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Epidemiological characterization and risk evaluation associated with the presence of *Megninia* spp. in pasture farms

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ABSTRACT: This study was accomplished with the aim to evaluate and to characterize the risks for the presence of *Megninia* spp. in poultry farms from Minas Gerais, using for that Correspondence Analysis (CA). A secondary database was used and adapted for this study, with information from 402 chicken houses of 42 laying hens commercial properties. Variables used to compose the correspondence model were selected through tests of Qui-square being considered the significant result of $P \leq 0,05$. A risk index was built to the presence of *Megninia* spp. starting from variables considered as risk factors for the presence of those ectoparasites. The CA graph produced for the epidemiological characterization of the presence of *Megninia* spp. presented an accumulated qui-square value of 58,55%. There was an association of the risk index with the age ranges of the poultry, among the presence *Megninia* spp. and the use of mineral oil and acaricide in the ration and; finally, an association between the ruddy ground-dove (*Columbina talpacoti*) presence and the absence of mites of the *Megninia* genus. The results supply knowledge on the epidemiology of *Megninia* spp. In addition, these information can contribute in the decision, reducing the risks of possible infestations in poultry farms and the negative effects of that parasitism.

Key words: *Megninia* spp., risk index, correspondence analysis.

Caracterização epidemiológica e avaliação de risco associados à presença de *Megninia* spp. em granjas de postura

RESUMO: Este estudo foi realizado com o objetivo de avaliar e caracterizar os riscos para a presença de *Megninia* spp. em galpões de granjas de postura de Minas Gerais, utilizando para isso Análise de Correspondência (AC). Foi utilizado um banco de dados secundário e adaptado para este estudo, com informações de 402 galpões de 42 propriedades comerciais de galinhas poedeiras. As variáveis utilizadas para compor o modelo de correspondência foram selecionadas através de testes de Qui-quadrado ($P \leq 0,05$). Foi construído um índice de risco para a presença de *Megninia* spp. a partir de variáveis consideradas como fatores de risco para a presença desses ectoparasitos. O gráfico da AC produzido para a caracterização epidemiológica da presença de *Megninia* spp. apresentou um valor de qui-quadrado acumulado de 58,55%. Observa-se que houve uma associação do índice de risco com a faixa de idades das aves, entre a presença *Megninia* spp. e a utilização de óleo mineral e de acaricida na ração e, por último, uma associação entre a presença de rolinhas (*Columbina talpacoti*) e a ausência de ácaros do gênero *Megninia*. Estes resultados fornecem conhecimento sobre a epidemiologia de *Megninia* spp. Além disso, estas informações poderão contribuir na tomada de decisão diminuindo os riscos de possíveis infestações nos plantéis e dos efeitos negativos decorrentes por esse parasitismo.

Palavras-chave: *Megninia* spp., índice de risco, análise de correspondência.

INTRODUCTION

Among the arthropods, ectoparasites of domestic and wild birds are the group of mites that feed only of feathers or dead skin cells (PROCTOR, 2003; TUCCI, 2005; POUCKE, et al., 2016). These

mites are among the most abundant and diversified arthropods of permanent life in the poultry, with more than 2400 species described in the whole world, which is supposed to represent only 20% of the total number of existent species (MIRONOV, 2003). The non-hematophagous mites of the *Megninia*

genus (Suborder Astigmata, Family *Analgidae*) are included in this group.

In the industrial layer hens, the species of the genus *Megninia* are important and responsible ectoparasites for damages in the eggs' production, being also told in other hosts, as parakeets, turkeys and pigeons (GUIMARÃES et al., 2001; TUCCI et al., 2005; REZENDE et al., 2013). These mites can bring consequences as appearance of lesions caused by the saliva, which result in pruritus and may trigger secondary lesions such as pyodermitis (TUCCI et al., 2005).

Occurrence of *Megninia* spp. in laying chickens can vary according to the climatic and geographical conditions, varying from 2,6% in Israel (MUMCUOGLU & LUTSKY, 1990) to 89,6% in Cuba (HERNÁNDEZ et al., 2006). In Brazil, REZENDE et al. (2015) observed an occurrence of 18,09% of mites of the *Megninia* genus in chicken houses of poultry farms posture in the state of Minas Gerais.

In an outbreak of *Megninia* spp. in an industrial poultry farm located in the state of São Paulo - Brazil, it was verified that the infestation caused around 20% of reduction in the eggs' production. Besides, was observed the presence of a serous fluid responsible by forming a crust in the lesions, what could provide the occurrence of secondary infection and possible bacterial, fungus contaminations (TUCCI et al., 2005). The species *Megninia ginglymura* (Mégnin 1877) has already presence notified in the states of São Paulo, Ceará, Rio de Janeiro and Minas Gerais, while *Megninia cubitalis* (Mégnin 1877) it was already reported in Bahia, Rio Grande do Sul, São Paulo, Ceará and Minas Gerais (GUIMARÃES et al., 2001; REZENDE et al., 2015).

Considering the economic, productive and sanitaries damages for the commercial laying hens industry can be attributed to the ectoparasitism by *Megninia* spp., the present research has the aims to develop a risk index and to accomplish the epidemiological characterization of the presence of those mites using for that the CA.

MATERIALS AND METHODS

This research was accomplished starting from an adapted secondary database of CUNHA (2013) and structured with information on the presence and absence of ectoparasites, characteristics from the chicken houses, the poultry, the facilities, the geographical location and the management.

The selection of farms and stratification of the samples was accomplished being taken into account

the proportion of existent industrial poultry properties of laying in each one of Administrative Regions of the Agricultural Institute of Minas Gerais (IMA).

A database was built with information from 402 chicken houses of 42 commercial properties from the state of Minas Gerais to evaluate some epidemiological aspects that could characterize the presence of *Megninia* spp. in the chicken houses of the poultry farms, using for that CA. The present variables in the database went dichotomized to the accomplishment of that analysis.

A risk index was built to characterize the presence of the mites of the *Megninia* genus and, for that, the risk factors were considered described by REZENDE et al. (2015). In the construction of the risk index a score was attributed for the risk variables (importance 1) and of protection (importance 0). Besides for variables that presented three categories as the interval of removal of dejections, poultry age and number of poultry for cages, the importance was related to the risk that each one would act for the presence of *Megninia* spp. in the chicken houses of the poultry farms. From this, the result was possible to classify the risk for the presence of those ectoparasites in three categories (low, moderate and high). Variables used for the construction of the risk index for the presence of *Megninia* spp. are showed in the table 1.

The variables that would compose the correspondence model were selected starting from a screening through the Pearson's qui-square test ($P \leq 0,05$). The selected variables were submitted to CA to evaluate the possible associations among the presence of *Megninia* spp. with the risk index through graphic figures. The evaluation and interpretation of the graphs was made by evaluating the proximity of the variables with the variable answer, that is, the risk index. Besides, it was considered the intensity of associations with values of accumulated inertia above 40% according to MINGOTI (2005) and DINIZ (2015) reached in the analyses. For the accomplishment of the selection of variables and for the graphic construction for correspondence in three axes the software Stata®/SE 12.0 was used (STATA CORP, 2012).

Also a study of space analysis of chicken houses was accomplished with the presence of *Megninia* spp. with use of Kernel map. In this way, the intensity of the presence of that ectoparasite was analyzed in chicken houses of the poultry farms. For that, the software QGIS 2.18.1 was used (NANNI, 2016) that made possible the georeferencing of the counties that presented chicken houses with the presence of those ectoparasites in the state of Minas Gerais (Figure 1).

Table 1 - Variables used in the construction of the risk index for the presence of *Megninia* spp. in the chicken houses of poultry farms in the state of Minas Gerais.

Risk Index
Use or not of mineral oil in the chicken houses
IMA administrative regions of the Minas Gerais
Type of removal of dejections (manual or by mat)
Number of chickens by cage: 1 (0 – 8 poultry), 2 (9 – 16 poultry) e 3 (more de 17 poultry)
Age of the poultry: 1(98 – 382 days), 2 (383 – 667 days), 3 (668 – 1047 days)
Presence or absence of subsistence chickens in the <i>adjacencies</i> of the chicken houses
Interval of removal of dejections: 1 (0 – 168 days), 2 (169 – 336 days) e 3 (337 – 560 days)

RESULTS AND DISCUSSION

The risk index is a tool that can be used to predict possible variables associated to the presence of *Megninia* spp. Besides, it make possible to qualify and to classify certain conditions predisposing for the occurrence of those mites in a graphic head office.

The appraised variables in the graph of CA are contained inside of the blue circles (Figure 2). Age of the poultry was associated to the three risk indexes (Figure 2). Besides, the presence of the non-hematophagous mites of the genus *Megninia* was associated with the control measures, as the use of mineral oil and acaricide in the ration. Also, an association is observed among the ruddy ground-dove (*Columbine talpacoti*) presence with the absence of *Megninia* spp. and non use of mineral oil. Risk indexes evidenced the profile of the farms that possess at their chicken houses these mites in the state of Minas Gerais. Besides, the knowledge of such characteristics could evidence aspects of the epidemiology of the infestations for those mites, as well as to contribute in the implementation of measures that could prevent or even reducing the occurrence *Megninia* spp. in chicken houses of poultry farms in the state of Minas Gerais. The graph produced to characterize the presence of those non-hematophagous mites presented an accumulated qui-square value of 58,55%. Variables used in the graphic construction of correspondence are in the table 2 with their respective legends and abbreviations.

High risk for the presence of *Megninia* spp. in the chicken houses of the poultry farms was made of the association with the age 1 (98 - 382 days), that is, young poultry are hosts with larger risk of infestations for that ectoparasite. This resulted agree with the result that was observed in Cuba, in which was verified that poultry with approximate age

of 39 weeks were more susceptible to the infestations (HERNÁNDEZ et al., 2007).

The moderate and low risk were associated; respectively, with the ranges of age of the poultry 2 (383. 667 days) and poultry 3 (668. 1047 days). Result observed between the association of the age of the poultry and the presence of the non-hematophagous mites of the *Megninia* genus, may be justified according to some reports and descriptions of the literature, in what was verified that the age of the poultry is a predisposing factor for the appearance of microbial and parasitic diseases (SCHOUER et al., 2012; CEOLIN et al., 2012). In CA, it was observed that, as the poultry got old, risks of parasitism for *Megninia* spp. decrease and, such result possibly is related to the immunological answers of the host, which began to control the population of that mite. Similar result was observed by MULLENS et al. (2009), who evaluated the spread of *O. sylviarum* in poultry houses. In the same research, the author observed that the intensity and prevalence of that mite increased quickly from 4 to 8 weeks and, after the infestation intensity decreased and the prevalence stayed high, probably to the immune answer of the poultry. Part of the farms can present in their flocks poultry with varied ages in their chicken houses, increasing the risk for the presence and possible infestations for those mites in these establishments.

The presence of *Megninia* spp. was associated with control measures, as the use of mineral oil and acaricide in the ration. Results corroborated partially with other present studies in the literature that described the use of the aspersión of oils for the insects control, mites and other agricultural plagues.

This products are not used directly for the control of *Megninia* spp. due, among other reasons, to the difficulty of diagnosis of the parasitism for the farmer in little severe infestations. However,

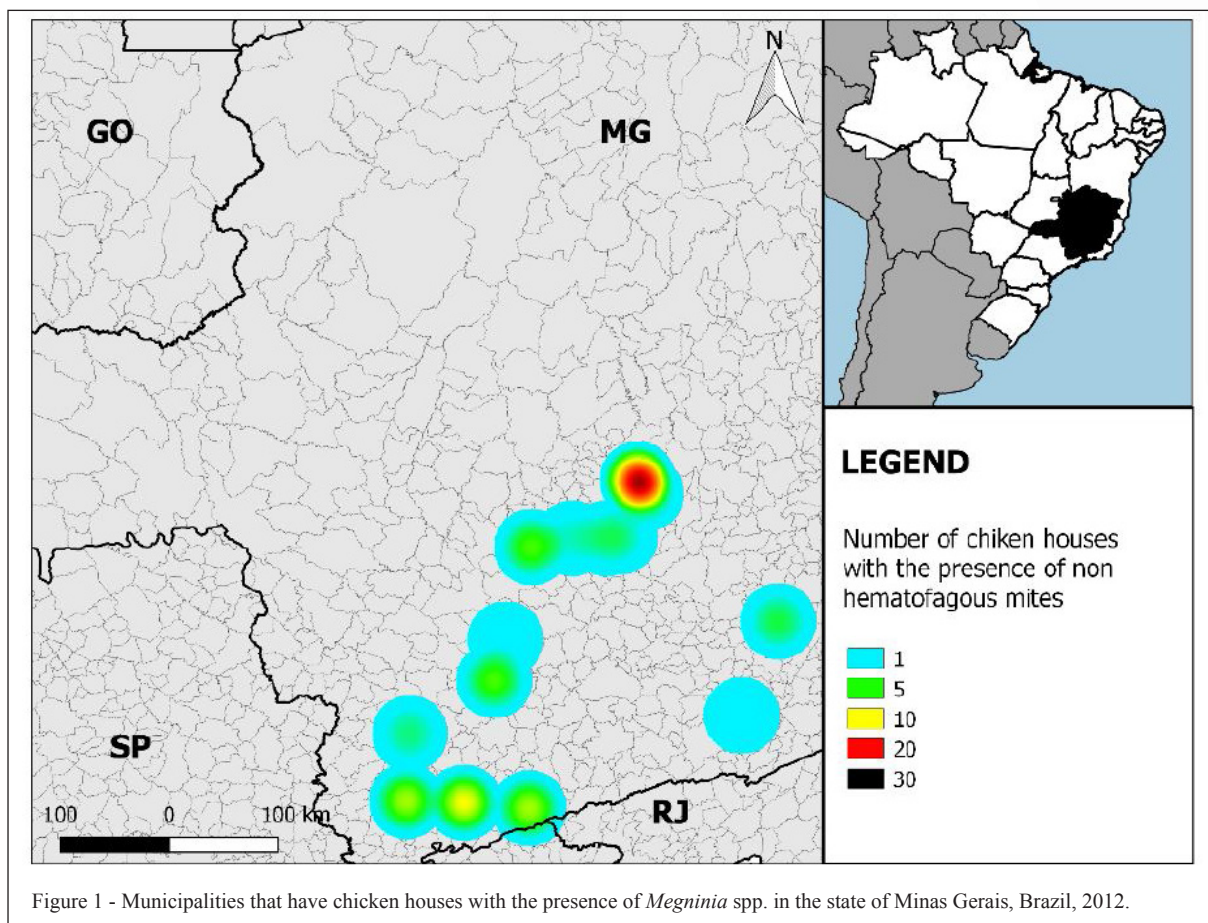


Figure 1 - Municipalities that have chicken houses with the presence of *Megninia* spp. in the state of Minas Gerais, Brazil, 2012.

these control methods are targeted to control hematophagous mites (*D. gallinae*, *O. bursa* and *O. sylviarum*) that are visualized easily on the poultry and in the poultry facilities. As in some research there are acaricide and the mineral oil application, they can take the reduction of the mites populations of *Megninia* genus and underestimate the occurrence of the same ones in the chicken houses of poultry farms (MAURER et al., 2009; REZENDE et al., 2015). The present study agreed also with REZENDE et al. (2015), who verified that chicken house which used mineral oil had six times less chance of occurrence of mites infestations with *Megninia* genus than those that didn't use.

The acaricide use in the ration is not now the most appropriate technique to combat infestations for ectoparasites in Brazil, because there are no products recommended by the Ministry of Agriculture, Livestock and Food Supply that they can be used in the ration, being registered only products in the environment application or in the poultry. Therefore,

it is not known which would be the possible impacts of handling for the health of the poultry and for the quality of the eggs produced in relation to the daily consumption of acaricide in the ration.

An association was verified between the ruddy ground-dove (*Columbina talpacoti*) presence and the absence of *Megninia* spp., such fact, was also observed by REZENDE et al. (2015) when accomplishing the selection procedures with statistics univariate to evaluate the predisposing factors for the occurrence of infestations for those mites. These authors obtained a result that indicated less chance of occurrence of those ectoparasites when there were reports of the ruddy ground-dove presence. However, such a study considered this discovery as a confounding variable, resulting in the exclusion of the same in the final logistic models, in function of the inexistence of reports of this nature for the literature. Besides an epidemiological indicator, this study suggested that the presence of the ruddy ground-dove (*C. talpacoti*) in the adjacencies of the chicken

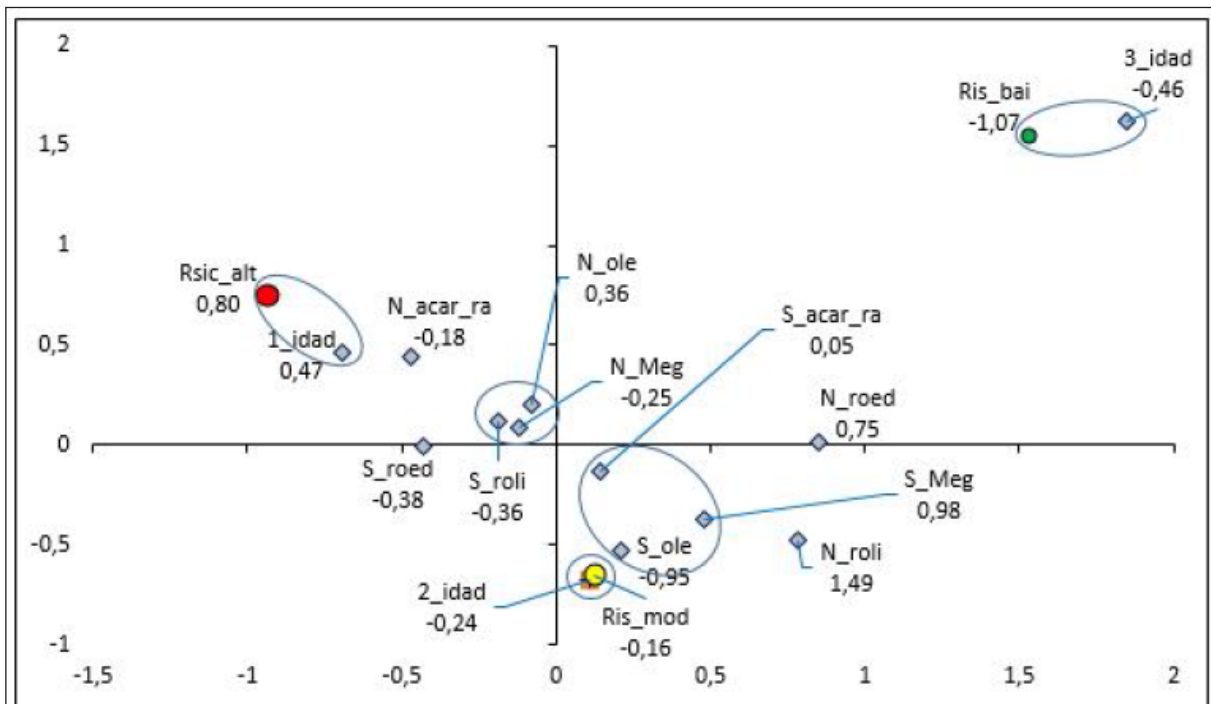


Figure 2 - Graph of the correspondence analysis for the epidemiological characterization associated to the presence of *Megninia* spp. in chicken houses of poultry farms in the state of Minas Gerais, Brazil.

houses of the poultry farms could be classified as a protection factor for the presence of *Megninia* spp. These birds presented competitive characters, preventing the presence of other species that could be carriers or hosts of this mite. There are no reports in the literature that justify such statement and, this way, it is necessary a new study that can assess the actual characteristics of this association.

The municipalities with chicken houses detected the presence of mites of the *Megninia* genus are represented in the figure 1. The presence of cluster points was observed in the South Mesoregion/ Southwest of Minas Gerais and in the Metropolitan Mesoregion of Belo Horizonte that possess chicken houses with the presence of those ectoparasites. The variations among the patterns of the points presented in the map of Kernel, the climatic conditions can be attributed, with relative relevance for the geographical location of the non-hematophagous mites of *Megninia* genus. Located municipalities where the temperature ranges are higher with dry climates didn't present the presence of those ectoparasites in the chicken houses; however, places with mild temperatures possessed them. This report was also described according to REZENDE et al. (2015) which verified that areas of

hot climate in the state of Minas Gerais didn't possess those mites, the administrative regions of IMA with high chances of occurrence of *Megninia* spp. are in areas with humid climate and mild meridionally.

Another relevant aspect that may contribute to the distribution of the geographical points of the mites of *Megninia* genus in the state of Minas Gerais was the association demonstrated in CA with poultry age. In this way, areas with farms that possess flock with ages very diversified and with younger poultry, are subjected to present in their chicken house *Megninia* spp.

CONCLUSION

The characteristics related to poultry, to chicken houses environment and the mites of *Megninia* genus were analyzed and they presented results that allowed to qualify them as important aspects in the epidemiology of the presence of those parasites in poultry farms of posture.

It was verified that the age ranges of the poultry was associated with the risk indexes for presence of *Megninia* spp., demonstrating that young poultry are more susceptible to the parasitism

Table 2 - Legend of the present variables in the graph of correspondence analysis for non-hematophagous mites (*Megninia* spp.)

Variables used in the correspondence model	Abbreviations
Age of the poultry 1 (98 – 382 days)	1_idad
Age of the poultry 2 (383 – 667 days)	2_idad
Age of the poultry 3 (668 – 1047 days)	3_idad
No acaricide use in the ration	N_acar_ra
Acaricide use in the ration	S_acar_ra
No use of mineral oil use in the chicken houses	N_ole
Use of mineral oil use in the chicken houses	S_ole
Absence of rodents in the chicken houses	N_roed
Presence of rodents in the chicken houses	S_roed
Absence of ruddy ground dove in the adjacencies of the chickens houses (<i>C. talpacoti</i>)	N_rol
Presence of ruddy ground dove in the adjacencies of the chickens houses (<i>C. talpacoti</i>)	S_rol
Absence of non-hematophagous mites in the chicken houses (<i>Megninia</i> spp.)	N_meg
Presence of non-hematophagous mites in the chicken houses (<i>Megninia</i> spp.)	S_meg
Low risk for presence of ectoparasites	Ris_bai
Moderate risk for presence of ectoparasites	Ris_mod
High risk for presence of ectoparasites	Ris_alt

for those mites than the old poultry. Besides, the relevance of the construction of the risk indexes was evidenced as important tools for understanding of the epidemiology of the megninioses in laying hens.

The use of mineral oil and acaricide can reduce the chances of *Megninia* spp. infestation; although, the target parasite is not necessarily this mite. Eventually, control measures and monitoring of young poultry are important strategies for decreasing risk of the presence of those mites in the chicken houses of posture poultry farms.

Ruddy ground-dove (*C. talpacoti*) presence in the adjacencies of the chicken houses can be classified as a protection factor for the presence of *Megninia* spp., and for confirmation of that hypothesis, new studies should be carried out.

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