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Biodiversity and prevalence of chewing lice on local poultry

Abstract

Biodiversity and prevalence of chewing lice on local poultry (Gallus Gallus Domesticus, family Phasianidae) have been successfully determined for five selected sites around Qaser Bin Ghashir region, Libya between November 2017 and April 2018. The total investigated chicken samples are 135, and the infected samples were found to be 94. Ticks, fleas, and mites were detected in a small quantity in addition to three different species of biting lice. The obtained results show that Asuani has the lowest amount of ectoparasites, while Suq AL-kamees samples were infected completely by 100 % prevalence of chewing lice. The calculated total average prevalence percentage (TAP, %) of all sites are ≤70%. Three species of lice were detected and identified on the local poultry, *Menopon gallinae, Menacanthus stramineus* and *Lipeurus caponis*. The most abundant species in the study area is Menopon gallinae with prevalence percentage about ≈ 69.84%. A comparison between chewing lice around Qaser Bin Ghashir region in Libya and other countries has been carried out and it was found that (TAP, %) for Algeria > (TAP, %) for Libya > (TAP, %) for USA. Finally, the study proves that Libya contains a mild status of biodiversity.

Keywords: biodiversity, prevalence, chewing lice, poultry, ectoparasites

Volume 8 Issue 1 - 2019

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Received: December 18, 2018 | **Published:** January 17, 2019

Introduction

Nowadays, poultry is an economic and effective source for the production of animal protein within the shortest possible time, playing a vital role in narrowing down the gap of animal protein supply worldwide especially in the developing countries.[1] The poultry industry is one of the most sectors of meat production with a significant contribution to human food production.[2] Moreover, consumers have their own high preferences for poultry meat. In fact, in rural regions chicken live side by side with human and was considered as a meaningful source of the food for several communities. Occasionally, biologists considered chicken as a perfect animal/bird for the experimental purposes[3] to indicate the quality and the health of the environment. The importance of chickens for people may be due to the fact that poultry products such as light white meat and egg provide animal protein of high biological value.[4] Poultry as an animal can easily be infected or infested with several types of parasitic pathogens.[5] Among various parasitic diseases, ectoparasites infestation is of great importance. External ectoparasites, like ticks, mites, fleas, and chewing lice live on and attack poultry by either sucking blood or feeding on the skin or feathers by consuming the dead cells of skin and tissue fluids.[6] Lice are important ectoparasites of poultry which cause health problems in poultry such as irritation, reduction of hemoglobin, a decrease in erythrocyte values, hyper chromicanemia, weight loss, local inflammation, intense itching, and sleepless problems in addition to a reduction of egg production.[7–9] At present, there are about 5,500 species of parasitic lice described and named from many birds and mammals, which are as relevant to the world biodiversity as their hosts.[10] Also, most people are unaware of the vast diversity of body shapes, sizes, and colors exhibited by lice. In small flocks of poultry, it is difficult to prevent direct contact with wild birds and rodents that may carry parasites like lice that can infect poultry.[11] It is important to occasionally check rural flocks for external parasites. Early detection can prevent a flock outbreak. In general, there is limited information about the common species composition of poultry ectoparasites in the whole of our country, Libya, particularly in the studied area. Therefore, the main objective of the present study is to identify species composition of chewing lice of local poultry circulating in the area of study and to assess and evaluate the biodiversity and prevalence percentage of each species around Qaser Bin Ghashir region, Tripoli, Libya.

Experimental

Study area: position and climate

Qaser Bin Ghashir region is located at an elevation of 73 meters above the Mediterranean Sea level and about 25 km far from the center of Tripoli, the capital of Libya. Its coordinates are 32º 40' 60" N and 13º 10' 60" E in DMS (Degrees, Minutes, Seconds) or 32.6833 and 13.1833 in decimal degrees.[12] Its UTM position is US21 and its Joint Operation Graphics Reference (JOGR) is NI33-13. It has a Mediterranean climate, characterized by a hot summer and a mild wintry temperature. The annual average temperature is 18°C. January and February are the coldest months (16-20°C on average). July and August are the hottest months (38-43°C on average). The relative humidity is about ≈ 65-84 % in winter and 25-35 % in summer.[13] Both geographical position and warm weather in Qaser Bin Ghashir region support the prevalence and abundance of ectoparasites in poultry such as ticks, mites, fleas, and lice.

Chicken samples

Adult female chicken samples were chosen from different open farms around Qaser Bin Ghashir region, south of Tripoli, Libya in the winter 2017 and spring 2018. The total number of the examined chicken samples is 135 from different five sites. All investigated chicken samples have nearly the same average weight (about ~ 1100±150g), same volume, health status and same age avoiding the interference of different factors affecting the obtained results. Examined chicken samples come from Qaser Bin Ghashir, Tariq AL-matar, Atwaisha, Suq AL-kamees, and Asuani. The number of examined samples is equal to 27 from each site. Chickens (Gallus Gallus Domesticus) are classified as order Galliformes, family Phasianidae, genus Gallus (junglefowl) which is distinguished from all other Phasianidae species in having the comb and the wattles associated with it.[14]

Collection and identification of chewing lice samples

For each site around Qaser Bin Ghashir region, 27 chicken samples were apparently examined for the presence of ectoparasites, especially lice of all areas of the body of the bird, including the head and the neck feather, the wing feathers, the belly feathers, tail feathers, the whole body, and the anus. The non-infected chicken samples were excluded and recorded, while the infected one was subjected to the counting method after exposure of the body of the live bird, but not its head to anesthesia (chloroform, $CHCl_3$), according to Dale H. Clayton and Devin M. Drown method[15] where a huge sealed plastic bags contain a chloroform wet tissue paper have been used instead of anesthesia jar. After about 10min. all ectoparasites were removed from the bird's feather. Then, the takeoff parasite's samples were collected using plastic bags, forceps, light source, and a hand magnifying convex lens, then transferred and kept in a separated small glass container with a stopper containing a previously prepared 70% ethyl alcohol solution (about ~ 2mL). Finally, the whole samples were sent to the biological laboratory for counting, classification, and investigations. Chewing lice and other ectoparasites were identifying using a binuclear light microscope after a clarification on the basis of morphological and anatomic differences between the collected parasites. Ectoparasites were identified to genera and species levels when possible using an available key, published taxonomic drawings and reference number.[16–18] Prevalence percent (P, %) was calculated by the equation:

$$(\mathrm{P}, \%) = \frac{n}{N} \times 100 \quad (1)$$

Where n is the number of infected birds and N is the total number of birds examined.

Results and discussions

Ectoparasites in different sites

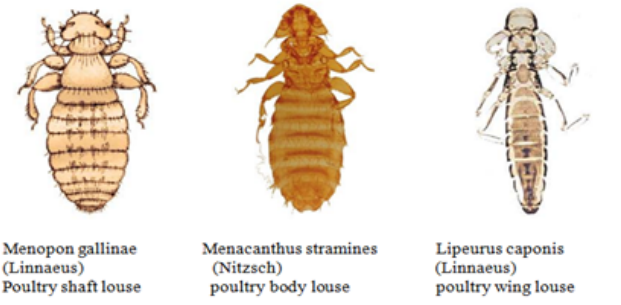
To find and calculate the biodiversity and prevalence percent of ectoparasites in different five sites around Qaser Bin Ghashir region, a parasitological scanning on 135 chicken samples have been done. All investigated samples were lives in a rural region under a free range open system in the center of Qaser Bin Ghashir, Tariq AL-matar, Atwaisha, Suq AL-kamees, and Asuani. The obtained results were summarized in Table 1, from which it was found that external ectoparasites like lice, ticks, mites, and fleas were present in all investigated samples in different extent from the minimum value of ≈ 3.70 in Asuani to the maximum percentage 100 % in Suq AL-kamees and the average percentage of prevalence of all sites is slightly more than 69.83 %, accordingly prevalence percentage of ectoparasites in different sites can be arranged as follows:

Suq AL-kamees > Atwaisha > Tariq AL-matar > Qaser Bin Ghashir > Asuani

In general, depending on the above-mentioned order, Asuani region was described as the cleanest area with low infectious percent while Suq AL-kamees, Atwaisha, and Tariq AL-matar regions can be considered as the most contaminated areas by ectoparasites with prevalence percent equal to 100, 93.33, and 84% respectively. Qaser Bin Ghashir itself has a medium infectious percent with prevalence percent equal to 68.15%. Totally, it was found that 94 chicken samples were infected by ectoparasites, and 41 chicken samples are free from infection represents about ≈ 30.40%. These results may be lead to a high recommendation to accrue therapeutic efforts towards the ectoparasite problems around Qaser Bin Ghashir region especially, in Suq AL-kamees, Atwaisha, and Tariq AL-matar to avoid ectoparasite's catastrophe. Birds in these regions should be checked for lice at least twice a month. The examination involves spreading the bird's feathers in the vent, breast, and thigh regions to look for egg clusters or feeding adults lice at the base of the feathers. The presence of some lice on most birds or of egg clusters on one or more birds is enough to indicate the need for treatment.[19] Again, for all investigated samples, ticks, mites, and fleas were found in addition to three different species of lice as shown as in Table 1, but lice is the vast majority of the present ectoparasites, and therefore lice is the most abundant parasites around Qaser Bin Ghashir region which we need to know more and more about it through further research programs. Differently identified ectoparasites around Qaser Bin Ghashir region take the following sequence:

Lice species > Mites ≈ Fleas > Ticks

The above result was in agreement with the references number.[20–22] Fleas are small, wingless bloodsucking insects (order Siphonaptera) with a characteristic jumping movement. So, the above-expected results can be attributed to and maybe reflects the special biological characteristics of both fleas and mites where fleas are the only parasites in this group which can jump or escape suddenly, and hence the quantity of detected fleas is less that lice species. Louse is a fast parasite to catch it, but it does not jump or fly so it is easy to detect and be countable. Mites are considerably small insect less than 0.4 mm long. However, mites can be identified easily after magnification using a convex lens. Ticks can easily be detected and identified, especially fed one because it is a relatively big slow bug, it cannot fly or jump. Practically, it was noticed that the quantity of mites, fleas, and ticks is much less than that of lice, so the counting of mites, fleas, and ticks was neglected and the counting of lice species is the only one taken into consideration. Figure 1 shows the morphological structures of the three identified species of chewing lice with two families (Menoponidae and Philopteridae) and their classification. The quantities of the three identified species of lice on local poultry samples around Qaser Bin Ghashir region take the following arrangement:



Phylum:	ARTHROPODA	ARTHROPODA	ARTHROPODA
Class:	HEXAPODA	HEXAPODA	HEXAPODA
Order:	Phthiraptera	Phthiraptera	Phthiraptera
Family:	Menoponidae	Menoponidae	Philopteridae
Reference:	16	17	18

Figure 1 Identifying chewing lice Species around Qaser Bin Ghashir region.

Menopon gallinae > *Menacanthus stramines* > *Lipeurus caponis*
(Poultry shaft louse) (Poultry body louse) (Poultry wing louse)

Citation: Mansur MK, Mahmoud NM, Allamoushi SM, et al. Biodiversity and prevalence of chewing lice on local poultry. *J Dairy Vet Anim Res.* 2019;8(1):26–31. DOI: 10.15406/jdvar.2019.08.00238

Table 1 Biodiversity and prevalence of ectoparasites in different sites

		Species of lice					
Local site	**Prevalence (%)**	**Menopon gallinae**	**Menacanthus stramines**	**Lipeurus caponis**	**Ticks**	**Mites**	**Fleas**
Qaser Bin Ghashir	68.15	+++	Nil	Nil	Nil	++	++
Tariq AL-matar	84	++++	Nil	Nil	+	++	++
Atwaisha	93.33	++++	++++	++++	+	++	++
Suq AL-kamees	100	++++	++++	Nil	+	+++	+++
Asuani	≈ 3.70	+	Nil	Nil	+	++	++
Average = $\sum_{1}^{n} D$=69.836%							
+: Weak infection		**++: Medium infection**			**+++: Strong infection**		
++++: Highly infected		**Nil: No infection**					

Note: The total number of samples=135, and the number of samples from each site=27

Menopon gallinae species is the most abundant chewing lice around Qaser Bin Ghashir region which spent its live cycle in poultry shaft. This result was in agreement with the results in reference number.[1,23,24] *Menacanthus stramines* was found only in two sites, Atwaisha, and Suq AL-kamees while *Lipeurus caponis* was found in Atwaisha only, and hence we can conclude that the wings of investigated chicken samples are the cleanest part of the birds. It was known that lice of birds are placed in the family *Philopteridae*, of which we are interested in six genera, as follows*: Menopon, Gonoides, Gonoicotes, Lipeurus, Docophorus,* and *Nirmus*.[25] Fortunately, all of these genera were absent except *Lipeurus*. According to the type of infection, Investigated or studied area can be divided into three categories:

I. Single infection area such as Qaser Bin Ghashir, Tariq AL-matar, and Asuani which infected only by one type of lice species,

II. Double infection area such as Suq AL-kamees area which infected by two types of lice species, and

III. Multiple infection area such as Atwaisha which infected by three types of lice species.

However, the rate of infestation between investigated chickens is equal to about ≈ 50-60 louse per bird. Because of the chewing lice are the predominant ectoparasites around Qaser Bin Ghashir region, so we undergo a mathematical comparison between our present study and different countries in the next section.

Biodiversity of chewing lice in different countries

All species of chewing lice are spread worldwide. Recently, published articles are talking about the presence of more than 10 species of chewing lice in the USA, Algeria, Bangladesh, Ethiopia, Malaysia, Nigeria as well as Libya. Table 2 summarizes the obtained results, presents the percentage of prevalence of chewing lice and shows the types of different species from these countries. It is clear from this table that Libya contains the lowest number of chewing lice, *Menopon gallinae, Menacanthus stramineus, and Lipeurus caponis* and this three species was recorded in five countries: Libya, USA, Algeria, Bangladesh, and Ethiopia. The prevalence percentage of *Menopon gallinae, Menacanthus stramineus, and Lipeurus caponis* in these five countries were compared in Figure 2. Other species outlined in Table 2 were absent from the Libyan environment. *Menopon gallinae and Lipeurus caponis* were recorded in all countries except Nigeria, while *Menacanthus stramineus* was recorded in all countries except Malaysia. However, all species of chewing lice found on the investigated chickens around Qaser Bin Ghashir region of our present work were already identified in reference.[26–28] Also, the size of poultry samples vary broadly from country to the other, but the highest number of examined samples was from Ethiopia (n=384 samples), and the lowest was from Malaysia (n=20 samples). This variety in sample size may be due to the design of the experimental work, the type of the poultry studied, and the total number of birds in the farm, where the number of samples must be increased as the total number increased and vice versa.[29] However, the number of samples in our present work in Libya, USA, and Algeria are closely related. So the comparison between them is scientifically logic and maybe leads to significant and valuable discussion. There are 3, 6, and 9 species of chewing lice in Libya, the USA, and Algeria respectively, and all of these species under two families, Menoponidae and Philopteridae. Table 2 shows five types of variables in (1) countries, (2) sample size, (3) % prevalence, (4) species, and (5) references. This table shows a real case of biodiversity in our world. According to Table (2) and Figure (2), the prevalence percentage of *Menopon gallinae* species in Libya is more than that in the USA by 4.5 times, while Algeria is more than the USA by ≈ 6.5 times. In the case of *Menacanthus stramineus*, Libya and Algeria have the same prevalence percentage, but the USA is more than both countries by 1.75 times. For *Lipeurus caponis species*, Algeria has prevalence percentage more than Libya by about ≈ 3 times, and more than the USA by two times. From these observations, it was concluded that the total average prevalence (TAP, %) percentage of the three species are 55.77, 37.57, and 28.33 % for Algeria, Libya, and the USA respectively. This means that the TAP percentage of the three identified species for Libya is in between Algeria and the USA. The total average prevalence (TAP, %) of *Menopon gallinae, Menacanthus stramineus, and Lipeurus caponis* takes the following sequence:

(TAP, %) for Algeria > (TAP, %) for Libya > (TAP, %) for USA

The above result may reflect the civilization distance between developing countries and the USA in the field of animal public health. Although Libya and Algeria are neighbor's countries, Algeria is greater than Libya by about 1.5 times in its total average prevalence (TAP, %) percentage of the three species, while the gap between Libya and the USA is about 1.3 times. Algeria and Libya have more environmental biodiversity in chewing lice species than the USA, but low in poultry health. Actually, the warm climate or weather and the high humidity in a rural region like Qaser Bin Ghashir, are the origin of this diversity in chewing lice species.[30] Biodiversity of ectoparasites especially

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chewing lice is inversely proportional to the health status of poultry. The high biodiversity of ectoparasites the low poultry health will be and vice versa. According to Figure (2), the mentioned countries can be categorized to:

Table 2 Biodiversity and prevalence of chewing lice on poultry in different countries

Country	Total Samples (n)	*Prevalence (%)	Identified species of chewing lice	Reference
Tripoli	135		Menoponidae	Present study
Libya		69.84	*1) Menopon gallinae*	
		28.57	*2) Menacanthus stramineus*	
			Philopteridae	
		14.29	1) Lipeurus caponis	
California	100		Phthiraptera	26
USA		50	*1) Menacanthus stramineus*	
		35	*2) Goniocotes gallinae*	
		20	*3) Lipeurus caponis*	
		15	*4) Menopon gallinae*	
		5	*5) Menacanthus cornutus*	
		5	*6) Cuclotogaster heterographus*	
Algerian North East	**144**		**Menoponidae:**	**23**
		97.2	*1) Menopon gallinae*	
		28.5	*2) Menacanthus stramineus*	
		20	*3) Menacanthus cornutus*	
		2.0 0	*4) Menacanthus pallidulus*	
			Philopteridae:	
		41.6	*1) Lipeurus caponis*	
		46.5	*2) Goniocotes gallinae*	
		18.8	*3) Cuclotogaster heterographus*	
		34.7	*4) Goniodes dissimilis*	
		31.9	*5) Goniodes gigas*	
Bangladesh	300		Phthiraptera	27
		74	1) Menacanthus stramineus	
		63	2) Menopon gallinae	
		48	3) Lipeurus caponis	
		25	4) Cuclotogaster heterographus	
		18	5) Goniodes gigas Taschenberg	
		14	6) Goniocotes gallinae de Geer	
Ethiopia	384	18.75	1) Lipeurus caponis	28
		13.28	2) Menopon gallinae	
		4.95	3) Menacanthus stramineus	
		5.73	4) Cuclotogaster heterographus	

Table Continued...

Country	Total Samples (n)	*Prevalence (%)	Identified species of chewing lice	Reference
Malaysia	20	45	1) Menopon gallinae	24
		35	2) Menacanthus pallidulus	
		40	3) Lipeurus caponis	
		30	4) Goniocotes gallinae	
		20	5) Chelopistes meleagridis	
Nigeria	265	78	1) Lipeurus lawrensis tropicalis	32
		48	2) Menacanthus stramineus	
		33	3) Chelopistes meleagridis	
		35	4) Goniocotes gallinae	

*The average value

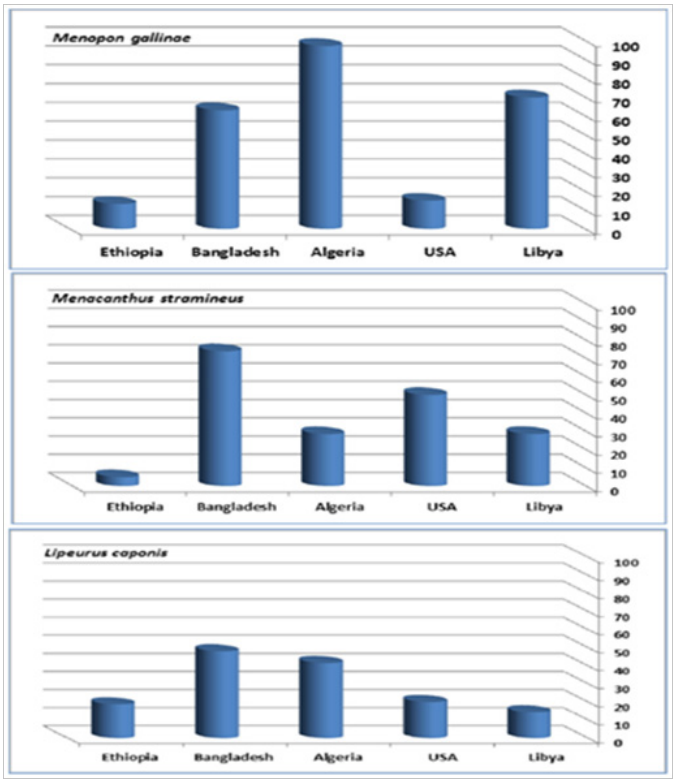

Figure 2 Prevalence of *Menopon gallinae, Menacanthus stramineus, and Lipeurus caponis* in different countries.

For *Menopon gallinae* species:

- The highest biodiversity countries include Algeria, Libya, and Bangladesh.
- The lowest biodiversity countries include the USA and Ethiopia.

For *Menacanthus stramineus* species:

- The highest biodiversity countries include Bangladesh and USA.
- The lowest biodiversity countries include Libya, Algeria, and Ethiopia.

For *Lipeurus caponis* species:

- The highest biodiversity countries include Bangladesh and Algeria.
- The lowest biodiversity countries include the USA, Ethiopia, and Libya.

Bangladesh seems to be the richest biodiverse country, while Ethiopia is the poor one in biodiversity, while Libya contains the mild status of biodiversity.[31]

Conclusions and recommendations

Our present study aimed to evaluate and calculate the status of biodiversity and prevalence percentage of chewing lice on local poultry (Gallus Gallus Domesticus) from five selected sites around Qaser Bin Ghashir region. The results show relatively high biodiversity and a high prevalence percentage (≤70%) of chewing lice in Libyan environment. Therefore it is highly recommended to give more attention to the animal health in the study area from the governmental authorities especially Suq AL-kamees region. It was found that the chewing lice species is the most abundant ectoparasites with a small and neglected quantity of ticks, fleas, and mites. *Menopon gallinae, Menacanthus stramines, and Lipeurus caponis* is the only identifying three species of the biting lice on the investigated chicken samples. The same species were found in other countries such as Algeria, USA, and Bangladesh. Although Libya and Algeria are neighbor's countries, Algeria is greater than Libya by about 1.5 times in its total average prevalence (TAP, %) percentage of the three species. Finally, the study proves that Libya contains a mild status of biodiversity.

Author's declaration

We declare that this study is an original research by our research group and we agree to publish it in the journal.

Acknowledgments

None

Conflicts of interest

The author declares that there are no conflicts of interest.

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Citation: Mansur MK, Mahmoud NM, Allamoushi SM, et al. Biodiversity and prevalence of chewing lice on local poultry. *J Dairy Vet Anim Res*. 2019;8(1):26–31. DOI: 10.15406/jdvar.2019.08.00238