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Short Communication

Preliminary Studies on Storage Mites in Litter and Animal Fodder Collected from Farm Buildings in Northwestern Poland

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Abstract

The aim of our study was to determine the acarofauna composition in litter and animal fodder samples taken from farm buildings in northwestern Poland. Mites were isolated from the samples using Berlese-Tüllgren extractors. Fifty-five samples were collected from 45 premises, including 16 hen houses, 13 pigsties, 12 barns, 3 cowsheds, and the laboratory animal house of the Pomeranian Medical University. In 43 samples (78.2%) were collected 1,343 specimens that belonged to the orders of Astigmata, Prostigmata, and Mesostigmata. In most samples the following taxa were observed: *Lepidoglyphus destructor* (72.3%), *Cheyletus* sp. (52.7%), *Acarus siro* (41.8%), and *Tyrophagus putrescentiae* (40.0%). Among these taxa, the mites of known allergen importance were *L. destructor*, *A. siro* complex, and *T. putrescentiae*, and also *Glycyphagus domesticus*, *Tyrophagus longior,* and *Chortoglyphus arcuatus* (although these were much less frequent in the examined samples). The greatest taxonomic richness was observed in fodder samples from the university animal house and samples from hen houses, and the smallest in cowshed litter. The results confirmed the high incidence of storage mites in the examined farm buildings.

Keywords: Acaridae, allergenic mites, storage mites

Introduction

Mites are the pest of stored agricultural products [1-6]. In products stored by people, one can find mites belonging to five orders: Gamasida, Actinedida, Tarsonemida, Acaridida, and Oribatida [7-9]. The most frequent and most numerous are Acaridida, mainly the representatives of two families: Acaridae (*Acarus siro*, *Tyrophagus putrescentiae*) and Glycyphagidae (*Lepidoglyphus destructor*, *Glycyphagus domesticus*). Moreover, one can find some species from the families Chortoglyphidae, Suidasiidae, and Carpoglyphidae [7, 10]. The most common and best known storage mite is *A. siro*, but recently more attention has been paid to *L. destructor* and *T. putrescentiae*, due to their harmful effect on humans. The harmfulness of storage mites is associated with pollution of food products with faeces, ecdyses, and the dead bodies of different species (mainly from orders Mesostigmata, Oribatida, and Promastigmata), and also with the order Astimagata consuming, polluting, and increasing the moisture in products, namely the families Acaridae and Glycyphagidae [11]. In addition to the afore mentioned taxa, allergic reactions may also be caused by predator mites from the genus *Cheyletus* of the order Prostigmata. Storage mites can cause allergies in farmers,

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employees at food product warehouses, mills, and in the food industry in general. Frequent contact with products contaminated with mites, or with mite-containing dust, their excrement, or remains floating in the air, is the cause of allergic symptoms in the form of atopic asthma, atopic rhinitis, conjunctivitis and skin allergies. Skin allergies (dermatitis) caused by the storage mite, manifest in the form of "copra itch" – a result of contact with the allergen of the mite *T. putrescentiae*, and "warehouseman's itch" most often caused by contact with *A. siro* [9, 12]. Similar types of skin allergies can be found in bakers (the so-called "baker's eczema" as a reaction to *A. siro*) and staff of food stores with "colonial articles" – the so-called "shopkeeper's eczema" associated with reaction to *G. domesticus* [7, 10, 13]. Studies on the mite fauna in farm buildings [14-17] and grain stores [3, 5, 6, 18] are carried out in many European countries, but there exists only one paper on mites in farm buildings in Poland [19].

In this study, we determined the composition of acarofauna in litter (hay, straw) and laboratory animal fodder samples collected from selected farm premises in the West Pomeranian Voivodship in northwestern Poland.

Material and Methods

In this study we used samples of plant material (litter and laboratory animal fodder) from selected rooms at farm premises, collected in the area of the West Pomeranian Province in northwestern Poland. We collected 55 samples from 45 premises, including 16 hen houses, 13 pigsties, 12 barns, 3 cowsheds, and the animal house of the Pomeranian Medical University. In hen houses, cowsheds, and pigsties we collected samples from the litter (hay, straw), used for covering space for animals. In barns, hay samples were collected, and in the university animal quarters fodder samples (LSM and LSK grain granulates) mixed with sawdust contaminated with faeces of laboratory animals. Samples were collected directly from the location of the animals. Mites from litter and fodder, after weighing with the precision of 0.1 g, were isolated from the samples using a Berlese-Tüllgren photoeclector of our own design, based on the method described by Haarlov [20]. The equipment consisted of a funnel with black insulation material in which the samples were placed. Light from a 60 W incandescent bulb was directed at the funnel from a distance of approximately 30 cm. This system enabled effective isolation of mites, thanks to the negative photonasty that is typical for these arachnids. Mites moved from the light source to a container with a mixture of 70% ethanol and glycerol (9:1). After a week of mite extraction, they were caught and washed in a mixture of distilled water and glycerol (4:1). After isolation, mites were closed in solid preparations, without staining, in Hoyer liquid [15]. The determination of order, family, genus, and species of the mites was performed using identification keys [7, 21] using an OLYMPUS light microscope with the phase contrast system [11]. Some species were determined under a ZEISS Axioskop 2 microscope with differential interference contrast DIC (Nomarski) technology.

Statistical assessment was based on two main coefficients: dominance and frequency. Dominance expresses the percentage of a given taxon compared with the total number of individuals of all taxa found. It is designated as follows:

$$D = \frac{100 \cdot \delta}{\Sigma} \qquad F = \frac{100 \cdot P}{\Sigma p}$$

...where: δ – the number of individuals of the taxon, Σ – sum of all taxa found.

The coefficient of frequency (F) defines the percentage of samples in which the taxon occurred. It is calculated by the formula where: P – trials in which the taxon occurred, Σp – total number of trials.

Results

In 43 out of 55 samples from 45 farm buildings, we found a total of 1,343 specimens of mites. They represented 12 species, but some specimens due to the difficulties with determination were qualified only to genus, family, or order. Mites found in litter and fodder samples were classified as three orders: Astigmata, Prostigmata, and Mesostigmata. Within the order astigmata, the following families were found: Glycyphagidae (*Lepidoglyphus destructor*, *Glycyphagus domesticus*, *Gohieria fusca*), Acaridae (*Tyrophagus putrescentiae*, *T. longior*, *T. perniciosus*, *Acarus immobilis*, *A. farris*, *A. siro*, *Aleuroglyphus ovatus*), Pyroglyphidae (*Gymnoglyphus longior*), and Chortoglyphidae (*Chortoglyphus arcuatus*). Mites belonging to the order Prostigmata Cheyletidae were identified as the family Cheyletidae (genus *Cheyletus* and family Tarsonemidae). In addition, these samples were found to contain the order Mesostigmata (Table 1). Mites identified in the study were qualified to one of four groups that were separated on the basis of frequency ratio (F): I ≥40%, II 39%-20%, III 19%-10%, IV <10% (Table 1).

Group I included: *L. destructor*, *Cheyletus* sp., *A. siro*, *T. putrescentiae*, group II: *A. farris*, *C. arcuatus*, *A. ovatus* and order Mesostigmata, group III: *G. fusca*, *G. domesticus,* and *T. longior*, and group IV: *A. immobilis*, *T. perniciosus*, *G. longior*, Tarsonemidae and other mites of the order Prostigmata. Mite species belonging to *L. destructor* and genus *Cheyletus* were the most dominant (more than 20%). A quite high coefficient of dominance (approximately 13%) was reported in the case of mites belonging to the order Mesostigmata. Other taxa were characterized by a distinctly reduced (<10%) dominance: *A. siro*, *T. putrescentiae*, *A. farris*, *A. immobilis*, *C. arcuatus*, *G. fusca*, *G. domesticus*, *A. ovatus*, and *T. perniciosus* (Table 1). Species *T. longior* and *G. longior* and family Tarsonemidae were observed occasionally, and their coefficient of dominance did not exceed 1%.

In the collected material, representatives of 16 taxa have been identified (Table 2). The greatest taxonomic richness of mites was found at the university animal house – with 15 out of 16 specific taxa (only representatives of the order

Table 1. Mites isolated from 55 litter and fodder samples collected from utility rooms in farms in northwestern Poland.

Mite taxa	Number of samples	Frequency (*F*)	Number of mites	Dominance (*D*)
Ordo: Astigmata				
Family: Acaridae				
Acarus siro complex	25	45.4	243	18.1
Acarus siro	23	41.8	97	7.2
Acarus farris	16	29.1	74	5.5
Acarus immobilis	5	9.1	72	5.4
Tyrophagus putrescentiae	22	40.0	79	5.9
Tyrophagus longior	6	10.9	7	0.5
Tyrophagus perniciosus	4	7.3	33	2.4
Aleuroglyphus ovatus	12	21.8	33	2.5
Family: Glycyphagidae				
Lepidoglyphus destructor	40	72.3	314	23.4
Gohieria fusca	9	16.4	42	3.1
Glycyphagus domesticus	7	12.7	38	2.8
Family: Chortoglyphidae				
Chortoglyphus arcuatus	15	27.3	50	3.7
Family: Pyroglyphidae				
Gymnoglyphus longior	1	1.8	1	1.8
Ordo: Prostigmata				
Family: Cheyletidae				
Cheyletus sp.	29	52.7	302	22.5
Family: Tarsonemidae				
Tarsonemidae	3	5.4	6	0.4
undetermined Prostigmata	2	3.6	21	1.6
Ordo: Mesostigmata				
undetermined Mesostigmata	13	23.6	174	12.9

Mesostigmata were not found) and samples from the hen houses in which representatives of 14 taxa were detected (there were no representatives of the species *G. longior* and the order Prostigmata). In samples from these places, 284 and 677 specimens were found, respectively. The university animal house was dominated by the species *L. destructor*, and representatives of the order *Cheyletus*. In hen houses the most frequent were the orders Mesostigmata, *Cheyletus* and the species *L. destructor*. In hay coming from barns and in material found in pigsties, we found representatives of 9 and 7 taxa, respectively. We isolated 188 and 160 specimens of mites, respectively. In hay and material from pigsties the most common were representatives of the species *L. destructor*, and representatives of the order *Cheyletus*. The lowest taxonomic diversity of mites was found in samples collected in cowsheds, with only 34 specimens of mites representing 4 taxa of the 16 reported in the study.

Disscusion

In the collected material we found Astigmata orders, Prostigmata, and Mesostigmata. Within the order Astigmata were the families Glycyphagidae: *L. destructor*, *G. domesticus*, *G. fusca*; Acaridae: *T. putrescentiae*, *T. longior*, *T. perniciosus*, *A. immobilis*, *A. farris*, *A. siro*, *A. ovatus*; Pyroglyphidae: *G. longior*; and Chortoglyphidae: *C. arcuatus*. Order Prostigmata was represented by families cheyletidae (genus *Cheyletus*) and Tarsonemidae. In addition, we found the presence of Mesostigmata order. In this study, we found 16 taxa of mites, but not always was it possible to identify species and sometimes only genus or family or order are presented. Comparing the results to other European papers, it should be stressed that much greater diversity of mites were found on farms in Ireland [14], Greece [8], Germany [15], the Czech Republic [3], and

Table 2. The occurrence of mites in vegetable material coming from various types of farm buildings in northwestern Poland.

Taxon	Number of taxons in:					Total
	hen houses	pigsties	barns	cowsheds	laboratory animal house	
Lepidoglyphus destructor	117	76	62	7	52	314
Glycyphagus domesticus	21	-	5	-	12	38
Gohieria fusca	32	-	-	-	10	42
Tyrophagus putrescentiae	39	13	15	-	12	79
Tyrophagus longior	3	-	-	-	4	7
Tyrophagus perniciosus	15	-	-	-	18	33
Acarus immobilis	57	-	-	-	15	72
Acarus farris	41	9	9	8	15	82
Acarus siro	42	17	12	-	18	89
Aleuroglyphus ovatus	19	-	5	-	9	33
Chortoglyphus arcuatus	24	6	9	-	11	50
Gymnoglyphus longior	-	-	-	-	1	1
Cheyletus sp.	135	30	49	6	82	302
Tarsonemidae	2	-	-	-	4	6
Prostigmata (unidentified)	-	-	-	-	21	21
Mesostigmata (unidentified)	130	9	22	13	-	174
Total	677	160	188	34	284	1,343

Croatia [16], 70, 65, 49, 25, and 23, and in southern Poland 28 taxa, respectively [19]. All these taxa are classified as storage mites, remarkably including allergenic *L. destructor*, *A. siro* complex, *T. putrescentiae*, *G. domesticus*, *T. longior*, and *C. arcuatus* [7, 10]. These results are consistent with studies of other authors in Europe and North America. For example, allergic reactions among people in contact with the aforementioned taxa have been reported in Spain, Denmark, Germany, Croatia, and the U.S. [22-26]. In this study, the most common species was *L. destructor* (70%). Similarly, this species was the most common taxon in the samples from farm premises in other European countries, including Greece [8], Finland [27], Sweden [28], Norway [29], the Czech Republic [3, 5, 18], and Germany [15]. It is expected that the high occurrence of *L. destructor* may be associated with the significant risk of humans to atopic diseases [29]. In contrast, in plant materials from the animal quarters at the Silesian Zoological Garden, Solarz et al. [30] found that the occurrence of the species was lower in comparison to other species, for example the most commonly occurring being *Acarus farris*. In addition to the aforementioned species, allergenic properties are exhibited by other taxa that were found in samples from northwestern Poland: *Cheyletus* sp., *A. siro* complex, *T. putrescentiae*, *C. arcuatus*, *A. ovatus*, *G. fusca*, *G. domesticus*, and *T. longior*, representatives of Mesostigmata order, with a frequency from 50% down to 10% [7, 10, 22]. Greater occurrence of *A. siro* complex than in our study (45.4%), at a level of 80%, was reported in samples of plant material collected from farm buildings in Iceland [31] and Sweden [28].

The frequency of *C. arcuatus* (27.3%) in samples from northwestern Poland was half that of samples collected in Sweden [28]. A lower frequency of *C. arcuatus* than in this paper, about 1%, was observed in agricultural products kept in stores in the Czech Republic [3] and Greece [8]. In contrast, species *Aleuroglyphus ovatus*, whose occurrence in our study exceeded 20%, amounted to only 3% in plant material from farm buildings in Sweden [28]. A lower frequency of *A. ovatus* than in this paper was observed in stored products in Greece – about 5% [8], and in stored barley in the Czech Republic 2% [3]. This species is rarely analyzed for its pathogenicity, although it has been assigned alergogenic properties in studies conducted in the USA [32], Colombia [33], Singapore [34], and Ecuador [35].

The frequency of other taxa identified in samples of northwestern Poland was lower than 10% – *A. immobilis*, *T. perniciosus*, *G. longior*, Tarsonemidae, and other Prostigmata mites. Mite species belonging to the species *L. destructor* and genus *Cheyletus* strongly dominated in the examined samples (23.4% and 22.5%, respectively). Quite a high dominance (approximately 13%) characterized mites belonging to the order Mesostigmata, but other taxa were not as frequent: *A. siro* (7.2%), *T. putrescentiae* (5.9%), *A. farris* (5.5%), *A. immobilis* (5.4%), *C. arcuatus* (3.7%), *G. fusca*

(3.1%), *G. domesticus* (2.8%), *A. ovatus* (2.5%), and *T. perniciosus* (2.4%). Mites *T. longior*, *G. longior*, and family Tarsonemidae occurred only sporadically, and their dominance coefficient did not exceed 1%.The results of this study and acarological research by other authors [3, 5, 27, 28, 31] confirmed that in quarters and buildings for farm animals, mites from the Pyroglyphidae family were observed extremely rarely, with the exception of *G. longior*. Its presence was reported by Mehl [29] in warehouses with vegetable products. In this study, the greatest taxonomic richness of mites was found in samples collected in hen houses, and the least rich were samples from cowsheds. In contrast to these results, Solarz et al. [19], who conducted a study in southern Poland, ascertained a greater taxonomic diversity of mites in samples of litter collected in barns and cowsheds than in hen houses. In tests with litter from hen houses in northwestern Poland, representatives of 14 taxa were found, of which 12 taxa represented the order astimgata, and one taxon per orders Prostigmata and Mesostigmata. In contrast, Solarz et al. [19], in samples of litter from the hen houses in southern Poland, observed representatives of the 4 orders: Prostigmata, Mesostigmata, Taksonemida, and Orbitida, but did not find specimens representing the order Astigmata. In this study, hay samples collected in barns had mites representing 9 taxa, including *L. destructor*, *G. domesticus, T. putrescentiae,* and *Cheyletus* sp. These species were also found in hay from barns in southern Poland [19]. In addition, samples from the barns in northwestern Poland contained two other species: *A. farris* and *A. siro*, which also was reported by Terho et al. [27] in samples collected in barns in eastern Finland. Common species of mites for samples from barns in northwestern Poland and Ireland [14] are *A. siro*, *G. domesticus,* and *T. putrescentiae*. Pigsties in this study had mites representing 7 taxa, but all of them were also found in samples from pigsty walls in different regions of Germany [15]. The lowest taxonomic diversity of mites (only 4 taxa) had samples collected in cowsheds. In the material derived from similar facilities, but located in southern Poland, also contained *L. destructor* and representatives of Prostimagata and Mesostigmata [19]. In samples of litter and fodder from the University Animal House, we found representatives of 15 out of 16 taxa described in the farm buildings in the West Pomeranian Voivodship, with the exception of mites belonging to the order Mesostigmata. Similar taxonomic composition was recorded in farm stores in Greece that kept animal fodder, among other things [8]. Comparing the composition of acarofauna in the litter from the farm buildings and in the fodder at the University Animal House, all situated in northwestern Poland, Prostigmata mites and the species *G. longior* occurred only in the fodder. The order Mesostigmata, found in all the farm buildings, was never found in the fodder. Moreover, litter had characteristically low frequency of *T. longior* and *T. perniciosus*, and also representatives of the family Tarsonemidae, which were abundant in the fodder sampled at the University Animal House (frequency of 40%).

Based on the research of acarofauna in farm premises in northwestern Poland, it can be concluded that storage mites can be found at great frequency and may cause allergic reactions in people.

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