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An investigation of Endo- and Hemoparasitic Infection in Quails (*Coturnix coturnix*) Population of Sulaymaniyah Province/Iraq

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Abstract

QUAIL is an interesting group of galliform birds. The study aimed to investigate the parasitic infection in common grey quails (*Coturnix coturnix*). During the hunting seasons from2023 to 2024, a total of 45 birds were examined for detection of parasitic infection. All the quails were captured from different regions belonging to Sulaymaniyah province. Parasitological examination was applied to define endoparasites, and haemoparasites were detected through Giemsa-stained blood smears. The investigation revealed that 73.33% of examined quails harbored at least one parasitic species. Enteric parasites, including helminths, *Choanotaenea infundibulum* was discovered from one bird 3.03%, and *Heterakis gallinarum* from two birds 6.06%. Enteric protozoa belonging to the genera *Eimeria* and *Cryptosporidium* with prevalence rates of 36.36% and 30.30% were detected, respectively. *Tetratrichomonas gallinarum* was also observed from 3 quails 9.09%. Infection by hemoprotozoa revealed a higher infection rate of 78.78%. *Haemoproteus* spp. represented the prevalence one and was reported in 45.45%, *Plasmodium* spp. was the second more prevalent, found in 33.33% of inspected birds; and *Aegyptianella pullorum* was another recognized blood parasite, observed with an occurrence rate of 12.12 %. The intensity of co-infection by hemoparasites was high 72.72%. The current study provided an insight into the existence of different parasites that harbour the common quails; applying reliable diagnostic procedures is essential for identifying the discovered parasites.

Keywords: Quails, haemoparasites, intestinal parasites, enteric protozoa, Sulaymaniyah.

Introduction

The common Quail is a migratory bird belonging to the order Galliform, family Phasianidae, genus Coturnix [1]. *Coturnix coturnix*, lives in woodland areas around the world. More than 15 different species have been identified [2].

The quail has begun to hold a significant position in the poultry sector and provides more advantages than other birds. Low feed consumption, short generation intervals, high production rates, and greater disease resistance compared to other poultry are some of the contributing factors [3]. Infections brought on by parasites are one of the main health issues that can harm birds [4].

The association of intestinal parasites with anorexia, diarrhoea, catarrh, intestinal obstruction, emaciation, anaemia, weakness, paralysis, poor feathering, and even death makes them significant issues for the efficient production of avian species and causes financial losses [5, 6]. In general, helminths and protozoans are the types of parasites that frequently infiltrate the gastrointestinal tracts of bird species [7].

Avian infection by cestodes does not result in a fatal illness, the damage caused by an insidious and long-term process to the avian population as a whole result in a vast and complete loss of parasitize bird [8]. The cestodes in habitat in the small intestine, causes adult birds to become emaciated, delayed growth in juvenile birds, and a reduction in laying birds' egg output. Severe intestinal ulcers and diarrhoea could occur, which would presumably lead to poor health and possibly death [9]. *Choanotaenia infundibulum* and *Raillietina echinobothrida* are significant species of worldwide cestodes that habitat small intestine of poultry, are spread by ants, houseflies, and beetles [10].

The main protozoan parasite infecting bird species' digestive tracts is *Eimeria* [11]. Tyzzer

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(1929) was the first to report coccidiosis in quails after identifying *Eimeria dispersa* in bobwhite quail (*Colinus virginianus*) [12]. Numerous *Eimeria* species have been isolated from various quail species, including *E. colini* and *E. lettyae* from bob white quail [13], *E. bateri E. tsunodai*, and *E. uzura* from Japanese quails [14], *E. conturnicis* and *E. bateri* from grey quail [15], *E. lophortygis* and *E. okanaganensis* from California quails, *E. crusti* and *E. oreortygis* are defined from mountain quail [11].

Cryptosporidium is an obligatory intracellular Apicomplexan parasite that affects several hosts' intestinal epithelial cells [16]. Cryptosporidiosis have been found in numerous bird species with varying prevalence rates [16]. Through oocyst inhalation, the parasite can also colonize the lungs, bronchi, air sacs, and trachea [17]. The parasite's diversity is demonstrated by the species of *Cryptosporidium* that infect birds, such as *C. meleagridis* and *C. baileyi*, which have different oocyst sizes and host-specific effects [18]. Poultry frequently has many gastrointestinal parasite infections, which interfere with their regular activities and are primarily characterized by excruciating pains [15].

Recent studies confirming the global occurrence of blood parasites from diverse bird hosts *Plasmodium, Haemoproteus, Leucocytozoon* and *Aegyptianella* are recognized genera of avian hematozoa [4]. Various bloodsucking insect species, including mosquitoes, louse flies, black flies, and biting midges, are thought to be the vectors that spread these parasites [19].

The distribution and prevalence of vector-borne hemosporidian parasites are impacted by climate changes [20]. Hemoprotozoal infections can have a wide range of outcomes, from high morbidity or fatality in previously unexposed individuals to no or very moderate clinical impact [21]. Severe infections can be fatal and cause a variety of physiopathological symptoms, including inflammation, thrombo-cytopenia, and anaemia [22, 23]. *Haemoproteus* species are the most-common avian hemoparasite, approximately 200 different species have been reported from avian hosts [24].

The common parasitological techniques are useful diagnostic tools for demonstrating the gastrointestinal parasites. The common method for diagnosis of *Cryptosporidium* is microscopic examination using modified Ziehl- Neelsen stain, which is regarded as an appropriate diagnostic method [25].

Hemosporidian identification is accomplished through observing characteristic features under a microscope, such as the size and quantity of hemozoin granules and the erythrocytic phases [26]. Smear preparation and staining with Giemsa is an improved procedure for detection of blood parasites, it continues to be crucial for haemoporidian diagnosis. Additionally, it's cheap and quick methodology, that can be easily applied in veterinary diagnosis [27].

Currently in Sulaymaniyah province there were a significant build of research focused on parasitic detection in various bird's species including domestic and wild, however, evidence related to the parasitic infection in quail is infrequent. current study provides a preliminary data regarding an investigation for different parasites habituating the blood and intestine of common quail (*Coturnix coturnix).*

Material and Methods

Study area and sampling

The investigation was carried out in Sulaymaniyah province, Northern region of Iraq. For the current study A total of 45 free living grey quails (*Coturnix coturnix*) were captured during the hunting seasons from 2023 to 2024 from different regions. The purchased birds were transfered to the Laboratory at Veterinary Medicine College, University of Sulaimani.

Laboratory examination

After arrival at the laboratory, live Quails were killed by decapitation. Blood films were made, fixed and stained with Giemsa stain. The birds were then necropsies, each viscera was examined separately in a sterile petri dish with 0.9% saline solution. small and large intestine opened and the intestinal contents were inspected grossly to check for nematodes and cestodes. The recovered helminth parasites were collected individually, washed in normal saline, examined under microscope and fixed in 10% formalin for further identification. Slides were prepared from intestinal and caecal content for observing protozoan parasites through direct wet mount procedure [28], and observed protozoan stages (oocysts and trophozoites) were photographed for morphological studies.

A drop of the intestinal contents with a drop of 0.9% saline were combined on the clean slide, and the mixture was thoroughly mixed until a homogenous smear formed. A systematic and comprehensive examination was conducted using the microscope's 10X objective lens, and a 40X objective lens was used for confirmation [29]. For staining, smears were prepared, fixed by methanol and stained Modified acid- fast staining procedure (Ziehl-Neelsen) for detection of *Cryptosporidium* spp. [30].

For detection of hemoparasitic infection, thin blood films were prepared from each bird, following fixation by absolute methanol stained with Giemsa stain, the dried films were diagnosed under Oil immersion lens (X100) for observing different stages of blood protozoan parasites.

Results

Parasitological examination revealed that 73.33% of the examined Quails harboured at least one of the parasitic species. Enteric protozoa belonging to the genus *Eimeria* were recovered from 12 birds 36.36%, The denoted *Eimeria* oocysts illustrated in Fig. 1 were belong to different species. *Cryptosporidium* was another recovered intestinal protozoon that isolated from 10 birds with the prevalence rate of 30.30% Fig. 2.

Tetratrichomonas gallinarum was the third recovered enteric protozoan species that observed in 3 quails 9.09% Fig. 3. Totally two helminth species were recognized *Choanotaenea infundibulum* from one bird 3.00% and the caecal nematode *Heterakis gallinarum* from two birds 6.10% as viewed in Fig. 4.

Hemoprotozoan parasites were also detected from studied quails with higher prevalence rate of 78.79%. Infection by blood protozoa were belong to different species with various prevalence rates. The higher occurrence rate was belonged to the *Haemoproteus* spp. 45.45% Fig. 5, followed by *Plasmodium* spp. the second most prevalent which was found in 33.33% Fig.6, and *Aegyptianella pullorum* was reported in only 4 quails 12.12% Fig.7. Mixed parasitic infection was a dominant phenomenon and reported from 24 birds 72.73%, co-infection of blood protozoa was found with higher frequency rate of 33.33%, as viewed in table 2.

Discussion

Based on parasitological examination the inspected quail 33 of them 73.33% were harbour one or more parasitic species in their gastro intestinal tract and or blood. Despite the fact that quails are more disease-resistant than poultry due to their wild lifestyle [31].

Helminthological examination, revealed that 9.09% of quails were infected with helminth parasites, *Choanotaenea infundibulum* was one of them which found in one bird 3.03%. *Choanotaenia infundibulum's* morphological description aligned with that of Soulsby [7] and Gamra et al., [10] who described the scolex as triangular and anteriorly pointed [7,10]. Approximately 10 to 15 cm in length, the worms had rostella hooks, a nearly circular sucker, a narrow, short neck, and broad segments that grew longer throughout time. *Choanotaenia infundibulum* has been recovered from Japanese quail by [10, 32]. Furthermore, higher prevalence of helminths infection 26% was reported by [28] including *Raillietina echinobothrida* and *Choanotaenia infundibulum* with prevalence rate of 21.81% and 6% of quails harboured *Raillietina tetragona.*

In addition to causing the birds to lose body weight, avian cestodiasis is one of the most prevalent endoparasitisms that seriously disrupts poultry production., may potentially result in a numerous problem, including anaemia, reduced output, enteritis, neurological symptoms, and death [33]. Access to the intermediate of these cestodes including house flies ants and beetles are essential sources for infection [10]. However [34], have recorded *C. infundibulum* and *R. echinobothrida* in quails with the presence of histological changes in the intestines.

The poultry parasite *Heterakis gallinarum* is a prevalent nematode that thrives in the caeca of several gallinaceous birds [35]. Quails are among the poultry species that infected by caecal nematode *H. gallinarum.* In current study it was recognized from caeca of two birds 6.06%.

Higher prevalence of 25.8% by Heterakidae parasite was observed in *Coturnix japonica* [32], in addition Malik et al., [36] recovered *H. gallinarum* from common quail (*Coturnix coturnix*) caeca of 2 birds out of 10 with frequency of 28.57% [36]. Previously reported that the parasitic *H. gallinarum* causes mild pathology that has no obvious impact on the performance of birds [35], although inflammatory reaction with pathological changes from ceca of infected quails were observed by [36]. In terms of morphology, *H. gallinarum* is a tiny roundworm that ranges in length from 4 to 15 mm. Its life cycle is direct, doesn't need an intermediary host to finish developing [35].

The intestinal protozoa, *Eimeria* spp., were also detected in the quails under investigation. The examined quails were positive for the presence of oocysts with frequency rate of 36.36%. Coccidiosis has been reported previously from *Coturnix* spp. with various prevalence rates, higher frequency of 64.54% found by [37], 30% from farmed quail was reported by [3], and 24% stated by [28], *Eimeria* spp. was also reported by [38] 68.82% and 23.21% in migrant and farm quails, respectively. The mild and nonspecific clinical symptoms of quails with a natural *Eimeria* infection were found to indicate a subclinical illness [39].

Morphological observation revealed that oocysts recovered from studied quails were belonged to different species. Diverse *Eimeria* species were isolated and identified previously from *Coturnix* spp. AL-Zarkoushi, & AL-Zubaidi [37] diagnosed four species from *Coturnix japonica* including *E. bateri, E. uzura, E. tsunodai* and *E. fluminensis* [37]. Other species of *E. taldykurganica, E. dispersa*, and *E. coturnicis* recovered from *Coturnix coturnix*. *E. tsunodai* shows an obligate preference to the intra cecal infection, while *E. uzura* together with *E. fluminensis* and *E. bateri*, have been recognized to colonize both the caeca and the small intestine [40].

Contrary to the findings of [40] most of the recovered oocysts were consistent with those of *E. uzura* and *E. bateri*, which are spherical or subspherical. According to reports, *Eimeria* spp.

affecting quails including *E. bateri, E. tsunodai*, and *E. fluminensis* lacking the micropyle, on the other hand, only *E. uzura* has been found to have micropyle, although reports of its presence and absence have produced contradictory results. Polar granules have been identified as a feature of *Eimeria* species that infect Japanese quails. Although the variability of oocysts linked to the environment and host-parasite relationship has been previously documented, oocyst size can still be a valid criterion for species differentiation (40).

Another recognized enteric protozoon from studied quails was *Cryptosporidium*, which recovered from 10 birds in which 30.30% of examined birds were harbour *Cryptosporidium* parasites, higher prevalence of intestinal cryptosporidiosis was reported 76.7% [41], 23.9% [42], 20% [30], 19% [3] and 6% of farmed quail are infected by intestinal cryptosporidiosis [28].

Quails were found to be infected with three *Cryptosporidium* species: *C. parvum, C. meleagridis*, and *C. baileyi* [43]. Reduced weight gain, decreased egg production, and potential death are all consequences of cryptosporidiosis in quail [3]. It is possible that quails could act as biological carriers of *Cryptosporidium* species, which can infect people and other animals [42]. Through contaminated water, wild birds can contract *Cryptosporidium*. various epidemiological factors have significant role and associated with cryptosporidiosis occurrence such as the tiny size of oocysts, their ability to withstand environmental stresses, the low infection dosage, and their moderated or absent host specificity [44].

Tetratrichomonas gallinarum is another observed intestinal protozoan species that recovered from 4 of the studied quails12.12%. The intestinal flagellate *T. gallinarum* is frequently found in both domesticated and wild galliform and anseriform birds [45]. It was seen as motile pyriform protozoa in wet mount preparation, with four front flagella and a posterior flagellum that extends past the undulating membrane [3]. *Tetratrichomonas gallinarum* was reported previously from intestinal content of farmed quails by Hassan et al. [3] with frequency rate of 15%.

Poultry frequently suffer from many gastrointestinal parasite infections, which interfere with their regular activities and are primarily characterized by excruciating discomfort [15]. Hassan et al. [3] also identified intestinal protozoa from farmed quail belonging to *Eimeria* spp. 30%, *Cryptosporidium* spp. 19%, *Cyclospora* spp. 4%, *Isospora* spp. 3% and *Microsporidia* spp. 3%.

Infection by hemoparasitic protozoa was denoted from studied quails with frequency rate of 78.78%. the identified protozoa were *Haemoproteus* spp. 45.45%, *Plasmodium* spp. 33.33% and *Aegyptianella pullorum* Co- infection by different hemoparastic species was observed with frequency rate of 33.33%. In accordance to current findings Hassan et al., [3] recovered mixed hemoparasitic infection with various prevalence rates of *Haemoproteus* spp. 4%, *Plasmodium gallinaceum* 4%, *Aegyptianella* spp. 7%, as well as *Leucocytozoon* spp. 9%, *Babesiosoma* spp. 8%, *Atoxoplasma* spp. 1% and *Ehrlichia* spp. 1% were detected. In different to current finding higher prevalence of *Plasmodium* spp. 50% and low prevalence of 3.5% from common quails were reported by [41] and [46] respectively.

One of the main contributing factors to the incidence of blood parasites in birds is vector dispersion. Two elements that affect how vectors and parasites develop are ambient temperature and humidity [19]. When vector numbers are low during the dry season, parasites can thrive because some infected birds may not exhibit any symptoms of sickness yet continue to be infected [47]. Low blood parasitaemia rates have been shown to offer some protection against infection in the past [48]. Nevertheless, a number of variables, including the host's age and sex, the parasite and host species, the bird's immunity, the infection stage and time of establishment, and inherent host characters like the presence of sex hormones, might affect parasitaemia [49, 19]. According to Ribeiro et al., [50] the biological and behavioural traits of the host may have an impact on the prevalence of infection, feeding habits may also influence the likelihood of coming into contact with vectors, and physiological alterations may increase the bird's susceptibility to haemoparasites [50].

Singl parasitic infection from examined birds have been observed in 27.27%, including 9.09% and 18.18% for both of intestinal parasites and blood parasites. Although co-infection was prominent feature and observed in 72.72% of examined birds, of these 12.12% represented intestinal parasites, 33.33% blood parasite s and 27.27% were harboured both intestinal and blood parasites. Similarly, Hassan et al., [3] reported higher prevalence of mixed intestinal infection 25% than single intestinal protozoal infection 19% of examined birds.

The absence of other reported parasite species and presence of investigated parasites could be due to the biological diversity of the Iraq environment as a factor enhancing the parasitic infections.

Conclusion

The current investigation defined parasitic infection in quails (*Coturnix coturnix*) at various level including endo and haemo-parasites, although the frequency of parasitic burden was low. Infection with different intestinal parasitic species might affect the body condition of infected bird and lead to loss of weight. Hemoparsitic species mostly associated with low productivity and mortality of infected birds. The common parasitological techniques, can serve as a practical diagnostic technique in the lab for

demonstrating the gastrointestinal and blood parasites. Different environmental condition s has an impact on parasitic infection, as well as the vector born blood parasites. Applying of molecular techniques as a reliable detection method for assessing the prevalence, species identification and phylogenetic analysis of intestinal and blood parasites are essential.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical of approval

This study follows the ethics guidelines of the Faculty of Veterinary Medicine, Sulaimani University, Iraq, 4/11/2024).

TABL 1. Frequency of parasitic infection of studied quails (*Coturnix coturnix*) from Sulaymaniyah province.

Identified parasite	No. of infected birds	% of infection
Intestinal parasite	17	51.51
Helminths	3	9.09
Choanotaenea infundibulum	1	3.03
Heterakis gallinarum	2	6.06
Intestinal Protozoa	14	42.42
Eimeria spp.	12	36.36
Cryptosporidium spp.	10	30.30
Tetratrichomonas gallinarum	3	9.09
Blood protozoa	26	78.78
Haemoproteus	15	45.45
Plasmodium	11	33.33
Aegyptianella pullorum	4	12.12
Total	**33**	**73.33**

TABL 2. Pattern of parasitic infection in studied quails (*Coturnis coturnis*) from Sulaymaniyah province.

Infection pattern	No. of infected birds	% of infection
Single infection	9	27.27
Intestinal parasites	3	9.09
Blood protozoa	6	18.18
Mixed infection	24	72.72
Intestinal parasites	4	12.12
Blood protozoa	11	33.33
Blood protozoa & intestinal parasites	9	27.27
Total	**33**	**73.33**

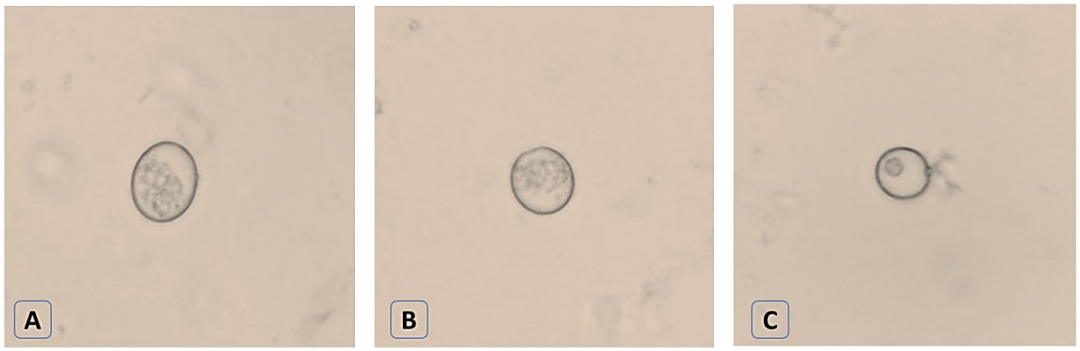

Fig. 1. Photomicrograph of *Eimeria* spp. oocysts isolated from infected quail (*Coturnix coturnix*) Flotation (400X).

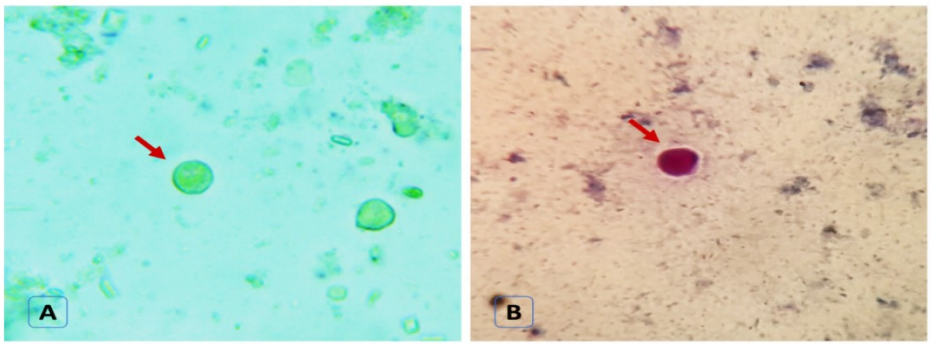

Fig. 2. Photomicrograph of *Cryptosporidium* spp. oocysts isolated from infected quail (*Coturnix coturnix*) A. Direct wet mount(400X), B. M. Ziehl- Neelsen stain (1000X).

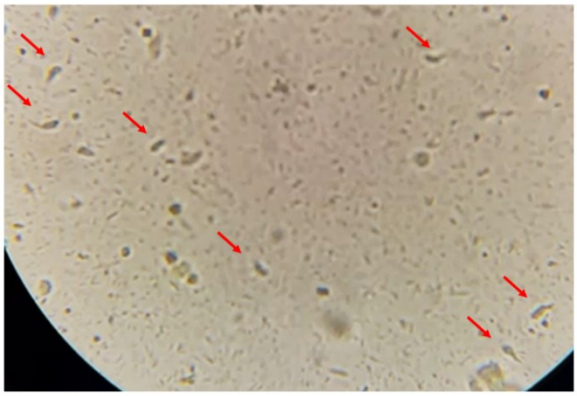

Fig. 3. Photomicrograph of *Tetratrichomonas gallinarum*. trophozoites isolated from infected quail (*Coturnix coturnix*). Direct wet mount (400X).

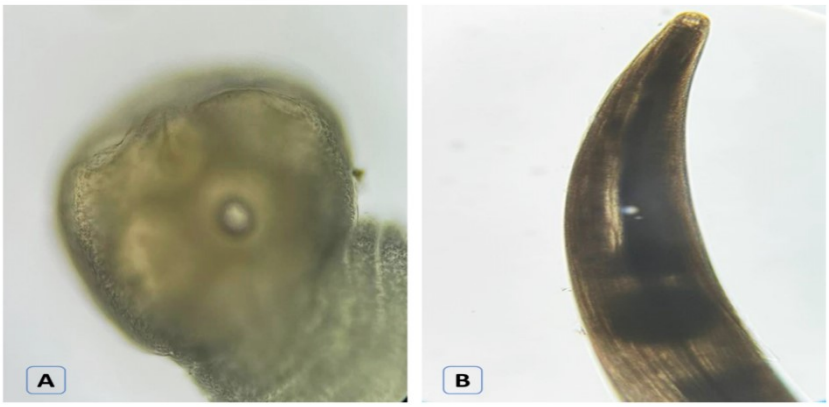

Fig. 4. Photomicrograph of anterior end of intestinal parasitic helminths isolated from infected quail (*Coturnix coturnix*). (40X) A. *Choanotaenea infundibulum*, B. *Heterakis gallinarum.*

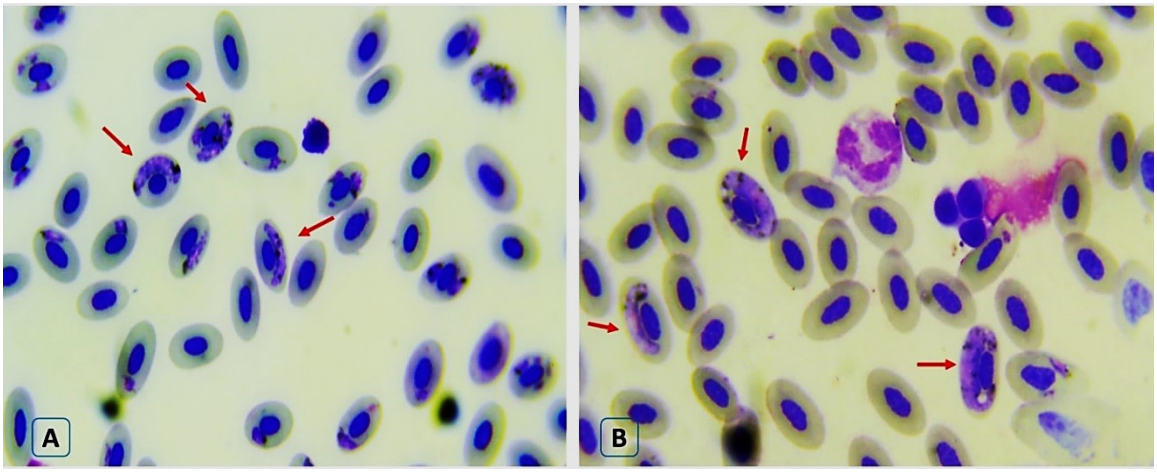

Fig. 5. Photomicrograph of erythrocytes from infected quails with haemoprotozoa (arrows). A & B *Haemoproteus* spp., Giemsa stain 1000X.

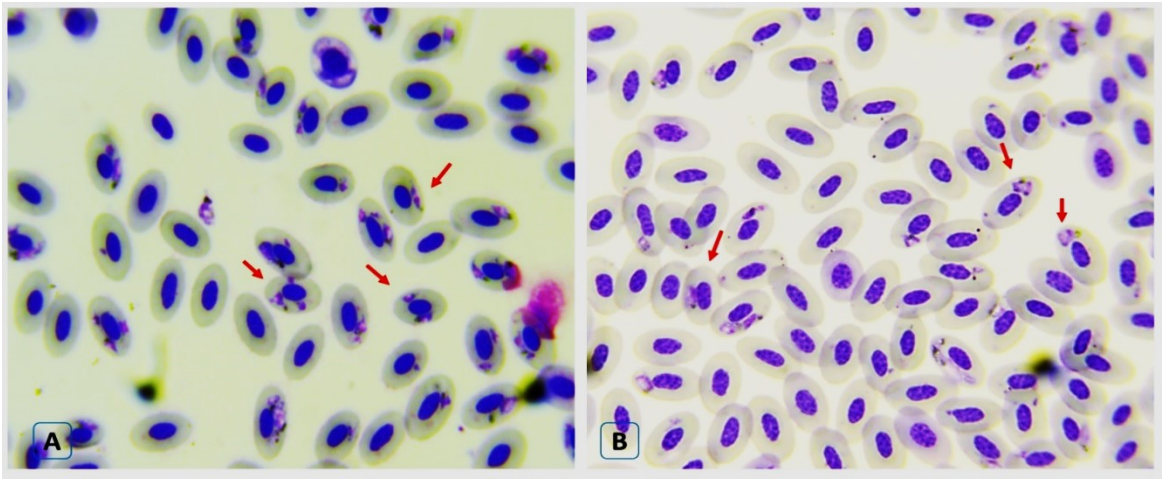

Fig. 6. Photomicrograph of erythrocytes from infected quails with haemoprotozoa (arrows). A & B *Plasmodium* spp., Giemsa stain 1000X.

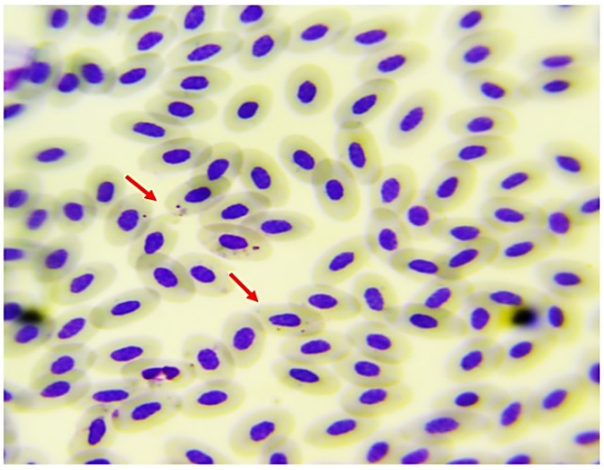

Fig. 7. Photomicrograph of erythrocytes from infected quails with haemoprotozoa (arrows). *Aegyptianella pullorum*, Giemsa stain 1000X.

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دراسة حول الإصابة بالطفيليات الداخلية والدموية في طيور السمان (*Coturnix coturnix*) في محافظة السليمانية/العراق

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الملخص

ينتمي السمان إلى فصيلة الطيور السمانية. هدفت الدراسة إلى كشف الإصابة الطفيلية في السمان الرمادي الشائع (*Coturnix coturnix*). تم فحص ما مجموعه 45 طائرًا للكشف عن الإصابة الطفيلية خلال مواسم الصيد من 2023 إلى 2024، تم اصطياد جميع السمان من مناطق مختلفة تابعة لمحافظة السليمانية. تم تطبيق الفحص الطفيلي لتحديد الطفيليات الداخلية وتم الكشف عن الطفيليات الدموية من خلال لطاخات الدم المصبوغة بصبغة الجيمسا. كشف 73.33٪ من السمان المفحوصة حاملة نوعًا طفيليًا واحدًا على الأقل. اكتشفت الطفيليات المعوية بنسبة 3.03٪ مثل الديدان الطفيلية *Choanotaenea infundibulum* من طائر واحد و *Heterakis gallinarum* من طائرين بنسبة 6.06%. تم الكشف عن الأوالي المعوية التي تنتمي إلى جنس *Eimeria* و *Cryptosporidium* بمعدلات انتشار بلغت 36.36% و30.30% على التوالي. كما لوحظ وجود *Tetratrichomonas galinarum* في 3 طيور السمان بنسبة 9.09%. وكشفت الاصابة بالطفيليات الدموية بمعدل إصابة أعلى بلغ 78.78%. والمتمثلة ب spp *Haemoproteus*. وتم تسجيل معدل الانتشاربنسبة 45.45%، وجاءت spp *Plasmodium* في المرتبة الثانية من حيث الانتشارحيث وجدت في 33.33% من الطيور التي تم فحصها وتم الكشف عن طفيليات دم اخرى مثل *Aegyptianella pullorum* بمعدل حدوث بلغ 12.12%. وكانت شدة العدوى المشتركة بالطفيليات الدموية عالية بنسبة 72.72%. قدمت الدراسة الحالية رؤية لوجود طفيليات مختلفة تحمله السمان الشائع ويعد تطبيق إجراءات تشخيصية موثوقة أمرًا ضروريًا لتحديد الطفيليات المكتشفة.

الكلمات الدالة: السمان، الطفيليات المعوية، الطفيليات الدموية، الكائنات الأولية المعوية ، السليمانية.