

Tarsonemid Mites in Danish House Dust

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From a study of 98 typical Danish city apartments it was found that pyroglyphid and tarsonemid mites dominated the housedust acarofauna. Both groups of mites show a remarkable similarity in their occurrence and dependence on the microclimate. Room air humidities above 7 g water/kg dry air involved the highest densities. Below this limit only background contamination appeared. At least 14 distinct forms of tarsonemid mites were found, with *Tarsonemus floricolus* Can. & Fanz., 1876 as the dominating species.

As tarsonemid mites were found regularly rather than occasionally, it is suggested that these mites may be responsible for at least a part of the cases of housedust allergy that cannot be ascribed to the content of *Dermatophagoides* mites in the housedust.

Key words: allergy; *Dermatophagoides*; housedust; mites; *Tarsonemus* spp.

Up to 10-15% of the cases of allergic diseases caused by the inhalation of housedust cannot be ascribed to its content of *Dermatophagoides* mites or other known allergen sources (22). Korsgaard (unpubl.) found that specimens of extremely small mites, of the cohorts Tarsonemina, occur frequently in housedust. Immunochemical investigations (17) show that their concentrations in housedust are not correlated with the content of the housedust allergen produced by the pyroglyphid mites (*Dermatophagoides* spp.). Therefore, we suspect that they may be the origin of a separate allergen(s) accounting for at least a part of the hitherto unexplained cases of allergy caused by the inhalation of housedust.

The role of tarsonemid mites as members of the housedust fauna has been overlooked. In the monographs of Hughes (15) and Wharton (38), concerning housedust acarofauna, they are not even mentioned as such. Knowledge of their specific identity, as well as the ecological conditions for keeping them in culture, is incomplete.

In this paper we present investigations on the occurrence of tarsonemid mites in housedust, their frequency, identity, and the conditions under which they occur.

MATERIAL AND METHODS

A total of 310 samples were collected from 98 apartments in the city of Aarhus, 75 apartments being selected at random through the courtesy of the Statistics Office of the city, while 23 apartments were the residences of patients suffering from newly (within 1 year) diagnosed *Dermatophagoides* allergy. Apart from this grouping, the apartments are typical of a Danish city. Samples were collected with a vacuum-cleaner (AKA HSS 09) from mattress surfaces, floors and/or floor carpets of the sleeping and living rooms. Relative humidity and temperature were measured with a Thies psychrometer 20 cm above floor level in the relevant rooms. Within 5 h the samples were processed in the laboratory: 0.1 g dust was mixed with 10 ml 90% lactic acid in a 10-cm

Petri dish, a few crystals of the dye, Lignin Pink, were added, and after stirring, the suspension was incubated for 2 days at 55°C. (Preliminary experiments showed that the addition of Lignin Pink increased the recovery of mites in housedust samples by a factor 2.5.) The animals were found during at least half an hour's search for each dish under a stereomicroscope at $\times 25$. Quantitative mite-findings are based on counts made under the low-power microscope. For species identification more than 100 single specimens were mounted in Hoyer's medium on slides.

The dust samples were collected during the period April 6th to June 10th, 1977. The mean temperature and humidity in this period were 10°C, 79% RH outdoors, and 20°C, 42% RH indoors.

Specimens from a few additional samples in Aarhus (Denmark), Thorshavn (the Faroe Islands) and Jacobshavn (Greenland) are included in the taxonomic chapter.

RESULTS

Occurrence

The tarsonemid mites were found in samples from 73 (74.5%) of the apartments. Our reference group, the pyroglyphid mites, was present in 84 (85.7%). The tarsonemid mites constituted 10, 13, and 15% of the mites found in mattresses, bedrooms, and living rooms respectively, corresponding to 11% of the mites found in our investigation.

The findings show the following characteristics in the occurrence of the two mite groups:

1. The occurrence of both the tarsonemid and pyroglyphid mites decreases with increasing distance from bedding (Tables 1 and 2).
2. The observed frequencies of occurrence may be derived from the mean concentrations ($\bar{x}$) of mites from the locations considered. This is also valid for both groups. A possible empirically found con-

version formula is:

$$10^2 (\bar{x} 10^{-2})^{\frac{\ln 10}{10}} = \text{frequency of occurrence}$$

Consequently, the density distributions of both the tarsonemid and pyroglyphid mites are almost identical. Their concentrations, however, are different as seen in Tables 2 and 3.

3. The observed occurrence in "all apartments" agrees well with the chance expectation, i.e. the frequencies of "all samples" observed or derived from the formula above, raised to the power of 98/310. This means that the samples are unclustered so that one positive sample in an apartment does not increase the chance of finding another positive sample in the same apartment.
4. Their qualitative co-occurrence in the samples equals the frequency products and thus the observed co-occurrence can be explained as a simple chance expectation.

Characteristics 1, 2 and 3 disclose a remarkable similarity in the occurrence of tarsonemid and pyroglyphid mites in human habitations.

Density and microclimate

Table 2 shows a distinct relation between the density of mites in the samples and the water content of the air in the room where the samples were collected. The peak concentrations of both pyroglyphid and tarsonemid mites are found in rooms where there is more than 7.9 g H₂O/kg dry air. This common dependence on microclimatic factors also demonstrates the similarity in the occurrence of tarsonemid and pyroglyphid mites in housedust.

Annual yield of mites per m₂ (mite flux)

Dust obtained from mattresses is generally fine and light, while dust from carpets in living rooms is coarser and has a higher specific gravity because it contains more

Table 1
Occurrence of pyroglyphid and tarsonemid mites in the samples

Origin	Per cent occurrence		Per cent co-occurrence	
	<i>n</i>	Tarsonemina	Pyroglyphidae	
Mattresses	98	41.8	74.6	33.7 (31.2)
Bedroom floors	102	37.3	62.7	25.5 (23.4)
Living-room floors	110	32.7	41.0	15.5 (13.4)
All samples	310	38.1	59.4	25.5 (22.6)
All apartments	98	74.5 (73.7)	85.7 (84.8)	64.3 (63.9)

Numbers in parentheses show the calculated expected frequencies.

Table 2
Mean number of mites in 0.1 g dust samples from three locations

Humidity g H ₂ O/kg dry air	Mattress			Bedroom floor			Living-room floor		
	<i>n</i>	Tarson.	Pyrogl.	<i>n</i>	Tarson.	Pyrogl.	<i>n</i>	Tarson.	Pyrogl.
< 6.0	22	0.59	1.18	22	1.27	2.14	27	0.56	0.33
6.0-6.9	28	0.36	3.00	25	0.40	3.36	31	0.39	1.16
7.0-7.9	32	3.78	16.75	38	0.89	9.50	25	0.56	2.68
> 7.9	16	5.94	96.44	17	2.30	10.82	27	4.81	6.48
Mean conc.	98	2.44	22.34	102	1.09	6.63	110	1.56	2.61

The mean number of all samples was 1.68 tarsonemid and 10.17 pyroglyphid mites per 0.10 g dust.

Table 3
Mite density in mattress samples

Mites/0.10 g dust	Samples with tarsonemids	Samples with pyroglyphids
0	57	25
1	16	15
2-3	14	23
4-7	4	6
8-15	2	5
16-31	4	10
32-63	1	7
64-127	0	4
> 127	0	3
	98	98

sand, hair and coarse texture fibres. The dust from bedroom floors is usually an intermediate type. Apart from this difference in appearance and specific gravity it is impor-

tant to note that floor cleaning is done more often than vacuum-cleaning of mattresses. These factors may produce a distorted picture of the amounts of mites actually present when the findings are expressed as numbers of mites per unit weight of the dust.

Alternatively let us consider the amounts of mites removed from 1 m² surface throughout the year, estimated as the product of three factors:

1. The concentration of mites in our dust sample.
2. The weight of dust removed from 1 m² surface, when vacuum-cleaned for 1 min.
3. The annual frequency of vacuum-cleaning according to the owner of the apartment.

The results in Table 4 show that considerable amounts of tarsonemid mites are removed with the dust from the floor carpets in rooms which are supposed to be dry, and

Table 4
Estimated annual yield of mites from 1 m² of the locations (the mite-flux)

Humidity g H ₂ O/kg dry air	Mattresses		Bedroom floor carpets		Living-room carpets	
	Tarson.	Pyrogl.	Tarson.	Pyrogl.	Tarson.	Pyrogl.
<6.0	69 (7)	145 (10)	24,646 (4)	12,068 (10)	2,216 (6)	2,858 (6)
6.0-6.9	59 (6)	216 (12)	3,593 (8)	12,802 (8)	1,500 (10)	15,236 (5)
7.0-7.9	273 (17)	1,717 (24)	4,137 (12)	10,814 (22)	6,717 (7)	61,070 (7)
<7.9	5,214 (6)	27,754 (14)	21,326 (5)	220,254 (9)	57,387 (9)	36,960 (21)
Mean flux	1,134 (37)	7,290 (60)	9,780 (29)	49,863 (49)	18,494 (32)	33,256 (39)

The Table is based on positive samples from locations which have been cleaned at least once yearly. Number of samples is shown in parentheses.

this shows a difference in occurrence between the tarsonemid and the pyroglyphid mites.

The mite species involved

Tarsonemid mites or the Tarsonemina is a cohorts of small Trombidiform mites (19). Most of our mounted Tarsonemina specimens had broken legs and were slightly damaged with respect to specific

characteristics, presumably because of the dust sampling method, and the male/female ratio was ambiguous. For a more detailed account a less destructive isolation technique will be needed. In the samples we were able to distinguish at least 14 different types. The dominating species was *Tarsonemus floricolus* Can. & Fanz. 1876. This species has previously been mentioned in housedust investigations (5, 7, 16). Our specimens con-

Table 5
Records of *Tarsonemus* spp. from housedust samples

Ref. no.	Author(s) name(s)	Per cent of total mite numbers	Origin of samples
(7)	Carter et al.	+	Sri Lanka
(35)	Spieksma	2.7	Holland
(36)	Spieksma & Spieksma-Boezeman	1.0-0.8	Holland
(21)	Maunsell et al.	3.1	England
(13)	Haarløv & Alani	+	Denmark
(23)	Oshima	6.6	Japan
(25)	Penaud et al.	+	France
(27)	Sesay & Dobson	1.3-3.6	Scotland
(5)	Bronswijk	+	Holland
(16)	Karg	10	E. Germany
(14)	Hewitt et al.	2.3	England
(24)	Pearson & Cunningham	1.7	Barbados
(1)	Anderson & Cunningham	0.01	New Guinea
(2)	Blythe et al.	+	England
(3)	Blythe et al.	5.4	England
(8)	Černelč et al.	+	Jugoslavia
(11)	Gridelet-de-saint-George	5.0	Belgium
(6)	Bronswijk & Jorde	+	W. Germany
(26)	Samsišák et al.	+	Czechoslovakia
(22)	Momcoughlu	0.15	Switzerland
(37)	Takaoka	0.7	Japan

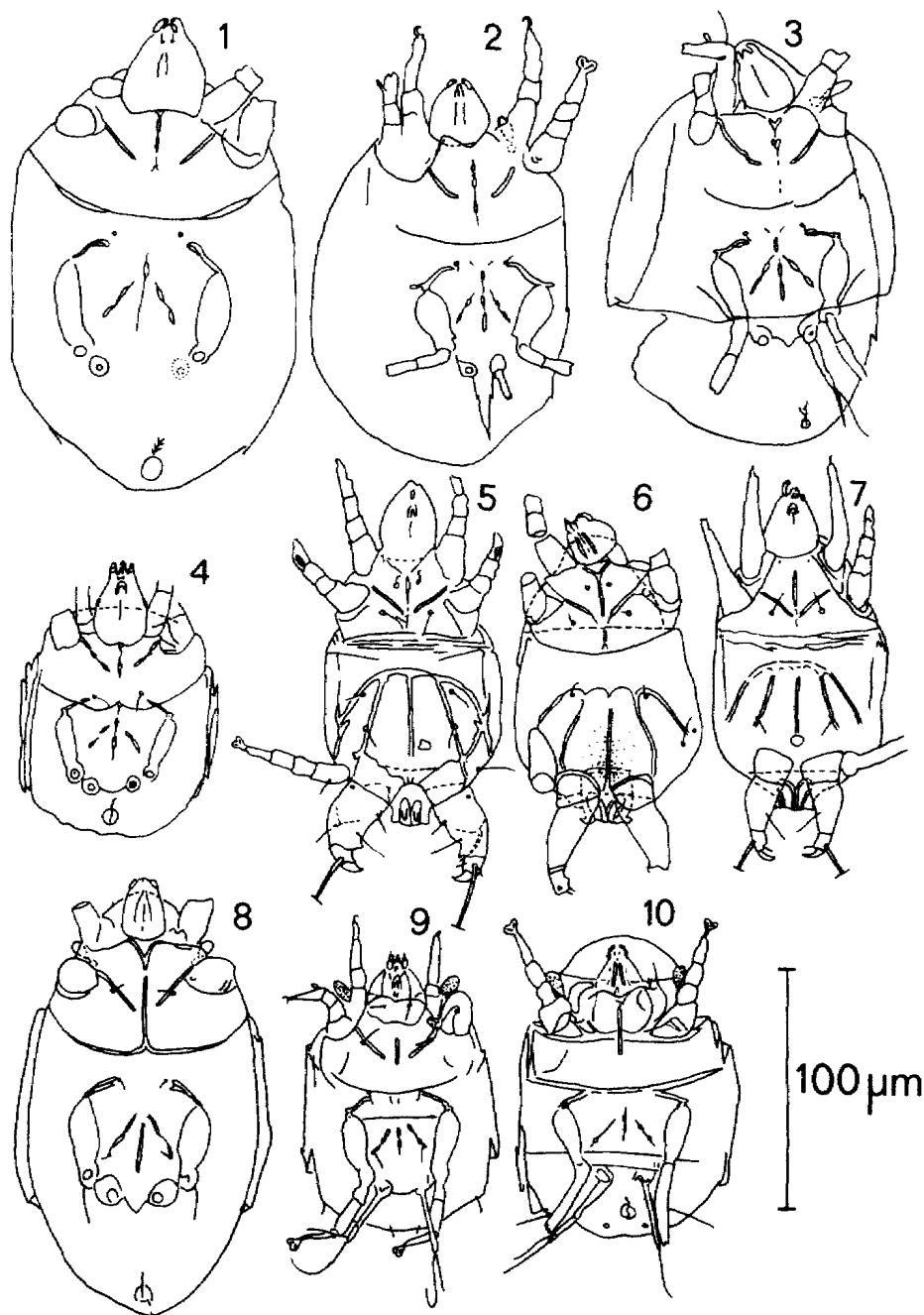


Fig. 1. Some representatives of the genera *Tarsonemus* and *Tarsonemoides* found in the present investigation.

1. *Tarsonemus fennicum*, female

2. *Tarsonemoides belemnitoides*, female

3. *Tarsonemoides* sp., female

4. *Tarsonemus floricolus*, female

5. *Tarsonemus floricolus*, male

6. *Tarsonemoides* sp. (near *pomi*), male

7. *Tarsonemus fusarii*, male

8. *Tarsonemoides ellipticus*, female

9. *Tarsonemus fusarii*, female

10. *Tarsonemoides* sp., female

formed with those collected by Dr. Karg. *T. floricolus* was also found in samples from the Faroe Islands. *Tarsonemus fusarii* Cooreman 1944 and *Tarsonemoides belemitoides* Weis-Fogh 1948 were not quite as frequent; *T. fusarii* is known as the pest of fungal cultures in the laboratory. Less frequently found was *Pyemotes* sp. (near *beckeri* Krczal 1958) – G. Rack det., *Pyemotes* sp. – G. Rack det., *Pygmephorus* sp. – G. Rack det., *Pseudopygmephorus* cf. *haarloevi* (Krczal 1958) – G. Rack det., *Scutacarus* (*Variatipes*) *quadrangularis* (Paoli 1911) – G. Rack det. – a common free-living species, *Tarsonemus fennicum* Oudemans 1903 – found in a Greenland housedust sample only. *Tarsonemoides ellipticus* Schaarschmidt 1969, *Tarsonemoides* sp. (near *pomi* Suski 1967), *Tarsonemus* spp. (unidentified females), *Tarsonemoides* spp. (unidentified females), *Daidalotarsonemus vandevoeriei* Suski 1967 – G. Rack det. This species was found in a sample from an apartment where the owner suffered from increased skin scale production. Another species of this rare genus was found in England from human clothes described by Mahunka (19). Our reference group, the pyroglyphid mites, was mainly *Dermatophagoides* spp. Further results concerning this group will be published later. Other mites (dominated by *Acarus siro* L. and *Glycyphagus domesticus* De Geer and their hypopi) only amounted to 7% of the mites found and were infrequent.

DISCUSSION

The Tarsonemina and particularly *Tarsonemus* spp. has previously been reported in housedust, mainly from beds, by several workers (Table 5). In this investigation we found that the Tarsonemid mites constituted 11% of the housedust acarofauna. The occurrence of *Tarsonemus* spp. in housedust is not surprising since they are well-established faunal members in the dust from stored grain and cereal (4, 9, 10, 12, 15, 18, 28, 29, 30, 31, 32, 33, 34). They have been extracted from grain and cereal dust mainly by means of Berlese

funnels, a technique not used in housedust investigations. This may partly explain why so many housedust workers have not reported them. The Tarsonemina are very small and therefore hard to recognize, although the addition of Lignin Pink dye makes them easier to find. Moreover, through a low-power microscope some of the tarsonemid adults might have been confused with the larvae of the pyroglyphid mites.

We have shown that the occurrence of at least one mite of either tarsonemid or pyroglyphid origin can be a matter of chance. The basic factors are the mean concentration and a dust density factor in each type of location. Thus, generally at least 0.4–0.6 specimens of tarsonemid mites per 0.1 g dust are present in the homes of a Danish city population. This concentration is raised considerably only in those rooms where the water content of the indoor air exceeds 7 g/kg dry air. The same holds for our reference group, the pyroglyphid mites.

The annual fluxes from 1 m² of the locations show the same trend when the water content of the indoor air is high. In rooms where the water content is supposed to be low, the flux of tarsonemid mites is considerably increased compared with the flux of pyroglyphid mites. We are unable to explain this. Counting errors and inaccurate information from the apartment owners should not affect the ratio of the two kinds of mites. The tarsonemid mites have piercing sucking mouthparts with stylets and are thus likely to feed on objects with a fluid content. In our investigation their low numbers and the fact that they occur in highest densities at humidities which suit pyroglyphids (and not fungi) indicate that they may be predators, devouring the eggs and larvae of the pyroglyphid or other mite species.

Little is known about the medical significance of tarsonemid mites. Hewitt et al. (14) and Hewitt & Turk (see ref. 20) mention their role in human skin rashes and the ability of *Pyemotes* to penetrate human skin. According

to Samšínák et al. (26), at least some of the case histories concerning the role of *Tarsonemus* spp. as human parasites may be the result of contamination from external sources, e.g. grain or housedust. The present study shows that the tarsonemid mites occur frequently enough to support this suggestion. Investigations of their possible role as the cause of asthmatic and/or rhinitic symptoms have hitherto been neglected, and we are not aware of any cases where extracts of this group of mites have been used in skin tests in individuals allergic to housedust. This is surprising since *Tarsonemus* is found more frequently in fresh human sputum than any other kind of mite (7); just as their minute size, compared with other mites, favours their penetration into target organs.

In our opinion the results presented here indicate that these particular mites, which are second in frequency only to the pyroglyphid mites, may be the cause of at least a part of the allergic diseases which are caused by housedust, but which cannot be ascribed to the content of pyroglyphid mites (*Dermatophagoides* spp.).

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