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House Dust Mite Species in Ordu Province, Turkey

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ABSTRACT

House dust mites inhabit human houses, causing allergies and respiratory disease. Of them pyroglyphid mites produce at least 23 allergen groups, affecting millions of people worldwide. We determined the house dust mite fauna in the city of Ordu situated on the Black Sea coast of Turkey. Dust samples were taken from a total of 53 houses in 2013-2015. The mite family Pyroglyphidae had the highest abundance in our samples, followed by family Chortoglyphidae. The most common species were *Dermatophagoides pteronyssinus* (Trouessart) and *Dermatophagoides farinae* Hughes (Astigmata: Pyroglyphidae). These two mite species are main allergen-producing species throughout the world, occurring in all sampled houses in the city of Ordu.

Keywords: Acari; House dust mites; Allergy; *Dermatophagoides pteronyssinus*; *Dermatophagoides farinae*

1. Introduction

House dust contains many organic and inorganic materials causing allergies. The most important one is the dust mites (Fassio & Guagnini 2018). The common families of mites observed in house dust belong to the families Pyroglyphidae, Glycyphagidae and Acaridae (Kosik-Bogacka et al 2010). However, actually, the term "house dust mite (HDM)" is usually used for *Dermatophagoides pteronyssinus* (Trouessart), *D. farinae* Hughes, and *Euroglyphus maynei* (Cooreman) (Astigmata: Pyroglyphidae). Furthermore, the most common and effective HDM allergens are Der p, from *D. pteronyssinus* exposure and Der f, from *D. farinae* exposure (Vidal-Quist et al 2015). The allergenic features of HDMs are caused by their feces and their body tissues. Over time, mite feces and body-tissue residues from their fragmentation after death accumulate in carpets, fabric-covered furniture, fuzzy toys, mattresses, and pillows. These allergens remaining suspend in air for a time and mix with air taken into the respiratory track, thereby stimulating immune-system elements (Zeytun et al 2018).

HDMs were first suspected as a source of allergen in 1928 and have been recognized as an important cause of allergic disorders since 1964 (Voorhorst et al 1964). To date, numerous faunistic studies in many countries including Turkey have been conducted on HDMs that are thought to play a role in the pathogenesis of several allergic diseases, including allergic rhinitis, allergic asthma, allergic dermatitis, and allergic conjunctivitis (Ree

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et al 1997; Chew et al 1999; Mariana et al 2000; Nadchatram 2005; Boquete et al 2006; Henszel et al 2010; Kosik-Bogacka et al 2010; Solarz 2010; Catanghal & Paller 2012; Sun et al 2013; Sun et al 2014; Gill & Kaur 2014; Heikal 2015; Yu et al 2015; Ziyaei et al 2017). There are also reports on HDMs in several cities in Turkey: İzmir (Gülbahar 2003), Konya (Aldemir & Baykan 2004), Kütahya (Akdemir & Gürdal 2005; Akdemir & Soyucen 2009; Akdemir & Yılmaz 2009), Malatya (Atambay et al 2006), Afyon-Usak, Isparta-Kütahya-Denizli (Çiftçi et al 2006), Eskişehir (Doğan et al 2008), Samsun (Çelik 2009; Çelik & Ozman-Sullivan 2009), Kayseri (Hasgül 2011; Kılınçarslan 2012), Muş-Bitlis (Aykut et al 2013), five regions of Anatolia (Kalpaklioglu et al 1997). In Ordu province, there are no records of mites in house dusts except for Akyazı et al (2018). However, Akyazı et al (2018) studied the seasonal changes in the populations of the HDM in five houses in the Ordu central district between 2013 and 2015. In this research, the mite species were listed resulted from surveys carried out in 53 houses in Ordu province except for the five above-mentioned houses.

Ordu is situated on the Black Sea coast of Turkey, which has a very humid climate. HDMs thrive in warm, humid environments (Arlian 1992). High humidity in coastal cities can facilitate mould growth and proliferation causing a range of respiratory and dermatological allergies (Bornehag et al 2004). Thus, our general hypothesis is that Ordu, being a coastal city, has a rich HDM fauna. This study was carried out to survey HDM fauna of the city of Ordu in 2013-2015.

2. Material and Methods

2.1. Study area and houses

This study conducted in randomly selected 53 houses in the city of Ordu province situated on the Black Sea coast of Turkey (Figure 1).

The mean annual temperatures (±SD) were 15.6 (±6), 16.11 (±6) °C and 15.47 (±6) °C, the mean annual relative humidities (±SD) were 67.70 (±4) %, 69.80 (±4) % and 69.86 (±3) % and the total rainfall estimates (±SD) were 978.4 (±49), 985 (±54) mm and 1059 (±50) mm in 2013, 2014 and 2015 in Ordu province, respectively.

During the sampling period of the study, the mean monthly temperatures (±SD) were 22.9±2.0 °C, 24±2.0 °C and 23.7±2.0 °C, the mean monthly relative humidities (±SD) were 67.7±2%, 68.8±1% and 70.5±3%, the mean monthly rainfall estimates (±SD) were 64±26, 86±30 and 46.2±25 mm in 2013, 2014 and 2015, respectively. The annual and monthly temperature, relative humidity and rainfall estimates were obtained from Ordu Meteorological Station.

2.2. Dust collection methods

Dust samples were obtained between July and August of each year (2013-2015). Because, the dust mite population was generally higher during these months in Ordu (Akyazı et al 2018). House dust samples were taken from beds (pillows, quilts, sheets, and mattresses), carpets, floor of bedrooms and furniture, carpets and floor of living rooms in each home. Samples were collected with a portable vacuum cleaner (Rowenta RO582301, 2200 W-Silent Force Extreme) for 2 minutes per 1 m^2 (Ozman-Sullivan & Celik 2010).

A new bag for each vacuuming was used. In addition, subtracting hoses and mouthpieces of the vacuum cleaners were cleaned before each vacuuming to prevent any possible contamination. After each vacuuming, the dust bag was taken out,

Figure 1- A map showing the city of Ordu in Turkey (from Google Maps)

placed in a plastic bag and brought to the laboratory for analysis (Wassenaar 1988). Dust samples were stored in a refrigerator at 4 ºC to prevent proliferation of mites, and the samples were examined within 24h.

One dust sample per house was taken for analysis. A total of 53 dust samples were collected from randomly selected 53 houses during the study.

2.3. Extraction and preparation of mite specimens

Mites were isolated from 1 g fine dust sample by a wet-sieving method adapted from Natuhara (1989). The mites within the samples were isolated immediately. Isolated mite specimens were stored in 70% alcohol. Specimens were cleared in Lacto-phenol and mounted in Hoyer on microscope slides and dried for 5-7 days in an oven at 50 °C according to the method of Krantz & Walter (2009).

The mean number of mites per gram of dust, percentage and incidence rates of each species detected during the sampling period were calculated as follows (Yu et al 2015).

The mean number of mites per gram of dust= Total number of isolated mite/Number of mite positive house (Zeytun et al 2015)

Percentage of each species (*%= (Number of each mite species/Total number of isolated mite*)×100) (Yu et al 2015)

Incidence of each species (*%= (Number of positive house for each species/Total number of sampled houses*)×100) (Yu et al 2015)

2.4. Identification of mite specimens

Mite species were identified under a light microscope (Leica DM 2500, Heerbrugg, Switzerland) equipped with phase contrast. Identification of mites at the species level was performed using the available keys, some relevant books and papers such as Fain et al (1990); Zhang (2003); Nadchatram (2005); Colloff (2009); Krantz & Walter (2009); Solarz (2010); Solarz et al (2016). Mite specimens were deposited in the Mite Collection at the Ordu University, Agricultural Faculty, Plant Protection Department, Ordu, Turkey.

3. Results and Discussion

A total of 53 dust samples from 53 houses were collected during the study and all of samples were found to be mite-positive. Çelik (2009) in Samsun, Aykut et al (2013) in Bitlis-Muş and Zeytun et al (2016) in Erzincan houses also found all examined dust samples to be positive for the mites. In other cities, the mite-holding rates of houses were 57.66% in Konya (Aldemir & Baykan 2004), 57.5% in Hatay (Gülkan 2004), 34.38% in Bursa (Güleğen et al 2005), 46.3% in Malatya (Atambay et al 2006), 23.1% in western Anatolia (Afyon, Uşak, Isparta, Kütahya, and Denizli) (Çiftçi et al 2006), 74.49% in the Aegean Region (Budak & Özbilgin 1988), 16.67% in Eskisehir (Doğan et al 2008), 18.05% (Akdemir & Gürdal 2005) - 31.7% (Akdemir & Yılmaz 2009) in Kütahya, 56% in Muş (Hasköy) (Aykut & Yılmaz 2010), 39.47% in Kayseri (Hasgül 2011), 94.44% (Zeytun et al 2015) and 98.5% (Zeytun 2015) in Erzincan. Kosik-Bogacka et al (2010) identified dust mites in 30% of urban and 53% of rural samples in West Pomerania in northwestern Poland. The infestation rate of homes in Singapore (Chew et al 1999), India (Patiala City, Punjab) (Gill & Kaur 2014) and Xishuangbanna, a tropical rainforest region in Southwest China, (Yu et al 2015) were 97%, 88%, 97.5%, respectively.

During the study, a total of 694 mite specimens in various development stages were collected; 89.19% adults (60.09% females, 29.11% males), 9.51% tritonymphs, 1.15% protonymphs, and 0.14% larvae (Table 1). Mean number of the mites per gram was found as 13.09 mites with minimal 3 mites g^{-1} dust and maximal 48 mites g^{-1} dust.

During the study, a total of 11 different species were detected. Seven of which are identified to species level with respective of predominancy of *Dermatophagoides pteronyssinus* (508, 73.2%), *Dermatophagoides farinae* (136, 19.6%), *Chortoglyphus arcuatus* (27, 3.89%), *Glycyphagus domesticus* (7, 1.01%), *Euroglyphus maynei* (2, 0.29%), *Lepidoglyphus destructor* (2, 0.29%), *Haplochthonius simplex* (2, 0.29%). However, 10 specimens were identified only to the genus level

as *Dermatophagoides* sp. (7, 1.01%), *Rhizoglyphus* sp.1 (1, 0.14%), *Rhizoglyphus* sp. 2, (1, 0.14%) and *Tyrophagus* sp. (1, 0.14%). All of isolated mites belonged to 5 families and 8 genera. The family Pyroglyphidae (94.09%) occupied the highest percentage of the total amount of mites collected, followed by Chortoglyphidae (3.89%), Glycyphagidae (1.30%), Acaridae (0.43%), and Haplochthoniidae (0.29%) families, respectively (Table 1).

D. pteronyssinus (Figure 2) was detected to be the most common (92.45%-49/53) and predominant (73.2% of total mites) species in the houses. While many researchers detected *D. pteronyssinus* as the most common species in house dust samples around the world, its rate was variable in different cities or countries (Çiftçi et al 2004; Gülbahar et al 2004; Gülkan 2004; Güleğen et al 2005; Atambay et al 2006; Boquete et al 2006; Doğan et al 2008; Çelik 2009; Aykut & Yılmaz 2010; Aykut et al 2013; Zeytun et al 2016; Soleimani-Ahmadi et al 2017; Wahongan et al 2017; Zeytun et al 2017a; Ziyaei et al 2017; Dutra et al 2018; Goutam 2018; Kaur & Dhingra 2018; Navarro-Locsin & Lim-Jurado 2018; Shafique et al 2018). In contrast, the most common mites were *Tarsonemus* sp., *Blomia* sp. and *Acarus siro* in Kayseri (Kılınçarslan 2012), and *T. putrescentiae* in Kütahya (Akdemir & Gürdal 2005). While the mite-holding rates of houses in Kayseri was 39.47%, the rate of *Dermatophagoides* sp. was just 8.2% (Hasgül 2011). Moreover, the most common species was *Acarus siro* (55.55%) in Erzincan (Zeytun et al 2015). However,

Table 1- Mite species found in house dust samples in Ordu city (Black Sea cost, Turkey) in 2013-2015 (TN, Tritonymph; PN, Protonymph; L, Larva)

Species	*House number (n: 53)*	*Incidence in houses (%)*	*Number of isolated mites*						*Percentage (%)*
			♀	♂	*TN*	*PN*	*L*	*Total*	
Astigmata									
Pyroglyphidae	53	100.00	392	188	64	8	1	653	94.09
Dermatophagoides pteronyssinus (Trouessart)	49	92.45	339	129	38	1	1	508	73.20
Dermatophagoides farinae Hughes	35	66.04	49	54	26	7	0	136	19.60
Dermatophagoides sp.	2	3.77	2	5	0	0	0	7	1.01
Euroglyphus maynei (Cooreman)	2	3.77	2	0	0	0	0	2	0.29
Acaridae	3	5.66	2	0	1	0	0	3	0.43
Rhizoglyphus sp. 1	1	1.89	0	0	1	0	0	1	0.14
Rhizoglyphus sp. 2	1	1.89	1	0	0	0	0	1	0.14
Tyrophagus sp.	1	1.89	1	0	0	0	0	1	0.14
Glycyphagidae	4	7.55	6	2	1	0	0	9	1.30
Lepidoglyphus destructor (Schrank)	1	1.89	2	0	0	0	0	2	0.29
Glycyphagus domesticus (De Geer)	3	5.66	4	2	1	0	0	7	1.01
Chortoglyphidae	7	13.21	15	12	0	0	0	27	3.89
Chortoglyphus arcuatus (Troupeau)	7	13.21	15	12	0	0	0	27	3.89
Oribatida									
Haplochthoniidae	1	1.89	2	0	0	0	0	2	0.29
Haplochthonius simplex (Willmann)	1	1.89	2	0	0	0	0	2	0.29
Total			417	202	66	8	1	694	100
			60.09	29.11	9.51	1.15	0.14		100

it is reported that *D. pteronyssinus* is the predominant species in studies carried out in 2016, 2017, and 2018 in Erzincan province (Zeytun 2015; Zeytun et al 2016; Zeytun et al 2017a, Zeytun et al 2018). Chew et al (1999) in Singapore and Mariana et al (2000) in Malaysia found that *Blomia tropicalis* was the most common mite followed by *D. pteronyssinus*. *D. pteronyssinus* was also the second common species (39.8%) in the southern part of Poland (Solarz 2010).

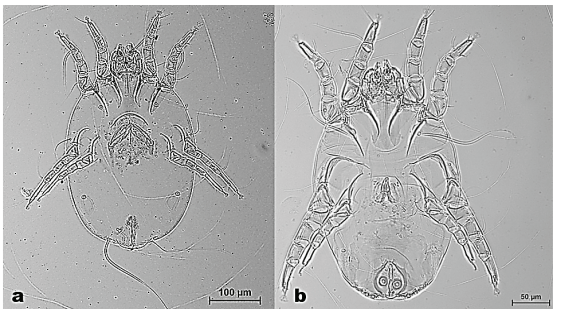

Figure 2- *Dermatophagoides pteronyssinus*; female (a) and male (b)

D. farinae (Figure 3) was the second most common species (66.04%) in Ordu homes such as in Izmir (Gülbahar et al 2004), Hatay (Gülkan 2004) and Erzincan (Zeytun et al 2017a) provinces in Turkey. Lower rates of *D. farinae* were detected in dust samples collected in Samsun (3.77%) (Çelik 2009), Bursa (4.16%) (Güleğen et al 2005), western Anatolia (0.7%) (Çiftçi et al 2006), Erzincan (3.67%) (Zeytun 2015), (2.1-7.5%) (Zeytun et al 2016) in Turkey. On the other hand, there was no *D. farinae* in any house in Malatya (Atambay et al 2006), Kütahya (Akdemir & Soyucen 2009), Eskişehir (Doğan et al 2008), Muş (Haskoy) (Aykut & Yılmaz 2010) and Afyon (Çiftçi et al 2004). From other countries, in India (Gill & Kaur 2014 (88.63%); Goutam 2018), Iran (98%) (Ziyaei et al 2017) and Philippines (95.8%) (Navarro-Locsin & Lim-Jurado 2018), *D. farinae* was also detected to be the second most common species (Gill & Kaur 2014; Ziyaei et al 2017). In contrast, the most common species was *D. farinae* in Korea (Ree et al 1997), Poland (Henszel et al 2010; Kosik-Bogacka et al 2010; Solarz 2010), Philippines (Los Banos, Laguna) (Catanghal & Paller 2012), China (Beijing) (Sun et al 2013; Sun et al 2014), Egypt (Shebin El-Kom Locality) (Heikal 2015), China (Xishuangbanna) (Yu et al 2015). Lower rates of *D. farinae* were detected in Malaysia (Klang Valley) (0.5%) (Chew et al 1999), Spain (Galicia) (5.2%) (Boquete et al 2006), India (Punjab) (7.1%) (Kaur & Dhingra 2018).

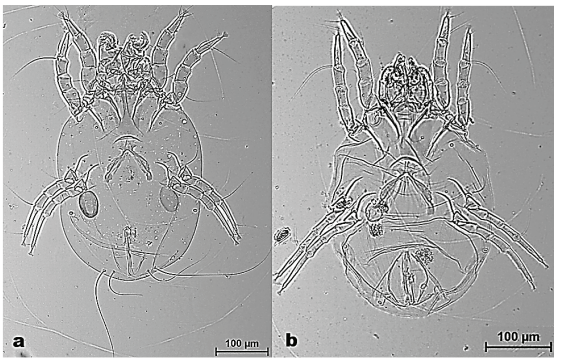

Figure 3- *Dermatophagoides farinae* females; dorsal (a), ventral (b)

Here, we report intermediate and heteromorphic males in *D. farinae* (Figure 4). According to Solarz et al (2016), heteromorphic males differ from normal homeomorphic by the thickening of the legs I and fusion of the epimera I to form a V or Y (with a sternum). The degree of thickening or fusion of epimera I may vary according to individuals in the same population. Mite species have been found in varying rates in numerous studies from our country and abroad.

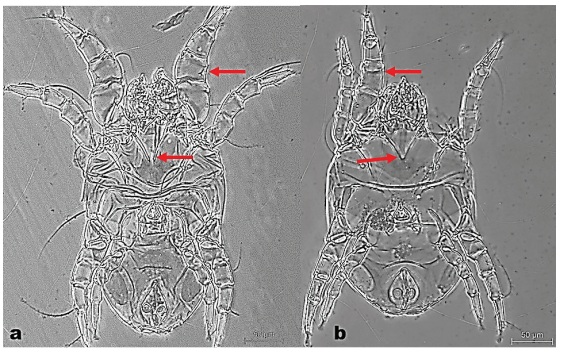

Figure 4- *Dermatophagoides farinae* male; intermediate (a) and heteromophic (b) form

Chortoglyphus arcuatus (Figure 5) was the third most common species (13.21%). It was found in varying rates in numerous studies from our country and abroad (Gülkan 2004; Çiftçi et al 2004; Atambay et al 2006; Boquete et al 2006; Çiftçi et al 2006; Doğan et al 2008; Aykut & Yılmaz 2010; Henszel et al 2010; Kosik-Bogacka et al 2010; Aykut et al 2013; Sun et al 2014; Heikal 2015).

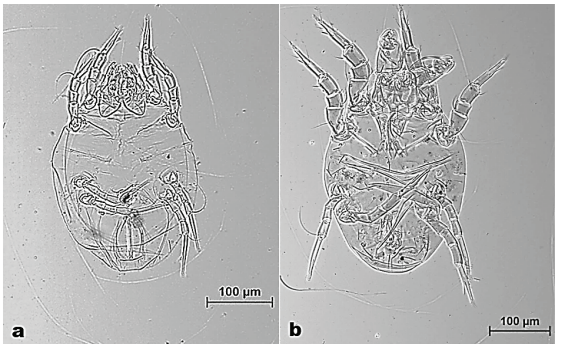

Figure 5- *Chortoglyphus arcuatus* female (a), male (b)

In our study, another species in dust samples was *G. domesticus* (5.66%) (Figure 6). Same species was found in Kütahya (2.58%, 23%, 3.33-3.48%) (Akdemir & Gürdal 2005; Akdemir & Soyucen 2009; Akdemir & Yılmaz 2009, respectively), Bursa (12.50%) (Güleğen et al 2005), Bitlis-Muş (1.3%) (Aykut et al 2013), Erzincan (0.06%) (Zeytun 2015) from Turkey and in Spain (10.4%) (Boquete et al 2006) and Egypt (Shebin El-Kom Locality) (1.44%) (Heikal 2015).

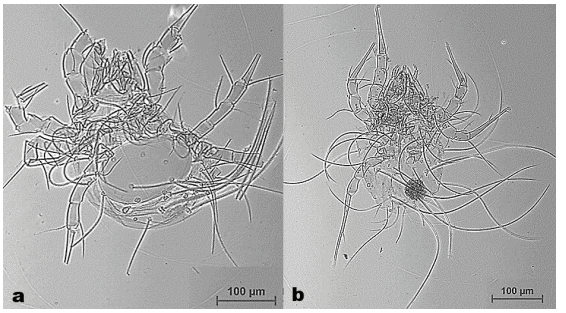

Figure 6- *Glycyphagus domesticus*; female (a), male (b)

The remaining mite species, *E. maynei* (Figure 7a), *H. simplex* (Figure 7b) and *L. destructor* (Figure 8) were detected only sporadically in Ordu homes. *E. maynei* which is of great medical importance was detected at varying rates in Turkey (Zeytun 2005; Aykut et al 2013; Zeytun et al 2015; Zeytun et al 2016) and abroad (Colloff 1987; Mehl 1998; Spieksma & Dieges 2004; Boquete et al 2006, Henszel et al 2010; Kosik-Bogacka et al 2010; Solarz 2010).

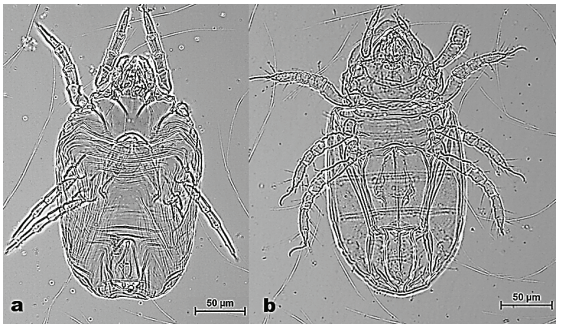

Figure 7- Females of *Euroglyphus maynei* (a) and *Haplochthonius simplex* (b)

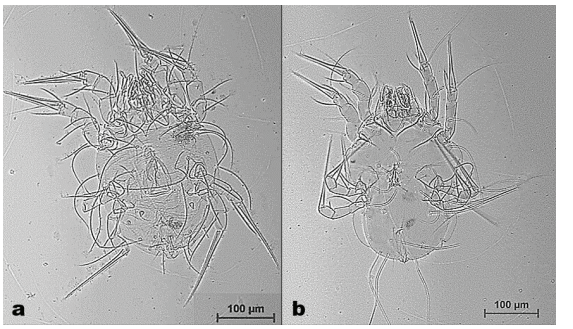

Figure 8- *Lepidoglyphus destructor;* female (a), male (b)

H. simplex, an oribatid mite species belong to the family Haplochthoniidae was also found in house dusts in Ordu similarly to Erzincan (Zeytun 2015; Zeytun et al 2017b). *Histiostoma* sp. was recorded in Samsun by Ozman-Sullivan K & Celik (2010). However, they didn't mention any species name. This species was also collected from house dusts in Okinawa Prefecture (6%) by Takeda et al (1998),

in Nagoya (Japan) (8.3%) by Suto et al (1992) and Sakaki & Suto (1995), in Brazil (0.36%) by Rosa & Flechtmann (1979), in Japan (26.2%) by Hatsushika & Miyoshi (1992).

L. destructor has been reported in varying rates in numerous studies in Turkey (Gülkan 2004; Akdemir & Gürdal 2005; Atambay et al 2006; Çiftçi et al 2006; Akdemir & Soyucen 2009; Aykut & Yılmaz 2010; Kılınçarslan 2012; Aykut et al 2013; Zeytun 2015; Zeytun et al 2015; Zeytun et al 2016), and abroad (Boquete et al 2006; Henszel et al 2010; Kosik-Bogacka et al 2010; Sun et al 2014; Yu et al 2015).

HDM species have been investigated in Turkey and the world by numerous researchers and noted different compositions of the dust mite fauna, as well as the abundance of each species. These differences may be due to the complex factors that involve geographical factors and household factors, affecting the distribution and abundance of mite species.

4. Conclusions

Our study shows that all surveyed homes in Ordu city were found to be positive for dust mites. The majority of homes sampled were infested with more than one dust mite species. Among the 53 sampled homes, 1 home had four mite species, 5 homes had three species, 34 homes had two species and 13 homes had one species. A total of 11 different species belonged to 5 families, 8 genera were determined in the dust samples collected from Ordu houses. The family Pyroglyphidae (94.09%) had the highest percentage of the total collected mites. All surveyed homes had *D. pteronyssinus* and *D. farinae*, which are two main allergenic dust mite species. They were also the most commonly seen species in the houses of Ordu province (Turkey).

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