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Incidence and morphological study of lice infested chicken (*Gallus gallus domesticus*) in Nineveh governorate, Iraq

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Abstract

Lice were the most common Ectoparasites in birds, especially chickens that stay in their life cycle from eggs to the adult same bird, causing poor chicken health. The current study was conducted to detect lice infestation in 130 backyard chickens in some areas in Nineveh Governorate. The result indicated that the incidence of backyard chickens was 90(69.2%), and they were infested with two species of lice, *Menacanthus stramineus* and *Lipeurus caponis*. *M. stramineus* lice were the most prevalent, as they were observed on all parts of the chicken's body, recording a high infestation rate 61.5%, while the wing lice *L. caponis* recorded 30.8%. Lice infestation on one chicken varied between single and mixed infestation, with single infestation being the most common, reaching a rate of 80%, while mixed infestation reached 20%. Lice were identified by using a dissecting microscope and scanning electron microscopy to determine the exact structure of chewing lice, such as features of the head, chest, abdomen, legs, and claws of legs location and segmentation of antennae, setae of *M. stramineus*, and *L. caponis*. This study aimed to identify the morphological characteristics of lice isolated from backyard chickens using scanning and dissecting microscopes.

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Introduction

Domestic birds are an important role source of national income for all countries of the world, as they provide high nutritional value and other economic benefits, in addition to providing job opportunities and income for small farmers, especially during seasons other than crop cultivation (1,2). The chicken is one of the domestic birds, as it lives in symbiotic relationships with human societies. It also lives freely, feeds on food waste, or obtains food from breeders. It also drinks water from various sources, so it predisposes to infection with parasites, especially ectoparasites (3-5). The risk of infestation with ectoparasites is almost equal to the risk of infection with internal parasites due to the widespread of these parasites, in addition to their high efficiency in reproduction, tolerance of conditions, and hiding, which makes them pests that kill birds (6,7). The presence of ectoparasites on the body of the infected bird puts this bird in poor health, represented by emaciation, fatigue, general weakness, anemia, allergies, irritability, and lack of appetite for food, with its feathers exposed to severe damage, which causes its death (8,9). One of the most critical external parasites that infect chicken is lice, which affects the health of chickens and causes severe symptoms of irritation, dermatitis, sucking blood, and allergies. In periods of severe infection, it may weaken it, reduce its resistance, and may lead to death. In addition, feathers become worn out and shed, with bleeding, ulcers, and skin tears occurring (10,11). The infected bird is susceptible to secondary diseases due to the wounds and scratches it causes on the skin, and they also serve as vectors for many pathogens, which negatively affect the economic production of poultry (12,13). The lice are classified into two orders *Anoplura* (sucking lice) and *Mallophaga* (chewing lice); sucking lice are less common

than chewing lice (14). The head of a sucking lice is narrower than the thorax. Additionally, sucking lice do not possess maxillary palps. The mouthparts are adapted for blood feeding and are only visible during feeding. The chewing lice are flattened dorso-ventrally, and the head is wider than the thorax. *Mallophages* are divided into two suborders, *Amblycera* and *Ischnocera*, containing 70% and 30% of all avian species, respectively. *Menacanthus stramineus*, most common in poultry, is called the chicken body louse. It punctures the skin at the base of the feathers and feeds on the blood. Chickens are the least commonly infested with *Menopongallinae* and *Lipeurus caponis* (15-17). The female louse lasts about 12 days and produces four eggs a day. The life cycle requires about 2 weeks to complete (18).

Because lice are important economically, it is necessary to classify them carefully. This study was conducted to investigate lice in poultry, determine the infestation rate in backyard chickens, and diagnose lice species based on the morphological characteristics of each species with a dissecting microscope and scanning electron microscopy.

Materials and methods

Ethical approval

According to the Animal Welfare Committee at Mosul University, College of Veterinary Medicine No. UM.VET.2024.058, all chickens were euthanized ethically.

Lice sources

During the period of this research, 130 backyard chickens were examined in different areas of Nineveh governorate to detect chickens infested with lice by carefully examining the head wings, back, belly, legs, breast, tail, and crissum of the chickens directly using a magnifying glass and with the help of medical forceps and placing the lice in tubes containing 70% ethanol alcohol.

Sample preparation

The samples are divided into two parts: the first prepares them for microscopic examination, and the second prepares them for electronic examination. The first part prepares 30 samples for microscopic examination: Lice are soaked for 24 hours in a 10% potassium hydroxide and mixed with distilled water for one day. The lice then underwent several ascending solutions, starting with 70% alcohol, 80 %, 90%, and 99% samples for dehydration. The lice were mounted on slides in Canadia balsam, and the lice were examined under the light and dissecting microscope identify lice infestation in backyard chickens in Nineveh Governorate (19-22). In the second part, the lice prepared for scanning electron microscopy, the lice (n=5 each of *Menacanthus stramineus* and *Lipeurus caponis* were fixated in 2.5% glutaraldehyde. After that, the lice were washed by rinsing buffer 0.1M for 15 minutes at 4°C. The lice were then kept in osmium tetra oxide at 4°C. f for 2.5 hours, followed by dehydrating gradually with 30% ethanol 40, 50, 60, 70, 80, and 90% for 1-20 min each and washings with 100% ethanol at 4°C for 20 min. Finally, the samples were placed overnight in a desiccator. The lice were mounted on the brass stubs and coated with a thin layer of gold ions with the help of an ion sputter (5). For identification and morphological characteristics of the lice under the scanning electron microscopy (23-26).

Statistical analysis

The results were analyzed using Jandle Sigma stat Scientific Software V 3:1 Chi-square at a certain level $P<0.05$.

Results

Incidence of parasite

In the current study, out of 130 backyard chickens examined, 90(69.2%) appeared to be infested with two species of chewing lice under two sub-orders, called Ischinocera and Amblycera. The species identified, *Lipeurus caponis* (belonging to the sub-order Ischinocera and *Menacanthus stramineus* (belongs to the sub-order Amblycera) (Figure 1); the common species was *M. stramineus*, with a percentage reaching 61.5%. The least common species was *Lipeurus caponis*, 30.8% (Table 1). During visual inspection of different body parts like head, body, shaft, feather, etc., it was found that the common location of *Menacanthus stramineus* in the chicken's body while species of lice *Lipeurus caponis* in the wing feather. In addition, infection with one type of lice (single infection) was 80%, while the rate of mixed infection with two types was 20%. There is a significant difference between single and mixed infestation at a significant level of $P<0.05$ (Table 2).

Table 1: The incidence of infestation depends on the type of lice diagnosed and their location on the animal's body

Species	No. infested chicken	Infestation rate %	Location
Menacanthus straminus	80	61.5%[a]	Body
Lipeurus caponis	40	30.8%[b]	Wing feather

Different letters indicate a significant difference.at $P<0.05$.

Table 2: Single and mixed infestation rate of lice in backyard chicken

Infestation	No. infested chicken	Infestation rate
Single	72	80%[a]
Mixed	18	20%[b]

Different letters indicate a significant difference at $P<0.05$.

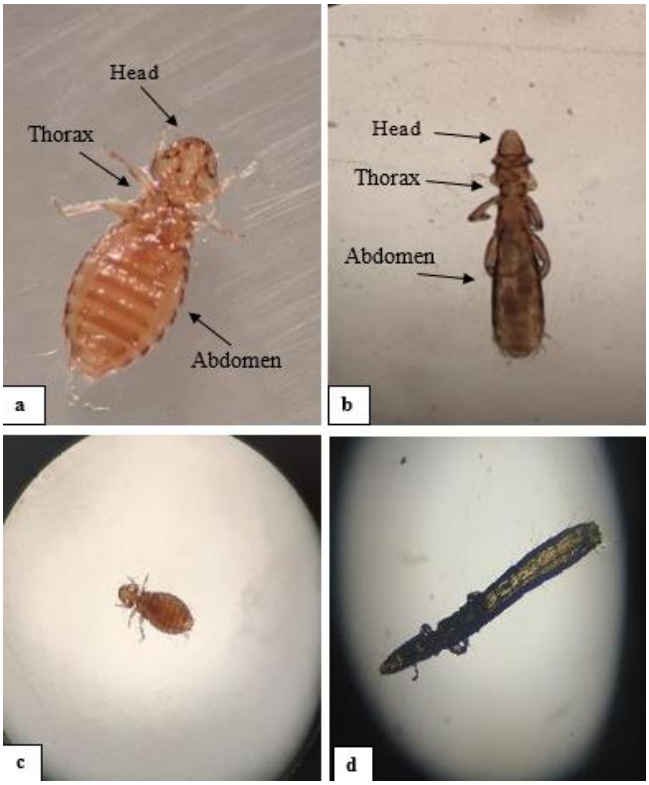

Figure 1: a- Lice *Menacanthus straminus* b- *Lipeurus caponis* under a dissecting microscope (4X). c- Lice *Menacanthus straminus.* d- *Lipeurus caponis* under a light microscope (4X).

Menacanthus straminus

Chewing lice are common ectoparasites of chickens (body louse), and they have been diagnosed using a light and scanning electron microscope. Lice appear small, yellowish, flat, and wingless. Menacanthus are 3.5 mm long and have straw-colored bodies. They move very fast and will quickly scatter when exposed to light. *Menacanthus* live close to the bird's skin. They were found around the head, breast, vent, and underneath the wings. The body is segmented and composed of a head, thorax, and abdomen (Figure 2). The triangular head is wider than the longest, distinctly narrow in front but bulging widely at the back. Numbers of short seta are distributed above and side, the ventral part of the forehead is armed with a pair of spiny processes, the antennae are club-shaped and mostly hidden under the head antenna composed of three segments, second segment is the smallest one and third one is largest characterized by several sensory terminal bristles, the head contains the mandibles and maxillary palp (Figure 3), the head is directly attached to the first part of the thorax called prothorax was small and triangular (Figure 4), the other two were both integrated with different number of seta on each segment. Legs were 3 pairs connected with the thorax segment; the first pair was small, and the third leg pair was longer Each leg consisted of 5 parts: coxa, trochanter, femur, and tibia, and each leg has two tarsal claws (Figure 5). abdomen was elongated and rounded posteriorly with a set of short and long seta and spicules visible at the dorsal edge of the abdominal segments; the last segment of the dorsal and ventral angular rounded, covered with fine hairs, with two large bristles.

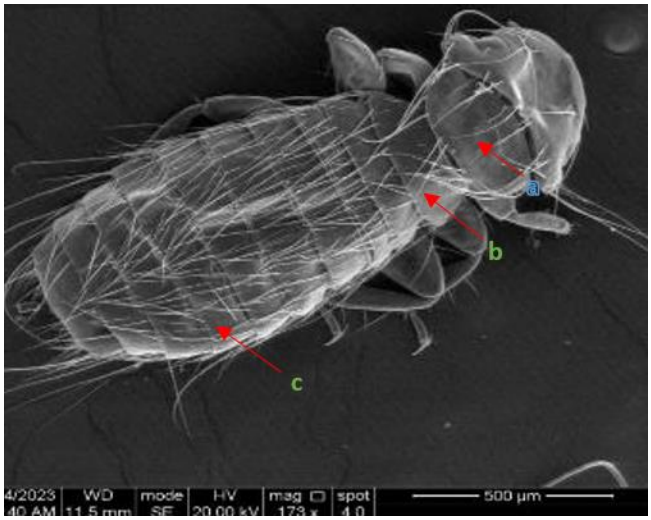

Figure 2: Lice *Menacanthus straminus* under the scanning microscope: a-head, b-thorax, c-abdomen. 173x.

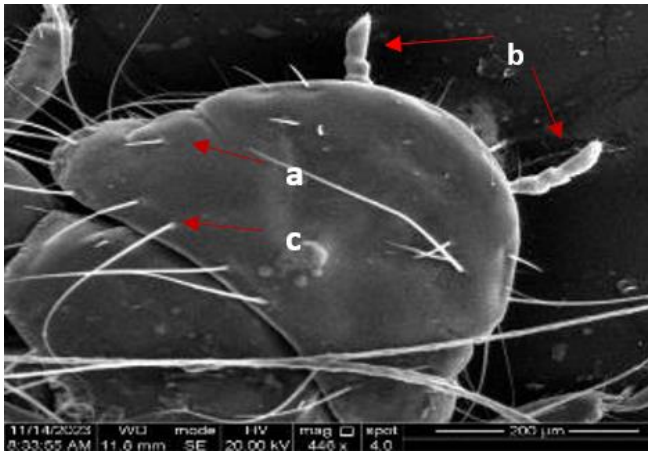

Figure 3: Head triangular integrated of lice *Menacanthus straminus*: a- antenna: maxillary palp, c-numbers of short seta distributed above and side. 440x.

Lipeurus caponis

The species is usually called poultry wing louse, and it is considered a special type of lice that infestation chickens *Lipeurus spp.* are grey, slow-moving lice, which are found close to the skin and undersides of the large wing and tail feathers, characterized by brown or black with dorsoventrally flattened, long and slender about 2.1-2.2 mm consist of head, thorax, and abdomen (Figure 6). the head is

usually oriented forward and elongated, and large have segmented antennae consisting of 5 segments. Not equal size in males, the first is characterized as inflated, and the second segment is rectangular. The end of the third segment is an extension of the outer body, and the fourth and fifth segments are equal and small. The fifth segment ends with sensory bristles in different shapes and sizes. In contrast, the general shape of the antenna sensor in females is characterized by equal segments. It contains the sensory hairs at the end of the antenna sensor in lice *Lipeurus caponis* (Figures 7 and 8). and the maxillary palps are absent; the ventral part of the head contains a mouth cavity, which is composed of lingual sclerites, mandibles, and a labrum, with a head capsule with two short bristles that appear dorsally and ventrally (Figure 9), thorax contains three segments connected bears three pairs of legs. Each one consists of a coxa, trochanter, femur, tibia, and tarsus end with two claws; hind legs are twice the length of mid as shown in (Figure 10); the abdomen has 9 segments in females and 8 in males with pair of spicules inside of each one (Figure 11). Female posterior end contains two lobes with groups of small bristles. In contrast, the male posterior end contains gentile organs with a short curve border (Figure 12).

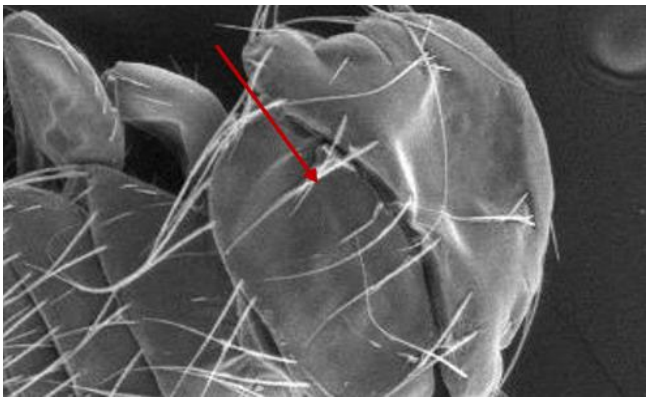

Figure 4: The first part of the thorax is called the prothorax. 205x.

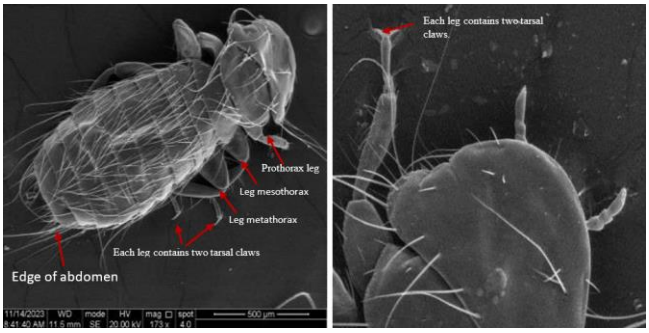

Figure 5: Legs of lice *Menacanthus straminus* and dorsal edge of abdominal segments, with two large bristles. 158x-446x.

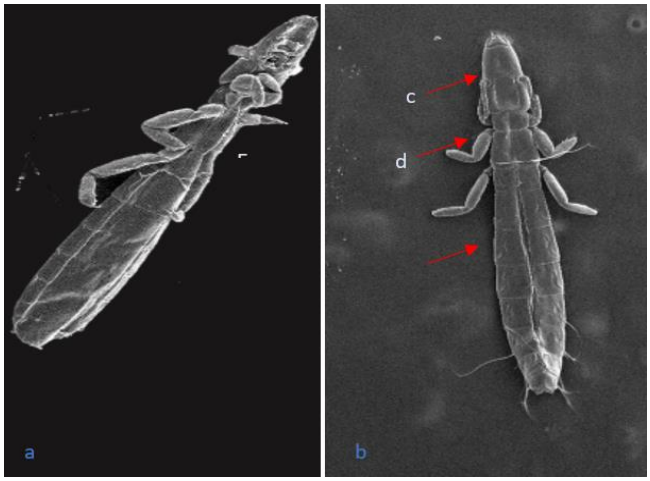

Figure 6: Lice of *Lipeurus caponis* under scanning electron microscope: a-male of *Lipeurus caponis*, b-female of *Lipeurus caponis*, c- head area, d- thorax area, E- abdominal area. 84x.

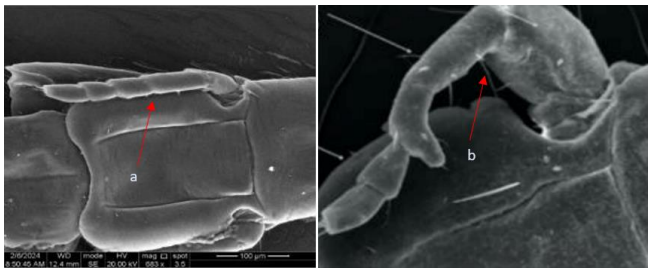

Figure 7: The general shape of the female antenna sensor, which is characterized by equal segments. b- The shape of the antenna sensor in males is characterized by unequal segments. 683x.

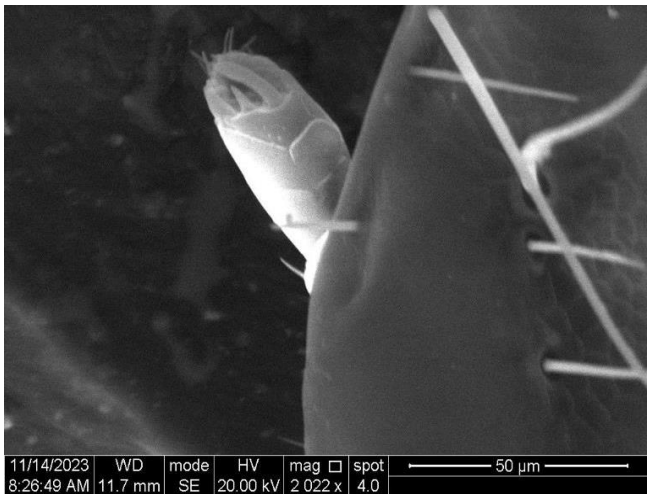

Figure 8: The enlargement of sensory hairs at the end of the antenna sensor in lice *Lipeurus caponis.* 2022X.

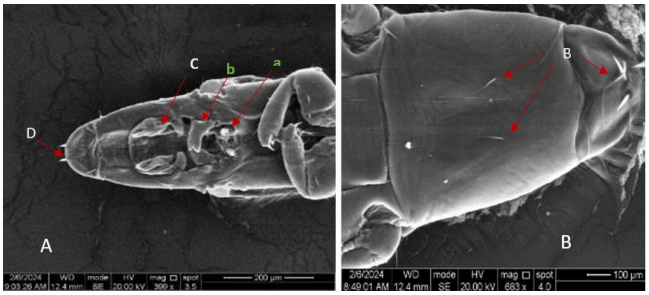

Figure 9: A-Ventral section around the head (the shape of the mouthparts). A-lingual sclerite b- Mandibles c- labrum d- the shape of the bristles in the end head. B- Dorsal section of the head (the shape of the bristles in the head). 399X,683X.

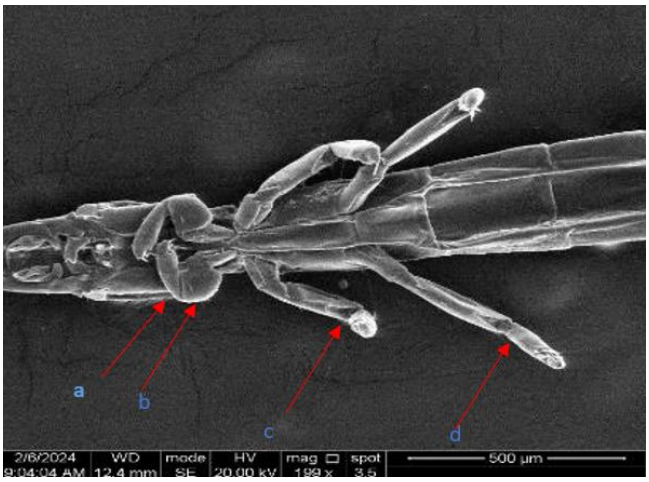

Figure 10: Parts of the thorax and legs of *Lipeurus caponis* (ventral view). A first part of the thorax, b- the first part of the leg, the second part of the leg, and the third part of the leg. 199X.

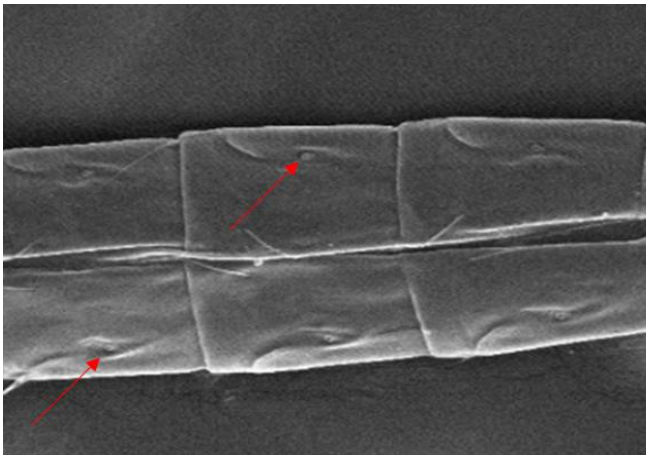

Figure 11: The spiracles located on the abdomen segments of lice *Lipeurus caponis*. 205X.

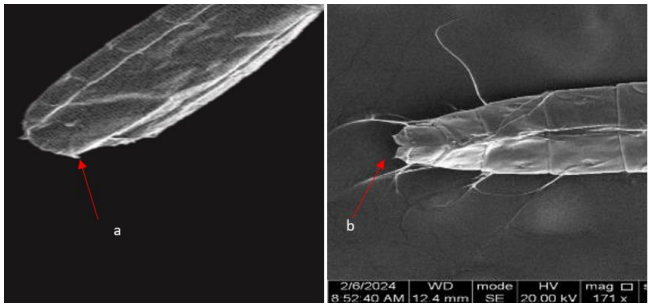

Figure 12: Posterior end of *Lipeurus caponis*: a-Posterior end of male *Lipeurus caponis*. b- Posterior end of female *Lipeurus caponis* terminal end of female with two parts and sensory. 199X ,171X.

Discussion

Poultry as an animal can easily be infested with several types of pathogens. Among various parasitic diseases, external ectoparasites infestation is important, like chewing lice (27), which are obligate ectoparasites wingless living on the host body. As the result of this study, the prevalence of lice in backyard chickens was 69.2%, buoyed by the study of Hatem *et al.* (28), who recorded the prevalence of lice in 66.67% of the population in Iraq. On the other hand, the study by Nadi and George (29) found that the lice in Nigeria were 62.2%. In contrast, the other research found that the prevalence in the Suleimani region of Kurdistan/Iraq was 81.36% (30). The study of Salam *et al.* (31) in Kashmir reported that the prevalence of lice was 100%; our study's results were higher than that of the Kurdistan region at 42% (32). This study provides an overview of population dynamics and the prevalence of lice in backyard chickens in Nineveh governorate; variation in the infestation rate with other studies might be due to weather, seasonal fluctuations, age, and chicken species, and how to give an insecticide. In the current study, the common species of lice was *M. stramineus*; the prevalence of this species was 61.5%. This current study is buoyed by the study of Al Iraqi and Amin (33), which was 58.41%, while the study in the Suleimani region found the prevalence of lice of *M. stramineus* was 72.92% (30). On the other hand, this study was higher than the other study. Abafaji (34) and Kouam *et al.* (35) found a lower prevalence of lice at 30% in Ethiopia and 16% in the Minoura Division, Western highlands of Cameroon, respectively.

In this study, the prevalence of *Lipeurus caponis* was 30.8%. This study is higher than in Diwaniya province, Iraq, and Nigeria 15.78%,15.6%respectively (36,37), while not in agreement with Nadeem *et al.* (38), they found 53.2% in Faisalabad, Pakistan. The difference in the percentage of infestation in many studies may be related to different factors such as environmental conditions, seasonal fluctuations, type and history of pesticide use, and species of *M. stramineus*

present on the body of the chicken. While the *Lipeurus caponis* was present on the wing feathers, this agreement with studies conducted by Al-Iraqi and Hamad-Ameen (39) on chickens in Erbil governorate, Iraq. The results revealed that the infestation by the lice on one chicken differed between single and mixed; infestation was the single infestation common in most locations, and it was 80% while it was 20% mixed infestation, respectively. This result is similar to that obtained by Aliraqi and Amin (33), who detected lice infestation in the Erbil governorate at 66.25% and 28.75%in *M. stramineus* and *Lipeurus caponis*, respectively. Present results showed the isolation and diagnosis of two main species of chewing lice on backyard chickens in Nineveh governorate by dissecting and scanning electron microscope: *Menacanthus straminens* and *Lipeurus caponis. M. Straminens* and *Lipeurus caponis* lice. That is one of the external parasites that infested backyard chickens and has been recorded in many studies (40-43). Diagnosis of lice in this study based on morphology by light and dissecting microscope confirmed with other studies which described it (19-22).

Conclusion

This study determined the presence of biting lice in backyard chickens in Nineveh Governorate and estimated the incidence of lice and their types. The study showed that chickens are attacked by two types of biting lice: *Menacanthus straminus* and *Lipeurus caponis*. *Menacanthus straminus* infestation was the most severe in all locations. The study also showed that a single infection with one type of lice was the most common. In addition, scanning electron microscope was used to identify the morphological characteristics of chewing lice, such as features of head, chest, abdomen, legs, and claws of legs location and segmentation of antennae, setae of *M. stramineus*, and *L. caponis*.

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Conflict of interest

The authors declare no conflicts of interest regarding the publication and/or funding of this manuscript.

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دراسة حدوثيه وشكليه لقمل الدجاج في محافظه نينوى، العراق

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الخلاصة

يعد القمل من الطفيليات الخارجية الأكثر شيوعًا في الطيور وخاصة الدجاج، إذ يقضي دورة حياته في نفس الطائر مما يتسبب في ضعف صحة الدجاج أجريت الدراسة الحالية للكشف عن الإصابة بالقمل في الدجاج المحلي في بعض المناطق في محافظة نينوى، حيث تم فحص ١٣٠ دجاج محلي، أشارت نتائج الدراسة إلى أن معدل الإصابة بالقمل في الدجاج المنزلي ٩٠ (٦٩,٢٪). كما بينت الدراسة إصابة الدجاج بنوعين من القمل، وهما قمل الجسم وقمل الجناح حيث كان قمل الجسم الأكثر انتشارا ولوحظت على جميع أجزاء جسم الدجاج المحلي مسجله نسبه إصابة ٦١,٥٪ في حين بلغت نسبه قمل الجناح ٣٠,٨% ومن خلال فحص العياني للدجاج المحلي وجد أن نسبة الخمج بنوع واحد من الطفيليات (خمج المفرد) كانت ٨٠%اما الخمج المزدوج بنوعين من القمل فقد سجل ٢٠% ثم فحص القمل وحددت هويته باستخدام المجهر التشريحي والمجهر الإلكتروني الماسح لتحديد التركيب الدقيق للقمل العاض مثل سمات الرأس والصدر والبطن والساقين ومخالب الساقين وموقع وتقسيم الهوائيات والشعيرات لكل من قمل الجناح وقمل الجسم. هذه هي الدراسة هدفت لتحديد الخصائص الشكلية للقمل المعزول من الدجاج المحلي، باستخدام المجهر الماسح والمجهر التشريحي.