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Sodium Hypochlorite as an Effective Means of Combating *Dermanyssus Gallinae* Mites in Chickens

Viktor Abrahamyan, Liana Grigoryan, Valeri Grigoryan, Armine Ghazaryan

Research Center of Veterinary Medicine and Veterinary Sanitary Expertise, ANAU

viktorabrahamyanv@gmail.com, lianagrigoryan7878@mail.ru, grigoryanvgv@mail.ru, ghazaryan.armine2018@gmail.com

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ABSTRACT

The chicken tick *Dermanyssus gallinae* is widespread across all climatogeographic zones of the Republic of Armenia. The invasion occurs with relatively high intensity in large poultry farms (such as in Arzni, Lusakert, and Jrarat). In 1 cm³ of substrate collected from poultry houses, the number of ticks ranges from 1,100 to 2,800 specimens. These parasites attack birds at night, while during the day they remain in the dust on the walls and under the feed conveyor. To disinfect poultry houses, organophosphate compounds are commonly used. However, these substances are toxic, requiring the removal of birds from the premises before use, which is a time-consuming process. In laboratory and production experiments, we tested a 20 % aqueous solution of sodium hypochlorite, achieving 100 % effectiveness. The solution was used without the need to remove the birds from the premises.

Introduction

Among the factors hindering the development of poultry farming, parasitic diseases play a significant role. There are numerous works that study blood-sucking ectoparasites of birds and poultry houses, including the *D. gallinae* mites (Frolov, 1975).

The red bird mite (*Dermanyssus gallinae*), an ectoparasite belonging to the phylum Arthropoda, class Arachnida, order Mesostigmata, and family Dermanyssidae, poses a significant threat to poultry and chicken health worldwide. With *D. gallinae* increasingly suspected of being a disease vector and reports of attacks on alternative hosts, including humans, becoming more frequent, the economic importance of this pest has grown substantially. As poultry production shifts away from conventional cage systems in many regions, *D. gallinae* is expected to become more prevalent and increasingly difficult to control (Sparagano, et al., 2014).

Dermanyssus gallinae mites have an unsegmented, oval-shaped body measuring 0.75–1 mm in length. They possess four pairs of legs in their nymph and adult stages, while larvae have only three pairs. Their color is grayish-white but turns reddish-brown after feeding on blood.

These blood-feeding mites can infest other bird and animal species, including humans. They are nocturnal, seeking shelter in dark, hidden areas during the day.The life cycle of *D. gallinae* includes the following stages: egg, larva, protonymph, deutonymph, and sexually mature adult. They are bisexual, with a full development cycle lasting between 6 and 12 days. When deprived of food, they can survive for up to 10 months. *D. gallinae* primarily parasitizes the featherless areas under birds' wings and in the armpits, causing anemia, exhaustion, and, in severe cases, limb paralysis. Young birds are particularly vulnerable to infection and often become ill.

The poultry red mite (*Dermanyssus gallinae*) is highly prevalent across Greek poultry production systems and regions. In the future, factors such as global warming, reduced acaricide availability, and the ban on cage systems are expected to contribute to a wider spatiotemporal distribution of PRM. These challenges highlight the urgent need for effective monitoring and control strategies to safeguard hen production, poultry welfare, and workers' health (Sioutas, G., et al., 2024). Various approaches have been employed to investigate the relationship between *D. gallinae* and pathogens. In this comprehensive review, we critically examine the available strategies and methods for conducting trials, assessing their strengths and weaknesses. Our analysis aims to provide researchers with valuable tools for accurately studying the vectorial role of *D. gallinae* (Schiavone, et al., 2022). We assume that an effective and sustainable approach to controlling poultry red mite infestations is urgently needed. This includes the implementation of integrated pest management strategies (Flochlay, et al., 2017).

The poultry red mite *Dermanyssus gallinae* is best known as a threat to the laying-hen industry; adversely affecting production and hen health and welfare throughout the globe, both directly and through its role as a disease vector. Nevertheless, *D. gallinae* is being increasingly implemented in dermatological complaints in non-avian hosts, suggesting that its significance may extend beyond poultry. The main objective of the current work was to review the potential of *D. gallinae* as a wider veterinary and medical threat (George David, et al., 2015). *D. gallinae* mites are widespread in poultry farms of Republic of Armenia, and they cause a serious economic demage (Ohanjanyan, 1979, Harutyunyan and Hakobyan, 2001, Hakobyan and Gasarjyan., 2001).

Organophosphorus compounds are mainly used to combat these mites, but they are toxic, and before using them, the poultry farm must be temporarily freed from birds, which is very difficult and time consuming. Therefore, we had a goal to search for a non-toxic, but effective means combating the mites.

Materials and methods

Dermanyssus gallinae is a mite that normally parasitizes small birds but may occasionally bite humans. We report an unusual case of an 82-year-old woman who presented with pruritus and bite-like lesions over her trunk. In the case of *D. gallinae*, the small size of the mites and the fact that they leave the host after feeding means that they may not be seen at presentation, thus such infestations are likely to be underdiagnosed. Physicians should be aware that infection with this mite is possible even in patients from urban areas, and it should be included in the differential diagnosis of conditions causing recurrent pruritus unresponsive to standard treatments (Collgros, et al., 2013).

Avian mite bites skin lesions can remain unrecognized or misdiagnosed. Inquiry about contact with pigeons or poultry may be helpful in patients with nonspecific skin lesions (Cheikhrouhou, et al., 2020).

To determine the infestation of poultry houses with *D. gallinae* mites, we took samples from various poultry houses in the republic: we've collected dust of the walls of the building and equipment, and by counting the number of mites in laboratory (based on the volume in 1 cm^3), we determined the intensity of infestation of the farms with mites.

Research was conducted in the poultry farms of Yerevan, Arzni, Lusakert, and Jrarat.

We've tested the new chemical compound in laboratory first, and in farms (Jrarat and Arzni poultries) afterwards.

Results and discussions

Thanks to regularly conducted surveys, we have determined the degree of contamination of some of the largest poultry farms with *D. gallinae* mites.

The data obtained is shown in the designed Table.

Table. Infestation intensity of farms with mites*

Poultry Farm	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
	Number of mites in 1cm^3 sample											
Yerevan	1100	1120	1152	1150	1200	1200	1300	1250	1250	1150	1125	1025
Jrarat	1200	1200	1230	1250	1300	1360	1350	1350	1000	1250	1230	1210
Lusakert	2255	2250	2275	2300	2350	2370	2410	2350	2330	2330	2300	2270
Arzni	2550	2570	2580	2610	2600	2650	2700	2800	2670	2670	2600	2580
Smaller farms	300	330	400	480	600	570	580	545	420	420	400	350

*Composed by the authors.

The data in the table show that all poultry farms surveyed are infected with the poultry mite. According to the data obtained the number of mites collected (in 1cm^3 material) from the walls of the poultry, around the bowls and feeders ranges from 1025 to 2800 in large farms, and from 300 to 600 in smaller individual poultry farms.

Since *D. gallinae* mites attack chickens at night, only a few mites are found during daytime inspections, even in case of intensive infection of the farm.

The data in the table also show that the intensity of poultry infestation is remaining almost at the same levels during all months of the year. This results in the fact that poultry farms have similar conditions for the development and reproduction of mites (temperature and humidity) in all months of the year. Although all the poultry farms studied are vulnerable to poultry mites, Lusakert and Arzni poultry farms had a higher intensity of infestation.

It's important to note that there were a few buildings in poultry houses that were not infected with *D. gallinae* mites. Further analysis of this situation could provide additional data to better understand how to address it from an epidemiological perspective.

To combat mites in infected poultry houses we've tested different concentrations of sodium hypochlorite. Sodium hypochlorite is one of the main compounds of perchloric acid (NaOCl). It is a volatile compound that releases chlorine and oxygen upon decomposition, which have antiseptic and disinfecting effects. Aqueous solutions are used in a cold state so that chlorine is not released when heated. Tests were conducted both in laboratory and in poultry houses. We've also tested the sodium hypochlorite on the chickens in Arzni branch of Institute of Zoology and Jrarat poultry farm.

In those farms chickens were treated by spraying 20 % sodium hypochlorite aqueous solution. The buildings themselves were also treated with 20 % sodium hypochlorite aqueous solution by spraying 200 ml of the solution on each 1m^2 of the surface. The procedure was repeated twice with an interval of 7 days.

It is important to note that no alive mites were found in the samples collected from farmhouses after the full procedure. The treatment was done in poultry farms without moving the birds. No changes were detected in the physiological state of the birds. Therefore, the 20 % sodium hypochlorite aqueous solution is recommended for widespread production use.

Conclusion

The results achieved allow us to come to the following conclusions:

1. *D. gallinae* mites are widespread and are found in all the farms examined. Moreover, some of the farms have very high infection intensity.
2. The 20 % sodium hypochlorite aqueous solution has a high insecticidal property, and thus, we recommend it for mass use.
3. It can be used in all times of the year, if necessary, as there is no need to temporarily move the birds out of the farm.
4. The advantages of sodium hypochlorite over organophosphorus compounds (chlorophosphite, neostomazan, diazinon) are that it has at least the same insecticidal properties and is environmentally friendly and does not cause any pollution.

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Declarations of interest

The authors declare no conflict of interest concerning the research, authorship, and/or publication of this article.

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