

The biology of mites

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In Denmark nearly 800 species of mites are known (5). About 50 of these species can be found in major numbers indoors if other suitable conditions are present. The indoor mites that are to be considered in connection with dustborne respiratory allergy can be divided into three groups: house dust mites, glistening mites, and storage mites.

In house dust acarofauna, the following mites are typically to be found:

More than 80% are house dust mites, represented by the species *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Dermatophagoides microceras*, and *Euroglyphus maynei*. Ten percent are glistening mites of the genus *Tarsonemus*, and 5-8% belong to the genus complex of storage mites that are mainly spread in grain, straw, and hay (*Acarus*, *Glycyphagus/Lepidoglyphus*, *Tyrophagus*, *Cheyletus*, *Tydeus*, and another *Tarsonemus* species). The combination of species can be subject to great variations, e.g. *Glycyphagus* can be dominating in homes with a very humid indoor climate.

All these different mites have some uniform characteristics.

They are small, measure from 0.1 to 0.6 mm and are whitish. In dust samples being together with thousands of dust particles they are not seen until they are coloured and observed through a stereo magnifying glass at 25 magnification. In particularly favourable cases, e.g. if the mites are moving on a dark background, they are only just to be seen with the naked eye.

The biology of house dust mites is dealt with in reviews by (2) and (10), and in an experimental work by (4). (1) summarizes the knowledge of the house dust mite biology of that time. Below is a brief review of some of the biological aspects that are of the greatest importance to our understanding the existence of house dust mites.

NUTRITION

The group of mites to which the house dust mite belongs seems to have specialized in eating

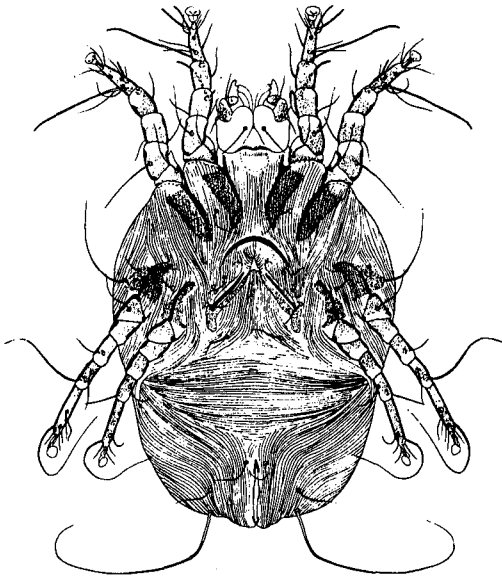


Fig. 1. The house dust mite, *Dermatophagoides pteronyssinus*, female (3).

Table 1

The duration of the single stages is dependent on temperature, which appears from the following statements of days from Furumizo's observations of *D. farinae* at 75% RH

Stage/phase	15.6°C	21.1°C	26.6°C	32.2°C
Egg stage	58.5	13.9	7.1	6.3
Larva, active	28.3	6.8	3.5	3.0
Larva, ecdysis	6.0	4.6	2.6	1.8
Protonymph, active	24.5	15.7	2.5	2.7
Protonymph, ecdysis	143.8	5.0	2.4	1.4
Tritonymph, active	67.3	4.3	2.6	2.1
Tritonymph, ecdysis	50.5	4.2	2.2	1.4
(from egg to adult)	388.8	54.5	23.2	18.8

breaking-down epidermal material from animals. In cultures, house dust mites can be grown on a large number of different sorts of food material, as a rule pulverized animal material to which dried yeast is added. In the natural habitats, our house dust mites feed on scales. Quite fresh scales may be eaten, but mites thrive better on scales a bit older. In humid environments, rather old scales are attacked by fungi. It is said that fungi either pre-digest scales for mites or that mites digest fungi. It has not been understood yet which fungi are involved; however, yeast fungi of the genus *Pityrosporum* are a possibility (7). The dependence of mites on fungi is shown by the fact that the number of house dust mites can be reduced by treating their habitats with a fungicide (9).

Scales will apparently pass nearly undigested through the intestines of mites. Faeces are discharged as small balls surrounded by a peritroph membrane. An active mite is able to discharge about twenty per day. The diameters of the faeces balls are proportional to the size of the mites in question, so that small animals (larvae) discharge the smallest faeces and adult mites discharge the largest ones. The faeces are 10-40 μm in diameter (mean 24 μm) (8).

Part of the explanation why they do particularly well in bed mattress surfaces is the house dust mites' need for many moist and old scales.

LIFE CYCLE

Adult mites are found as males and females which mate. Fertilized females lay a couple of eggs a day

in some few days or months before they die. Small six-legged larvae hatch from the eggs. When the larva has been active and has eaten for some time it will enter a recumbent position of ecdysis. After the position of ecdysis an eight-legged protonymph appears, which likewise finishes with a position of ecdysis. After this the protonymph becomes a larger nymph, which is named the tritonymph. The latter develops through one more recumbent position of ecdysis into an adult female or an adult male.

Of course there is a difference in the periods of growth in the above observations of culture and in what happens when many uncontrolled factors work together in the natural substrates of house dust mites. Nevertheless, it is suggestive that about 60% of the growth period takes place in stages which do not move, do not take nourishment, and which only have a minimum of metabolism and very little giving off of water.

The absence of these responses surely gives house dust mites some survivor advantages. The non-active stages are suitable for e.g. passive transport (spreading) or survival at temporary unfavourable conditions in their habitat.

HUMIDITY CONDITIONS

Much simplified, it can be said that it is mostly temperature that decides how quickly mites can develop, whereas humidity determines the number of house dust mites able to live in a home. In practice the two factors work together and are virtually never constant. In culture tests with constant temperature and air humidity it

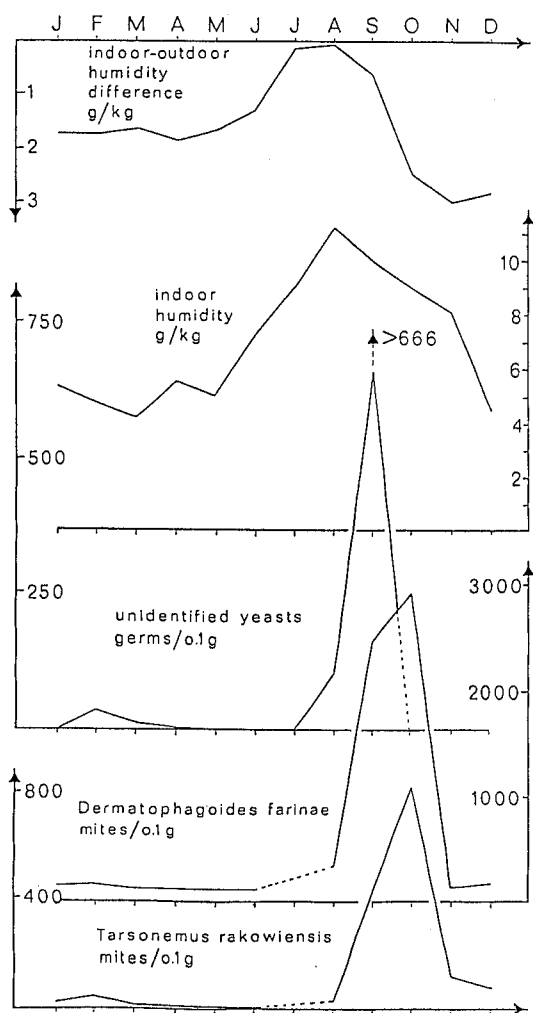


Fig. 2. In the autumn when the difference between the absolute water content of the out-of-door air and the indoor air is reduced, the water content of the indoor air will increase and there will be a higher humidity in the basement room where the measuring took place. Simultaneous samples of the mattress dust showed that a fungus species benefited from the increase in humidity. This phenomenon again forms the basis of a mass occurrence of house dust mites, and perhaps the end of it may be that the glistening mite *Tarsonemus rakowiensis* will eat the house dust mites all up. (6).

can be seen that house dust mites develop their populations most quickly at 25°C and 75% RH. This humidity percentage is, however, optimum for reasons that have no direct relation to mites.

The fact is that, if the humidity in cultures is constantly very high, the artificial substrate will be taken over by intruder fungi and become inaccessible for mites. In the natural habitats of mites this hardly ever takes place, and here the density of mites seems to grow exponentially with the humidity until the increase will stop owing to overcrowding, predators, lack of food, or the like.

House dust mites have no special humidity preference, but prefer the most humid place when having the opportunity to choose themselves. It is probable that the relations of the active stages to air humidity in reality is an adaption to the growth rate of the fungi fed on by mites – the fungi that attack scales. Owing to this and because the single stages to a different extent can endure drier air, there is no sharply indicated lower humidity limit where mites cannot survive, but rather a major margin where conditions for mites gradually become worse. As a rule of thumb, it is said that viable populations are not seen below 65% RH, but that the percentage has to drop to 45% RH, if you want to avoid having mites at all. It is a general rule that the degree of protection needed against house dust mites cannot be derived from culture tests, but has to be estimated from measurement of humidity and its variation in the natural habitats of the animals.

The humidity of the air out-of-doors decides the seasonal variation of house dust mites.

The causality is shown in Figure 2.

STRATEGIES FOR CONTROL

House dust mites are spread with dust, clothes, and objects, and are just as omnipresent as the micro-organisms they feed on.

As opportunists, they arrive in a constant stream to every locality and settle where they can. For that reason an "on-the-spot" control will only have a short-term effect unless the control agents are constantly present. From a biological point of view, an ineffective control has a selection effect so that the remaining part of the house dust mite population will have improved survivor possibilities the next time control takes place. This applies to all sorts of

ineffective vacuum-cleaning, drying up, poison treatment, etc.

REFERENCES

1. Bronswijk JEMH van. House dust biology for allergists, acarologists and mycologists. NIB Publishers, the Netherlands, 316 pp, 1981.
2. Bronswijk, JEMH van, Sinha RN. Pyroglyphid mites (Acari) and house dust allergy. *J Allergy*, 47, 31-52, 1971.
3. Fain A. Nouvelle description de *Dermatophagoides pteronyssinus* (Trouessart, 1887). Importance de cet acararien en pathologie humaine (Psoroptidae: Sarcoptiformes). *Acarologia* 8, 302-327, 1966.
4. Furumizo RT. Laboratory observations on the life history and biology of the American house dust mite *Dermatophagoides farinae* (Acarina: Pyroglyphidae). *California Vector Views* 22, 49-60, 1975.
5. Hallas TE. Fortegnelse over danske mider (Acari). *Ent meddr* 47, 27-45, 1978.
6. Hallas TE, Korsgaard J. Annual fluctuations of mites and fungi in Danish house-dust: An example. *Allergol Immunopathol* 11, 195-200, 1983.
7. Maunder JW. Atopic dermatitis: A problem in applied entomology. *Skin Forum* 3, 38-40, 1984.
8. Platts-Mills TAE, Mitchell EB, Rowntree S, Champman MD, Wilkins SR. The role of dust mite allergens in atopic dermatitis. *Clin Exp Immunol* 8, 233-247, 1983.
9. Saint-Georges-Grèdelet D de. Mise au point d'une stratégie de contrôle de L'acarien des poussières (*Dermatophagoides pteronyssinus*) par utilisation d'un fongicide. *Acta Oecol/Oecol Appl* 2, 117-126, 1981.
10. Wharton GW. House dust mites. *J Med Entomol* 12, 577-621, 1976.

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