









Ornithonyssus sylviarum (Acari: *Macronyssidae*) parasitism among poultry farm workers in Minas Gerais state, Brazil

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ABSTRACT: *Ornithonyssus sylviarum* is a hematophagous mite present in wild, domestic, and synanthropic birds. However, this mite can affect several vertebrate hosts, including humans, leading to dermatitis, pruritus, allergic reactions, and papular skin lesions. This study evaluated the epidemiological characteristics of *O. sylviarum* attacks on poultry workers, including data on laying hens, infrastructure and management of hen houses, and reports of attacks by hematophagous mites. In addition, a case of mite attack on a farm worker on a laying farm in the Midwest region in Minas Gerais is presented. It was found that 60.7% farm workers reported attacks by hematophagous mites. Correspondence analysis showed an association between reports of mite attacks in humans with (1) presence of *O. sylviarum* in the hen house, (2) manual removal of manure by employees, and (3) history of acaricide use. The specimens collected from the location were confirmatively identified as *O. sylviarum*. *O. sylviarum* attacks have not been reported when manure was removed in a shorter time interval and did not use acaricide in the sheds when the removal was done by manure conveyor belt. Parasitism by *O. sylviarum* should be considered a relevant occupational hazard affecting employees working in direct contact with commercial egg-laying hens in Minas Gerais. We emphasized the need to monitor hen infestations by this mite to improve the development of mite control strategies.

Key words: *Ornithonyssus sylviarum*, skin lesions, mites, hen houses, occupational hazard.

Parasitismo de *Ornithonyssus sylviarum* (Acari: *Macronyssidae*) em trabalhadores de avicultura no Estado de Minas Gerais, Brasil

RESUMO: *Ornithonyssus sylviarum* é um ácaro hematófago de aves silvestres, domésticas e sinantrópicas. No entanto, este ácaro pode afetar vários hospedeiros vertebrados, incluindo humanos, levando a dermatites, prurido, reações alérgicas e lesões cutâneas papulosas. O presente estudo avaliou os aspectos epidemiológicos do ataque de *O. sylviarum* em trabalhadores de granjas avícolas e descreveu um relato de caso em uma granja de postura. Este estudo utilizou um banco de dados secundário com informações sobre as poedeiras, infraestrutura e manejo dos galinheiros e relatos de ataques por ácaros hematófagos. Foi apresentado um caso de ataque de ácaro a um trabalhador rural no Centro-Oeste em Minas Gerais. Houve uma frequência de 60,7% de trabalhadores que relataram ter sido atacados por ácaros hematófagos em fazendas. A análise de correspondência mostrou uma associação entre relatos de ataques de ácaros em humanos com (1) presença de *O. sylviarum* na fazenda, (2) remoção manual de esterco por funcionários da fazenda e (3) histórico de uso de acaricidas. Os espécimes coletados do local foram identificados como *O. sylviarum*. Não há ataques de *O. sylviarum*, quando a remoção do esterco é feita em menor intervalo de tempo, e não se utiliza acaricida nos galpões quando a remoção é feita por esteira transportadora de esterco. Conclui-se que o parasitismo por *O. Sylviarum* deve ser considerado como um risco ocupacional relevante, que afeta trabalhadores que trabalham diretamente com poedeiras comerciais em Minas Gerais. Ressaltamos a necessidade de monitorar as infestações de aves por esse ácaro, a fim de melhorar o desenvolvimento de estratégias de controle.

Palavras-chave: *Ornithonyssus sylviarum*, lesões cutâneas, ácaros, galpões, risco ocupacional.

INTRODUCTION

Ornithonyssus sylviarum (CANESTRINI & FANZAGO, 1877), also referred to as the northern fowl mite, is an ectoparasite infesting domestic and wild birds worldwide (AXTELL & ARENDS, 1990). This arthropod species is a hematophagous

mite reported in chicken reared in industrial poultry systems and in other species of birds. It is considered a pest in layer poultry management and is an ectoparasite of significant economic importance for commercial poultry industries of the New World (DEVANEY, 1978; MULLENS et al., 2009; MURILLO & MULLENS, 2017).

In Brazil, *O. sylviarum* was first reported in the 1970s in laying hens from farms located in the southern region of Minas Gerais State (FACCINI & MASSARD, 1974). Subsequently, new reports on the presence of this ectoparasite were established in other commercial systems with laying hens on the south-eastern and southern regions of the country (PEREIRA et al., 1977; FACCINI, 1987). In São Paulo State, a study on the occurrence of hematophagous mites in layer poultry showed that *O. sylviarum* was present in 48.8% of the 43 farms visited (TUCCI et al., 1996). More recently, a study of 43 commercial farms in Minas Gerais State, with the aim to determine the main risk factors for the occurrence of hematophagous mites, revealed that *O. sylviarum* was the most frequent mite species in these systems, being present in more than half (53.48%) of the evaluated farms (CUNHA, 2013).

Economically, *O. sylviarum* has been considered as the most important poultry ectoparasite in the United States, where losses in poultry industry exceeded US\$ 68 million in 1974 (DEVANEY, 1979). Studies have shown that mite infestations may lead to deficits of US\$ 0.07–0.10 per laying hen in 10 weeks (MULLENS et al., 2009).

Although, chicken is the preferred host, in their absence, *O. sylviarum* can affect several vertebrate hosts, including humans, leading to possible dermatitis, allergic respiratory disease, or both (KNEE & PROCTOR, 2007; TÉLLEZ et al., 2008). In poultry farms, parasitism in humans by *O. sylviarum* occurs mainly during management practices, including during egg collection, and is common when the level of mite infestation in hen houses is high.

It is important to note that in urban areas, human infestations may also occur, which are related to synanthropic birds such as pigeons that may be infested by mites. According to AKDEMIR et al. (2009), the nests of these birds are usually located on roofs, near windows, or on air conditioners. When this occurs, public places such as schools and hospitals can be affected. Cases of acariasis have been attributed to mesostigmatid mites in human hospitals, houses, and other buildings. However, only few studies have analyzed these mite infestations as an endemic occupational problem to layer poultry farm workers in Brazil.

Considering the economic, productive, and health significance of the commercial poultry industry and the potential occupational health hazard caused by the parasite, an epidemiological study of ectoparasitism by *O. sylviarum* in layer farm employees was conducted.

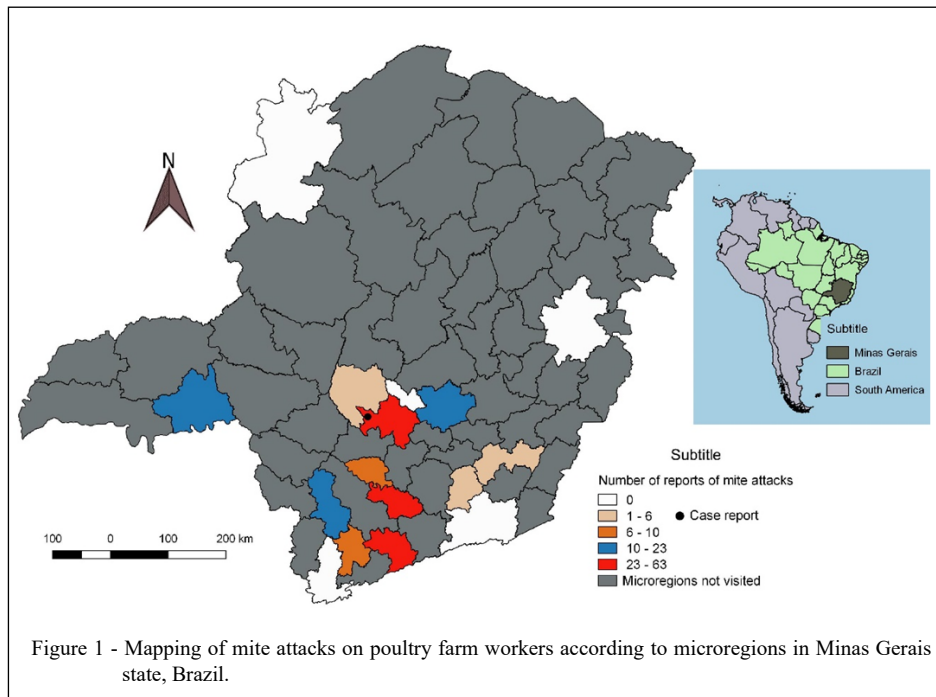
MATERIALS AND METHODS

This study was conducted based on the findings of a previous study that aimed to evaluate the epidemiological characteristics of hematophagous mite infesting layer farms in Minas Gerais State, Brazil (CUNHA, 2013) and to describe a hematophagous mite attack during a study, which aimed to test a proposal of strategic chemical control of *O. sylviarum* (TEIXEIRA, 2016). A database was adapted from the study by CUNHA (2013) and structured based on information from 402 hen houses in 42 commercial properties regarding the occurrences of hematophagous mite attacks on farm workers, method and interval of manure removal, chemical control with acaricides, and presence or absence of mite species. Some parts of the data in this study were obtained from an epidemiological questionnaire applied in poultry farms March to June of 2012. The present variables in the database were dichotomized or categorized. Additionally, this study presented a case report of *O. sylviarum* infestation on a laying farm.

In this study, to evaluate a strategic control of *O. sylviarum* on birds, a case of a farm worker reporting that she was attacked by mites in March 2015 in a poultry farm located in the Midwest region of Minas Gerais was evaluated. During visual inspection, mites were not observed on the worker's body; although, mites were collected in the hen houses. These mites were preserved in 70% alcohol and sent to the Universidade Federal de Minas Gerais, Laboratory of Parasitic Diseases of Domestic Animals from the Preventive Veterinary Medicine Department for identification.

The confirmation and identification of the hematophagous mite species were performed using the morphological characterization key of Moss (1968) and FACCINI (1987), after the preparation of slides for optical microscopy. The mites were placed on slides containing lactophenol solution for clarification. Subsequently, the specimens were removed and immersed in 70% alcohol for 24 hours, and the slides were prepared in Hoyer's medium (FLECHTMANN, 1975; KRANTZ, 1978).

To elucidate the geographical distribution of hematophagous mite attacks on workers, a georeferencing map containing microregions that have farms with these characteristics was constructed using the QGIS software 2.18.1 (QGIS, 2016) (Figure 1). Direct and indirect information regarding the participants in this study, such as workers and farm owners, were undisclosed.



Variables present in the correspondence model were primarily screened using Pearson’s chi-squared test ($p \leq 0.05$). The selected variables were assessed using Multiple Correspondence Analysis (MCA) to evaluate possible associations through graphic figures. MCA graphs were plotted using the statistical software Stata®/SE 12 (STACORP, 2011). The three first axis generated by the analysis were interpreted by evaluating the proximity between the variables and the accumulated inertia, with an established cut-off of above 40%, according to MINGOTI (2005).

RESULTS AND DISCUSSION

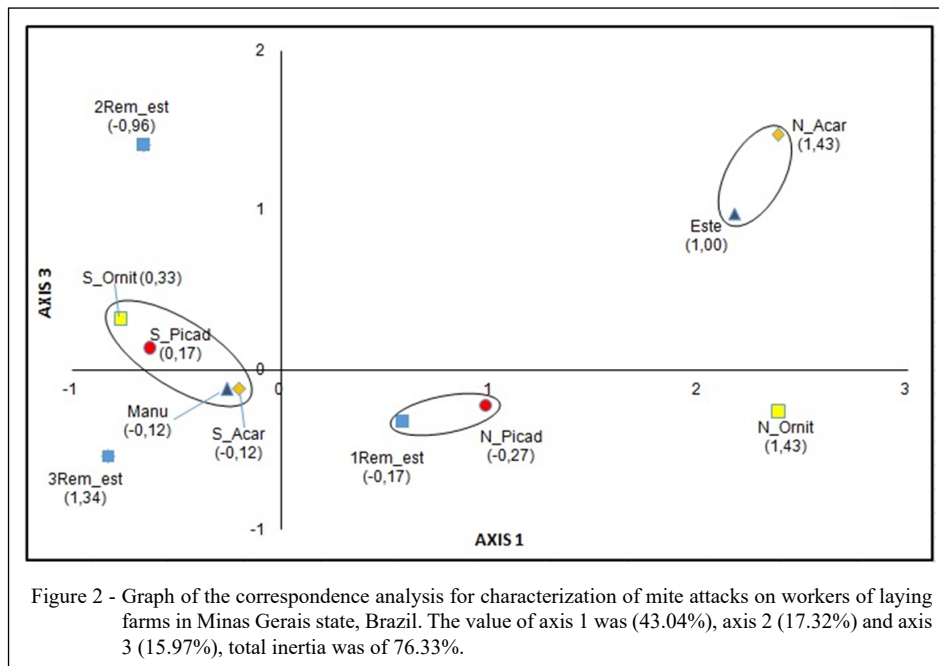
In the analyzed database, a frequency of 60.7% of workers who reported mite attacks was observed. The MCA graph characterizing mite attack reports presented an accumulated chi-squared value of 76.33% (Figure 2). The position in a third dimension is shown in parentheses. The variables used for the graphical presentation of correspondence are presented in table 1 with their respective captions and abbreviations. The appraised variables in the MCA graph are present inside the circles.

According to the correspondence analysis, an association between reports of mite attacks and

the presence of *O. sylviarum* in the sheds, with the manual removal of manure and chemical control with acaricides, was observed. Manure removal interval 1 was associated with the absence of mite bites.

In addition to these results, a case report was evaluated during a visit to monitor strategies aiming to control *O. sylviarum*. During the visit, a farm worker reported a “chicken lice attack” (Figure. 3A). The mites present in the sheds were identified following some characteristics, such as: *O. sylviarum* adult anal shields have a teardrop-shaped anal plaque (Figure 3B, 3C), these mites are generally smaller (ca. 0.6 mm), in addition to claw-shaped chelicerae. During the evaluation of the lesions, it was verified that it was parasitism caused by *O. sylviarum* since no other ectoparasites were reported in the sheds and birds. Additionally, the chickens present in same environment had a high degree of mite infestation, with a score between 6 and 7 (ARTHUR & AXTELL, 1983), equivalent to 1.001 to over 10.000 mites per hen (Figure 3D).

High mite infestation in chickens contributed to greater dispersion inside the sheds since *O. sylviarum* can actively fall or leave the birds in search for other hosts, which are found in the facilities and in the manure under the cages



(DEVANEY, 1978; GUIMARÃES et al., 2001). The accumulation of manure contributed to the prolonged stay of *O. sylviarum* below the cages and to an increased chance of proliferation. This hypothesis was based on the research by MULLENS et al. (2001), who described the dispersal capacity of *O. sylviarum* even if there are empty cages between birds. Mite displacement and its possible fall in the manure could contribute for its presence on the excreta, resulting in probable infestations in chickens and humans.

The lower the time period that wastes stay below the cages, the lower the risk of *O. sylviarum* parasitism in humans.

It was found that hen houses that perform manual removal of manure or tend to leave it below the cage for a longer time period use acaricides more frequently to control these ectoparasites. However, farms that periodically remove the manure or do so through manure conveyor belt do not use acaricide (OLIVEIRA et al., 2018; REZENDE et al., 2019).

Table 1 - Variables used in the correspondence analysis graph for characterization of mite infestations on layer poultry farm workers.

| Variables used in Correspondence Analysis | Abbreviations |
|---|---------------|
| Manure removal manually | Manu |
| Manure disposal by mechanized conveyor belt | Este |
| Use of acaricides in laying-hen houses | S_Acar |
| Non-use of acaricides in laying-hen houses | N_Acar |
| Presence of <i>O. sylviarum</i> | S_Ornit |
| Absence of <i>O. sylviarum</i> | N_Ornit |
| Reports of mite attack presence | S_Picad |
| Reports of mite attack absence | N_Picad |
| Manure removal interval 1 (0 – 168 days) | 1Rem_est |
| Manure removal interval 2 (169 – 336 days) | 2Rem_est |
| Manure removal interval 3 (337 – 560 days) | 3Rem_est |

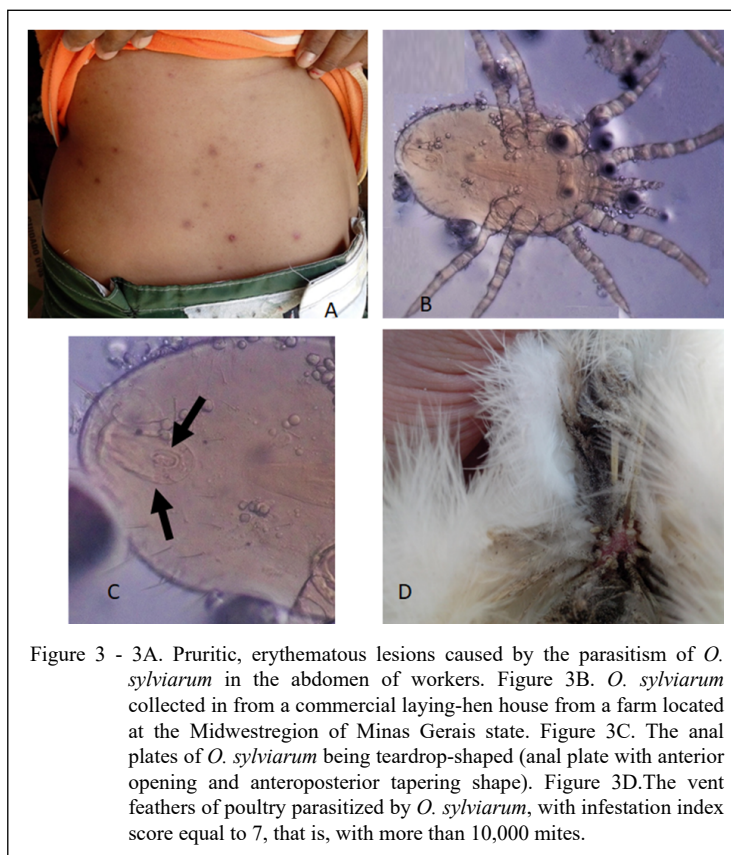


Figure 3 - 3A. Pruritic, erythematous lesions caused by the parasitism of *O. sylviarum* in the abdomen of workers. Figure 3B. *O. sylviarum* collected in from a commercial laying-hen house from a farm located at the Midwestregion of Minas Gerais state. Figure 3C. The anal plates of *O. sylviarum* being teardrop-shaped (anal plate with anterior opening and anteroposterior tapering shape). Figure 3D. The vent feathers of poultry parasitized by *O. sylviarum*, with infestation index score equal to 7, that is, with more than 10,000 mites.

These results are consistent with the results of other studies that demonstrated the possibility of the presence and possible survival of hematophagous mites in manure (KIRKWOOD, 1963; TUCCI et al., 1996; NORDENFORS et al., 1999; CHEN & MULLENS, 2008; TEIXEIRA, 2016).

Mites can actively leave the chickens in search of new hosts, specifically in high infestations in hen houses. Furthermore, when kept without poultry, they can feed from several vertebrate hosts, including humans. Thus, occupational routine on a farm contributes to a possible infestation of *O. sylviarum* in humans. Dermatological examination of the worker revealed the presence of disseminated flat erythematous papules, sometimes with a central vesicle, distributed in the abdominal region (Figure 3C). These symptoms are consistent with other reports that described dermatitis, pruritus, excoriations, allergic reactions, and temporary papular cutaneous lesions caused by *Ornithonyssus* in humans (SUZUKI et al., 2014; MENTZ et al., 2015).

The dispersion of hematophagous mites on farms is related to infestation level, as observed

in this study, in which the birds presented a high degree of infestation by *O. sylviarum* (score equal to 7). This result is consistent with the findings of KIRKWOOD (1963), CHEN & MULLENS (2008), TEIXEIRA (2016) and MURILLO & MULLENS (2017) who stated that when the intensity of mite infestation is high, they tend to fall or exit actively from the poultry and are found in the manure underneath cages, in the facilities, and in eggs produced, being capable to survive for a few weeks in the environment. It was noted in the case report that employees had insufficient knowledge about the ectoparasite itself and its biology since part of the population erroneously consider these mites to be “lice.” The same was reported by REZENDE et al. (2013), stating that in Brazil, these species of mites are popularly misclassified as “lice.” Actually, “lice” are taxonomically referred to as ectoparasites of several families, genera, and species belonging to class Insecta, order Phthiraptera. These parasites are biologically and epidemiologically different from mites and require specific control measures.

The high degree of infestation may contribute to the spread of parasites in the

environment, being found in the excreta under cages, in eggs produced, and by infesting poultry workers. Hence, possible reinfestations may occur on farms (GUIMARÃES et al., 2001; CHEN & MULLENS, 2008). In humans, the non-specific dermatitis caused by hematophagous mites of the suborder Mesostigmata is not pathognomonic, which makes the diagnosis difficult and may cause them to be confused with other ectoparasites (ORTON, 2000). It is important to highlight that factors such as identification, analysis of epidemiological conditions, and knowledge regarding the life cycle of *O. sylviarum* are important to establish the accurate diagnosis.

CONCLUSION

Considering the clinical manifestations in humans and high frequency of occurrences in Minas Gerais, it is suggested that parasitism by *O. sylviarum* should be treated as an occupational hazard affecting employees working in direct contact with commercial egg-laying hens in the state. It is important to highlight that frequent removal of manure manually or by conveyor belt could reduce the presence of this mite in manure and sheds and prevent the possible attacks of this mite on farm workers. Additionally, monitoring the intensity of avian infestation and development of more efficient control strategies of *O. sylviarum* are required from a non-econometric perspective, in addition to the health of nonhuman animals, specifically workers working in direct contact with commercial egg-laying hens, as part of a one-health approach.

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BIOETHICS AND BIOSECURITY COMMITTEE APPROVAL

The present study was approved by Animal Ethical Committee of the Universidade Federal de Minas Gerais (UFMG) COEP (n° 0238.0.203.000-11) and CEUA (n°74 / 2013).

DECLARATION OF CONFLICT OF INTERESTS

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

AUTHORS' CONTRIBUTIONS

All authors contributed equally for the conception and writing of the manuscript. All authors critically revised the manuscript and approved of the final version.

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