

OCCURRENCE AND SPECIES COMPOSITION OF THE DOMESTIC MITES IN SIX EGYPTIAN GOVERNORATES

By

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Abstract

Domestic mites, the combined group of household-living storage mites and pyroglyphid house-dust mites, belong to subclass Acari. Identifying mites to species level help to improve the management of their allergies as they produce species-specific allergens. Knowledge of the impact of the diverse and changing ecological conditions in the home environment is useful in developing strategies to avoid the development and growth of large populations of domestic allergic mites. This study identified domestic mite's species in six Egyptian Governorates. The dust samples were collected from the HDM allergic patients for identification and seasonal distribution. From 120 samples, seven species were identified: *Dermatophagoides farinae* (69.4%), *D. pteronyssinus* (55.5%), *Tyrophagus* spp. (38.8%), *Blomia tropicalis* (30.5%), *Cheyletus* spp. (13.8%), *Euroglyphus maynei* (5.5%), and *Tarsonemus* spp. (5.5%). The highest positive samples were in Qalyobia Governorate (73.7%) and lowest in Cairo Governorate (33.3%). Highest number of mites was in spring and autumn seasons, and *D. farinae* was the commonest one.

Keywords: Egypt, *Dermatophagoides*, *Tyrophagus*, *Blomia*, and seasonal variation.

Introduction

House-dust mites are the major source of the allergens in house dust. They have adapted to living in or around human habitations such as houses and storage facilities for grain and hay (Johnston *et al*, 2018). They are members of the family *Pyroglyphidae* of which *Dermatophagoides farinae* (*D. farinae*) and *D. pteronyssinus* were the most significant ones. The storage mites belonged to Astigmata families, often found in grains, hay, and straw (Colloff, 2009). Environmental factors as temperature, humidity, and ecology influenced mites' growth and prevalence (Casley *et al*, 2018).

Domestic mites (HDM) cause different allergic conditions as sneezing, runny nose, itchy, red or watery eyes, stuffy nose, itchy nose, itchy skin and mouth or throat as well as cough (Attia *et al*, 2019). The sensitizing and developing allergic symptoms are particularly in children and immuno-compromised (Soleimani-Ahmadi *et al*, 2017). The pyroglyphid mites account for >90% of the mite population in doors (Saad *et al*, 2006). House dust mites and their complications were reported among man and domestic animals in many Egyptian Governorates such

as Qalyobia (Morsy *et al*, 1994), Suez Canal Zone (El-Kady *et al*, 1995), Dakahlia (El-Shazly *et al*, 2006), South Sinai (El-Kady *et al*, 1998), North Sinai (El-Sherbiny *et al*, 2010), Alexandria (Sadaka *et al*, 2000), Cairo (Kenawy *et al*, 2012), Menoufia (El Kersh *et al*, 2016), and Sohag (

This study aimed to determine the domestic mite species composition by using light and electron microscopy and to study their indoors seasonal variations in allergic patient's in six representative Egyptian Governorates (Cairo, Qalyobia, Menoufia, Dakahlia, Sharkia, and Menia).

Materials and Methods

Collection of house dust samples: A total of 120 dust samples were collected from 60 mites infested houses with patients suffered from allergic rhinitis, allergic dermatitis and/or asthma over the period from August 2018 to November 2019. Dust samples were collected seasonally in separate labelled bags. The studied population was asked to bring two dust samples from different areas of their houses using a vacuum cleaner. The second sample was considered as a replicate. Dust samples were collected from the bedrooms, mattresses, floor, bedding, living room

ms, and kitchens. One square meter of each place was vacuumed for 2-3 min. Collected dust was kept inside a disposable plastic bag and carefully tied. Collected dust was stored at 4°C to avoid mites escaping by decreasing their motility and transferred to the laboratory within 24hr in separate labelled bags.

Examination of dust samples: The samples were sieved through a stainless-steel mesh screen (6 cm diameter, 500 µm pore size) to remove large particles and fibres, mites were extracted from sieved dust samples using Berlese funnels. Fifty grams of a sample of dust was placed on the stainless-steel sieve 20cm diameter. The funnel was placed directly under a light bulb (25 V) fixed 7cm above the sieve containing dust for half an hour to be separated in a glass Petri-dish (10cm) and then examined under a stereomicroscope 10 x & 30x. Four samples of 1gm each were examined for mites and counted per site and species. Each identified species was isolated in a separate glass Petri dish with the aid of a needle tip (Heikal, 2015).

Identification of mites: A-The temporary preparation method: For more accurate identification, isolated dust mites were mounted on glass slides in a drop of 70% ethanol, and examined directly under a research microscope (100x & 400x) and identified adopting the standard keys (Colloff, 2009). B- SEM identifications: Mites were removed from the collected dust using a needle tip and transferred to Glutaraldehyde after that, they were dehydrated by washing for 15 min in a graded series of ethanol (40%, 50%, 60%, 70%, 80%, & 90%) and absolute ethanol. The mites were then dried to a critical level, before being mounted and placed on platforms prepared with adhesive tape, coated with gold and examined through a The FEI ESEM Quanta 450 FEG 501 SEM using accelerating voltages of 15 & 30 KV, at the National Research Centre, Dokki, Giza.

Statistical analysis: Data analysis was performed using the software SPSS version 20. Statistical presentation and analysis of the present study were conducted, using the me-

an, standard deviation, and Kruskal-Wallis test.

Results

Morphology and classification: A mite has a tiny oval or globular body (0.2-0.4mm), bilaterally symmetrical body, and covered with a tough translucent cuticle, white to light tan coloured. Cuticle striated, and long setae (hairs) to outer body margins and shorter setae on rest of body. Adult with four pairs of legs, each end with a pair of claws and mouth parts protruded anteriorly forming capitulum armed with chelicerae. Mite body consists of three main parts: gnathosoma carried mouthparts, propodosoma carried forelegs, and hysterosoma carried hind-legs and external adult sexual organs. Body and legs covered with many setae of various sizes, structures, and functions.

The dust mites were isolated from 72/120 (60%) samples from houses in different areas six governorates. Qalyobia showed the highest rate (73.7%), and Cairo the lowest one (33.3%). The recovered house dust mites were *Dermatophagoides farinae*, *D. pteronyssinus* and *Euroglyphus maynei* of family Pyroglyphidae (Wharton, 1976).

Storage mites were *Tyrophagus putrescentiae* of family Acaridae and *Blomia tropicalis* of family Echymyopodidae and *Cheyletus* spp. of family Cheyletidae and *Tarsonemus* spp. of family Tarsonemidae (Hughes 1976).

The majority of dust samples contained different mite species, but some samples showed only one mite type. *D. farinae* was predominant 50/72 (69.4%) isolated from all samples, which accounted for 45.4% of the total mites. Other species as *Cheyletus* spp. and *Tarsonemus* spp. were sporadic isolated (< 1% of total mites).

Mites' seasonal distribution from six governorates on years 2018/2019 showed significant difference in all collections ($p \leq 0.05$). Pyroglyphidae species were the lowest in summer and the highest in spring and autumn. Species of families Echymyopodidae, Acaridae, Cheyletidae & Tarsonemidae were statistical highest in spring, but rare in winter.

The details were given in tables (1, 2, & 3) and figures (1, 2, 3, 4, & 5).

Table 1: Domestic mites in collected dust from six Governorates in Egypt

Governorate	Number of samples	Number of positive domestic mite samples (%)
Cairo	12	4 (33.3%)
Menia	12	6 (50%)
Menoufia	26	16 (61.5%)
Qalyubia	30	22 (73.7%)
Sharkia	22	14 (63.6%)
Dakahlia	18	10 (55.5%)
Total	120	72 (60%)

Qalyubia showed highest rate (73.7%), and Cairo lowest (33.3%)

Table 2 Identification and population density in one gram of dust samples over four / year:

Type of mite	Total No. of mites	Species composition (%)
Pyroglyphidae: <i>Dermatophagoides farina</i>	3056	45.4%
: <i>D. pteronyssinus</i>	1312	19.5%
: <i>E. maynei</i>	142	2.1%
Echymyopodidae: <i>Blomia tropicalis</i>	836	12.42%
Acaridae: <i>Tyrophagus putrescentiae</i>	1336	19.84%
Cheyletidae: <i>Cheyletus malaccensis</i>	40	0.6%
Tarsonemidae: <i>Tarsonemus</i> spp.	10	0.14%
Total	6732	100 %

Predominant species *D. farinae* and least one *Tarsonemus* spp.

Table 3: Population density of dust mites in one-gram dust collected from houses at 2018/2019-year seasons:

Type of mite	Winter	Spring	Summer	Autumn	H value	P value
<i>D. farinae</i>	45±4.4	82.6±6.7	27±3.6	76.7±7.5	16.6314	0.008*
<i>D. pteronyssinus</i>	25.6±6.8	49±4.9	14.6±3.8	42±5.9	17.8571	0.0047*
<i>E. maynei</i>	7.3±2.5	9.3±2.5	4±3.6	8.6±4.2	15.7886	0.0125*
<i>Blomia tropicalis</i>	6±6.5	33.4±6.6	28.2±5.8	20±7.7	17.8571	0.0047*
<i>Tyrophagus putrescentiae</i>	15.8±5.3	54.6±5.8	36.6±6.5	33±11.5	17.7171	0.005*
<i>Cheyletus malaccensis</i>	0.75±0.95	8.2±1.25	5.5±2.1	3.5±1.3	17.3314	0.006*
<i>Tarsonemus</i> spp.	00±00	2.25±1.3	1.0±0.8	0.5±0.58	13.3743	.0038*

All data represented as Median and SD. Kruskal-Wallis Test was used. * $p \leq 0.05$ was significant.

Discussion

In the present study, 72(60%) of collected dust samples were positive for domestic mites. Seven species of five families were isolated from the house dust collected from 60 houses of mites' allergic patients from in the six governorates. These mites in descending order of abundance were *Dermatophagoides farinae* (45.4%), *Tyrophagus putrescentiae* (19.8%), *D. pteronyssinus* (19.5%), *Blomia tropicalis* (12.42%), *Euroglyphus maynei* (2.1%), *Cheyletus* spp. (0.6%) and *Tarsonemus* spp. (0.14%).

These mites species were reported from some Egyptian Governorates such as Gharbia (Gamal-Eddin *et al*, 1982; 1985), Menia (Gamal-Eddin and Shoker 1989), Sharkia (Gamal-Eddin and El-Besheir, 1990), South Sinai (El-Kady *et al*, 1998), Cairo (Koraieim and Fahmy, 1999; Yassin, 2011; Kenawy *et al*, 2012), Alexandria (Sadaka *et al*, 2000), Dakahlia (El-Shazly *et al*, 2006) and North Sinai (El-Sherbiny *et al*, 2010). Also, Saleh

et al. (2013) in a hospital recovered mites from allergic patients and nursing staff and considered mites allergy occupational safety or source of work-related allergens.

In the present study, *D. farinae* was the predominant species in all samples examined. This agreed with Kenawy *et al.* (2012) who reported that in Cairo Governorate, *D. farinae* (80%) was the dominant one. Also, Hossny *et al.* (2014) found that *D. pteronyssinus* and *D. farinae* were the most prevalent species among mites' allergic children. Besides, Heikal (2015) found that in Menoufia Governorate, *D. farinae* mites (5276) represented 66.1% of total collected mites

Abroad, Warner *et al.* (1999) in Sweden reported that *D. farinae* numbers collected from three climatic regions homes were more than that of *D. pteronyssinus* and their density increased in homes with high humidity and was higher in bungalows than in the flats. Sopelete *et al.* (2000) and Nascimento *et al.* (2016) in Brazil reported a higher pre-

valence of *D. farinae* than *D. pteronyssinus*. They added that humid indoor conditions and availability of blankets and clothes encourage a favourable climate for HD mites' growth during humid seasons. Milián and Díaz (2004) reported that *D. pteronyssinus* was found primarily in high relative humidity (>45%) and warm temperatures around the world, from 18 to 30°C, but *D. farinae* was mainly found in dry continental climates, rare in coastal climates such as the Mediterranean. Sharma *et al.* (2011) in India reported that mites in the dust samples varied from place to another due to the difference in structure, houses' age, individual status, type of furniture and difference in microclimate conditions that lead to the increased accumulation of mites in home dust. Soleimani-Ahmadi *et al.* (2017) in Iran reported that *D. pteronyssinus* (31.06%), *D. evansi* (23.49%), *D. farinae* (17.75%), *Ornithonyssus bacoti* (19.45%), and *Cheyletus malaccensis* (8.25%), were the main allergenic dust mite species *D. pteronyssinus* and *D. farinae* co-inhabited and collected from all kindergartens. Wilson and Platts-Mills (2018) in USA stated that dust mite allergy contributed to asthma worldwide, and long-term avoidance could be effective for preventing sensitization and minimizing development and severity of respiratory disease. Miller (2019) in USA reported that the major allergenic dust mites *D. pteronyssinus*, *D. farinae*, *Euroglyphus maynei*, and *B. tropicalis* were eight-legged members of class Arachnid.

Thus, in the current study the high frequency of *D. farinae* was due to a moderately hot climate in Egypt and low frequency of *D. pteronyssinus* was attributed to unfavourable environmental conditions of relatively low humidity.

In the present study, seasonal variation affected mite populations; Pyroglyphidae mites were more abundant during the spring and early autumn, and the least Pyroglyphidae mites' number was in summer season. As to mites of families Echympodidae, Acarid-

ae, Cheyletidae, and Tarsonemidae the highest numbers were during spring season and the least was in the winter. This agreed with Heikal (2015) in Menoufia Governorate, where the summer recorded the least Pyroglyphidae mite number, but spring and autumn yielded the highest mite numbers. Also, Ahmed *et al.* (2020) in Menia Governorate reported the highest storage mite density in spring and the lowest was in winter.

Abroad, Feng *et al.* (2009) in china reported that the worldwide seasonal variation of domestic mite species showed diverse patterns, based on varying temperature, humidity, and food availability. Nascimento *et al.* (2016) in Brazil found that the coldest seasons yielded largest dust mite populations, but summer showed least abundance.

Shafique *et al.* (2018) in Pakistan reported that *D. farinae* and *D. pteronyssinus* were significantly higher in rainy summer season. Winter *et al.* (2018) in Germany, stated that the global change processes affect seasonal dynamics of salt marshes and thereby their plant and animal communities. But, these changes have been little investigated for microarthropod communities.

Conclusion

Seven known species of domestic mites were recovered from the six surveyed governorates. These were in a descending order of abundance; *Dermatophagoides farinae*, *D. pteronyssinus*, *Tyrophagus* spp., *Blomia tropicalis*, *Cheyletus* spp., *Euroglyphus maynei*, and *Tarsonemus* spp. The *D. farinae* was the commonest one in the studied areas. The mite allergens indoor was high in cool months with heavy clothes and blankets.

No doubt, exposure of the furniture to sun and careful cleaning of indoors and avoiding pet animals is a must. Clinical pictures from mite sensitization and exposure include rhinitis, sinusitis, conjunctivitis, asthma, and atopic dermatitis. However, these allergic symptoms can also occur from the ingestion of cross-reacting invertebrates, such as shrimp or snail, or from the accidental ingestion of mite-contaminated foods.

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Authors' contributions: All authors equally contributed in the field and laboratory activities as well as manuscript revision and approval.

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Explanation of figures

P.1: Domestic mites in house dust (adults) showed a- *Tarsonemidae* spp female with modified long legs IV with 2 apical setae without claw (400x). b & c- *Tyrophagus putrescentiae* with dorsal transverse groove (400x). (d) *Blomia tropicalis*, globular shape mite with long dorsal setae (100x) & e- Pyroglyphidae with finger- print striations pattern.

Fig 1: SEM images of *Tyrophagus putrescentiae* adult dorsal view highlighting idiosoma with a smooth cuticle. Idiosomal setae: internal and external scapular (sci & sce, respectively), dorsal (1, 2, 3, & 4) with interior & exterior vertical setae (vi & ve). Idiosomal dorsal setae (1 & 4) short and vi & ve at anterior body end on propodosoma to chelicerae tip, with ve unequal to vi). Solenidion(s), arrow showed hollow, blunt-tipped structures.

Fig 2: SEM images of *D. farinae* female dorsal view showed idiosoma with a transverse striation in anterior half and convex or oblique striations in posterior one. Idiosomal setae, sce much longer than sci without vertical setae. Tarsi I & II with large apical spine, and solenidia (S) on tarsus I at distal end of segment.

Fig 3: SEM images of *Euroglyphus maynei* female ventral view showed coarse body striations, vulva & arched epigynum with lateral margin curved (arrow), P= pulvillus.

Fig 4: SEM images showed *Cheyletus* spp. gnathosoma with enlarged palps with an apical claw.

Fig 5: Seasonal variation among dust mite population in one-gram dust. All data represented as Median

