ significantly in the total numbers of mites present in their homes, a similar finding to those reported by Blythe *et al.* [17] and Maunsell *et al.* [14]. Nevertheless, many other factors must be taken into consideration before unequivocal conclusions about the influence of exposure on sensitization can be made, e.g. history of exposure, period (month) of birth [30]. We are therefore currently extending this preliminary investigation using larger study groups and employing both mite counts and allergen levels to measure exposure to house dust mite allergens in relation to patient sensitivity.

In conclusion, the only species of house dust mites which are likely to be important in allergic disease in Oxfordshire, and perhaps Britain, are *D. pteronyssinus* and *E. maynei*. Populations of these species do not seem to be greater in atopic subjects' homes than in the homes of non-atopics, however, because larger populations of these mites occur in mattresses than in living-room carpets, any control measures should focus on this habitat. Low temperatures and high humidities were associated with larger populations of mites, therefore increasing the bedroom temperature and decreasing the humidity by the use of heating should limit population development of these mites. Our results also suggest that regular vacuuming of the mattress may be useful in attempts to control mite populations.

Acknowledgments

The authors wish to thank the 30 participants involved in this study and Dr J. Hopkin and Pam Sharp, Churchill Hospital, Oxford, for skin test, RAST and IgE data. B. J. Hart was funded during this study by the Asthma Research Council, London.

References

- 1 Tovey ER, Chapman MD, Platts-Mills TAE. Mite faeces are a major source of house dust allergens. *Nature* 1981; 289:592–3.
- 2 Wharton GW. House dust mites. *J Med Ent* 1976; 12:577–621.
- 3 Van Bronswijk JEMH. *Dermatophagoides pteronyssinus* (Trouessart 1897) in mattress and floor dust in a temperate climate (Acari: Pyroglyphidae). *J Med Ent* 1973; 1:63–70.
- 4 Korsgaard J. House dust mites and absolute indoor humidity. *Allergy* 1983; 38:85–92.
- 5 Platts-Mills TAE, Hayden ML, Chapman MD, Wilkins SR. Seasonal variation in dust mite and grass-pollen allergens in dust from the houses of patients with asthma. *J Allergy Clin Immunol* 1987; 79:781–91.
- 6 Douglas AE, Hart BJ. The significance of the fungus *Aspergillus penicilloides* to the house dust mite *Dermatophagoides pteronyssinus*. *Symbiosis* 1989; 7:105–16.
- 7 Hart BJ, Fain A. A new technique for isolation of mites exploiting the difference between ethanol and saturated

- NaCl: qualitative and quantitative studies. *Acarologia* 1987; 28:251-4.
- 8 Colloff MJ. Mite ecology and microclimate in my bed. Proceedings of mite allergy, a world-wide problem, Bad Kreuznach. September 1987. Brussels: UCB Institute of Allergy, 1987:51-4.
 - 9 Krantz GW. A manual of acarology. Corvallis: Oregon State University Book Stores Inc, 1978.
 - 10 Hart BJ, Fain A. Morphological and biological studies of medically important house-dust mites. *Acarologia* 1988; 29:285-95.
 - 11 Hughes AM. The mites of stored food. London: MAFF Technical Bulletin No 9, 1961.
 - 12 Eaton KK, Downing FS, Griffiths DA, Lynch S, Hockland S, McNulty DW. Storage mites, culturing, sampling technique, identification and their role in house dust allergy in rural areas in the United Kingdom. *Ann Allergy* 1985; 55:62-7.
 - 13 Van Hage-Hamsten M, Johansson SGO, Johansson E, Wiren A. Lack of allergenic cross-reactivity between storage mites and *Dermatophagoides pteronyssinus*. *Clin Allergy* 1987; 17:23-31.
 - 14 Maunsell K, Wraith DG, Cunnington AM. Mites and house-dust allergy in bronchial asthma. *Lancet* 1968; i:1267-70.
 - 15 Sesay HR, Dobson RM. Studies on the mite fauna of house dust in Scotland with special reference to that of bedding. *Acarologia* 1972; 14:384-92.
 - 16 Colloff MJ. Mites from house dust in Glasgow. *Med Vet Ent* 1987; 1:163-8.
 - 17 Blythe ME, Williams JD, Morrison Smith J. Distribution of pyroglyphid mites in Birmingham with particular reference to *Euroglyphus maynei*. *Clin Allergy* 1974; 4:25-33.
 - 18 Carswell F, Robinson DW, Oliver J, Clark J, Robinson P, Wadsworth J. House dust mites in Bristol. *Clin Allergy* 1982; 12:533-45.
 - 19 Mulla MS, Harkrider JR, Galant SP, Amin L. Some house-dust control measures and abundance of *Dermatophagoides* mites in Southern California (Acari: Pyroglyphidae). *J Med Ent* 1975; 12:5-9.
 - 20 Feldman-Muhsam B, Mumcuoglu Y, Osterovich T. A survey of house dust mites (Acari: Pyroglyphidae and Cheyletidae) in Israel. *J Med Ent* 1985; 22:663-9.
 - 21 Cunnington AM. Allergy to mites in house-dust and the domestic environment. *R Soc Health J* 1980; 6:229-30.
 - 22 Koekkoek JJM, Van Bronswijk JEMH. Temperature requirements of a house-dust mite *Dermatophagoides pteronyssinus* compared with the climate in different habitats of houses. *Ent Exp Appl* 1972; 15:438-42.
 - 23 Haarløv N, Alani M. House-dust mites (*Dermatophagoides pteronyssinus* (Trt.), *D. farinae* Hughes, *Euroglyphus maynei* (Cooreman) Fain) in Denmark (Acarina). *Ent Scand* 1970; 1:301-6.
 - 24 Korsgaard J. Preventive measures in house-dust allergy. *Am Rev Respir Dis* 1982; 125:80-4.
 - 25 Walshaw MJ, Evans CC. The effects of seasonal and domestic factors on the distribution of *Euroglyphus maynei* in the homes of *Dermatophagoides pteronyssinus* allergic patients. *Clin Allergy* 1987; 17:7-14.
 - 26 Van Hage-Hamsten M, Johansson SGO. Clinical significance and allergenic cross-reactivity of *Euroglyphus maynei* and other non pyroglyphid and pyroglyphid mites. *J Allergy Clin Immunol* 1989; 83:581-9.
 - 27 Van Bronswijk JEMH. House dust biology for allergists, acarologists and mycologists. Zeist: Zoelmond, 1981.
 - 28 Taylor RN. Studies on house-dust mites. PhD Thesis, University of Glasgow, 1971.
 - 29 Mosbech H, Korsgaard J, Lind P. Control of house dust mites by electrical heating blankets. *J Allergy Clin Immunol* 1988; 81:706-10.
 - 30 Korsgaard J, Dahl R. Sensitivity to house dust mite and grass pollen in adults. Influence of month of birth. *Clin Allergy* 1983; 13:529-36.

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.