Evaluation of the Acarofauna of the Domiciliary Ecosystem in Juiz de Fora, State of Minas Gerais, Brazil

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From August 1999 to January 2000, samples of house dust were collected from 160 domiciles in the city of Juiz de Fora, State of Minas Gerais, Brazil. In 36 of these domiciles kitchen samples were obtained. Prevalence rate was 77.5%, varying according to the geographical sector. There were found 2,278 specimens of mites, with 1,530 (67.2%) in the adult stage and 748 (32.8%) in immature forms. The main species found were Dermatophagoides pteronyssinus, D. farinae, Euroglyphus maynei, Blomia tropicalis *and* Tyrophagus putrescentiae. *In a minor incidence we found* Lepidoglyphus destructor, Suidasia pontificiae, Chortoglyphus arcuatus, Cheyletus malaccensis, C. fortis, Ker bakeri, Cheletonella vespertilionis, C. caucasica *and others*. C. vespertilionis *and* C. caucasica *were identified for the first time in the domiciliary ecosystem and in Brazil. The abundance rate and the infestation intensity were analyzed. There was a varied correlation between climatic conditions and positive domiciles and number of mites. The difference between the number of positive domiciles in the urban area and in the expanding urban area was significant and so was the difference between samples from the domiciles compared to those from the kitchens.*

Key words: house dust mites - domiciliary ecosystem - allergic diseases - aeroallergens - Minas Gerais - Brazil

Strong evidence supports a direct relationship between allergens from house dust mites and allergic diseases. These mites belong to the families Pyroglyphidae, Glycyphagidae, Acaridae, and Cheyletidae and are still considered the most important to human health (Maunsell et al. 1968, Cohen 1980, Feldman-Muhsam et al. 1985, Galvão & Guitton 1986, Fain et al. 1990, Geller 1999).

Extrinsic asthma, one of the most important allergic respiratory diseases known to be associated with aeroallergens such from house dust mites, is now considered a relevant public health problem, due to its high pediatric prevalence (around 20%), increasing morbidity and mortality in the last years and high social and economic cost (Platts-Mills & Weck 1989, Gergen & Weiss 1990, Platts-Mills et al. 1992, Pereira & Naspitz 1999).

Allergic rhinitis and rhinoconjunctivitis are other relevant human diseases which have house dust as a major etiologic factor (Frankland & El-Hefny 1971, Cuthbert et al. 1979, Geller 1990, Philip & Naclerio 1996, Passàli & Mösges 1999). Furthermore mites have been also associated with cutaneous diseases such as atopic dermatitis (Harving et al. 1990, Adinoff & Clark 1996), urticaria, and other mite dermatitides related to the Dermanyssidae (Gupta et al. 1988), Cheyletidae (Cohen 1980, Yoshikawa 1987) and Pyroglyphidae (Hewitt et al. 1973) families, among others.

Researches carried out in all continents have demonstrated the worldwide distribution of *Dermatophagoides pteronyssinus* [Trouessart, 1897] with a regional distribution of the other species involved in the allergic processes, influenced by both biotic and abiotic factors, leading to the local epidemiological features of the acarofauna of the domiciliary ecosystem in a given physiographic area (Maunsell et al. 1968, Stenius & Cunnington 1972, Wharton 1976, Mumcuoglu 1976, Smith et al. 1985, Croce et al. 1988, Parada et al. 1988, Mendes 1989, Malheiros et al. 1990, Platts-Mills et al. 1992, Geller 1999).

The importance of allergic processes as public health hazards, their recognized relation to mites, and the known regionalization of the acarofauna, prompted this survey of mite species in the domiciliary ecosystem of Juiz de Fora, State of Minas Gerais, Brazil.

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MATERIALS AND METHODS

Between 18 August 1999 and 14 January 2000, samples of house dust from 20 randomly chosen domiciles from each of the eight urban sectors of the municipality of Juiz de Fora (longitude west 43°20'50'', latitude south 21°45'35'', altitude 679 m), situated in the "Serrana" region of the "Zona da Mata" in Minas Gerais, were obtained. A total of 114 domiciles belonged to the so called urban area and 46 to the expanding urban area (expanding urban areas present aspects physical, economical and social inside of the urban section, including, however, rural characteristics).

Collection was performed using a household vacuum cleaner (Feldman-Muhsam et al. 1985, Harving et al. 1990, Sarinho et al. 1996, Sporik et al. 1998), with a separate paper filter for each domicile. The sites preferentially chosen were mattress surfaces, pillows, bedclothes, furniture covers, carpets, curtains, close grounds to the beds and bedroom corners. In 36 domiciles separate samples from the kitchen and storage areas were collected. The mites were separated from house dust by means of a Tullgren modified funnel, with direct slide preparations with Hoyer's solution being made (Flechtmann 1986). Species identification was based on the keys by Summers and Price (1970), Krantz (1978), Flechtmann (1986), Fain et al. (1990), Collof (1998).

The following indices were obtained: prevalence rate, sample positivity in distinct areas (chi-squared test), similarity of the acarofauna between two environments (similarity rate), number of mites in all domiciles (abundance rate), number of mites in the positive domiciles (infestation intensity), species frequency, dominance and diversity (dominance rate, parasite diversity rate and equitability), correlation between number of positive domiciles and climatic conditions and number of mites and climatic conditions, composed of relative humidity, temperature and rainfall (correlation).

RESULTS

Of the 160 domiciles studied, 124 were positive for mites, corresponding to a prevalence of 77.5%. Sector prevalence ranged from 60% in the southeast to 100% in the central region (Table I).

The prevalence rates for mite positive domiciles ranged from 47% in September to 100% in November (Table II). The correlations between the number of mite positive domiciles and the secular trend of relative humidity rainfall, and temperature were, respectively, 0.19, 0.42, and 0.50, i.e., correlation was low for relative humidity, appreciable for rainfall and high for temperature. The correlations between the same climatic conditions and the number of mites, however, were inverse, with -0.15 for rainfall, -0.004 for relative humidity and -0.09 for temperature, i.e., low or irrelevant levels.

Abundance rate for the municipality of Juiz de Fora was 9.56, ranging from 2.25 in the south to 17.20 in the central region. The infestation intensity was 12.34, ranging from 3.46 in the south to 17.89 in the west (Table I).

The overall number of specimens found was 2,278, of which 1,530 (67.2%) were in the adult stage

TABLE II

Number and monthly prevalence rates (PR) for mites in the domiciliary ecosystem in Juiz de Fora, State of Minas Gerais, Brazil, from 18 August 1999 to 14 January 2000

Months	Samples analyzed	Positive samples	PR (%)
August	29	23	79.3
September	17	8	47
October	24	21	87.5
November	23	23	100
December	22	21	95.5
January	45	28	62.2
Total	160	124	77.5

TABLE I

Number and prevalence rates (PR) for positive mite samples, as well as mite abundance index (AI) and meaninfestation intensity (MII) in samples from house dust, according to the sectors analyzed, in Juiz de Fora, State of Minas Gerais, Brazil, from 18 August 1999 to 14 January 2000

Sectors or district of Juiz de Fora	Samples analyzed no. (%)	Positive samples	PR (%)	AI	MII
North	20 (12.5)	13	65	5.25	8.08
Northeast	20 (12.5)	16	80	7.25	9.06
East	20 (12.5)	16	80	11.35	14.19
Southeast	20 (12.5)	12	60	8.9	14.83
South	20 (12.5)	13	65	2.25	3.46
West	20 (12.5)	19	95	17	17.89
Northwest	20 (12.5)	15	75	7.25	9.66
Center	20 (12.5)	20	100	17.2	17.2
Total	160 (100)	124	77.5	9.56	12.34

and were examined under microscopy. A total of 748 (32.8%) specimens were immature forms, with 644 (28.8%) nymphs and 104 (4.6%) larvae.

The major families present in the domiciliary ecosystem were Pyroglyphidae with 1,226 specimens (80.1%) and Glycyphagidae with 256 specimens (16.7%) (Table III). The relationship between the species found and positive domiciles can be seen in Table IV. The finding of 220 positive domiciles for one of the species is due to the fact that more than one species was found in the same domicile. *D. pteronyssinus* was responsible for 71.9% of all the adult mites found and for 89.8% of Pyroglyphidae species.

TABLE III

Adult mite absolute and relative frequency for family or superfamily, in the domiciliary ecosystem of Juiz de Fora, State of Minas Gerais, Brazil, from 18 August 1999 to 14 January 2000

Taxa	Absolute frequency	Relative frequency (%)
Pyroglyphidae	1,226	80.1
Glycyphagidae	256	16.7
Acaridae	25	1.6
Chortoglyphidae	3	0.2
Cheyletidae	13	0.8
Pseudocheyletidae	2	0.1
Dermanyssidae	4	0.3
Brachychtonoidea	1	0.07
Total	1,530	100

Despite the higher rates for some species such as *Dermatophagoides pteronyssinus*, *Blomia tropicalis* Bronswijck, Cook & Oshima, 1973, *Dermatophagoides farinae* Hughes, 1961, *Euroglyphus maynei* [Cooreman, 1950] and *Tyrophagus putrescentiae* [Schrank, 1781], the analysis of indices such as DR, PDR, Shannon's rate (Ish), and Eq point to a lack of dominance among the aforementioned species (Table V).

Comparison between positive samples of domicile dust and positive samples of kitchen dust was statistically significant (Chi squared 8.64 with 5% significance). The overall number of mites found in samples of kitchen dust was 49 (15.4%) specimens found in the dust of 36 domiciles analyzed, with 30 (61.2%) *D. pteronyssinus* and 15 (30.6%) *B. tropicalis* as the predominant species (Table VI). There was a low similarity rate (0.55) between species found in kitchen dust and those found in the domicile.

Difference between the urban area and the expanding urban area in the different sectors was significant. Species similarity rate between these two areas was 0.48, pointing to a lack of acceptable similarity.

DISCUSSION

House dust mites, which are irrefutably associated with allergic diseases, will, henceforth, be referred to as domiciliary ecosystem mites (DEM).

Humidity is the main factor limiting the growth and development mite populations. Osmoregula-

TABLE IV

Number and relative frequency of positive domiciles and mite specimens, for mite species, in Juiz de Fora, State of Minas Gerais, Brazil, from 18 August 1999 to 14 January 2000

Taxa	Positive domiciles	Relative frequency (%)	Number of mites	Relative frequency (%)
Dermatophagoides pteronyssinus	98	44.5	1,101	72
Dermatophagoides farinae	26	11.8	77	5
Euroglyphus maynei	22	10	48	3.1
Blomia tropicalis	40	18.2	247	16.1
Lepidoglyphus destructor	2	0.9	9	0.6
Chortoglyphus arcuatus	2	0.9	3	0.2
Tyrophagus putrescentiae	13	5.9	24	1.6
Suidasia pontificiae	1	0.4	1	0.065
Cheyletus malaccensis	4	1.8	4	0.3
Cheyletus fortis	2	0.9	4	0.3
Cheletonella caucasica	1	0.4	1	0.065
Cheletonella vespertilionis	1	0.4	1	0.065
Ker bakeri [a]	3	1.4	3	0.2
Pseudocheyletidae	2	0.9	2	0.1
Dermanyssidae	2	0.9	4	0.3
Brachychtonoidea	1	0.4	1	0.065
Total	220	100	1,530	100

a: Zaher & Soliman 1967

TABLE V

Parasite diversity index, dominance coefficient and equitability of the most frequent mite species in the domiciliary ecosystem in Juiz de Fora, State of Minas Gerais, Brazil, from 18 August 1999 to 14 January 2000

	Dp	*Df*	*Em*	*Bt*	*Tp*
Dominance coefficient	0,72	0,05	0,03	0,16	0,02
Parasite diversity index	2,96	2,18	2,88	2,79	2,51
Equitability	0,98	0,73	0,96	0,93	0,83

Dp: Dermatophagoides pteronyssinus; Df: Dermatophagoides farinae; Em: Euroglyphus maynei; Bt: Blomia tropicalis; Tp: Tyrophagus putrescentiae

TABLE VI

Number and frequency of mite species found in kitchen dust samples in Juiz de Fora, State of Minas Gerais, Brazil, from 18 August 1999 to 14 January 2000

Taxa	Number	Frequency (%)
Dermatophagoides pteronyssinus	30	61.2
Dermatophagoides farinae	1	2.04
Euroglyphus maynei	1	2.04
Blomia tropicalis	15	30.6
Tyrophagus putrescentiae	1	2.04
Ker bakeri	1	2.04
Total	49	100

tion is chiefly through the cuticle, requiring high levels of environment air humidity to prevent desiccation. DEM need an ideal environment temperature of around 25-30°C and a relative humidity of 75-80% for their growth (Bronswijk & Sinha 1971, Murray & Zuk 1979, Platts-Mills & Chapman 1987, Hart 1998). Thus, DEM prevalence varies in the literature according to different regions, being chiefly dependent on the climatic conditions (Turos 1979, Feldman-Muhsam et al. 1985). In Brazil, a 13.8% prevalence found in Araraquara, State of São Paulo, in a given season jumped to 88% in the rainy season (Bonini et al. 1988). Also in the State of São Paulo, 94% prevalence was reported in Cubatão (Baggio et al. 1988a) and 100% in Mogi das Cruzes (Antilla et al. 1988). In the Northeast of Brazil, Recife's metropolitan area presented a prevalence of 85% (Sarinho et al. 1996). Therefore, mesoclimatic conditions in Juiz de Fora can account for the 77.5% prevalence found in this study. These climatic conditions associated with discrete anthropic features of each sector are responsible for the distinct prevalence found among them. Because of its high population density associated with its altitude and climatic conditions, the central urban sector presented a 100% prevalence with the highest abundance rate (17.20) while the southeast sector, with opposite features, had the lowest prevalence (60%) (Table I). These factors also influenced abundance rate and infection intensity which were lower in the south sector (Table I).

The prevalence of positive domiciles in the different sampling months revealed important differences, ranging from 47% in September to 100% in November (Table II). Mean temperature, air humidity and rainfall during sampling were within the secular trend, being representative of the typical mesoclimatic conditions of Juiz de Fora. Though the method used did not quantify the population of mites, the homogeneous procedure during the six months of sampling allows us to point to a low, appreciable or marked direct correlation between the number of positive domiciles and rainfall, relative humidity and monthly temperature. The low direct correlation with relative humidity might be due to relatively constant high humidity levels in Juiz de Fora, always favouring the growth and development of mite populations. There was an inverse relationship between the climatic conditions and the number of mites found each month, ranging from low to negligible, i.e., the climatic conditions in this study affected more the increase in positive domiciles than an increase in the mite populations. It must be remembered that DEM, residing in protected sites in the house, are more directly influenced by microclimate. However, we know of no work evaluating DEM population fluctuations according to microclimatic conditions.

Our results reported *D. pteronyssinus* as the most frequent species, a finding reported from several studies carried out in Brazil (Mello et al. 1988, Bonini et al. 1988) and worldwide (Muncuoglu 1976, Feldman-Muhsam et al. 1985, Parada et al. 1988) wherever continuous humidity is present. On the other hand, *D. farinae* is extremely rare in such climatic conditions (Platts-Mills & Chapman 1987), with a tendency to predominate in areas which experience long dry periods (Wharton 1976). This probably accounts for the small number of *D. farinae* (77 specimens, 5.03%) in comparison with *D. pteronyssinus* during the period of the study (Table IV).

Another relevant species in tropical countries is *B. tropicalis* (Rosa & Flechtmann 1979, Geller et al. 1995, Sarinho et al. 1996, Tsai et al. 1998). If one takes into account the tropical climate of altitude of Juiz de Fora, the finding of *B. tropicalis* as the second most frequent species is not unexpected (Table IV). *Lepidoglyphus destructor* [Schrank, 1781], apparently not highlighted in Juiz de Fora, has been reported in literature as important in the sensitization of farmers or those dealing with grains (Wraith et al.

1979, Warren et al. 1983, Iversen & Pedersen 1990).

Of the two Acaridae species, the most frequent was *T. putrescentiae* (Table IV), responsible for sensitization in allergic patients (Green & Woolcock 1978). The other species, *Suidasia pontificiae* Oudemans, 1905, was an occasional finding in this study. This is an interesting finding if one considers that studies carried out in the city of São Paulo showed 81.9% positivity for this species in skin tests in the allergic population (Ambrozio et al. 1989). Our results allow to question the importance of this species as an allergenic factor in the city of Juiz de Fora.

The number of mite positive samples from the houses was significantly higer than the number of mite positive samples from the kitchens of the same houses. Despite this, the number of specimens found in the kitchen made up 15.4% of the overall number of specimens found in samples from these domiciles, with *D. pteronyssinus* and *B. tropicalis* as the predominant ones (Table VI). The kitchen is thus a habitat in the domiciliary ecosystem, with the potential of being a source for recolonization of the entire house. It is clear that failure to properly clean this environment may maintain populations that will recolonize the whole domiciliary ecosystem.

Several studies have shown Cheyletidae mites in domiciliary dust, chiefly *Cheyletus malaccensis* Oudemans, 1903 (Rosa & Flechtmann 1979, Croce et al. 1988, Parada et al. 1988, Baggio et al. 1988b) and *Cheyletus fortis* Oudemans, 1904 (Croce et al. 1988, Mello et al. 1988, Antila et al. 1990). We reported a great species diversity within this family in Juiz de Fora, despite a relatively small number of specimens (Table IV). *Cheletonella caucasica* Volgin, 1955 and *C. vestertilionis* Womersley, 1941 are being reported for the first time in the domiciliary ecosystem and in Brazil.

One specimen of the Brachychtonoidea superfamily, two of Pseudocheyletidae, four of Dermanyssidae families, and three *Chortoglyphus arcuatus* Troupeau, 1879 were also found in the dust samples (Table IV). These are also occasionaly reported in several studies (Mumcuoglu 1976, Galvão & Guitton 1986, Antila et al. 1990).

Dominance and parasite diversity rates and equitability did not show any marked predominance among the most frequent species, which may lead to sensitization directly or through cross reaction, with consequent allergic manifestations in susceptible individuals. We conclude that the relative importance of the various mite species should not be underestimated.

A statistically significant difference in the proportion of positive domiciles, greater in the urban area, was found; this is probably due to discrete climatic conditions in this area coupled with microclimatic factors such as ventilation, housing types, household size and some population habits. Considering the strong rural features of the expanding urban area of Juiz de Fora, this finding differed from that of Turos (1979), who reported a larger prevalence of mites in dust from farms.

The specific features of the acarofauna of the domiciliary ecosystem of Juiz de Fora emphasizes the need for testing and treatment of patients with locally present antigen of the species. Because several studies have shown the importance of the various species we reported (mainly *D. pteronyssinus, D. farinae, E. maynei, B. tropicalis, L. destructor, T. putrescentiae*) as causative agents of respiratory allergic diseases, future investigations about the immunologic responses of local patients to these antigens are warranted.

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