



Research Article

Traditional Diagnosis of *Eimeria* Species in Water Buffaloes in Babylon Province, Iraq

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Abstract | Coccidiosis, caused by *Eimeria* spp., is one of the most significant parasitic diseases affecting water buffaloes, resulting in substantial economic losses due to morbidity, mortality, and reduced productivity. This study aimed to investigate the prevalence of *Eimeria* spp. in water buffaloes in Babylon Province, Iraq, using traditional microscopic diagnostic techniques, and to evaluate infection rates according to sex, age group, and geographical area. A total of 150 fecal samples were collected from water buffaloes of different ages and sexes from four areas in Babylon Province (Al-Hilla, Al-Musayyab, Al-Kifl, and Al-Hashimia). The samples were examined microscopically for the detection and morphological characterization of *Eimeria* oocysts. Statistical analysis was performed using the Chi-square (χ^2) test to determine significant differences among variables. Out of 150 examined samples, 94 (62.67%) were positive for *Eimeria* infection. The infection rate was significantly higher in females (70.48%) compared to males (44.44%) ($\chi^2 = 9.38$, $P = 0.0022$). Regarding age groups, calves less than one year old showed the highest infection rate (71.43%), followed by animals aged ≥ 3 years (62.22%) and those aged 1–3 years (58.57%), with no statistically significant difference among age groups ($\chi^2 = 1.73$, $P = 0.421$). Geographically, infection rates ranged from 54.05% in Al-Hashimia to 73.68% in Al-Hilla, with no significant differences among areas ($\chi^2 = 2.89$, $P = 0.408$). The high prevalence observed in this study indicates that coccidiosis remains a widespread parasitic problem among water buffaloes in Babylon Province. These findings highlight the need for improved management practices, regular monitoring, and the implementation of effective control strategies to reduce the impact of *Eimeria* infections.

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Keywords | *Eimeria* spp., Water buffalo, Coccidiosis, Prevalence, Babylon province, Iraq



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Introduction

Eimeria is a group of obligate intracellular, single-celled parasites (phylum: Apicomplexa; family: *Eimeriidae*) commonly found in water buffalo, especially calves during their first year of life. Major

losses occur in dairy herds where adult buffalo act as carriers, continuously shedding oocysts in their feces (Rotolo *et al.*, 2025). Among the 13 known species, *Eimeria bovis* and *Eimeria zuernii* are the most pathogenic, causing mucus- and blood-stained diarrhea, morbidity, and mortality in young calves

(Burrell *et al.*, 2020; Li *et al.*, 2024).

The appearance of clinical signs depends on the number of ingested sporulated oocysts, with younger animals being more severely affected. While molecular methods exist, traditional microscopic diagnostic techniques remain essential and widely used for the accurate detection and morphological characterization of *Eimeria* oocysts in field studies (Rotolo *et al.*, 2025). Coccidiosis is host-specific, and although most *Eimeria* species are non-pathogenic, they can cause intestinal tissue damage and decrease productivity in meat and milk (Gräfner *et al.*, 1985).

In Iraq, and specifically in Babylon province, water buffaloes represent a vital part of the livestock economy. However, comprehensive studies using traditional diagnostic tools to assess the prevalence of *Eimeria* are still needed. This study aimed to investigate the prevalence of *Eimeria* species in water buffaloes in Babylon province and to evaluate infection rates according to sex, age group, and geographical area using microscopic examination.

Materials and Methods

This study was conducted in Babylon Province, Iraq, including four main areas: Al-Hilla, Al-Musayyab, Al-Kifl, and Al-Hashimia. The sampling was carried out over a defined study period (2024–2025). The region is characterized by a semi-arid climate with hot summers and mild winters, conditions that may influence the sporulation and transmission of *Eimeria* oocysts. Study Animals and Sample Collection A total of 150 fecal samples were collected from water buffaloes (*Bubalus bubalis*) of different ages and both sexes. The animals were selected randomly from smallholder and semi-intensive farms across the four study areas. Approximately 10–20 g of fresh fecal samples was collected directly from the rectum using sterile gloves, placed in labeled plastic containers, and transported to the laboratory in an ice box for parasitological examination. Traditional (microscopic) fecal sample examination was used to know the presence of *Eimeria* oocysts using standard parasitological techniques. Initially, samples were processed by flotation method using saturated salt or sugar solution to concentrate oocysts. Smears were examined under a light microscope at 10× and 40× magnifications. Positive samples were recorded based on the presence of *Eimeria* oocysts. Oocysts

were identified morphologically according to their size, shape, wall structure, presence of micropyle, and internal contents, following standard taxonomic keys. Infection rate (prevalence) was calculated using the formula:

$$\text{Prevalence (\%)} = (\text{Number of positive samples} / \text{Total number of examined samples}) \times 100$$

Statistical analysis was performed using the Chi-square (χ^2) test to evaluate differences in infection rates according to sex, age group, and geographical area. A P-value of less than 0.05 was considered statistically significant.

Results

Out of 150 examined fecal samples collected from water buffaloes in Babylon province, 94 samples were positive for *Eimeria* spp., yielding an overall prevalence of 62.67%. The morphological characteristics of *Eimeria bovis* and *Eimeria zuernii* oocysts were shown in Figure 1 and 2, respectively.

Prevalence according to geographical area

Regarding geographical distribution, infection rates were as follows: Al-Hilla recorded 73.68% (28/38), Al-Musayyab 65.79% (25/38), Al-Kifl 56.76% (21/37), and Al-Hashimia 54.05% (20/37), as shown in Table 1. Al-Hilla recorded the highest prevalence; however, no statistically significant difference was observed among the four areas ($\chi^2 = 2.89$, $P = 0.408$).

Table 1: Rate of infection with *Eimeria* spp. according to areas of study.

Area	Examined fecal samples	No. of positive samples	Infection rate (%)
Al-Hilla city	38	28	73.68
Al-Musayyab	38	25	65.79
Al -Kifl	37	21	56.76
Al- Hashimia	37	20	54.05
Total	150	94	62.67
X ²	2.89		
P value	0.408 (NS)		

Prevalence according to sex

The infection rate in females was significantly higher (70.48%; 74/105) compared to males (44.44%; 20/45) as presented in Table 2. Statistical analysis using the Chi-square (χ^2) test showed a significant association

between sex and infection rate ($\chi^2 = 9.38$, $P = 0.0022$), indicating that females were more frequently infected than males.

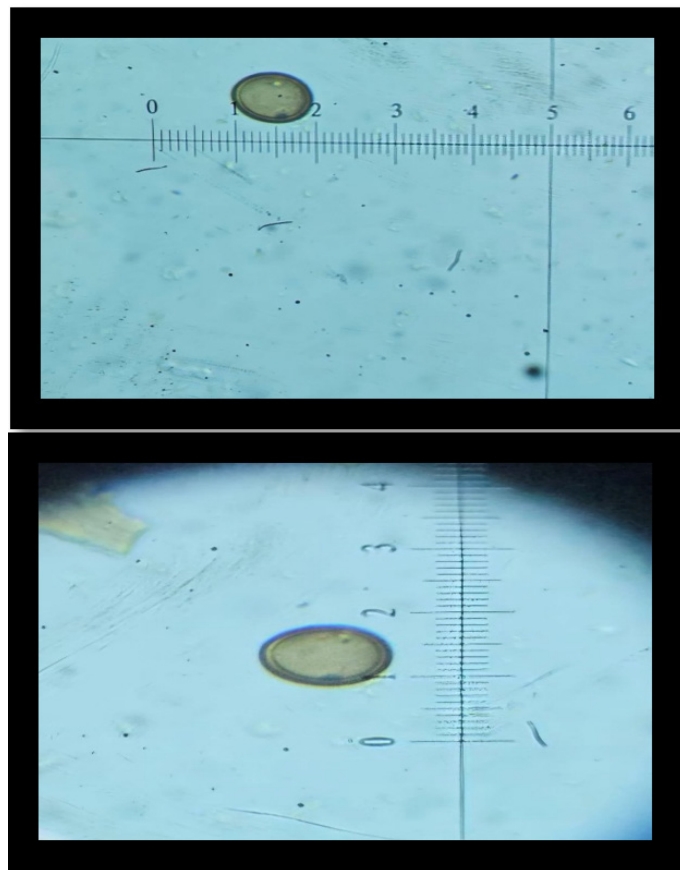


Figure 1: Morphological characteristics of *Eimeria bovis* oocyst. Micrograph (40X) showing an unsporulated oocyst of *Eimeria bovis* isolated from water buffalo feces in Babylon province. The oocyst exhibits a characteristic ovoid shape with a smooth, thick, yellowish-brown double-layered wall and a distinct micropyle at the tapered pole. The internal undifferentiated sporont appears as a granular mass, a key diagnostic feature used for the traditional identification of the species during the microscopic examination.

Table 2: Rate of infection with *Eimeria* spp. according to sex.

Sex	Examined fecal samples	No. of positive samples	Infection rate (%)
Male	45	20	44.44
Female	105	74	70.48
Total	150	94	62.67
X ²	9.38		
P value	0.0022 (S)		

Prevalence according to age groups

The highest infection rate was observed in buffaloes

less than one year old (71.43%; 25/35), followed by animals ≥ 3 years (62.22%; 28/45), and those aged 1–3 years (58.57%; 41/70) as shown in Table 3. No statistically significant difference was detected among the different age groups ($\chi^2 = 1.73$, $P = 0.421$).

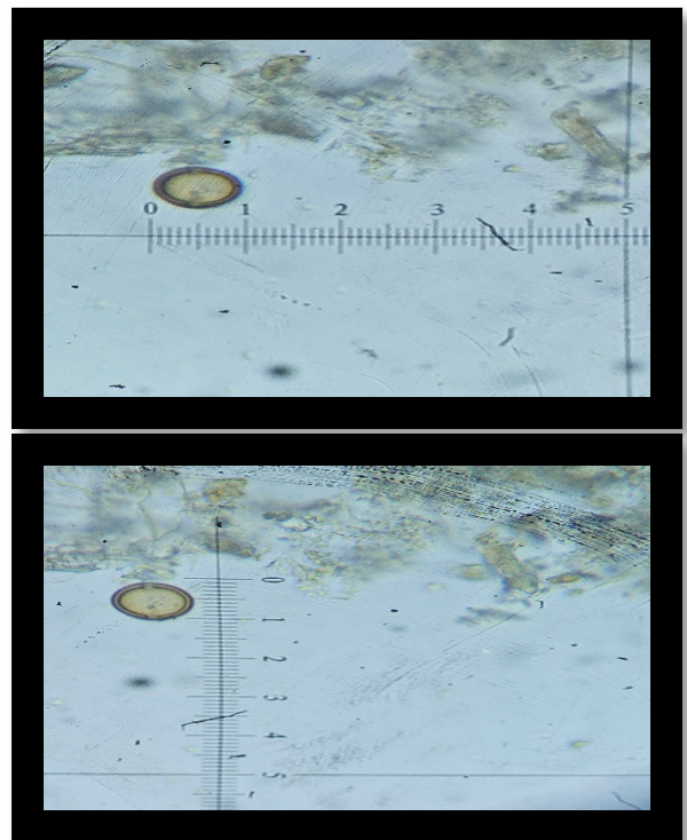


Figure 2: Morphological characteristics of *Eimeria zuernii* oocyst. Micrograph (40X) showing an unsporulated oocyst of *Eimeria zuernii* isolated from water buffalo feces in Babylon province. The oocyst is characterized by its small size and typically spherical to sub-spherical shape. The wall is smooth and lacks a visible micropyle, distinguishing it from other pathogenic species like *E. bovis*. The internal sporont appears as a distinct, rounded granular mass, which is a key diagnostic feature used for identification during the traditional microscopic survey.

Table 3: Rate of infection with *Eimeria* spp. according to age groups.

Age groups	Examined fecal samples	No. of Positive samples	Infection rate (%)
< 1 year	35	25	71.43
1 to <3 years	70	41	58.57
≥ 3 Years	45	28	62.22
Total	150	94	62.67
X ²	1.73		
P value	0.421 (NS)		

Discussion

The present study revealed a high overall prevalence of *Eimeria* infection (62.67%) among water buffaloes in Babylon province. This elevated infection rate indicates that coccidiosis remains a widespread and endemic parasitic challenge in the region. This high prevalence can be attributed to the traditional management systems, inadequate hygiene practices, and environmental conditions that favor oocyst sporulation and survival.

On a regional scale, the results of this investigation align with findings from neighboring countries; for instance, [Nalbantoglu et al. \(2008\)](#) reported a high prevalence of 75% in water buffaloes in Turkey. However, our findings are substantially higher than those reported in other Asian regions, such as Pakistan (49.6%) by [Khan \(2012\)](#), Bangladesh (3.39%) by [Mamun et al. \(2011\)](#), and India (1.19%) by [Swarnakar \(2015\)](#). These significant variations in prevalence are likely due to differences in management intensity, humidity levels, and the degree of environmental contamination with oocysts.

The significantly higher prevalence observed in females (70.48%) compared to males (44.44%) is a key finding of this study. This variation is often associated with physiological stress factors such as pregnancy and lactation, which can suppress the host's immunity and increase susceptibility to parasitic infections. Additionally, females are frequently kept longer for breeding and milk production, which increases their cumulative exposure time to contaminated pastures and housing compared to males.

Regarding age groups, the highest infection rate was recorded in calves less than one year old (71.43%). This is consistent with the general epidemiology of coccidiosis, although it is notably higher than the rate (16.10%) reported by [Rana et al. \(2011\)](#) in India. The heightened susceptibility in young animals is primarily due to their immature immune systems. Conversely, the high prevalence detected in adult animals suggests they may serve as asymptomatic carriers, maintaining the cycle of transmission within the herd.

Geographically, the lack of significant variation in infection rates across the four studied areas (ranging from 54.05% to 73.68%) indicates similar management

practices and climatic conditions across Babylon province. The high prevalence detected emphasizes the critical importance of implementing effective control measures, including improved sanitation and regular monitoring through traditional microscopic surveys, to mitigate the economic impact of *Eimeria* infections in water buffalo populations.

Conclusion

The present study demonstrated a high prevalence (62.67%) of *Eimeria* spp. infection among water buffaloes in Babylon province, Iraq, confirming that coccidiosis remains an important parasitic disease affecting buffalo production in the region. The significant association between infection rate and sex, with females showing higher prevalence (70.48%), suggests that physiological and management-related factors may influence susceptibility.

Although higher infection rates were observed in calves less than one year old (71.43%), age and geographical location did not show statistically significant associations with infection. The widespread occurrence of *Eimeria* spp. across all studied areas indicates continuous environmental contamination and the potential role of adult buffaloes as reservoirs of infection. These findings highlight the necessity for improved farm management practices, enhanced hygiene measures, and routine parasitological monitoring through traditional microscopic techniques to reduce transmission and economic losses in buffalo populations.

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Novelty Statement

This study represents one of the limited epidemiological investigations using traditional microscopic techniques for the diagnosis of *Eimeria* spp. in water buffaloes in Babylon Province, Iraq. The study provides updated data regarding the prevalence of infection according to sex, age groups, and geographical distribution.

Author's Contribution

Ameem Wael Tarteel performed sample collection, laboratory examination, statistical analysis, and manuscript preparation. Qasim Jawad Amer supervised the study, reviewed the manuscript, and contributed to data interpretation.

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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