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Detection of some species of intestinal parasitic infection in Iraqi sheep *Ovis aries*

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Abstract

Objective

Intestinal parasitic infections pose a significant threat to the health and productivity of livestock, particularly sheep (*Ovis aries*), which play a crucial role in the agricultural economy and food security. These infections can lead to poor growth, reduced wool and meat production, and increased susceptibility to other diseases. Identifying the prevalence and types of intestinal parasites in sheep is essential for effective disease control and management. This study aims to investigate the intestinal parasites affecting Iraqi sheep in Al-Diwaniyah Governorate, determine their infection rates, and assess the influence of age on susceptibility to infection.

Materials and Methods

A total of 123 fecal samples were randomly collected from sheep in various areas of Al-Diwaniyah Governorate between September 2023 and March 2024. The samples were stored at 4°C until microscopic examination. Parasitological analysis was conducted using direct smear, iodine staining, and Ziehl-Neelsen staining techniques.

Results

The overall prevalence of intestinal parasites was 65.85%. Six distinct types of intestinal parasites were identified in the fecal samples: three protozoan species—*Eimeria* sp. (43.90%),

Cryptosporidium sp. (39.02%), and *Tetrahymena* spp. (14.63%)—and three helminth species—*Trichostrongylus* sp. (26.02%), *Haemonchus* sp. (21.95%), and *Moniezia* sp. (13.01%). A statistically significant difference was observed between the highest infection rate of *Eimeria* sp. (43.90%) and the lowest infection rate of *Moniezia* sp. (13.01%). Additionally, age was significantly associated with infection prevalence, with the highest rate (72.0%) observed in sheep aged one to three years, compared to 56.25% in lambs under one year.

Conclusions

This study highlights a high prevalence (65.85%) of intestinal parasites in Iraqi sheep, with *Eimeria* sp. being the most common protozoan and *Trichostrongylus* sp. the most frequently detected helminth. The findings indicate a significant correlation between age and infection rates, with higher prevalence in sheep aged one to three years. These results emphasize the need for targeted parasite control programs, including age-specific prevention and treatment strategies, to mitigate the impact of parasitic infections on sheep health and productivity.

Keywords: *Cryptosporidium* sp., *Eimeria* sp., intestinal parasite, sheep

Paper Type: Research Paper.

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Introduction

Small ruminants, particularly native breeds, play a significant role in the livelihoods of a considerable portion of the human population in tropical regions from a socio-economic perspective (Molaei Moghbeli et al. 2013; Hajalizadeh et al. 2019; Jafari Ahmadabadi et al. 2023; Saadatabadi et al. 2023; Mohammadabadi et al. 2024). Therefore, integrated efforts focusing on

management and genetic improvement to enhance animal productivity are of critical importance (Askari et al. 2011; Vahabzadeh et al. 2020; Amirteymoori et al. 2021; Mohammadabadi et al. 2023). The economic and biological efficiency of small ruminant production enterprises generally improves by increasing the productivity and reproductive performance of these animals (Zamani et al. 2011; Safaei et al. 2022; Mohammadabadi & Tohidinejad 2017; Mohammadinejad et al. 2022; Shokri et al. 2023). Sheep (Ovis aries) constitute a crucial component of livestock in many countries worldwide due to their significant role in food security and human livelihoods. The Arab world has an estimated 118 million sheep, with Iraq alone accounting for approximately 10.5 million (Abd Al-Wahab 2003). The prevalence of sheep breeding in Arab countries is attributed to several advantages: sheep, being medium-sized animals, exhibit high reproductive efficiency due to their tendency to produce twins, their short gestation period of approximately six months, and their adaptability to diverse environmental conditions, including arid and semi-arid regions unsuitable for other livestock species (Dwyer & Lawrence 2005). The presence of body fat in sheep enhances their ability to withstand periods of drought and feed scarcity. This genetically inherent trait allows them to thrive in semi-desert areas characterized by poor and sparse pastures, enabling them to graze on prickly desert plants that other livestock species cannot consume (Fadl et al. 2011). These characteristics contribute to the increasing number of sheep and the widespread practice of their rearing due to their relatively low maintenance costs, minimal barn requirements, and reduced labor demands in open pasture systems (Abd Al-Wahab 2003).

The economic significance of sheep is particularly notable as they serve as a primary source of meat in many Arab countries, contributing approximately 48% of the total meat consumed in developing nations. In terms of red meat production, mutton ranks third after beef and buffalo meat (Al-Gelany 2003). Additionally, sheep are the third-largest contributors to milk production, following cows and buffaloes, with an annual yield of up to 22%. Furthermore, sheep skins are highly valuable in the leather industry, while their horns and hooves are utilized in glue production. The presence of sheep in pastures also enhances soil fertility, as sheep manure serves as a rich source of organic fertilizer, particularly abundant in phosphorus and potassium, and is highly degradable (Abbott 2018).

Like other farm animals, sheep are susceptible to a variety of diseases, including parasitic infections that significantly impact their health and productivity. Among these, gastrointestinal tract (GIT) parasites represent one of the most critical parasitic infections (Hamid et al. 2016). The digestive tract of ruminants, including sheep, hosts numerous parasites, particularly tapeworms and nematodes, which cause substantial economic losses due to direct effects on the animals and the costs associated with treatment and preventive measures (Pedreira et al. 2006). Several studies (Abd Al-Wahab 2003; Minnat 2014; Makawi et al. 2016) have reported high

infection rates in sheep diagnosed with various parasitic species. Moreover, research has documented the prevalence of protozoan infections in sheep, including species such as *Eimeria spp.*, *Cryptosporidium spp.*, and *Giardia sp.*. These parasites colonize the small intestine, damaging intestinal villi and inducing pathological symptoms such as diarrhea, abdominal pain, and gastrointestinal distress (Santin et al. 2007; Ryan 2005; Saleh 2011; Mohammed,2013). Transmission occurs through ingestion of cystic stages of these parasites via contaminated food and water, allowing infected animals to spread the disease to healthy livestock (Dawood & Abdullah 2007; Fayer 2010). A wide range of parasitic tapeworms and nematodes affecting sheep has been documented in previous studies (Rehman & Ali 2001; Vlasoff et al. 2001; Gorski et al. 2004; Gadahi et al. 2009; Bhat et al. 2012). Studies conducted in Iraq have reported varying prevalence rates of intestinal parasitic infections in sheep and lambs (Minnat 2014). Given the significant economic importance of sheep, these animals require extensive care and management to enhance their productivity. Since many intestinal parasites exhibit broad host specificity, this study aims to identify and highlight the types of intestinal parasites that infect sheep, particularly those that pose a risk of transmission to other economically valuable livestock species, such as goats, cattle, and buffalo.

Materials and Methods

Sample Collection: A total of 123 fecal samples were randomly collected from sheep of both sexes and varying ages in Al-Diwaniyah province, Iraq. The samples were collected using clean plastic containers, and the following data were recorded for each sample: sample number and the approximate age of the sheep. The fecal samples were then stored at 4°C until further examination.

Fecal Examination: The laboratory examination of fecal samples was conducted to detect the presence of parasites using the direct examination method described by Coles (1986). The examination process included the following steps:

1. Fecal samples were mixed with normal saline, placed in clean Petri dishes, and visually examined for tapeworms and nematodes.
2. Solid particles were removed by passing the fecal samples through medical gauze.
3. The filtrate was collected in clean test tubes and centrifuged at 2500 rpm for 10 minutes.
4. A portion of the supernatant was discarded, and the sediment was used to prepare direct smears on clean glass slides. These smears were examined under a microscope and photographed using a digital camera (Coles, 1986).

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5. Some smears were further processed with xylan dye to detect parasitic spores, following the method described by Baron et al. (1994):

a) The upper portion of the sediment was collected using a dropper and used to prepare thin smears on clean glass slides. These smears were fixed at 60°C for 10 minutes in a drying oven.

b) The slides were stained with carbol fuchsin dye for 5 minutes, then rinsed with distilled water.

c) Excess dye was decolorized using acidified alcohol for 1 minute, followed by washing with distilled water and air-drying.

d) The slides were counterstained with methylene blue for 1 minute, washed with distilled water, air-dried, examined under a microscope at 40x magnification, and photographed.

Statistical Analysis: The prevalence of parasites in fecal samples was analyzed using the Chi-square (χ^2) test to assess associations between parasite presence and categorical variables such as age and sex. The statistical model used was as follows:

$$\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

where:

- O_{ij} = Observed frequency in the i^{th} row and j^{th} column
- E_{ij} = Expected frequency, calculated as:

$$E_{ij} = \frac{(Row\ Total) \times (Column\ Total)}{Grand\ Total}$$

The test was conducted at a significance level of $\alpha = 0.05$, meaning results with $P \leq 0.05$ were considered statistically significant. Statistical analyses were performed using SPSS version 27 (IBM, 2024). Data were organized into contingency tables for the variables (age, sex, and parasite presence), and the Chi-square test was applied accordingly.

Results and Discussion

The results of this study indicate that various intestinal parasites infected 123 stool samples collected from local sheep (*Ovis aries*), leading to an overall infection rate of 65.85% (81 infected animals), as presented in Table 1.

Table 1. Prevalence of intestinal parasite infections in Iraqi sheep (*Ovis aries*)

No. of tested sheep	123	Percentage %
No. of infected sheep	81	65.85
No. of uninfected sheep	42	34.15

The data presented in Table 1 indicate an overall infection rate of 65.85% in sheep. This high prevalence among local sheep may be attributed to their limited exposure to controlled breeding conditions. These findings align with previous studies that have reported high rates of infestation in sheep with various protozoa, nematodes, and tapeworms. For instance, Abd Al-Wahab (2003) documented an infection rate of 85% in Baghdad, while Minnat (2014) reported an infection rate of 86.71% in Diyala. Similarly, Makawi et al. (2016) recorded a significantly high incidence of protozoan parasitic infections in sheep, reaching 91.66%.

Several factors may contribute to the observed high infection rates, including sampling locations, breeding methods, breed type, management system, sanitary conditions of barns, the extent of pasture contamination with infective parasitic stages, lamb breastfeeding conditions, exposure to stress, and susceptibility to concurrent diseases (Faleke et al. 2006; Fadl et al. 2011; Bhat et al. 2012). In Iraq, sheep are typically reared in open grazing systems and obtain drinking water from streams and small river branches, predisposing them to infection with various intestinal parasites (Al-Kaabi 2009; Salah 2011). In contrast, in many other countries, sheep are raised in controlled farm environments, which influence the transmission and spread of intestinal parasites within the herd. Additionally, the role of contaminated drinking water and feed in the dissemination of infections must be considered, as they may harbor infective parasitic stages (Rehman & Ali 2001; Hindson & Winter 2002; Sevinc et al. 2005). Table 2 presents the types of intestinal parasites identified in sheep fecal samples. The results indicate that sheep were infected with three protozoan species: *Eimeria* sp. (Figure 1), *Cryptosporidium* sp. (Figure 2), and *Tetrahymena* sp. (Figure 3), with infection rates of 43.90%, 39.02%, and 14.63%, respectively. Additionally, two nematode species were identified based on the presence of their eggs: *Trichostrongylus* sp. (Figure 4) at 26.02% and *Haemonchus* sp. (Figure 5) at 21.95%. Furthermore, the presence of *Moniezia* sp. eggs (Figure 6) was detected, with an infection rate of 13.01%.

The results of the study demonstrated that the highest incidence was observed for *Eimeria* sp. and *Cryptosporidium* sp., while the lowest incidence was recorded for *Moniezia* sp. (13.01%). These findings are consistent with several previous studies that have highlighted the significant prevalence of *Eimeria* sp. infection in sheep. For instance, Sulaiman et al. (2005) reported the infection of sheep with nine types of *Eimeria* sp., resulting in an overall infection rate of 60.52%. Similarly, Alani et al. (1988) identified sixteen types of *Eimeria* sp. in sheep, with a remarkably high infection rate of 96.3%. Kaya (2004) in Turkey documented ten types of *Eimeria* sp. with a 100% infection rate, while Minnat (2014) reported nine types with an infection rate of 86.09%.

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Table 2. Types of intestinal parasites identified in fecal samples of sheep

Type of intestinal parasite		No. of infected sheep	%
Protozoa	Eimeria sp.	54	43.90
	Cryptosporidium sp.	48	39.02
	Tetrahymena sp.	18	14.63
Nematoda	Trichostrongylus sp.	32	26.02
	Haemonchus sp.	27	21.95
Cestoda	Moniezia sp.	16	13.01
Total = 123		81	65.85

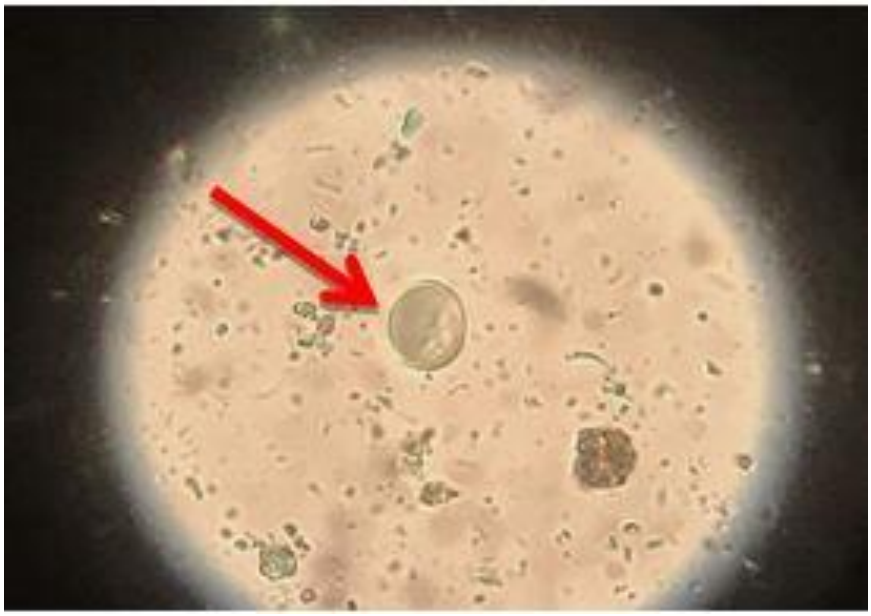

Figure 1. Oocyst of *Eimeria* sp. (iodine stain, X600; red arrow)

Regarding *Cryptosporidium* sp., several previous studies have indicated that this parasite is among the most prevalent protozoan infections in Iraqi sheep (Al-Gelany 2003; Dawood & Abdullah 2007; Saleh 2011; Mohammed 2013). Research conducted by Hamad & Al-Khaled (2016) reported a high incidence rate of *Cryptosporidium* sp., with a prevalence of 51.0% in sheep from Al-Diwaniyah. Likewise, Kadhim (2009) documented very high infection rates of 81.4% in lambs and 74.2% in goats in Baghdad. However, these findings are inconsistent with some international studies. For example, a study conducted in Turkey reported a significantly lower incidence of protozoan parasitic infections, at only 3.8% (Erman et al. 2000). Similarly, Siddiki et al. (2015) recorded an infection rate of just 11.3% in Australia. The differences in infection rates can be attributed to variations in breeding practices. Sheep raised in open grazing

environments with access to natural water sources, such as streams, are more susceptible to parasitic infections (Kadhim 2009). Conversely, in many developed countries, sheep are raised in controlled barns and farms, where stringent management practices help limit the occurrence and spread of parasitic infections within flocks.

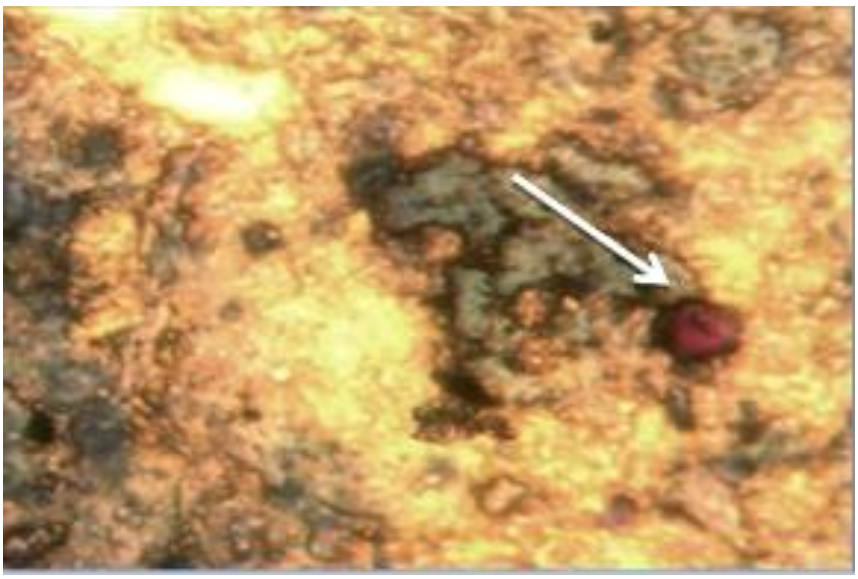

Figure 2. Oocyst of *Cryptosporidium* sp. (Ziehl-Neelsen stain, X600; white arrow)

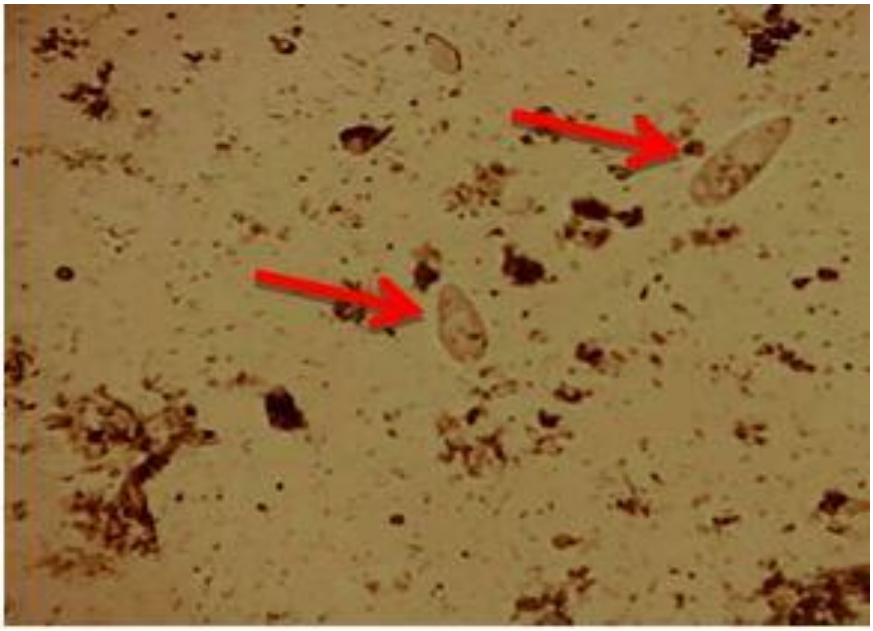

Figure 3. Ciliated trophozoite of *Tetrahymena* sp. (iodine stain, X400; red arrow)

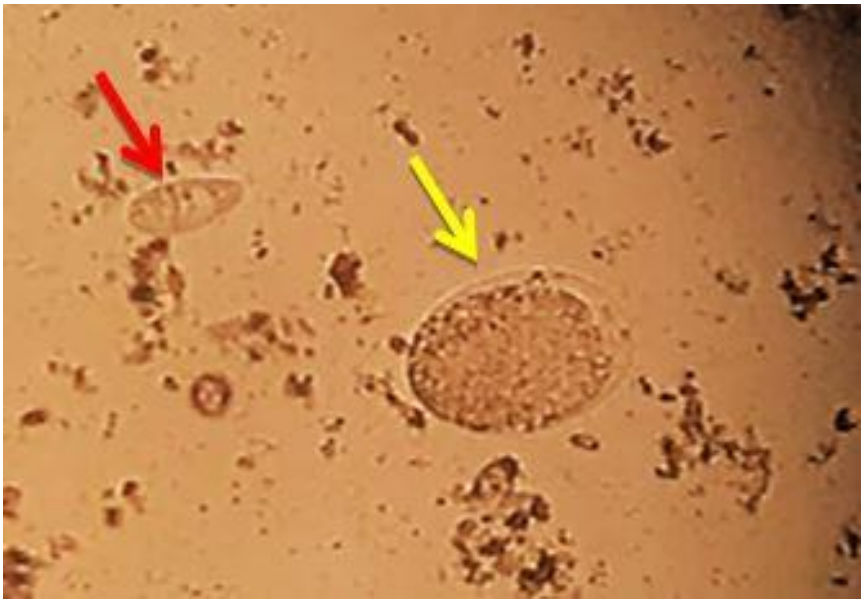

Figure 4. Egg of *Trichostrongylus* sp. (yellow arrow) and a trophozoite of *Tetrahymena* sp. (red arrow) (iodine stain, X400)

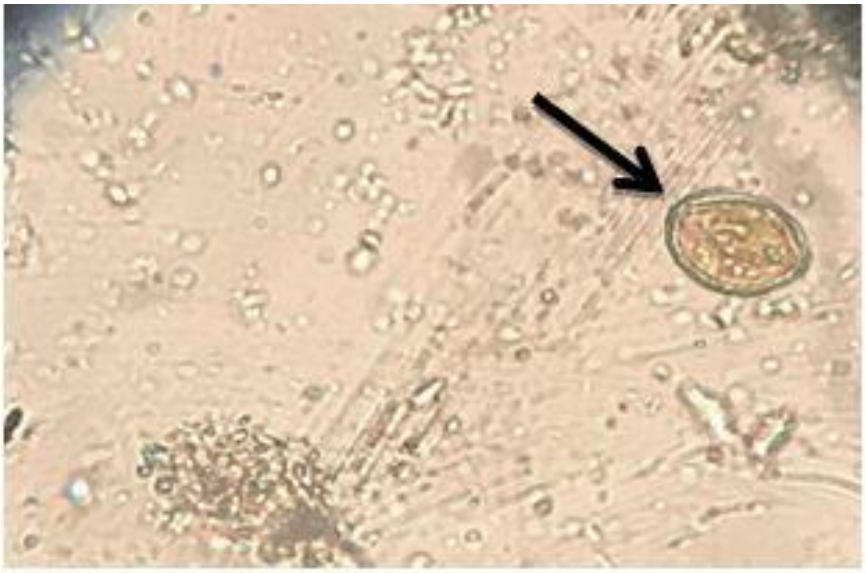

Figure 5. Egg of *Haemonchus* sp. (black arrow) (iodine stain, X400)

Notably, the current study revealed the presence of *Tetrahymena* sp. in the fecal samples of 18 sheep, marking the first record of this parasite in sheep in Iraq. *Tetrahymena* sp. is a free-living ciliate that can occasionally invade different hosts. This parasite colonizes the large intestine, particularly the colon, where it may cause severe damage and erosion of the intestinal mucosa. Infected areas often appear as white necrotic spots (Jerome et al. 1996). *Tetrahymena* sp. infections are frequently waterborne, as this parasite is found in freshwater sources such as rivers. Several studies have reported infections in freshwater fish, where the parasite was identified in

the gills and skin. Additionally, infections have been recorded in dogs (Hoffman et al. 1975; Denis et al. 2000).

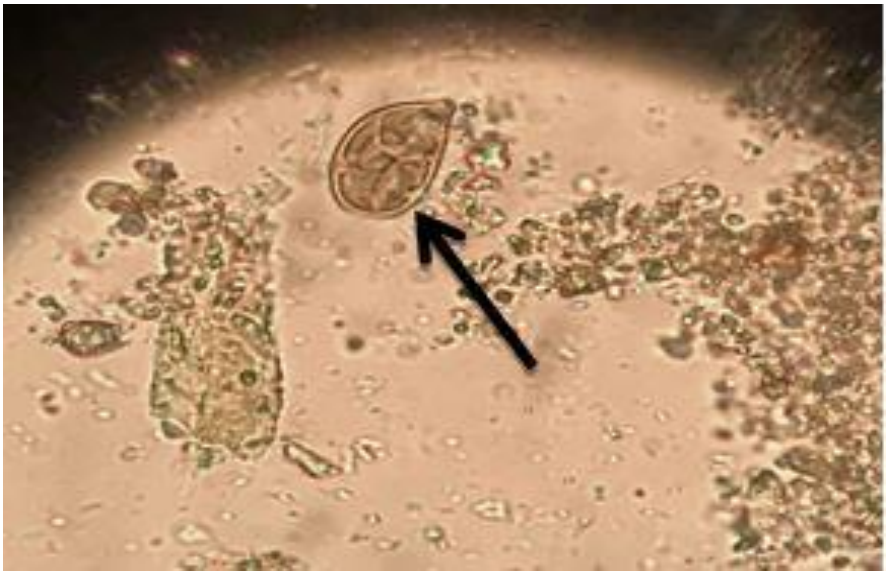

Figure 6. Egg of *Moniezia* sp. (black arrow) (iodine stain, X400)

The findings of the present study align with several local and international studies regarding the presence of nematode and tapeworm eggs in sheep feces. Suleiman et al. (2005) identified *Trichostrongylus* and *Haemonchus* as the most common nematodes in sheep; however, *Moniezia* sp. was not recorded in their study. Likewise, Yeasmin et al. (2014), Minnat (2014), and Mavrot et al. (2015) documented infections with these parasites in sheep. Sheep, like other livestock, are susceptible to infections caused by nematodes and tapeworms. The prevalence of these infections is influenced by environmental conditions, management practices, deworming protocols, and the presence of co-grazing infected hosts. These factors contribute to parasite transmission by contaminating food and water sources with infective parasite stages. The results of the current study also indicate a significant difference in infection rates based on animal age (Table 3). The infection rate in sheep aged between 1 and 3 years was 72.0%, whereas younger sheep (less than 1 year old) exhibited a lower infection rate of 56.25%. This finding is consistent with Swadi (2008), who reported an infection rate of 43.5% in sheep aged six months to one year and 36.8% in those under six months.

Adult sheep are more susceptible to infection than their younger counterparts. Therefore, the results of the current study do not align with the findings of Vieira et al. (1997), which reported that severe cases of infection predominantly led to death in young animals. Infected sheep exhibit symptoms such as weakness and lethargy, which can ultimately result in mortality. The observed

trend in this study may be attributed to the duration of exposure to infectious stages, as older sheep have had prolonged contact with these stages compared to younger sheep. Additionally, younger sheep benefit from passive immunity through colostrum, reducing their susceptibility to infection (Sulaiman et al. 2005; De Graaf et al. 1999).

Table 3. Frequency of Intestinal Infections Relative to Age

Sheep age	No. of examined sheep	No. of infected sheep	%
6 months to 1 year	48	27	56.25
1 year to 3 years	75	54	72.0
Total	123	81	65.85

The findings of the present study highlight the substantial burden of intestinal parasitic infections in local sheep populations, with an overall infection rate of 65.85% (Al-Kaabi 2009; Salah 2011). These results underscore the persistent challenge of parasitic infections in regions characterized by open grazing and limited veterinary interventions. The high infection rate observed aligns with previous research, reinforcing the impact of environmental factors, herd management practices, and restricted access to veterinary care on the spread and persistence of intestinal parasites in sheep (Faleke et al. 2006; Fadl et al. 2011; Bhat et al. 2012). The study identified six types of intestinal parasites, with protozoan infections being the most prevalent, particularly Eimeria sp. and Cryptosporidium sp. These findings indicate that protozoan infections pose a significant concern in sheep husbandry, potentially leading to economic losses due to decreased productivity and increased morbidity (Sulaiman et al. 2005; Alani et al. 1988). The dominance of Eimeria sp. is consistent with previous studies conducted in Iraq and other regions, emphasizing the need for effective control measures such as targeted anthelmintic treatments and improved sanitation in barns and grazing areas (Kaya 2004; Minnat 2014). A particularly noteworthy finding of this study is the identification of Tetrahymena sp. in sheep fecal samples, marking the first recorded case of this parasite in sheep in Iraq. Given its potential pathogenicity, further studies are necessary to assess its impact on sheep health and productivity (Jerome et al. 1996). The presence of this ciliate in fecal samples suggests that contaminated drinking water may be a primary source of infection. Consequently, implementing measures to improve water quality and minimize contamination risks is crucial for reducing infections (Hoffman et al. 1975; Denis et al. 2000). Additionally, the study confirmed the presence of two nematode species, Trichostrongylus sp. and Haemonchus sp., along with Moniezia sp., a cestode. The presence of these helminths indicates the ongoing challenge of parasitic worm infections in

sheep, particularly in regions with inadequate grazing management and high pasture contamination (Suleiman et al. 2005; Yeasmin et al. 2014). Trichostrongylus sp. and Haemonchus sp. are known to cause significant gastrointestinal distress, leading to weight loss, anemia, and reduced productivity in infected sheep (Minnat 2014; Mavrot et al. 2015). Given their economic impact, the implementation of integrated parasite management strategies, including rotational grazing and regular deworming programs, is essential to mitigate infection rates.

Age-related differences in infection prevalence were observed, with older sheep exhibiting a higher infection rate compared to younger individuals. This trend may be attributed to prolonged exposure to infective parasite stages in grazing environments. However, the relatively lower infection rates in younger sheep suggest that maternal immunity, derived from colostrum, may provide temporary protection against infections (Swadi 2008). Nevertheless, as maternal antibodies wane over time, the risk of infection increases, necessitating timely and effective prophylactic measures to prevent severe parasitic burdens (De Graaf et al. 1999; Sulaiman et al. 2005). Compared to global studies, the infection rates observed in this study were significantly higher than those reported in some developed countries, where intensive farming systems and stringent biosecurity measures are implemented (Erman et al. 2000; Siddiki et al. 2015). This stark contrast in infection prevalence highlights the need for improved sheep management practices in Iraq to mitigate parasitic infections and their associated economic losses. The introduction of advanced diagnostic tools, routine fecal examinations, and targeted treatment regimens could greatly enhance parasite control efforts (Kadhim 2009). Overall, the findings of this study underscore the urgent need for comprehensive parasite control strategies, including enhanced sanitation, improved herd management practices, and strategic use of antiparasitic drugs. Future research should focus on identifying risk factors associated with parasitic infections, evaluating the efficacy of various control measures, and exploring potential vaccination strategies against protozoan infections. Addressing these challenges will significantly improve sheep health and productivity in Iraq, ultimately benefiting the local agricultural economy.

Conclusion: The study revealed that Iraqi sheep are infected with six types of intestinal parasites, with Eimeria sp. and Cryptosporidium sp. being the most prevalent among protozoa, along with nematodes and cestodes. Furthermore, the study recorded Tetrahymena sp. as the first reported case in sheep in Iraq. These findings underscore the necessity for sheep breeders to adopt preventive measures to safeguard livestock health and productivity.

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Conflict of Interest: There is no conflict of Interest.

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تشخیص برخی از گونه‌های عفونت انگلی روده‌ای در گوسفند عراقی Ovis aries

هند عبدالزهرا عبدالکاظم الشیبانی

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چکیده

هدف: عفونت‌های انگلی روده‌ای تهدید قابل‌توجهی برای سلامت و بهره‌وری دام‌ها، به‌ویژه گوسفندان (Ovis aries) هستند که نقش مهمی در اقتصاد کشاورزی و امنیت غذایی دارند. این عفونت ها می‌تواند منجر به رشد ضعیف، کاهش تولید پشم و گوشت و افزایش حساسیت به بیماری های دیگر شود. شناسایی شیوع و انواع انگل‌های روده‌ای در گوسفند برای کنترل و مدیریت موثر بیماری ضروری است. هدف از این مطالعه بررسی انگل‌های روده‌ای مؤثر بر گوسفندان عراقی در استان الدیوانیه، تعیین میزان آلودگی آنها و ارزیابی تأثیر سن بر حساسیت به عفونت است.

مواد و روش‌ها: در مجموع ۱۲۳ نمونه مدفوع به طور تصادفی از گوسفندان مناطق مختلف استان الدیوانیه بین سپتامبر ۲۰۲۳ تا مارس ۲۰۲۴ جمع آوری شد. نمونه‌ها تا زمان بررسی میکروسکوپی در دمای ۴ درجه سانتی گراد نگهداری شدند. آنالیز انگل‌شناسی با استفاده از روش‌های اسمیر مستقیم، رنگ‌آمیزی ید و رنگ‌آمیزی Ziehl-Neelsen انجام شد.

نتایج: شیوع کلی انگل‌های روده‌ای ۶۵.۸۵ درصد بود. شش نوع متمایز از انگل‌های روده‌ای در نمونه‌های مدفوع شناسایی شدند: سه گونه تک یاخته Eimeria sp (۴۳/۹۰ درصد)، Cryptosporidium sp (۳۹/۰۲ درصد) و Tetrahymena spp (۱۴/۶۳ درصد) و سه گونه کرم Trichostrongylus sp (۲۶/۰۲ درصد)، Haemonchus sp (۲۱/۹۵ درصد) و Moniezia sp

(۱۳/۰۱ درصد). تفاوت آماری معنی داری بین بالاترین میزان آلودگی Eimeria sp (۴۳/۹۰ درصد) و کمترین میزان آلودگی Moniezia sp. (۱۳/۰۱ درصد) مشاهده شد. علاوه بر این، سن به طور قابل توجهی با شیوع عفونت، با بالاترین میزان (۷۲/۰۰ درصد) در گوسفند یک تا سه ساله، در مقایسه با ۵۶/۲۵ درصد در بره های زیر یک سال مرتبط بود.

نتیجه‌گیری: این مطالعه شیوع بالایی (۶۵/۸۵ درصد) از انگل‌های روده‌ای در گوسفند عراقی با Eimeria sp، شایع ترین تک یاخته و Trichostrongylus sp کرمی را نشان می‌دهد. که اغلب شناسایی می‌شود. یافته‌ها نشان دهنده ارتباط معنی داری بین سن و میزان آلودگی با شیوع بالاتر در گوسفندان یک تا سه ساله است. این نتایج بر نیاز به برنامه‌های کنترل انگل هدفمند، از جمله راهبردهای پیشگیری و درمان مخصوص سن، برای کاهش تأثیر عفونت‌های انگلی بر سلامت و بهره‌وری گوسفند تأکید می‌کند.

واژه‌های کلیدی: انگل روده، گوسفند، .Cryptosporidium sp، Eimeria sp

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