

EMERGENCE OF *DERMANYSSUS GALLINAE* AS AN ARTHROPOD PEST IN URBAN CONTEXT AND THE “ONE HEALTH” APPROACH

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Abstract The poultry red mite, *Dermanyssus gallinae* is not well known in occupational health circles, yet it is well documented in poultry farming communities and pigeon racing households. The blood feeding mite is difficult to locate and eradicate due to its nocturnal behaviour and its ability to leave the host after relatively short feeding bouts to hide in cracks and crevices; in urban context, even more challenging is to identify the origin of the infestation. Medical practitioners do not receive the appropriate training to recognise such arthropod infestations, which are typically confused with scabies and other similarly-presenting disorders, and are unfamiliar with mite behaviour or pathologies that would assist in diagnosis. An international patient group has now been created and supports that physical and chemical control methods for this pest seem ineffective in human habitation. Many patients have turned to self-treatment to contain the problem. Victims of mite infestations suffer tremendous physical and psychological damage, not seen on par with many other pest infestations, with symptoms including itching, dermatitis, skin lesions, biting, pinpricks, secondary infections, scarring/hyperpigmentation. Ineffective and often prolonged attempts to eradicate infestations commonly result in psychological and economic issues, manifested as an increase in depression and financial outlay when patients relocate and/or attempt to control these infestations. The serious lack of knowledge and misinformation regarding human infestation with *D. gallinae* across healthcare, science and pest control fields is disconcerting and, based on increasing reports of infestations, has potentially already led to the dangerous proliferation of the disease. An EU-funded project involving 28 countries (FA1404-COREMI) is pulling together expertise and scientific knowledge to identify new holistic approaches, immunologic, biological and chemical control methods, HAPCC) to combat *D. gallinae*, though these are primarily targeted to use in poultry facilities, not human habitation. Nevertheless, One Health approach allows veterinarians and medical practitioners to exchange information and treatment practices to alleviate the direct and indirect effects of this pest in both veterinary and medical sectors.

Key words poultry red mite, dermatitis, delusional psychosis, arthropod pest

INTRODUCTION

All animals are susceptible to attack by ectoparasites, where in most cases ectoparasites are (relatively) host-specific. In birds, mites are a particular issue with several species being significant pests of poultry, in particular the poultry red mite *Dermanyssus gallinae* and northern fowl mite *Ornithonyssus sylviarum*. Despite being historically considered as avian-specific, the number of reports documenting bird-mite attacks on humans and mammalian companion animals is increasing (George, et al, 2015), with peer-reviewed literature repeatedly suggesting that avian ectoparasitosis (gamasoidosis) may be of medical and veterinary concern (e.g. Mignon, and Losson. 2008; Cafiero, et al., 2008; Schwarz and Litschauer. 2009; Akdemir, et al., 2009). While the potential significance of gamasoidosis has been acknowledged by the scientific community, little research has been conducted on the threat of gamasoidosis to human health, with the bulk of work being formed of case studies documenting occurrence only, in contrast to work undertaken with other ectoparasites of medical concern (e.g. biting flies and ticks). Given the potential for avian mite species to spread a range of diseases, including potential zoonosis (Sparagano, et al, 2014), this paucity of research is surprising.

Diagnosis and treatment of gamasoidosis can be difficult. Bird mites have developed resistance to multiple pesticides and the different species concerned display varied ecologies that necessitate divergent treatment approaches; *D. gallinae* living primarily ‘off-host’ in contrast to *O. sylviarum*. In cases of human infestation, positive identification of species is therefore critical for recommendation of suitable treatment, this requiring an understanding of mite taxonomy and ecology that is typically lacking within healthcare and pest control organisations. Diagnosing infestations based on presenting symptoms alone is inadequate and likely to result in misdiagnosis for similarly-presenting parasitoses including scabies and pediculosis, general dermatitis or physiological conditions such as delusional parasitosis (Lucky, et al., 2001; Bellanger, et al., 2008; Akdemir, et al., 2009, Cafiero et al, 2013).

More research and greater recognition of gamasoidosis is urgently required to effectively treat this condition and prepare for what may represent an emerging global problem. Work to confirm prevalence, determine the mite species involved and establish possible links to human disease is especially needed. Also important are investigation of effective treatment inventions and more reliable means of diagnosis.

This paper will highlight the different perspectives from the patient, medical professionals and scientists’ perspectives to highlight the gaps in knowledge and effective treatments for human gamasoidosis.

PERSPECTIVES AND POTENTIAL ISSUES

Patient Perspective

As a host of these ectoparasitic mites, the grave lack of knowledge and misinformation across healthcare, science, and pest control fields is disconcerting and has led to the dangerous proliferation of the disease. There are no demonstrable protocols for the people suffering from this unrecognized affliction; in fact, there are more treatments and resources available for livestock and domestic pets. After contacting 18 different pest control companies, 13 entomologists, 5 medical doctors, and 11 veterinarians, I have come to the conclusion that there is little to no valid information to assist people with Gamasoidosis. Being a year into this infestation, I have had many moments in my sleep deprived, eaten alive state when I wanted to take my life because I just wanted peace. Nothing prepares you for the level of devastation mentally, emotionally, physically, and financially. There is no such thing as “normal” anymore, it is a constant daily battle for myself and my whole family. Having your reality be invalidated is almost as bad as having these mites. After living in isolation for so long, I believe that there is a dire need for scientists, pest control operators, veterinarians, and medical professionals to work together to research, share information, and develop treatment protocols for those who are suffering like me.

Medical Practitioner Perspective

Increasing reports of human *D. gallinae* infestations, particularly in residential settings, suggests that gamasoidosis may warrant urgent attention for the medical sector (George, et al., 2015). However, physicians have difficulties in diagnosing gamasoidosis, especially in new or atypical settings such as urban areas (Cafiero, et al., 2008; Dogramaci, et al., 2010). Most physicians are not familiar with the diagnosis of ectoparasites and are not aware of dermatitis caused by zoonotic ectoparasites (Cafiero, et al., 2009; Haag-Wackernagel, 2005; Collgros, et al., 2013). Moreover, they often omit the environmental anamnesis and do not advise patients to inspect their residence for ectoparasites (Cafiero, et al., 2013). Diagnosing *D. gallinae* infestations solely on presenting symptom is inadequate (George, et al., 2015) as the cutaneous reactions in humans caused by *D. gallinae* are uncharacteristic and, therefore, *D. gallinae* infestations are often misdiagnosed as bed bugs, scabies, pediculosis, urticarial or attributed to various causes (atopy, and various dermatitides) (Bellanger, et al., 2008, Cafiero et al, 2013). Moreover, the diagnosis of *D. gallinae* is even more difficult as the literature on this subject is scarce and the mite mostly feeds during the night and leaves its host afterwards, as usually reported in urban cases (Bellanger, et al., 2008; Cafiero, et al., 2013). As a result of misdiagnosis, the quality of life of patients might be negatively affected (Dogramaci, et al., 2010). This misdiagnosis is worrisome, because *D. gallinae* poses a significant threat to public health as the mite may be vector/reservoir of zoonotic pathogens, such as *Chlamydia psittaci*, *Erysipelothrix rhusiopathiae*, *Salmonella* spp., *Mycobacterium* spp., Venezuelan equine encephalitis virus, Eastern equine encephalitis virus, and fowl pox virus (Circella, et al., 2011; Boseret, 2013; De Luna, et al., 2008). Therefore, the differential diagnosis of non-specific pruritic dermatitis of obscure origin should always include gamasoidosis caused by *D. gallinae*. Furthermore, the environmental anamnesis could facilitate in diagnosing patients with pruritic dermatitis of unclear etiology (Cafiero, et al., 2008; Haag-Wackernagel, 2005). The importance of the environmental anamnesis is supported by physicians of the EU-funded project FA1404-COREMI (Personal communication). Moreover, one physician advocated a more effective collaboration of physicians and medical environmental specialists and another physician recommended using a magnifier and flash light when an infestation with *D. gallinae* is suspected. Furthermore, these doctors also stated that physicians should especially ask patients for the presence of pet birds and/or abandoned bird nests, mostly pigeons close to their habitation, which is also supported by literature (Haag-Wackernagel, 2005; Akdemir, et al., 2009; Cafiero, et al., 2013). Finally, physicians should bear in mind that immunocompromised patients, patients that take corticosteroids, and patients with dementia may have a more severe infestation than healthy patients.

Scientific Approach

In the last decade, we investigated the occurrence of PRM-skin disorders among farmers working on battery hen-laying farms in Southern Italy (Apulia region) and urban cases. As to the first research, we investigated most of the small-scale laying-hen farms (1,000-5,000 birds) with high level of parasite infestation and, from 2007 to 2009, 58 caged poultry farms were visited. One worker from each farm was interviewed by questionnaire to gather information about their knowledge/awareness of PRM and its zoonotic role and on possibly episodes of red-mite bites occurring/occurred during their working activities (egg collection, poultry managing, etc); they were also asked about the body areas involved in bites.

As to the urban cases, from 2001 – 2016 the Medical Entomology Laboratory of the Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata, Italy has been contacted from private/Public Health Services/physicians to collect and/or identify samples of arthropods suspected to be related to cases of intense pruritus and skin lesions in city-dwellers.

Poultry industry cases. Workers (58/58) (100%) from all farms in the survey confirmed that they knew of the RM and its tendency to bite man. Out of 58 poultry workers, eleven (11/58) (18.96%) reported having experienced pruritic skin eruptions at work following episodes of red mites crawling

on their skin. 18% (11/58) of poultry farm staff experienced irritating itchy skin eruptions at work after red mites had crawled on their skin. Of the 11 infected workers, 2 (18.18%) reported dermatitis on just their arms and hands, with 7 (63.63%) reporting symptoms on their chests and 2 (18.18%) on their legs (Cafiero et al. 2011, 2011a).

Urban cases. All of the patients had no contact with pets/animals, with only three exceptions. Parasites were collected in public edifices (hospital/offices/Academic Institution) (7/21), private apartments (14/21) located in 9 different cities of the Southern Italy, and on patient and his clothes after occupational exposure. All of the patients, a total of 59 (54 adults and 5 children), suffered from itching and punctiform, erythematous papules. Cutaneous reactions were diffuse or almost exclusively on hands, arms, chest and legs and they lasted from a minimum of 2 days to a maximum of 36 weeks. In 14 cases (14/21), physicians (General Practitioners/Pediatricians/Dermatologists) were consulted by patients because of the pruritus and they attributed the symptoms to different arthropods species and/or other causes (atopy/ allergy/ psychogenic pruritus). Antihistamines and steroids were prescribed after the medical examination (14/14 cases), also in combination with parasitic shampoos (2/14), antibiotics (2/14) and tranquilizers (1/14). Symptoms returned after treatment was stopped. In the remaining outbreaks (7/21) no medical advice was sought.

The collected arthropods were identified by IZSPB staff as the red poultry mite, *Dermanyssus gallinae* (19/21 outbreaks) and as the tropical rat mite *Ornithonyssus bacoti* (2/21 outbreaks) according to Baker's morphological keys (Baker, 1999) and key characters (Di Palma et al., 2012).

A careful inspection at all reported sites revealed that the sources of the infestation by *Dermanyssus gallinae* (19/21 outbreaks) were abandoned/removed pigeon (17/21)/sparrow (1/21) nests close to the infested rooms; in only one case it was traced to caged canarians previously bought from an infested store and kept as pets (1/21); the source of the *Ornithonyssus bacoti* (2/21 outbreaks) were a previously eliminated rats' nest in the living room and a colony of laboratory rats, respectively. Removal of the source (empty nests) coupled with intensive vacuum cleaning and disinfestation using pyrethroids in 1-2 cycles of fumigation at the infested sites, led to the complete regression of the symptoms; in the case where canarians were involved, they were moved to a new cage. There was no evidence of mites or dermatitis in the follow-up period.

In all of the cases where physicians attributed the symptoms to different arthropods species, the patients referred that any instructions were done by physicians to find the ectoparasite in the environment (Cafiero et al., 2009; 2011abc; 2013; 2015; Giangaspero et al., 2016).

Recent surveys and sample collection have confirmed the endemicity of *Dermanyssus gallinae* in poultry farming worldwide (about 85%), including Italy where its prevalence were found be 74% in Apulia region (Sparagano et al., 2009). RM-bites can be considered a serious health hazard and a source of discomfort and stress for personnel working in Italian affected poultry farms. Furthermore, workers tend not to wear any personal protective equipment. In such conditions and due to ability of the mite to bite in less than 1 second (Auger et al., 1979), handling infested birds and/or cages but also only visiting infested farms can result in a major risk to human contamination.

Since the mite is also known to be a possible vector of a number of zoonotic agents, the inclusion of the red mite as a zoonotic agent in all regulations regarding occupational safety and RMD as an occupational hazard for poultry workers should be strongly considered (Cafiero, et al., 2011).

CONCLUSION

Identifying poultry red mites or other human mites can be tricky following human infestations as patients struggle to collect appropriate samples, which can be identified by entomologists or pest experts. Very often samples show debris, skin fragment or crushed arthropods beyond recognition. Therefore, such lack of identification can lead to frustration from both sides and misdiagnosis. The majority of co-authors of this paper are involved in the Cost Action called COREMI (for Control of the Red Mite) financed by the European COST scheme, with one working group focusing on the One Health concept to make sure that veterinarians and medical practitioners can exchange valuable information to lead

to a faster diagnostic and patient recovery. Considering that many arthropod specie can infest humans and their houses it is paramount that the diagnostic is made promptly and accurately to avoid using the wrong treatment products, producing side effects and damaging patient's health.

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