Ectoparasitic infestations of backyard chicken and the associated health impacts in resource-constrained communities of Nigeria

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Research Article

Keywords: Mite, Ectoparasites, Dermanyssus gallinae, Poultry red mites, Backyard chicken, and zoonotic

Posted Date: November 18th, 2025

DOI: https://doi.org/10.21203/rs.3.rs-7727989/v1

Abstract

The economic and health impacts of chicken ectoparasitic infestations are raising significant concerns. Developing control strategies requires understanding the epidemiological profiles and perspectives of poultry owners. Therefore, we investigated the prevalence and associated health impact of ectoparasitic infestation of backyard chickens in resource-poor communities of Nigeria. Of 354 (38.4% male and 61.5% female) chickens screened, 39 (11.0%) were infested (11.5% and 14.4% were male and female, respectively). Infestation is most common in chicks at least 3 months old. More than 11% of the infested chickens are lethargic due to severe infestation. Four species of lice, *Menacanthus strimineus*, (38.5%) followed by *Menopon gallinae* (22.0%), *Liperus caponis* (17.6%), and *Goniodes gigas* (4.4%) were identified. *Dermanyssus gallinae* was the only mite species found on the infested chicken, accounting for 17.6% of the total ectoparasites. Multiple infestations are common among female chickens, and a frequent combination is *M. strimineus*, *M. gallinae*, and *D. gallinae*. Chicken keepers signified unpleasant sensations and discomfort as public health consequences experienced while working near the infested chicken, and infestation is the leading cause of death of the affected chicks. Chicken owners have reported that local materials such as hot ash, palm kernel oil, and plants including *Citrus sinensis, Azadirachta indica, Ficus exasperata*, and *Bridella micrantha* are effective in mitigating the transmission of infestations. However, there is limited knowledge about the mode of action and suitable application methods. This research emphasizes the occurrence and health implications of ectoparasitic infestations in poultry, as well as their potential public health risks for those working near these animals. Thus, concerted actions are necessary to prevent future zoonotic transmission of ectoparasites.

Introduction

Poultry farming is a crucial aspect of agriculture that has significantly contributed to protein sources, food security, and employment in many countries. This sector accounts for approximately 25% of the agricultural domestic products of the Nigerian economy (GIREI, 2020). The global market is projected to achieve a value of $422.97 billion by 2025, with a compound annual growth rate (CAGR) of 7%. The traditional free-range system of poultry keeping is widely practiced in resource-constrained communities in Africa and certain parts of Asia (Ngongolo, Omary, & Andrew, 2021; Refisa, Firouzivand, Chanie, Garedaghi, & Rebuma, 2025). However, this system encounters significant challenges, including poor immunity, weak health, and low production efficiency. Parasitic infestation greatly endangers the overall health and well-being of birds, impacting their physical and mental condition as well as the quality of egg production. (Mohammed & Shamal, 2023). Severe ectoparasitic infestation causes irritation, reduced growth, anemia, emaciation, and bird deaths in the flocks (Sigognault Flochlay, Thomas, & Sparagano, 2017; Sparagano & Ho, 2020). Ectoparasites, specifically mites, have been known to transmit diseases of veterinary importance to chickens, such as *E. Coli*, chickenpox, Newcastle, and *Erysipelothrix rhusiopathiae*. Mites can also bite mammals and humans, leading to painful skin irritation. (Chirico, Eriksson, Fossum, Jansson, & entomology, 2003; Mccrea, 2005). Chewing lice, among the common ectoparasites of chicken (others are mites, soft ticks, and fleas), are the most widespread chicken ectoparasitic infestation, followed by blood-sucking red poultry mite - *Dermanyssus gallinae* (Nahal,

Righi, Boucheikhchoukh, & Benakhla, 2021; Pickworth & Morishita, 2007; Pritchard, Kuster, Sparagano, & Tomley, 2015).

Chicken lice are small wingless insects with chewing mouthparts and spend their entire life on a single host, except on a few occasions when they latch onto flies or transfer from a nesting hen to a chick. They exhibit a high degree of host specificity; poultry lice cannot survive on any other host, including humans. The nits attach to the feather while the adults feed on skin scales, scab tissue, and feathers, feeding on the blood from the punctured skin and feather quills. Lice infestations are more problematic for backyard flocks than commercial flocks due to the lack of parent-offspring interaction in commercial breeding practices. In backyard flocks, hens incubate eggs and care for chicks, making spreading lice between generations easier. This accelerates the death rates of the young birds upon secondary infection, causing reduced egg production in the older ones. On the other hand, mites are arachnids, smaller than lice, nocturnal feeders that hide in the crevices and the floor of the housing during the day. Mites such as *D. gallinae* exhibit a short life cycle; the development of juveniles to reproductive adult stages occurs within one week. *D. gallinae* is classified as a highly troublesome and annoying pest due to its consumption of blood at different life stages to facilitate rapid reproduction. Mites' feeding behavior can cause significant damage to the chest and legs of birds, resulting in skin inflammation, itching, and necrosis of feather follicles. Severe infestations may even lead to the death of newly hatched chickens (Hobbenaghi, Tavassoli, Alimehr, Shokrpoor, & Ghorbanzadeghan, 2012). Similarly, *D. gallinae* is a potential carrier of a range of pathogens like *Salmonella* spp., chicken pox virus, avian spirochetes, Newcastle disease virus, erysipelas, fowl typhoid, cholera, and eastern equine encephalitis virus, affecting poultry and livestock (Hobbenaghi et al., 2012; Schiavone et al., 2022). Unlike lice, chicken mites do not exhibit host specificity but rarely bite poultry keepers during the day, except at night. There are increasing reports of poultry red mites (PRM) parasitizing humans, leading to painful bites causing irritation, itching, red skin lesions, and dermatitis depending on the infestation load (George et al., 2015; Sioutas et al., 2021). All these suggest the poultry mites' potential host expansion and zoonotic tendencies that can potentiate erratic host immune response in the affected human.

In light of the potential economic and health consequences associated with these ectoparasites on both chickens and humans and the lack of a comprehensive understanding regarding the epidemiological profiles and attitudes of backyard poultry keepers in north-central Nigeria, specifically in Kwara state, towards management practices. The study aims to fill these gaps by conducting an epidemiological survey and assessing the attitudes and practices of backyard poultry keepers. The expected outcome is to facilitate the design and implementation of effective integrated control strategies, benefiting both chickens and humans in the region.

Materials and methods

Study location and design

The study was conducted in Ilorin, capital of Kwara state Nigeria (longitude 4º 30’ – 4º 45'N and latitude 8º 28’ – 8º 38'E) located in Nigeria’s central savannah region characterized by intense rainfalls from April to October and daily temperatures between 23ºC and 37ºC. Ilorin is the gateway between southern and northern Nigeria with approximately 765 square kilometers. The city comprises five local government areas (LGAs): Ilorin East, West, South, Asa, and Moro Local Government Areas. Local chickens reared across these LGAs were randomly screened in our house-to-house survey. We obtained information regarding age, gender, housing, knowledge of parasites, and the purpose of keeping chickens with a pre-tested open-ended structured questionnaire developed for this study (Supplementary file 1). Various chicken parts (such as feathers, comb, and thigh), egg carcasses, and the house were carefully examined for the collection of ectoparasites in a pre-labeled specimen bottle.

Collection and laboratory processing of samples

Different preference sites on the chickens were meticulously brushed using a gentle brush to avoid harm, and the ectoparasites retrieved from each site were gathered in labeled sampling bottles filled with 70% ethanol and 5% glycerin. The specimens were then transferred to the Department of Zoology Parasitology Laboratory, University of Ilorin where they were macerated and cleared in 10% potassium hydroxide (KOH) solution followed by the dehydration in ascending strength of alcohol (50%, 70%, 90% and absolute) for 10–15 minutes each. Then, the specimens were individually affixed in Canada balsam onto a pristine glass slide for microscopic analysis. The ectoparasite species were morphologically identified using the identification guides authored by Ikeme 1976, Soulsby (1982, Wall RL, Shearer D. 2001, and Pajot F-X 2000, and as reported (Ouarti et al., 2020). Photographs of the parasites were taken using a 15-megapixel Sony Cyber-shot digital camera attached to the microscope.

Statistical Analysis

The data collected from identifying ectoparasites in poultry and information regarding the chicken and chicken keepers were coded, entered, and descriptively analyzed using SPSS software version 16. The responses from the face-to-face questionnaire were coded for graphical representation using GraphPad Prism 8.0.1. The infestation pattern stratified by the chicken's age and sex was analyzed using SPSS.

Results

A total of 284 chicken keepers were visited; 75% were female with an average of 48.1 years, and 25% were male chicken keepers, with an average age of 42.3 years. Approximately 40% and 13% of them kept chickens for subsistence and commercial purposes, respectively, although 46.1% raised chickens for both purposes (Table 1). Overall, we screened 354 (38.4% male and 61.5% female) local birds, categorized into three age groups < 3, 3–9, and > 9 months old. The precise age of 23% of the chickens enrolled is unknown. (Table 1). The free-range system is the dominant housing system adopted by all the chicken keepers; 69.1% of the chickens examined were housed in sand-filled cages overnight, while

30.9% were without any housing facilities. Most local chicken keepers (75%) are female in our study areas, and the most commonly raised chickens are female (61.5%). Of the 354 chickens examined, 39 (11.0%) were infested, among which 11.5% and 14.4% were male and female chickens, respectively (Table 2). Chicken of less than 3 months was less infested; the incidence of infestation is common among 3–9 months old chickens (Fig. 1). Analysis of infestation based on the status of the chicken showed that 12.8% of the infested chickens were still active with no obvious sign of health impact, while 20.3% and 11.3% were in either isolation or sluggish, respectively as a result of heavy infestation. We collected ectoparasites on multiple parts of the infested chicken, including their housing/cage floor and egg carcasses. Thigh and breast regions were the most affected sites, accounting for 7.4% of infestations. The fluff of the feathers (6.7%), head, comb, and eyelid (3.5%), neck, back, and abdomen (5.3%) were moderately affected. Parasites were also found in 0.7% of the infested chickens' egg carcasses and 2.5% in their housing/cage floors in our study. We identified four species of lice; the dominant species, *Menacanthus strimineus*, accounted for 38.5% of the total ectoparasite population recovered, followed by *Menopon gallinae* at 22.0%, *Liperus caponis* at 17.6%, and *Goniodes gigas* at 4.4%. *Dermanyssus gallinae* was the only mite species found on the infested chicken, representing 17.6% of the total ectoparasites (Table 2). Figure 2 shows digital images of the identified ectoparasites. This study showed that 34 out of 39 infected chickens had multiple infestations, commonly among female chickens aged 3 months and older (Table 3). Over 43.5% of the infested chickens displayed three ectoparasitic infestations, while 35.9% exhibited more than three infestations. The most frequent combination of ectoparasites consists of *Menacanthus strimineus*, *Menopon gallinae*, and *Dermanyssus gallinae*. It is worth noting that we did not find any cases of *Dermanyssus gallinae* infestation without *Menacanthus strimineus* in our collection. Chicken keepers' knowledge, attitudes, and practices (KAP) concerning the transmission, control measures, and potential health effects of ectoparasitic infestations in chickens were evaluated with a questionnaire. The survey indicated that around 60% of chicken owners perceived the hatching period as the time with the greatest risk of ectoparasitic infestations in chickens, and 49.7% attributed the primary cause to an unclean environment (Fig. 3). Concerning infestation management, over 60% of participants used hot ash, while others applied local substances like palm kernel, kerosene, hot water, and, salt and water. Similarly, a considerable proportion of our study participants used plant materials such as *Citrus sinensis*, *Azadirachta indica*, *Ficus exasperata*, and *Bridella micrantha*, others include *Nicotiana tabacum*, *Annona senegalensis*, and *Elaeis guineensis*. Figure 4 shows that infestation causes high mortality in young chickens, while weight loss, decreased appetite, and lethargy are common in affected chickens of all ages and genders. In this survey, 65% of chicken keepers indicated that they experienced itching sensations, while 37.9% reported other forms of discomfort when their chickens were infested. These unpleasant sensations are significant public health consequences. About 15% of participants reported encountering chicken ectoparasites feeding on their blood, while 10% believe infestations do not significantly affect owners' health.

Table 1
Characteristics of chicken and chicken keepers

Characteristics	N (%)
The population of sampled chicken keepers	284
Average age examined (Years)	46.7
Percentage of males/females examined	25/75
The average age of males examined (Years)	42.3
The average age of females examined (Years)	48.1
The purpose of keeping chicken	
Subsistence	114 (40.1)
Commercial	39 (13.7)
Both	131 (46.1)
The population of sampled chicken	
Male examined	354
Female examined	127 (38.4)
Age group examined	227 (61.5)
<3 months	28 (9.9)
3–9 months	79 (27.8)
>9 months	111 (39.1)
Unknown	66 (23.2)
Chicken Housing	
Sand-filled cage/ container	196 (69.1)
None	88 (30.9)

Table 2
Prevalence of ectoparasite infestation and the species identified in the study

Variables	N (%)
Overall prevalence	39(11.0)
Genders	
Male	8(11.5)
Female	31(14.4)
Purpose of keeping	
Subsistence	16(13.9)
Commercial	6(13.3)
Both	17(13.7)
Status of the chicken	
Active	24(12.8)
Solitude	9(20.3)
Sluggish	6(11.3)
Predilection sites	
Head, comb, eyelid	10 (3.5)
Neck, back, abdomen	15 (5.3)
Fluff of feathers	19 (6.7)
Thigh and breast region	21 (7.4)
Carcass of eggs	2 (0.7)
Floor or sand	7 (2.5)
Species of lice	
Menacanthus stramineus	35(38.5)
Menopon gallinae	20(22.0)
Lipeurus caponis	16(17.6)
Goniodes gigas	4(4.4)
Species of mite	16(17.6)
Dermanyssus gallinae	

Table 3
Prevalence and patterns of co-infestation with respect to sex and age

Infestation Patterns	Overall N (%)	Sex: Male	Female	Age (months): 0–3	3–9	>9	Unknown
Single	5(12.8)	1(20.0)	4(80.0)	2(40.0)	0(0.0)	3(60.0)	0(0.0)
Double	3 (7.6)	2 (66.7)	1(33.3)	0(0.0)	1(33.3)	0(0.0)	2(66.7)
Triple	17 (43.5)	4(23.6)	13(76.5)	3(17.6)	8(47.1)	6(35.3)	0(0.0)
Multiple	14(35.9)	1(7.1)	13(92.9)	0(0.0)	8(57.1)	3(21.4)	3(21.4)

Discussion

This study revealed that ectoparasitic infestation is one of the major health concerns, posing a major threat to the growth and health of backyard-reared chickens in these study areas. The overall prevalence of 11.0% (39/354) observed in this study is slightly lower than 15.2% and 19% reported in Maiduguri, the northeastern part of Nigeria, in 2008 (Biu, Agbede, & Peace, 2007) and Northeast of Tunisia in 2019 (Kaboudi, Romdhane, Salem, & Bouzouaia, 2019) as well as 49.7% in Amhara, Ethiopia(Berihun, Yekoye, & Alemayehu, 2024), respectively. Higher prevalence was also documented in other parts of Nigeria (Ekpo, Ogbooye, Oluwole, & Takeet, 2010; Lawal et al., 2016; Rabana Lawal, Bukola Yusuf, Dauda, Ahmed Gazali, & Abubakar Biu, 2017), Ethiopia (Endale, Aliye, Mathewos, & Adimasu, 2023; Kebede, 2019), Algeria (Nahal et al., 2021), Iran (Rezaei, Hashemnia, Chalechale, Seidi, & Gholizadeh, 2016; Shamsi, Samaeinasab, & Haghighatkhah, 2020). In this study, four species of lice were identified; *Goniodes gigas* is the least prevalent species observed in 4.4% of the infested chicken, *Menacanthus strimineus* is the most prevalent, followed by *Menopon gallinae*, and *Liperus caponis*, accounting for 38.5%, 22.0% and 17.6% of the affected chicken, respectively. *Dermanyssus gallinae* is the only mite species identified in 17.6% of the infested chickens. Similar to Shamsi et al. (Shamsi et al., 2020), we did not find a tick and flea species in this study as previously reported by (Lawal et al., 2016; Rezaei et al., 2016; Riwidiharso et al., 2020), nor chigger as reported in a study from Malaysia (Rahman & Haziqah, 2015). The variation in the occurrence and species abundance of ectoparasites found in different studies may be influenced by several factors, such as the geographical location, the sampling season, host characteristics, and the level of awareness of chicken keepers (Wale, Bekele, & Yihune, 2023). The occurrence of infestation is influenced by seasonal variation (Mungube et al., 2008; Nadeem et al., 2007; Salam, Mir, & Khan, 2009), thus, the lower point prevalence of infestation in this study could be attributed to the sampling period, which aligns with the rainy season when temperatures were slightly lower. This decrease in temperature is probably linked to the resistance of chickens to parasites and unfavorable temperatures for the growth and reproduction of lice and mites, as noted in previous studies (Arlian & Morgan, 2003; Nadeem et al., 2007; Prendergast, 2020). However, the poor housing system, with about 70% of the examined chickens housed in sand-filled cages overnight, is one of the prevailing problems in our study area. This

accelerates the transmission of ectoparasite infestation among the local chickens, particularly through contact with sand that serves as a reservoir of a myriad of pathogens.

In this study, the infestation pattern shows that older female chickens of at least 3 months are mostly affected. This is consistent with many previous reports, although some studies have reported the opposite (Kaboudi et al., 2019; Kebede, 2019; Rabana Lawal et al., 2017). Overall, 87.2% of the infested chickens exhibit co-infestation of ectoparasites, making multiple infestations a common observation rather than an exceptional in our study area. Specifically, the prevalence rates for single, double, triple, and more than three infestations are 12.8%, 7.6%, 43.5%, and 35.9% respectively. At least 3-month-old female chickens are frequently co-infested with at least three parasites simultaneously. The common ectoparasites combination consists of *M. strimineus*, *M. gallinae*, and *Dermanyssus gallinae*. There have been no cases of *D. gallinae* infestation without *M. strimineus*, thus, their co-occurrence is the commonest double infestation recorded in this study. The heightened vulnerability of older chickens to a higher infestation rate is attributable to their foraging habits, increased interactions with other chickens, and prolonged exposure to infested environments. Nevertheless, low immunity may lead to the susceptibility of the younger chickens to infestation, as reported in some studies (Dagmawit A, 2014; Endale et al., 2023). We found that the prevalence of infestation remains consistent across all the chickens regardless of the purpose of keeping them. This indicates that chicken owners in our study area, especially those who keep chickens for commercial purposes, failed to apply necessary disease control measures to sustain their operations and achieve the expected compound annual growth rate (CAGR). Parasites were found all over the affected chickens' bodies, including the thighs, breasts, feathers, neck, back, abdomen, head, and comb, and some were also collected from the cage floors and egg carcasses. Surprisingly, most of the infested birds in this study remained active, possibly due to a lower infestation rate; only a few exhibited signs of lethargy, isolation, emaciation of the prominent keel bone, and atrophy of thigh muscle (Shanta, Begum, Anisuzzaman, Bari, & Karim, 2006). Many affected female chickens exhibit decreased egg production or unfertilized eggs. This observation aligns with the report that the presence of ectoparasites can lead to pathophysiological consequences, impacting the host's immune defenses, hormonal balance, and levels of crucial metabolites, like fecal glucocorticoid metabolites, and physiological function of the host (Díaz H & Castro Ke, 2015; St Juliana, Khokhlova, Wielebnowski, Kotler, & Krasnov, 2014).

The host expansion potential of *D. gallinae* has been recognized as an emerging threat by the World Organization for Animal Health and the World Health Organization, with many human cases (Banovic et al., 2024). Identifying this mite species in this study highlights the public health implications of the current investigation. In addition to the widespread challenge posed by poultry red mites (*D. gallinae*) within the laying-hen sector, such as anemia and death of hens by exsanguination, its saliva causes a skin condition called gamasoidosis in humans. It is emerging as a significant zoonotic dermatitis in human medicine, particularly for individuals residing or working near poultry operations, particularly children with low immunity (George et al., 2015). Similarly, these mites are identified as vectors of zoonotic diseases, caused by avian viral and bacterial pathogens that affect animals and humans (Sigognault Flochlay et al., 2017). As a result, it is crucial to put in place regulated measures in the

affected area; we enlightened our study participants and informed appropriate authorities in the affected local government of proactive measures to avert future outbreaks. In this current study, we used an open-ended questionnaire survey to gain insight into the overall effects of chicken ectoparasite infestation on the health of the chicken keepers and humans in the proximity. Most individuals who raise chickens reported itching and discomfort, as significant health issues caused by chicken ectoparasites. A few also experience blood-sucking sensations when close to severely infested chickens. This suggests that chicken mites may be transmitted to chicken keepers, aligning with previous research showing an increase in poultry red mites affecting humans, causing painful bites and skin irritation (George et al., 2015; Sioutas et al., 2021). Most chicken keepers cited unsanitary hatching conditions as the primary transmission risk factor and identified some local and botanical substances to control the transmission. Many chicken owners confirmed the effectiveness of hot ash, *Citrus sinensis, Azadirachta indica, Ficus exasperata*, and *Bridella micrantha* in controlling lice and mites. Thus, Local and botanical resources offer alternative approaches to address the shortfalls of some chemical-based treatments, particularly synthetic acaricides. These shortcomings include the ineffectiveness of active ingredients, the development of mite resistance, the deposition of harmful residues in the environment, and the unacceptable risks posed to non-target organisms as previously reported in many studies (Coles & Dryden, 2014; Hwang, 2023). Importantly, synthetic acaricide negatively impacts human health and the environment, with some neurotoxic compounds potentially being carcinogenic or harmful to mental well-being (Ansari, Moraiet, & Ahmad, 2014). However, many participants in our study show a limited understanding of the mechanisms of action and correct application techniques for the local and plant materials they explored, despite recognizing some level of effectiveness. Therefore, it is essential to offer clear guidance on their proper use to ensure optimal results. In conclusion, this research highlights the prevalence of ectoparasitic infestations and the economic impact on affected poultry. The study also illustrates the possible public health risks posed to individuals who work near the affected chickens. Therefore, coordinated efforts by individuals and organizations to foster awareness are crucial to avert future zoonotic transmission of diverse ectoparasites.

Abbreviations

CAGR
Compound annual growth rate and PRM:Poultry red mites

Declarations

Acknowledgments

We acknowledge the efforts of some undergraduate students who assisted during the work. The cooperation of study participants is appreciated.

Authors' contributions

BOA conceptualized, designed, and conducted the data analysis. He also supervised the work and drafted the manuscript, AUA and NMA were involved in data organization. AUA, IPA, and OOH collected samples and administered questionnaires. USU read the final manuscript. BOA and NMA revised the manuscript. All the authors read and approved the final manuscript

Funding: None

Availability of data and materials: Data and some of the processed samples/images are available upon request from the corresponding author

Ethics approval and consent to participate

The Ethical Review Committee of the University of Ilorin approved the research protocol. Furthermore, written informed consent was obtained from the participants involved in the study.

Consent for publication

All participants in the study provided their consent for the publication of the findings.

Competing interests: The authors declare that they have no competing interests.

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Figures

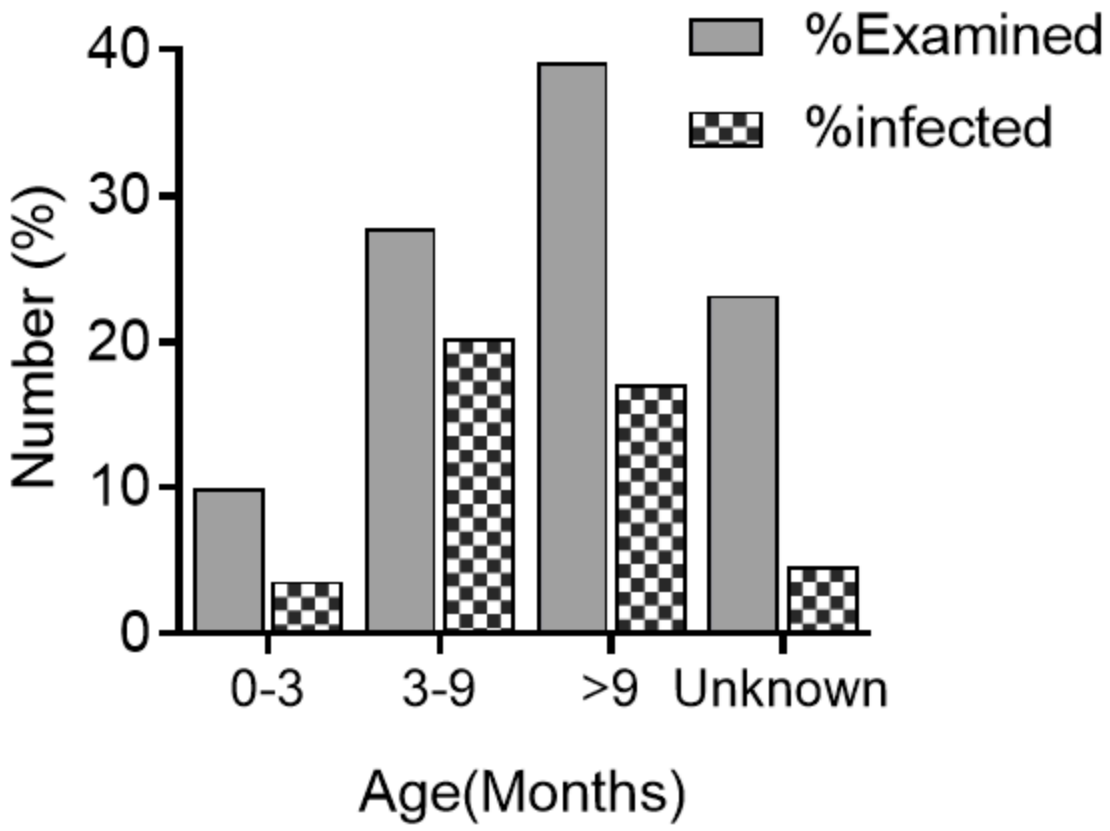

Figure 1

Prevalence of infestation with respect to age of the chicken

Figure 2

the species of lice identified in the study A: *Menopon gallinae* B: *Menacanthus strimineus* C: *Liperus caponis* D: *Goniodes gigas* E: *Dermanyssus gallinae*

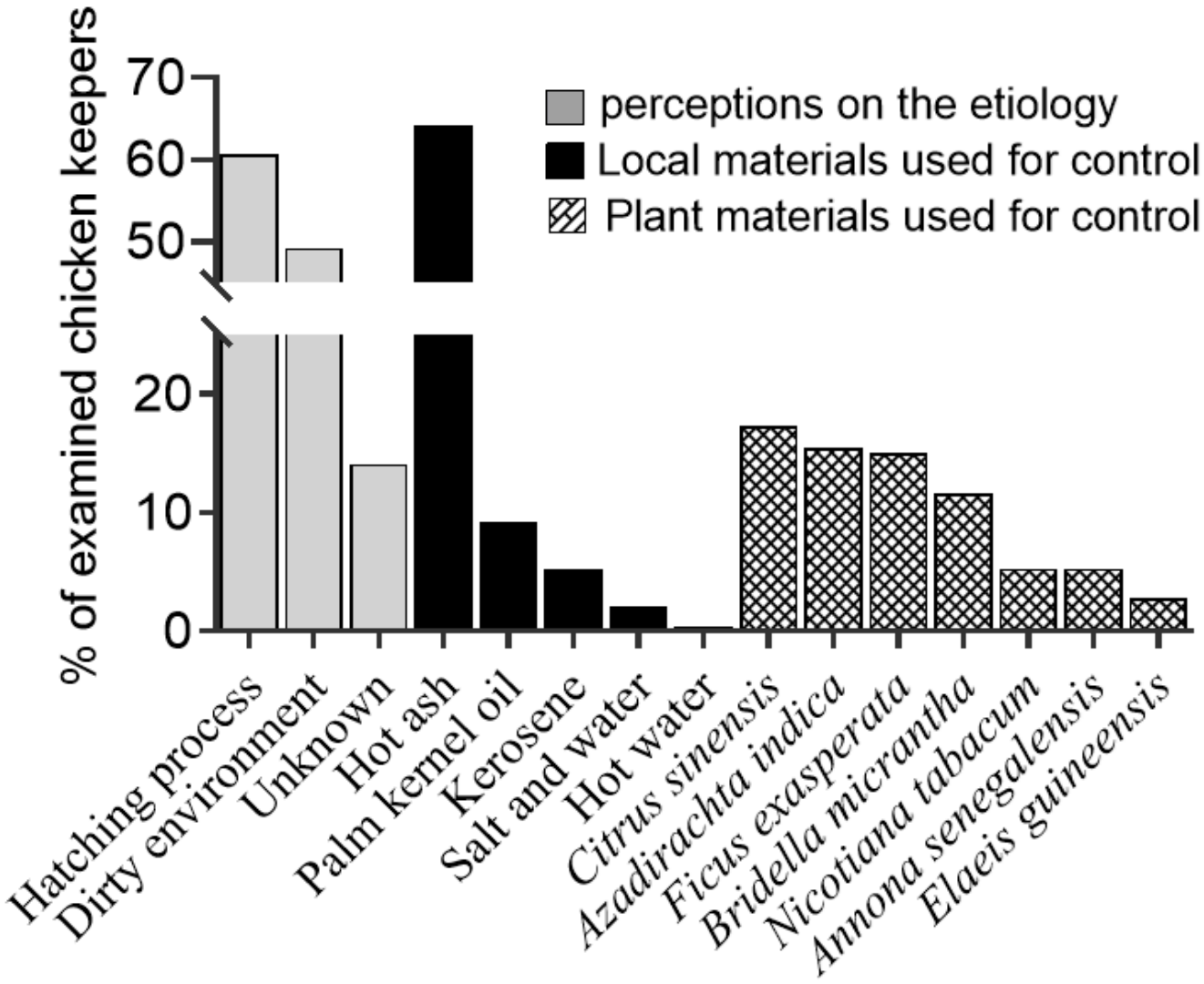

Figure 3

Chicken keepers' knowledge about cause and their control practices

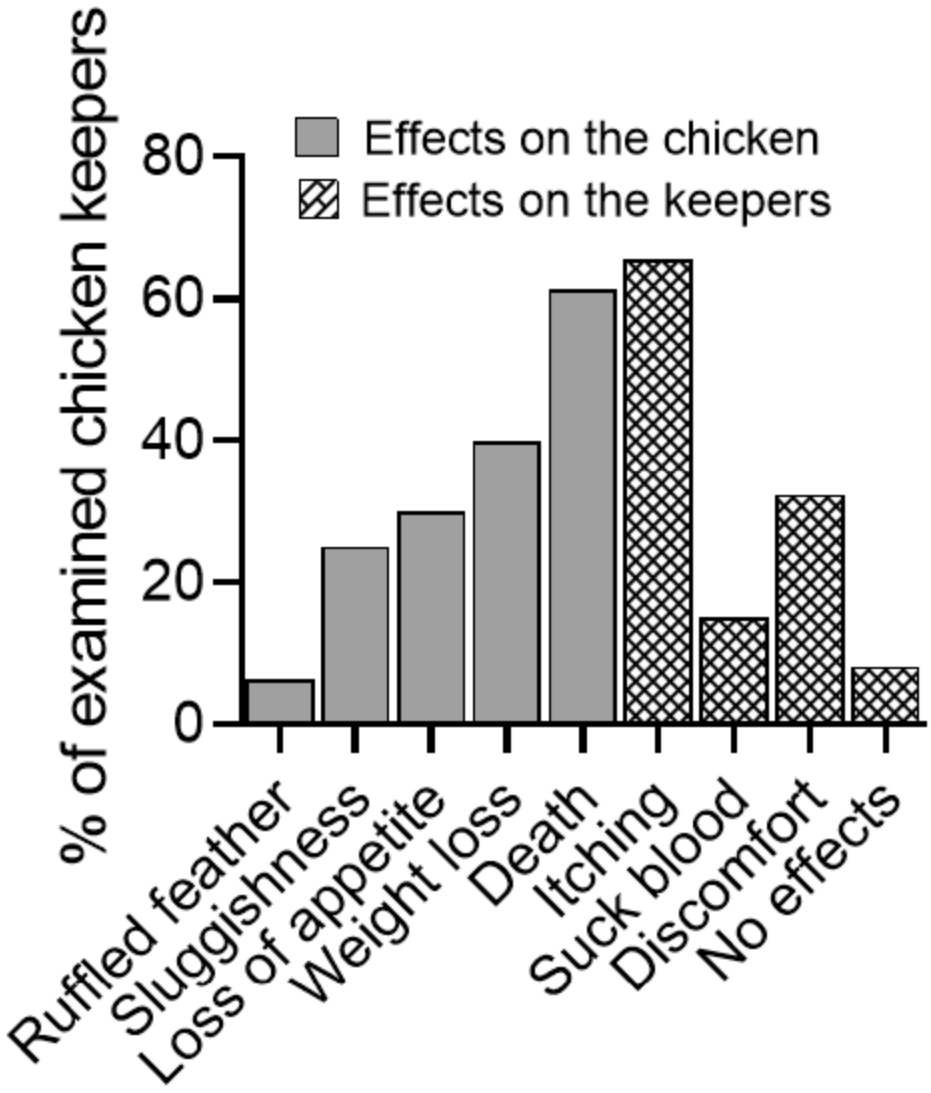

Figure 4

Health impact of ectoparasitic infestation on the chickens and their owners

Supplementary Files

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- SupplementaryFile1.pdf