



Effectiveness of *Solenostemma Argel* Extract on *Dermanyssus Gallinae* in Budgies (*Melopsittacus undulatus*)

Daouia K. Benmaarouf^{1*} , Amina Laieb² , Bernard China³ , Nezha Khouchane² , and Meriem H. Ben-Mahdi¹

¹Unit for evaluating the efficacy of pharmacological molecules and developing alternative strategies, Animal Health and Production Research Laboratory, Ecole Nationale Supérieure Vétérinaire, Algiers, Algeria

²Department of Veterinary Zoology, Jardin d'essai El Hamma, Algiers, Algeria

³Sciensano, Belgian institute of Health, Wytmanstreet 14, 1050 Brussels, Belgium

*Corresponding author's Email: d.benmaarouf@gmail.com

ABSTRACT

Dermanyssus gallinae (*D. gallinae*) is an important ectoparasite in veterinary and human medicine due to its role as a vector of infectious disease-causing pathogens and its economic impact. The present study reported the infestation of 45 budgies (*Melopsittacus undulatus*) reared in an aviary at the Jardin d'essai Zoo, Algiers, Algeria, showing signs of pruritus with sores due to itching. Skin samples were taken from the 45 budgies (26 females, 19 males), 26 nests, and an aviary containing the budgies were microscopically analyzed. The findings indicated the presence of *D. gallinae* (hematophagous mite) in all budgies and nests. To fight against this red mite, a treatment based on the *Solenostemma argel* (*S. argel*) aqueous extract was implemented. The *S. argel* aqueous extract 2% showed a fast and effective influence on *D. gallinae* mites present in the budgies, nests, and aviary. The aqueous extract of *S. argel* leaves could be a good candidate in the fight against red mites.

Keywords: Aqueous extract, Budgie, *Dermanyssus gallinae*, *Solenostemma Argel*

INTRODUCTION

Dermanyssus gallinae (*D. gallinae*), also called false louse or red louse of poultry, is a hematophagous avian parasitic mite with nocturnal activity. Its reservoir is usually the nests of various birds, aviaries, and chicken coops (Magdoud et al., 2019). The *D. gallinae* can infest other hosts, particularly dogs, cats, rabbits, horses, and humans (Dogramaci et al., 2010). The *D. gallinae* mite infestation is a serious public health concern, as the prevalence of red mites is expected to increase due to recent changes in hen-rearing practices, increased resistance to acaricides, global warming, and the lack of a sustainable approach to control infestations by this parasite (Sigognault Flochlay et al., 2017). The *D. gallinae* can cause great economic losses justifying the development of new effective and safe treatments for animals (Sadr et al., 2022). The increase in the rate of resistance to acaricides used against this parasite limits the effectiveness of these products (Decru et al., 2020). Several research studies have been carried out to establish alternative herbal treatments for the treatment and prophylaxis of *D. gallinae* infestation (Ghavami et al., 2020; Amer et al., 2021; Sadr et al., 2022). This clinical case falls within this context.

Solenostemma argel (*S. argel*) is a tropical plant widely used in traditional medicine for the treatment of several ailments, including gastrointestinal disorders, diabetes, rheumatism, lung, liver, and kidney infections, pain, inflammation, and wounds (Innocenti et al., 2005). The *S. argel* is distributed in the desert regions of Algeria, Egypt, Libya, and Sudan (Benmaarouf et al., 2020). The aerial parts of *S. argel* were formerly used in animal husbandry to control parasites present in animal drinking water (Benmaarouf et al., 2020). The *S. argel* extracts are known to have antibiotic, antifungal (Farrah and Ahmed, 2016), and insecticidal properties (Gipreel et al., 2020). The aim of this case study was to make known the effectiveness of the aqueous extract of *S. argel* on mite *D. gallinae* eradication.

CASE REPORT

The case of the current study was a budgie aviary located in the Jardin d'essai Zoo in Algiers, Algeria. The aviary housed 45 budgies (*Melopsittacus undulatus*), consisting of 26 females and 19 males, aged between 1 to 4 years (Figure 1). The zoo care staff reported signs of pruritus with squama and sores due to feather pecking, stress, and restlessness in the birds. Furthermore, the sanitary condition of the aviary was reported to be unsanitary, with bird feces present on the floor and in the drinking water (Pavlicevic et al., 2019; Decru et al., 2020). The sanitary condition of the aviary was not safe for birds. More precisely, the aviary, floor, and drinking water were soiled with bird feces.

The study was performed on October 2022 under a high relative temperature of 35°C and humidity of 70%. The clinical examination by a veterinarian highlighted the presence of pruritus signs as well as scales on the whole of the budgies' skin and in a greater quantity under their wings. Regarding the general clinical signs, the veterinarians observed a lack of appetite and restlessness in all individuals.

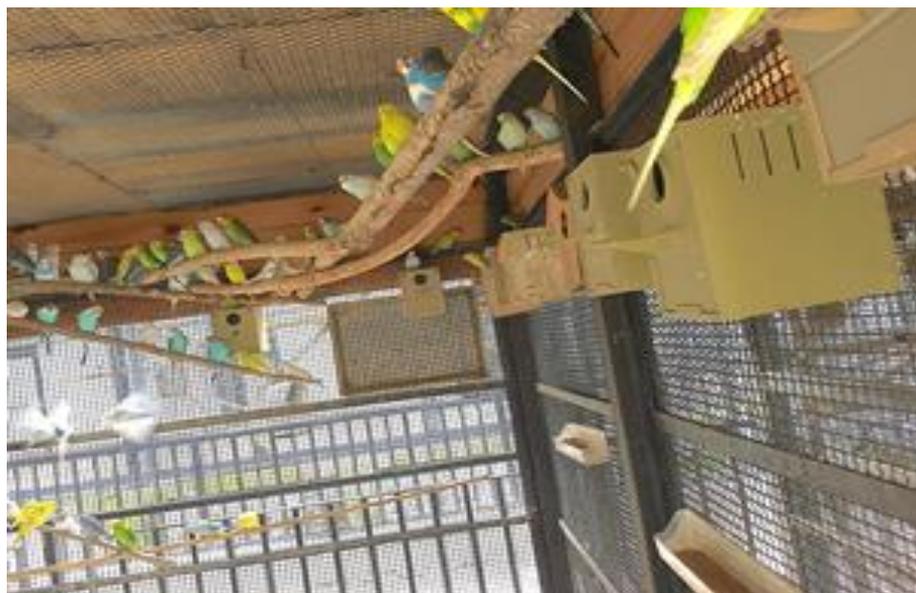


Figure 1. Budgerigar aviary in the Jardin d'essai zoo of Algiers, Algeria

Complementary examinations

To collect dander, skin samples were taken from the budgies in the form of scrapings, with at least one sample per animal. Feathers were also taken. In addition, samples were taken from the soil of the aviary and 26 nests. All the samples were then stained with lactophenol cotton blue (Sigma-Aldrich, Merck, Germany) and observed under an optical microscope (10x, Motic BA310, MoticEurope, Germany). Direct examination of collected specimens at the veterinary school of Algiers, Algeria, revealed the presence of blood-engorged *D. gallinae* mite (Figure 2 A), characterized by styliform chelicerae, long legs, and a dorsal shield narrowing at the rear (Sparagano and Giangaspero, 2011). Direct microscopic examination also indicated *Malassezia spp.* yeasts in very large numbers per field (Figure 2 B). The presence of *Malassezia* yeasts was a sign of a fungal superinfection, probably due to the weakening of the immune defenses (Velegraki, 2015; Hobi et al., 2022).

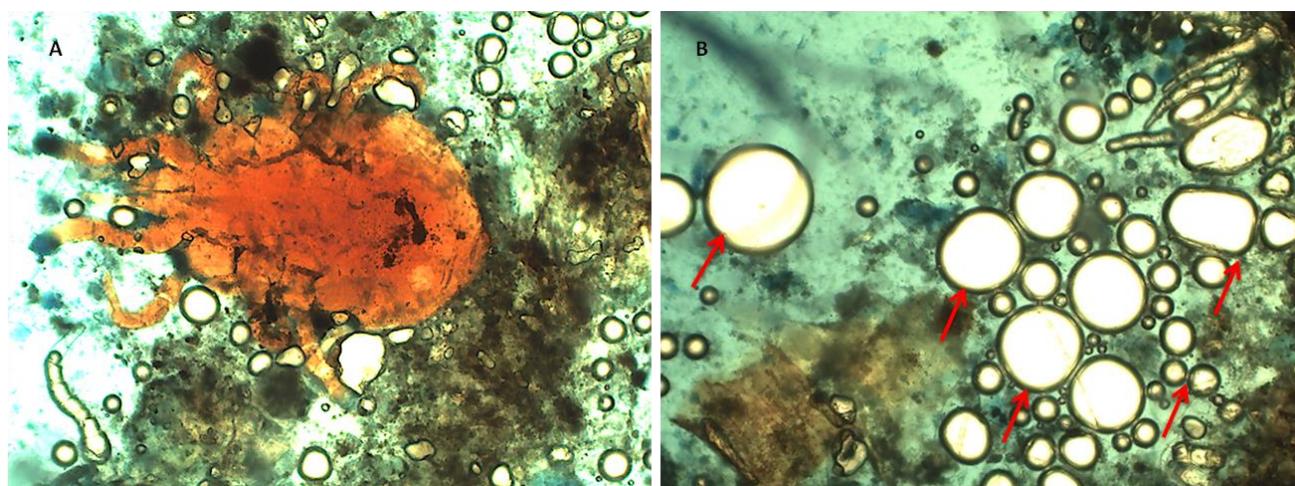


Figure 2. *Dermanyssus gallinae* (A) and *Malassezia spp.* (B, white spherical structures arrowed) collected from *Melopsittacus undulatus* (Algiers, Algeria, October 2022), magnification 10x.

Preparation of the extract

The aqueous extract was prepared from the leaves of the *S. argel* plant harvested in southern Algeria in the region of Abaessa in Tamenrasset in February 2022. The identification of the plant was carried out by the botanical service of the National School of Agronomy (Ecole Nationale Supérieure d'Agronomie, ENSA) of Algiers in Algeria with the delivery of an identification certificate (ENSA 08/01/2020). Reference specimens have been deposited in the herbarium

of the Animal Health and Production Laboratory of the National Veterinary School of Algiers (Santé Production Animale, SPA. 031).

The lyophilized aqueous extract was prepared by mixing 20 g of powdered dried leaves of *S. argel* in 1000 ml of boiling water, and the mixture was boiled in a water bath for 30 min. The mixture was filtered and then adjusted to 1000 ml before being lyophilized (Abubakar and Haque, 2020). To make the 2% aqueous solution, 20 g of the powder was dissolved into 1 liter of sterile distilled water (Unpublished data).

Treatment

In order to eliminate the blood-sucking mite *D. gallinae*, the budgies were individually sprayed on the whole body and especially below the wings using a sprayer with a 2% aqueous solution based on *S. argel* for a week. The aviary and the nests were disinfected with the 2% aqueous extract of *S. argel*. Each day after the treatment, the budgies were individually examined by a veterinarian for the presence of squama and itching. A marked improvement was noticed from the first application. On day 7, one skin sample (scratching) per animal below the left wing was taken from the budgies and from the aviary and nests to verify the effectiveness of the treatment. Direct examination of the skin samples under an optical microscope (10x, Motic BA310, MoticEurope, Germany) revealed the absence of *D. gallinae* on all of the examined samples from the budgies (*Melopsittacus undulatus*, Figure 3 A, B, C) and in the aviary and the nests (Figure 3 D). In addition, interestingly, the commensal *Malassezia* yeasts were found in smaller numbers on budgie samples (Figure 3 C).

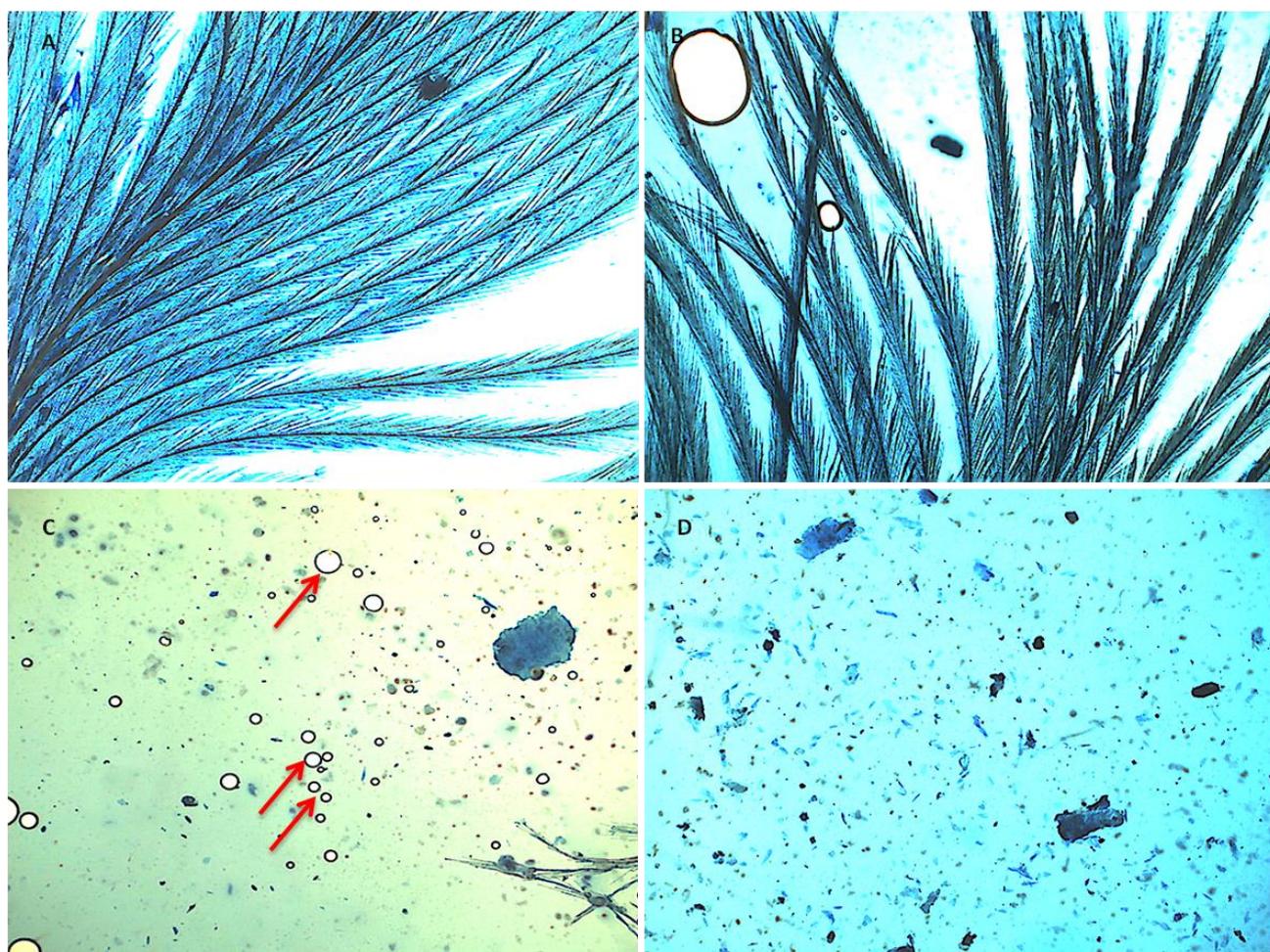


Figure 3. The treatment effects of aqueous extract of *S. argel* on *Dermanyssus gallinae* in samples with different sources in a zoo of Algiers (Algeria). **A, B, C:** Skin samples from budgies $\times 4$, **D:** Samples from aviary and nests $\times 4$. Red arrow: *Malassezia* spp. (spherical structures).

DISCUSSION

The *D. gallinae* is a cosmopolitan species, the most common Dermanyssidae mite, which parasites a wide range of hosts (Mullen and Oconnor, 2019). This mite is a major threat to the poultry industry and the breeding of ornamental birds worldwide, causing economic losses and serious animal health problems (Decru et al., 2020). The *D. gallinae* is a parasite of major importance both in veterinary and in human medicines insofar as it plays a vector role for several

pathogens, in particular, the bacteria *Escherichia coli*, *Pasteurella multocida*, *Coxiella burnetii*, *Erysipelothrix rhusiopathiae*, *Borrelia burgdorferi*, and *Salmonella enteritidis* as well as Avian Influenza virus A, Newcastle virus and equine encephalomyelitis virus (Valiente et al., 2007; Sparagano and Giangaspero, 2011; George et al., 2015; Sommer et al., 2016; Sigognault Flochlay et al., 2017).

The increasing prevalence of *D. gallinae* mite infestation around the world is a matter for concern, and can be attributed to several factors. These include the transformation of housing systems into avian breeding facilities, non-compliance with proper aviary management practices, global warming, and a lack of effective methods for controlling infestations, as well as the increasing resistance of mites to commonly used acaricides such as carbamates and pyrethroids (Sparagano and Giangaspero, 2011; Sigognault Flochlay et al., 2017). Furthermore, a shortage of effective acaricides has been reported, as several chemical treatments have been withdrawn from the market due to their adverse effects on humans, which limits the available options for controlling mite infestations (Abbas et al., 2014; Sigognault Flochlay et al., 2017).

In Europe, very few products are licensed for use against *D. gallinae*, and except for a recently approved phoxim-based product, they can be used only when the poultry house is empty, that is, between two productive cycles (Sparagano and Giangaspero, 2011).

The present clinical case demonstrated the efficacy of *S. argel* aqueous extract on budgies *M. undulatus* infested with the mite *D. gallinae*. The extract also allowed the elimination of the red mite from the nests and the aviary. Several studies have highlighted the phytochemical composition of *S. argel* (Tigani and Ahmed, 2009; Shafek and Michael, 2012; Benmaarouf et al., 2020). In particular, the main constituents of the *S. argel* leaves extracts are flavonoids (rutin, quercetin, kaempferol, Cen-Pacheco et al., 2020), alkaloids (Wu et al., 2021), tannins (Fernández-Salas et al., 2011) and saponins (Pavela, 2016; Teia, 2018) known to have antibiotic and acaricide effects. Therefore, *S. argel* extracts represent an interesting candidate in the fight against the hematophagous mite *D.gallinae*. The insecticidal effect of *S. argel* extracts was previously described on *Tribolium castaneum* (Gipreel et al., 2020) or *Culex pipiens* (Al-Mekhlafi et al., 2018). Several recent studies have highlighted the acaricidal effects of plant-based products against *D. gallinae*. The studies carried out previously showed the effectiveness of 50 plant essential oils (such as garlic, thymus, or tea tree) on red mites with mortality rates ranging from 80 to 100% (George et al., 2009; George et al., 2010). Another study demonstrated significant acaricidal activity of the essential oils of cade, clove, mustard, laurel, coriander, pennyroyal, red and white thyme, cinnamon, and spearmint against *D. gallinae* using direct contact and fumigation methods (Kim et al., 2004).

However, favorable sanitary conditions are necessary to guarantee the effectiveness of different drugs and extracts in control of the red mite. the aqueous extract of *S. argel* leaves seems to have an effect on the reduction of *Malassezia* yeasts, indicating an antifungal effect. It is in agreement with a previous study showing an antifungal effect on *Candida albicans* (Farah and Ahmed, 2016).

CONCLUSION

The aqueous extract of *S. argel* allowed total eradication of the blood-sucking mite and zoonotic agent *D. gallinae* in the current study. The aqueous solution of *S. argel*, therefore, could be an effective and safe means of combating this ectoparasite. Moreover, the antifungal effect of *S. argel* extract is also suggested. The effect of *S. argel* extract on different ectoparasites, as well as the determination of the active substances, can be considered in future studies.

DECLARATION

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Availability of data and materials

The raw data are available on demand from the corresponding author.

Authors' contributions

Daouia Keltoum Benmaarouf (DKB) is the major investigator, Amina Laieb is the zoo veterinarian collaborating with DKB for the diagnosis and the treatment of the animals, Bernard China was active in the redaction and verification

of the manuscript, Nezha Khouchane is the director of the Zoo allowing the study, Meriem Ben Mahdi is the research supervisor. All authors confirmed the final draft of the article for submission to the journal.

Competing interests

The authors declare no conflict of interest.

Ethical consideration

The authors take steps to abide by all ethical standards related to plagiarism, publication approval, inaccuracies in data, multiple submissions, and double publication.

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