Prevalence of ectoparasites in free-range backyard chicken flocks in northeast Algeria

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Abstract

Free-range backyard chicken breeding is gaining popularity in Algerian rural regions. Due to the natural rearing conditions, chickens are exposed a wide range of microbes and ectoparasites. Currently, little is known about the variety of ectoparasites infesting free-range chickens in Algeria. The present study was conducted over a two year period on 169 backyard chicken, with the aim of identifying and estimating the prevalence of ectoparasites on different body parts of the chickens, and their immediate environments in northeast Algeria. In total, 9943 ectoparasites were identified, and the seven most dominant species were: *Menopon gallinae* (82.84%), *Goniodes dissimilis* (15.97%), *Menacanthus stramineus* (13.60%), *Goniocotes gallinae* (6.50%), *Lipeurus caponis* (5.23%), *Argas persicus* (9.46%) and *Dermanyssus gallinae* (1.18%). *Menopon gallinae* was the most frequent isolated ectoparasite throughout the year. Soft ticks *Argas persicus* were isolated during spring and summer, mainly from crevices and cracks, while the chicken red mite *Dermanyssus gallinae* was detected in autumn with a low load on bird body parts and a high abundance in nests. These results list the most abundant ectoparasites in backyard chickens, which could facilitate the improvement of rearing management.

Key words: *Backyard chickens; ectoparasite; Prevalence; Algeria*

Introduction

Chewing lice, soft ticks, and chicken red mite are the most common poultry ectoparasites, affecting one in ten chickens (Tager-Kagan et al., 1992). Of these, chewing lice are the most widespread poultry ectoparasites, detected in domestic chickens worldwide (Al-Saffar and Al-Mawla, 2008; Gustafsson and Zou, 2020). While chewing lice is easy to control in modern poultry rearing structures, it remains a serious problem in backyard chickens (Price et al., 2003). Compared to other ectoparasites, such as fleas, chicken red mite and tick, chewing lice is less virulent (Clayton et al., 2008). Four species of hematophagous ectoparasites have been identified in poultry, *Argas persicus*, *Dermanysuss gallinae*,*Ornithonyssus sylviarum and Echidnophaga gallinacea* (Mullens et al., 2009; Murillo and Mul-

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lens, 2016; Rezaei et al., 2016; Aboulaila and Menshawy, 2020). Their extended presence can affect the chicken's health by inducing stress, irritation, toxicosis, allergies, dermatitis and blood loss. As a result, quality and quantity of meat and egg production is strongly affected (Chauve et al., 1998; Ruff, 1999; Mullens et al., 2009).Furthermore, hematophagous ectoparasites are responsible for the transmission of several pathogens such as *Bartonella* spp., *Anaplasma* spp., *Borrelia burgdoferi* spp., *Salmonella gallinarum*, and *Coxiella burneti* (Lafri et al., 2017; Raele et al., 2018; Pugliese et al., 2019; Hosseini-Chegeni and Kayedi, 2020).

Several studies have been conducted on poultry ectoparasites in Africa (Permin et al., 2002; Mata et al., 2018; Serda and Abdi, 2018; Kaboudi et al., 2019). Few studies have been conducted in Algeria, mainly on chewing lice inventory in the northwest and northeast of the country (Medjouel et al., 2013; Medjouel et al., 2014; Meguini et al., 2018). The aim of the present study was to identify and estimate the prevalence of backyard chicken ectoparasites in northeast Algeria.

Materials and methods

Study areas

The study was conducted from January 2017 to December 2018 in two regions in northeast Algeria (Figure 1). Annaba (36°54′15″N, 7°45′7″E) is a coastal region known for its Mediterranean climate with long, hot and humid summer and mild and humid rainy winters (ANDI, 2015). Guelma (36°28′0″N, 7°26′0″E) is an inland area characterized by a subhumid climate in the centre and north and semi-arid climate in the south. Overall, the climate is mild and wet in winter and hot in summer (ANDI, 2015).

Ethical statement

Verbal approval for the study was obtained from bird owners and from Annaba and Guelma local agricultural

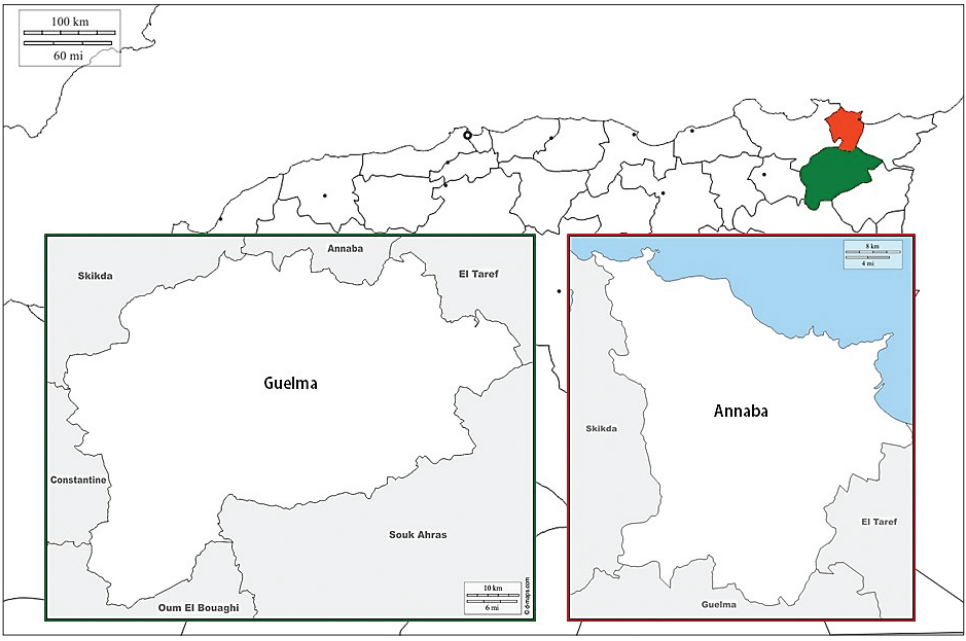

Figure 1. Geographical presentation of the study area

services. Permits for sampling on birds was granted by the Animal Ethics Committee of Chadli Bendjedid University, El Tarf, Algeria.

Sample collection and identification

During the study, 169 chickens were randomly selected from traditional farms in the selected regions. Different anatomical parts of the birds, such as neck, head, wings, body and cloaca, were visually examined to detect possible ectoparasites attached to the skin and feathers. Detected parasites were gently dislodged using entomological forceps and residues collected with a hoover. Furthermore, cracks, crevices and nests in the poultry house were examined in early morning for the presence of nocturnal parasites, which were collected by entomological forceps. Nests suspected of mite infestation were placed in plastic bags and frozen at -20 °C for 3 hours or more to kill the mites.

Collected ectoparasites were conserved in 70% ethanol and transferred to the parasitology laboratory of Chadli Bendjedid University, El-Tarf, for species identification on the basis of their morphological characteristics using appropriate dichotomous keys (Emerson, 1956; Estrada-Peña et al., 2004; Di Palma et al., 2012). Ectoparasites were examined under the microscope (Zeiss Axio Zoom V16) and photographs taken.

Statistical analysis

Pearson's Chi-squared $\chi 2$ and Fisher's statistical tests were used to examine the influence of season and sex on the infestation rates of each ectoparasite species. Shapiro-Wilk normality test and nonparametric Kruskal-Wallis test were used to compare variation of the parasitic charge. Statistical tests were performed using SPSS software (IBM SPSS Statistics for Windows, version 25.0, 2017) and were considered significant at $P<0.05$.

Results

A total of 9943 ectoparasites were collected in this study, of which 3122 ectoparasites were detected on anatomical parts of backyard chickens

Table 1. Infestation rate and collected ectoparasites on backyard chickens

Anatomical region	Ectoparasite	Infested chickens	Collected ectoparasites (number)		Infestation rate (%)
			On birds	Off birds	
Body feather	*Menopon. gallinae*	140	2333	-	82.84
Body feather	*Menacanthus stramineus*	23	227	-	13.60
Body feather	*Goniodes dissimilis*	27	38	-	15.97
Body feather	*Goniocotes gallinae*	11	17	-	6.50
Wings and neck feather	*Lipeurus caponis*	9	47	-	5.23
Breast, wings, crevices and cracks	*Argas persicus*	16	441	6339	9.46
Feather body, nests	*Dermanyssus gallinae*	2	12	330	1.18

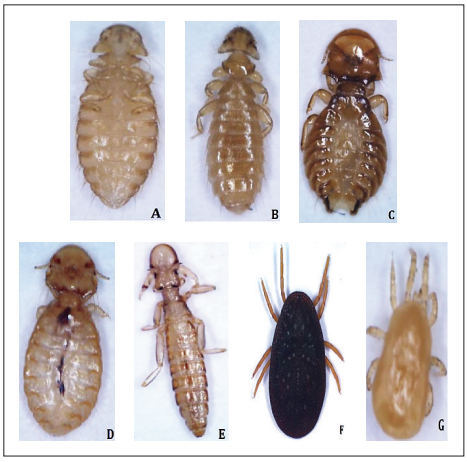

Figure 2. Microscopic images of the ectoparasites collected in the studied free-range chickens and their environment. (A) *Menopon gallinae* (B) *Menacanthus stramineus*, (C) *Goniodes dissimilis*, (D) *Goniocotes gallinae*, (E) *Lipeurus caponis*, (F) *Argas persicus*, (G) *Dermanysuss gallinae*

and 6821 parasites collected from the immediate environment. Interestingly, 153 (90.53%) range-free chickens were infested by one or more species of ectoparasites. Most were infested by one ectoparasite species (58.82%), while 32.03%, 5.23% and 1.96% were infested by two, three or four species, respectively.

Chewing lice, soft ticks, and mites were the main ectoparasite groups detected in this study. Furthermore, chewing lice were the most frequently detected (85.79%), with five species identified: *Menopon gallinae* (82.84%), *Goniodes dissimilis* (15.97%), *Menacanthus stramineus* (13.60%), *Goniocotes gallinae* (6.50%) and *Lipeurus caponis* (5.23%).

The soft tick *Argas persicus* was detected in 9.46% of backyard chickens. The larvae of this species were collected from the chicken bodies and wings, while nymphs and adults were found in cracks and crevices.

The red chicken mite *Dermanyssus gallinae* was the least common ectoparasite

Table 2. Infestation rate by sex.

Sex	Inspected	Infestation %	χ^2	P value
Males	36	91.66	0.069	0.793
Females	133	90.22		
Total	169	-		

Table 3. Prevalence of ectoparasites in male and female backyard chickens

Ectoparasite species	Infestation (%)		χ^2	P value
	Males	Females		
	n=36	*n*=133		
Menopon. gallinae	88.88	80.45	1.382	0.24
Menacanthus stramineus	8.33	15.03	1.083	0.29
Goniodes dissimilis	27.77	12.78	4.746	0.02
Goniocotes gallinae	8.33	6.01	0.250	0.61
Lipeurus caponis	5.55	5.26	0.050	0.94
Argas persicus	2.77	11.27	2.388	0.12
Dermanyssus gallinae	00	1.50	0.548	0.45

Table 4. Prevalence and number of ectoparasites collected on poultry by season

	Winter N= 43			Spring N =40			Summer N =43			Autumn N =43		
	Prevalence %	n ectoparasites		Prevalence %	n ectoparasites		Prevalence %	n ectoparasites		Prevalence %	n ectoparasites	
		On birds	Off birds	-	On birds	Off birds	-	On birds	Off birds	-	On birds	Off birds
Chewing lice												
Menopon gallinae	88.37	845	-	70	384	-	83.72	433	-	88.37	671	-
Menacanthus stramineus	16.27	106	-	25	37	-	9.30	12	-	4.65	72	-
Goniodes dissimilis	23.25	15	-	20	10	-	6.97	3	-	13.95	10	-
Goniocotes gallinae	13.95	9	-	5	4	-	4.65	2	-	2.32	2	-
Lipeurus caponis	-	-	-	20	45	-	-	-	-	2.32	2	-
Acari												
Argas persicus	-	-	-	5	64	-	32,55	377	6339	-	-	-
Dermanyssus gallinae	-	-	-	-	-	-	-	-	-	4.65	12	330

N: number of chickens examined per season.
n: number of ectoparasites collected.

(1.18%) found on chickens and their environment. The details of the collected ectoparasites during the two years of the study are shown in Table 1 and Figure 2.

The infestation rate was similar in male (91.66%) and female chickens (90.22%) (P>0.05) (Table 2). Interestingly, some ectoparasites species appear to have an affinity for host sex. For instance, the infestation rate of *Goniodes dissimilis* was higher in males (27.77%) than in females (12.78%) (P=0.02) (Table 3).The seasonal activity of each ectoparasite was monitored and chewing lice were found to parasitize domestic poultry year round, (Table 4), with the exception of *L. caponis* which were absent in winter and summer. Infestation with the soft tick *A. persicus* was recorded only in spring and summer, while red mites *D. gallinae* were only detected in autumn (Table 4). Thus, season had no effect on the infestation rates of these ectoparasites ($P\geq 0.05$).

Discussion

The infestation rates of backyard chickens by ectoparasites reported in the present study are considerably high and should be a matter of concern for poultry breeders. Similar findings were reported elsewhere in West Algeria (100%) (Medjouel et al., 2014), Nigeria (84.83%) (Lawal et al., 2017), Ethiopia (67.71%) (Kebede et al., 2016) and Zimbabwe (100%) (Permin et al., 2002). These high rates might be partly explained by the poor hygienic conditions in chicken coops, and the natural environment that favours the proliferation of different parasites.

Five chewing lice species were identified in this study: *M. gallinae*, *G. dissimilis*, *M. stramineus*, *G. gallinae*, *L. caponis*. The presence of these species confirm the finding reported in north-eastern Algeria (Medjouel et al., 2013; Meguini et al., 2018). Four of five species identified in the present study were also detected in Pakistan (Nadeem et al., 2007).

M. gallinae was the most predominant ectoparasite found in this study, corroborating previous reports from northeast Algeria (64.83%) (Meguini et al., 2018) and Ethiopia (49%) (Solomon and Elsabet, 2010). However, its abundance here was lower than in Iran (13.66%) (Rezaei et al., 2016) and California (11%) (Murillo and Mullens, 2016). These variations in the prevalence rates of this species might be partly explained by differences in geography, husbandry and management system, host factors, period of study and climate conditions such as temperature and humidity which may influence ectoparasite population dynamics (Arends, 2003; Prelezov and Kolnarski, 2006). *M. gallinae* and *M. stramineus* are considered potentially dangerous species compared to other chewing lice species because of their affinity to ingest chicken blood as source of nutrients, leading to severe anaemia (Belihu et al., 2009; Kumar et al., 2017). These species were less abundant in the present study compared to the literature (Sychra et al., 2008; Salam et al., 2009), which might be due to factors such as breed, sex, age or environmental conditions (Nadeem et al., 2007).

A. persicus was the only tick identified in this study. The infestation rates of this species in backyard chickens was higher than that reported in Tunisia (1.47%) (Kaboudi et al., 2019) or Nigeria (4.50%) (Lawal et al. 2017). However, they were lower than in west Iran (78.66%) (Rezaei et al., 2016). Nevertheless, we noted a higher abundance of *A. persicus* in the chicken's environment, which confirms a report from Ethiopia (Pader et al., 2012).

A. persicus parasitize the chickens for blood-feeding at night. It is known that *A. persicus* larvae can cause paralysis in birds (Rosenstein, 1976). The larvae may be responsible for episodes of infectious

bursal disease and spirochaetosis (Abdu, 1987). Furthermore, the DNA of several bacteria such as *Rickettsia hoogstraalii*, *Borrelia spp*., *Anaplasma* spp., *Bartonella* spp. and *Coxiella burnetii* have been found in this soft ticks species (Pader et al., 2012; Lafri et al., 2017; Boucheikhchoukh et al., 2018; Hosseini-Chegeni and Kayedi, 2020).

D. gallinae was the least prevalent ectoparasite in this study since it is a temporary diurnal ectoparasite (Murillo and Mullens, 2016). The overall infestation rate recorded in the present study was near that found in Nigeria (2.25%) (Lawal et al., 2017), but lower than in Iran (26.33%) (Rezaei et al., 2016) and Kenya (13.3%) (Mungube et al., 2008).

In this study, *D. gallinae* mites were collected in chicken nests. Similar observations were reported in chicken coops in the United States and Portugal (Murillo and Mullens, 2016; Waap et al., 2019). *D. gallinae* induces anaemia, blood staining of eggs, decreases egg production and may causes the death of the host (Chauve, 1998). In addition, this mite species is considered a vector of several highly pathogens bacteria, such as *Coxiella burnetii*, *Borrelia burgdoferi (s.l)* and *Salmonella gallinarum* (Raele et al., 2018; Pugliese et al., 2019).

In this study, the influence of chicken sex and season on infestation rates were assessed statistically. Sex was not found to have a significant effect on infestation rate. These findings support other reports (Bala et al., 2011; Sabuni et al., 2011), though some authors have stated that females are more exposed to ectoparasite infestations than males (Biu et al., 2007; Zeryehun and Yohannes, 2015). This could be explained by the fact that females spend more time in the nest, in contact with the environment, which increase the risk of exposure to parasites (Zeryehun and Yohannes, 2015). In terms of the seasonal effect on infestation rates, the chewing lice collected in this experimental study had year-round activity, with the exception of *L. caponis,* which was not observed during winter and summer. These results corroborate those reported in Kashmir province, where the chewing lice, including *L. caponis,* were present year round (Salam et al., 2009). In Pakistan, chewing lice were reported to be active during spring and summer (Nadeem et al., 2007). Furthermore, chewing lice infestation peaks were recorded in winter, spring, and autumn. Our results are in line with previous findings (Meguini et al., 2018; Kaboudi et al., 2019).

Among hematophagous arthropods, *A. persicus* was observed in spring and summer, with a peak of infestation in summer. The same findings were reported in Pakistan and Saudi Arabia, where *A. persicus* were more abundant in the dry season (Shahnaz et al., 2016; Alzahrani and Edrees, 2019).

There are no available findings concerning the seasonal dynamic effect of *D. gallinae* on backyard chickens infestation (Sparagano et al., 2009; Waap et al., 2019). The only available reference to seasonal activity was reported in Sweden, where *D. gallinae* was active during summer in laying chicken farms (Nordenfors and Hoglund, 2000).

Conclusions

This study demonstrated the diversity of chicken ectoparasites in northeast Algeria. Chewing lice, soft ticks, and mites were the main ectoparasite groups detected. More attention should be paid to the role of avian hematophagous arthropods as a vector of potentially pathogenic bacteria.

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Prevalencija ektoparazita u jatima dvorišnih pilića iz slobodnog uzgoja u sjeveroistočnom Alžiru

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Slobodni uzgoj dvorišnih pilića u ruralnim predjelima Alžira sve je popularniji. Zbog prirodnih uvjeta uzgoja, pilići su izloženi brojnim vrstama mikroba i ektoparazita. Međutim, manje je saznanja o raznolikosti ektoparazita koji napadaju piliće iz slobodnog uzgoja u Alžiru. Ova studija se provodila tijekom dvije godine na 169 dvorišnih pilića, s ciljem identifikacije i procjene prevalencije ektoparazita na različitim anatomskim dijelovima i u neposrednom okruženju uzorkovanih pilića u sjeveroistočnim predjelima Alžira. Ukupno je identificirano 9943 ektoparazita različitih vrsta, među kojima je pronađeno sedam glavnih vrsta ektoparazita; *Menopon gallinae* (82,84 %), *Goniodes dissimilis* (15,97 %), *Menacanthus stramineus* (13,60 %), *Goniocotes gallinae* (6,50 %), *Lipeurus caponis* (5,23 %), *Argas persicus* (9,46 %) i *Dermanyssus gallinae* (1,18 %). *M. gallinae* bio je najčešće izolirani ektoparazit tijekom godine. Mekani krpelji *A. persicus* izolirani su tijekom proljeća i ljeta, uglavnom iz procjepa i pukotina, dok su crvene grinje *D. gallinae* otkrivene u jesen uz niski broj na dijelovima pilića i veliko obilje u gnijezdima. Ovi rezultati navode najraširenije ektoparazite u dvorišnih pilića, što bi moglo pomoći boljem upravljanju uzgojem.

Ključne riječi: *dvorišni pilići, ektoparazit, prevalencija, Alžir*