Eradication of *Dermanyssus gallinae* in Industrial Poultry Production

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Abstract
The multi-decade increases in the prevalence of *Dermanyssus gallinae* in poultry production, together with all its harmful consequences, is the best indicator of the ineffectiveness of the control measures implemented to date. This experience should serve as a call to re-evaluate the current approach to the control of *D. gallinae*. In order to halt and subsequently reverse this negative trend, the primary objective of control, instead of suppression, should be the elimination—eradication—of *D. gallinae* from industrial facilities and farms.
Eradication of *D. gallinae* is a demanding and conditional, yet feasible, health- and environmentally justified and economically most cost-effective procedure. Under certain conditions, it can be achieved using acaricides, SiO_2, inert oils, and/or their combinations. However, the possibility of eradicating *D. gallinae* has not been accepted to date. The strictest criterion for evaluating eradication success has been established, namely that during regular inspections not a single *D. gallinae* specimen may be detected for at least one year after completion of the control program and restocking of the flock. Under these criteria, the presented study results unequivocally confirm the possibility of eradicating *D. gallinae* from production facilities and farms.

Keywords: eradication, *Dermanyssus gallinae,* poltry production,

1. Introduction

Egg production for human consumption has shown a multi-decade growth trend, with current production capacities at approximately 7.9 billion laying hens [1]. The poultry red mite, *Dermanyssus gallinae* (De Geer, 1778), is the most significant health-related and economic ectoparasite in this sector. Once *D. gallinae* is introduced into a poultry production facility, technological interconnections and the general control approach based on suppression over time enable the spread of the parasite within the system.
The increasing prevalence of *D. gallinae* facilitates further dissemination and increases exposure of remaining poultry production systems. Thus, the growth trend of the poultry industry has been accompanied by a parallel increase in the prevalence of *D. gallinae* and all associated harmful consequences. Examples of the potential impact of this parasitosis are reflected in its high prevalence in South Korea (90%) [2], Belgium, Germany, and the Netherlands (94%) [3] and Portugal (95%) [4]. The true situation remains unknown, as the prevalence of *D. gallinae* is not regularly monitored in any country.
The key question in order to halt this unfavorable trend and prevent harmful consequences for humans, poultry, and the environment is whether eradication of *D. gallinae* from production facilities and farms in industrial poultry production is possible.
Objective of our paper is to demonstrate the feasibility and justification of eradication procedures in industrial facilities and farms as a solution to the health and economic problem

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posed by *D. gallinae* in intensive poultry production.

2. Materials and methods

The selection of active substances and control methods was conducted in accordance with the *D. gallinae* control program [7-12]. Professional application was carried out by the authors themselves and/or by assistants under their supervision.

Monitoring of *D. gallinae* [13,14,15,16] included: early detection methods (once a month or more frequently); observations by personnel directly involved in production during routine daily activities; and monitoring of flock health status and production performance. In the case of a positive finding using early detection methods, a visual inspection of the entire internal environment of the facility was performed.

The criterion for confirming eradication was that during regular inspections not a single *D. gallinae* specimen could be detected for at least one year after completion of the control program and restocking of the flock. Assessment of the category of *D. gallinae* infestation was performed as described by [15]

3. Results and discussion

To date, the control of *D. gallinae* in industrial poultry production has been based on acaricides (synthetic neurotoxic compounds; insecticides when applied to insects). For an acaricide to be included in a *D. gallinae* control program, it must have sufficient efficacy and prolonged residual activity.

In six years of research on the active substance carbaryl [7], conducted in 2001, we determined that in subsequently exposed adult *D. gallinae*, with an exposure time of 5 minutes, a 0.1% dilution achieved 85% efficacy. The tested 0.1% dilution is ten times lower than the working dilution (1%), while a 0.5% carbaryl dilution already achieved 100% efficacy. Carbaryl, when properly applied, successfully eradicated *D. gallinae* in facilities and farms. In this way, the problem of *D. gallinae* could be resolved. However, uncontrolled and unprofessional use quickly led to the development of resistance and loss of efficacy, so that by 2006 efficacy had declined from 85% to 25.4%.

External application of selected acaricides for eradication purposes can be performed mechanically in empty facilities, without exposing humans or poultry. Eradication eliminates the need for further acaricide use, especially uncontrolled and frequent application, thereby preventing the development of resistance. With proper use, acaricides can be used to reduce and ultimately prevent further acaricide application. By solving the *D. gallinae* problem in industrial poultry production, the need for acaricide use ceases, thereby eliminating any toxicological risk.

The first justified alternative to acaricide use in industrial poultry production was provided by the active substance SiO_2. SiO_2 formulations are characterized by: highly demanding application; low acaricidal capacity per unit area; slow action, such that even lethally exposed individuals may lay fertile eggs; and sensitivity to environmental complexity, contamination, air and environmental humidity [9,10].The highest recorded control effects against *D. gallinae* (reported by other authors) were achieved by Ulrichs et al. [26] lasting up to 46 weeks, using the product Fossil Shield 90.0 White (SiO_2) in an aviary system. Eradication using SiO_2 is possible only in empty facilities under hygienically controlled conditions with downtime between production cycles, with the primary prerequisite being appropriate selection of active substances and their professional application [12]. There are major differences in the efficacy of SiO_2-based formulations [17,18,19,20]. We achieved eradication of *D. gallinae* by applying selected SiO_2 active substances, combining liquid and powder forms, in 11 facilities with a total capacity of 257,500 birds (2,500–40,000 laying hens per facility) [11,12]. Application of selected SiO_2 formulations was carried out using special applicators, by trained personnel supervised by the authors.

Rüster et al. [22] eradicated *D. gallinae* (it could not be detected for two years) in a flock of 380/500 laying hens by means of a combined application: the veterinary medicinal product Exzolt® (fluralaner) in an occupied house; two disinfectants in the empty house—VENNO® VET 1 super (formic acid) and NEOPREDISAN® (p-chloro-m-cresol); and external application of the product Fossil Shield 90.0 White (SiO_2). It is important to take into account that clinical trials conducted in small flocks are not fully comparable

to industrial facilities of average capacity, and especially not to large-scale operations. The differences lie in the possibilities for high-quality preparation, hygienic conditions, and the quality of external application. Our opinion regarding the applied measures is that eradication of *D. gallinae* can be achieved already through the correct, stand-alone application of SiO_2 technology in empty and appropriately prepared facilities.

The first purpose-designed formulation for *D. gallinae* control based on inert oils was P 437/17 [23]. After SiO_2, this represents the next major step toward abandoning acaricide use in industrial poultry production. This approach enabled effective control of heavy *D. gallinae* infestations in occupied facilities, while facilitating control and optimizing application in empty facilities [24]. The studies covered the period 2017–2021 and demonstrated eradication in: three parent flock facilities (total capacity 25,000 birds); eight cage-housing facilities (total capacity 144,000 laying hens); and five production facilities (total capacity 144,000 laying hens). In continued clinical research during 2023–2025, eradication was achieved in an empty facility with a capacity of 60,000 hens (Table 1, Figure 1-5).

Table 1. Presentation of a new result from the independent application of P 437/17.

Serial number	Facility capacity	Infestation intensity	Treatment date	Hygienic condition	Findings (months)	Note
1	60.000	+++	2023.06.08.-2023.09.26.	No	-(27,Duration)	Eradication

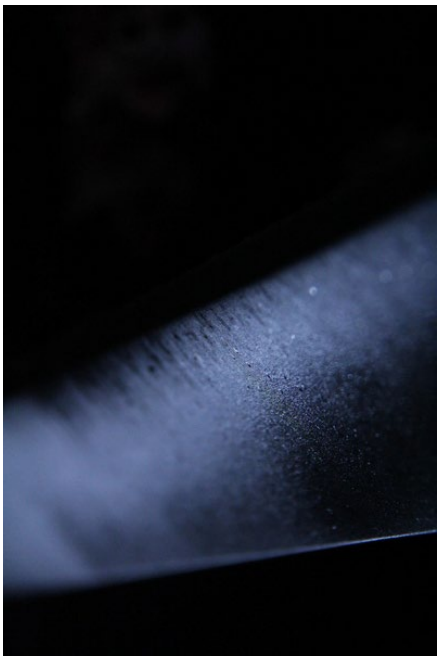

Figure 1. Cage surface treated with aqueous emulsion P 437/17.

Figure 2. *D. gallinae* directly exposed to aqueous emulsion P 437/17.

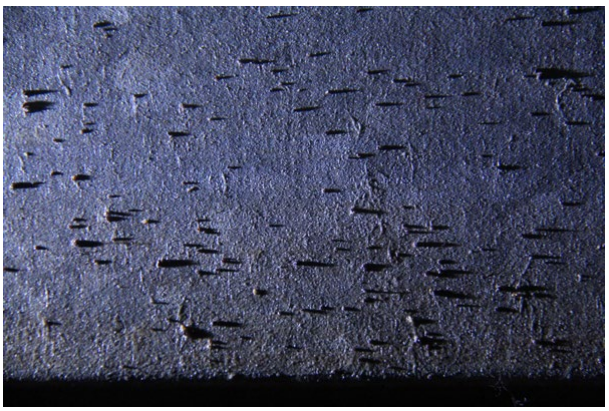

Figure 3. *D. gallinae* directly and subsequently exposed to aqueous emulsion P 437/17.

Figure 4. Preparation of a parent flock facility by manual application of P 437/17

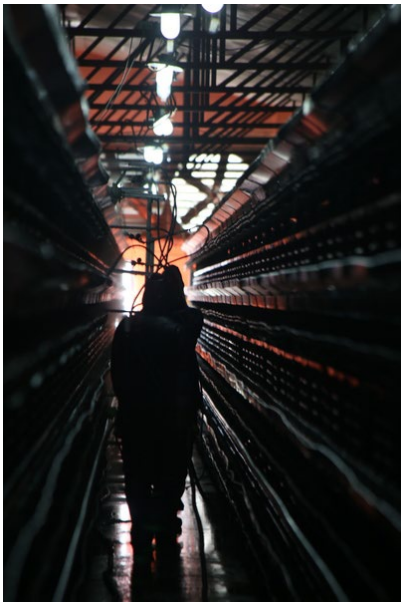

Figure 5. Preparation of a laying hen production facility with conventional cages using an applicator for aqueous emulsion P 437/17.
All photographs are an original part of the authors' research documentation.

The potential of inert oils was also investigated using the ANT22 method (New How). In occupied facilities, the ANT22 method achieved suppressive effects lasting 4–10 months, depending on infestation level, fulfillment of conditions, and quality of execution [23,24]. Preliminary studies in empty facilities showed outcomes ranging from 8 months to complete eradication of *D. gallinae*, depending on infestation level and conditions. A limitation of these studies was insufficient applicator quality (Table 2).

Table 2. Presentation of the first results of treatment using the ANT22 method in an empty facility.

Serial number	Facility capacity	Infestation intensity	Treatment date	Hygienic condition	Facilities (days)	Findings (months)	Note
1	12.000	++	2024.03.23.; 2024.03.27. (2)	Yes	2	14 ++ (?)	Control of a new flock
2	7.000	+++ (++)	2024.04.29.; 2024.05.07. (2)	Yes	Yes	9 ++ (?)	Control of a new flock
3	7.000	++++	2024.05.29.; 2024.06.05. (2)	Yes	6	8 ++ (?)	Control of a new flock
4	2.000	+ (++)	2024.06.07.; 2024.06.25. (2)	Yes	30	17 (Duration) -	Eradication

Note: The application was performed by the author with the assistance of an improvised applicator, using manual application.

The key factor for *D. gallinae* eradication is an empty facility. Treatment of empty facilities is performed via external application. In addition to product and method selection, external application depends on application quality, hygienic conditions, occupancy status (empty/occupied), environmental complexity [11,12], and facility downtime. Application quality depends on human factors and application equipment. Development is underway for a new multifunctional machine–applicator, P 2024/1051 [22], designed to optimize preparation and application of the ANT22 method

as well as other aqueous solutions and emulsions (Table 3).

In terms of simplicity and application demands, per os administration has advantages over external application. Independent use of the veterinary medicinal product Exzolt (fluralaner) does not lead to eradication. Exzolt is administered per os via drinking water and suppresses *D. gallinae* for 56–238 days [25] up to 8 months. In combination with inert oils, we identified a way to extend its effect to achieve eradication. Eradication was demonstrated in combination with product P 437/17 (New How). According to preliminary results of combined application of Exzolt and the ANT22 method in tested facilities, no *D. gallinae* specimens could be detected over a period of 4–6.5 months (New How). Applicators under development, not yet fully optimized, were used in these studies (Table 4).

Table 3. Presentation of the results of the combined use of the product P 437/17 and the veterinary medicinal product Exzolt (fluralaner)

Serial number	Facility capacity	Infestation intensity	Treatment date	Hygienic condition	Findings (months)	Note
1	60.000	+++	2024.11.20.-12.02.	No	- (12, Duration)	Occupied facility Eradication

Table 4. Presentation of the current results of the combined ANT22 method and the veterinary medicinal product Exzolt (fluralaner).

Serial number	Facility capacity	Infestation intensity	Treatment date	Hygienic condition	Findings (months)	Note
1	25.000	+++	2025.06.17.-30 (3+2)	Yes	- (6,5, Duration)	Start of procedure in an empty facility
2	5.000	+++	2025.07.29.-08.15. (3+2)	Yes	- (4, Duration)	Start of procedure in an empty facility
3	2.300	++	2025.08.06.-15. (2+2)	No	- (4, Duration)	Procedure in an occupied facility

Note: The application was performed by the author with the assistance of an improvised applicator, using manual application.

IPM [1,27] differs fundamentally from *D. gallinae* control programs in terms of: the defined objective (suppression rather than eradication), the elements of which it consists, preparation, the manner of selecting and applying active substances and methods, implementation, and the results obtained in clinical trials.

The studies fulfilled the established criterion for proof of eradication, namely that detailed and regular inspections detected no *D. gallinae* specimens for a minimum of one year. This represents the strictest criterion established to date for *D. gallinae* control. Evaluation considers eradication success through the effectiveness of implemented control measures and introduced biosecurity measures, which together constitute an integrated whole.

Adoption of *D. gallinae* eradication creates opportunities for:

1. Halting the unfavorable trend of *D. gallinae* spread in intensive poultry production and subsequently reducing it toward resolution;
2. Reducing and ultimately eliminating toxicological risks to humans, poultry, and the environment arising from acaricide use in *D. gallinae* control;
3. Positively influencing poultry health status by preventing the parasitic and vector roles

of *D. gallinae*, as well as the adverse effects of control measures on flocks;
4. Reducing and ultimately eliminating direct and indirect costs associated with *D. gallinae*. Suppression-based approaches are always associated with costs that tend to increase. Annual *D. gallinae* costs in poultry production are estimated at €0.6 per hen and are increasing [26]. Eradication eliminates these costs and accumulates savings [21] which for a farm with a capacity of one million hens could amount to approximately €6 million over ten years;
5. Reducing the potential for resistance development, thereby preserving available resources for *D. gallinae* control.
Suppression measures are not completely excluded by eradication; rather, their role is to safely and cost-effectively maintain infestation at a non-harmful level until the necessary conditions for eradication in a facility or farm are met.
The proposal for *D. gallinae* eradication is not universal. The MPŽ patent (P 2024/1123) offers a solution for *D. gallinae* control in family farms and extensive poultry production through natural balance.
Research aimed at facilitating eradication and optimizing its process, in light of contemporary developments and trends, continues through the development and explanation of all elements of the control program (https://program-control-d-gallinae.com/).

4. Conclusions

Through multi-decade laboratory and clinical research, we demonstrate the possibility of eradicating *D. gallinae* from industrial poultry production facilities using acaricides, SiO_2, inert oils, and/or their combinations. For this purpose, previously published data and results of new investigations were integrated, covering a total of 29 facilities with a combined capacity of 642,500 birds. Eradication was demonstrated according to the strictest criteria, as well as its justification and cost-effectiveness compared with suppression-based approaches.
Eradication, together with the implementation of biosecurity measures, represents a way to halt and subsequently resolve the unfavorable trend of *D. gallinae* expansion, protect the health of humans, animals, and the environment, and ensure more profitable table-egg production.

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