The Journal of Veterinary Medical Science

NOTE

Parasitology

The common gallinule, *Gallinula galeata* (Aves: Gruiformes: Rallidae), as a new host for *Eimeria paludosa* (Apicomplexa: Eimeriidae) in Mexico

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J. Vet. Med. Sci.
82(4): 494–496, 2020
doi: 10.1292/jvms.20-0042

Received: 23 January 2020
Accepted: 24 February 2020
Advanced Epub:
6 March 2020

ABSTRACT. Up to now, four coccidian species have been identified in Rallidae (Aves: Gruiformes): *Eimeria mongolica*, *E. alakuli*, *E. paludosa* and *E. porphyrulae*. Here, we described an *Eimeria* species, *E. paludosa*, from a common gallinule (*Gallinula galeata*) in Mexico. Oocysts were ovoid and wall pitted single-layered. A prominent micropyle was present, the oocyst residuum absent and the polar granule was present. On histological examination of tissues, endogenous stages (meronts, microgametocytes and macrogametocytes) were seen in the epithelial cells of the small intestine (upper and lower intestine). In addition to a new locality, this is the first description of *E. paludosa* from *G. galeata* and is the third description of a coccidian infecting Rallidae in the Americas.

KEY WORDS: *Eimeria paludosa*, *Gallinula galeata*, Gruiformes, Mexico, Rallidae

The common gallinule (*Gallinula galeata*) is a bird species (Aves: Gruiformes: Rallidae) widely distributed in the Americas [5]. In Central Mexico, it is a common gruiform in wetlands, easily recognized by its dark plumage, yellow legs and a red frontal shield [10].

The coccidia are a diverse group of parasitic protozoa. Some species of coccidia are homoxenous and strictly host specific, other species have complex heterogenous life cycles that involve a broad range of different host species [11]. Up to now, four coccidian species have been identified in Rallidae: *Eimeria mongolica*, *Eimeria alakuli*, *Eimeria paludosa* and *Eimeria porphyrulae* [6, 8]. The aim of this study was the description of *E. paludosa* from *G. galeata* as a new host.

An adult, common gallinule (*Gallinula galeata*), possibly attacked by a raptor, was submitted to the Centro de Investigación y Estudios Avanzados en Salud Animal (CIESA), Toluca (2,625 m a.s.l.; 19°17′32″N, 99°39′14″W). Fecal samples were taken and microscopy revealed coccidia oocysts. Each fecal sample was placed into a 1.5 m*l* a plastic vial containing 2.5% potassium dichromate solution ($K_2Cr_2O_7$) 1:6 (v/v) and observed in a light microscope [4].

At necropsy, a liver injury (parenchymal disruption) was observed and the following organs and tissues were collected from the bird: trachea, lungs, liver, stomach, duodenum and small intestine. These samples were placed in 10% neutral buffered formalin and processed, sectioned, and stained with hematoxylin and eosin for routine histologic examination. The fecal samples were placed in a thin layer (5 m*l*) of $K_2Cr_2O_7$ in Petri dishes, incubated at 23–28°C and monitored daily, until 70% of oocysts were sporulated. Morphological observations, photomicrographs and measurements (n=35), were made as elsewhere reported [2, 4], using a Nikon Eclipse 80i microscope coupled to a digital camera Nikon DS-Fi2 (Nikon, Tokyo, Japan).

Initially, the oocysts were non-sporulated, but approximately 70% of the oocysts were sporulated at day seven (under the conditions used in this study).

Oocysts (n=35) were ovoid, 18.0–23.9 × 13.0–16.5 (20.7 × 14.9); length/width (L/W) ratio 1.2–1.6 (1.3). Wall pitted single-layered, 0.7–0.9 (0.8) thick. Prominent micropyle present, oocyst residuum absent and polar granule present (Fig. 1). Sporocysts 2, elongate-ovoid, 9.6–13.1 × 5.9–6.7 (11.4 × 6.4); L/W ratio 1.5–2.0 (1.7). Stieda body present, nipple-like, 0.5 high × 1.6 wide; sub-Stieda present, rounded irregular, 1.4 high × 0.8 wide; para-Stieda body absent; sporocyst residuum present, consisting of scattered spherules of different sizes (up to 1.0 μm) (Fig. 1). Sporozoites 4, vermiform, with posterior refractile body. Phototypes of the host and photomicrographs of sporulated oocysts are deposited and available in the Repository of iBIRDS (www.ibirds.org), number ESV-30/2019.

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Fig. 1. Photomicrographs of a coccidian parasite *Eimeria paludosa* showing a pitted oocyst wall (A), micropyle (arrow) (B), and polar granule (arrow) (C). Scale bar: 10 μm.

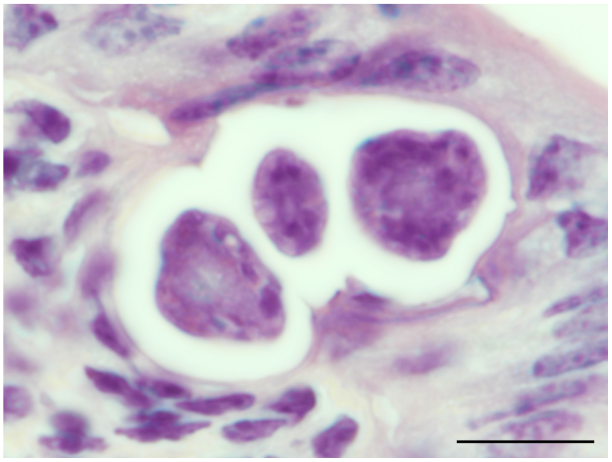

Fig. 2. Photomicrograph of a small intestine histological section of a coccidian parasite *Eimeria paludosa* from an adult common rail *Gallinula galeta*. Meronts are surrounded by its parasitophorous vacuole. Scale bar: 10 μm.

On histological examination of tissues, endogenous stages (meronts, microgametocytes and macrogametocytes) were seen in the epithelial cells of the small intestine (upper and lower intestine). Meronts were ovoidal and measured 18.0 × 11.0 μm and were surrounded by a parasitophorous vacuole (Fig. 2).

Up to now, four coccidian species have been identified in Rallidae: *Eimeria mongolica*, *E. alakuli*, *E. paludosa* and *E. porphyrulae* [6, 8]. *Eimeria paludosa* was first described from both *Fulica atra* and *Gallinula chloropus* in France [7]. Furthermore, *E. paludosa* has been idenfitfied from related birds: *Porphyrio poliocephalus* in Russia [12], *Porphyrio porphyrio* in India [1], *Fulica americana* in USA [8], *Gallinula tenebrosa* in Australia [13], and *Fulica atra* in Portugal [3]. In addition to a new locality, this is the first description of *E. paludosa* from *G. galeata*.

The sporulated oocysts obtained in this study were compared in detail with coccidian parasites from other birds that belong to the same host family [4]. The morphology and morphometry of the *E. paludosa* oocysts are different from other *Eimeria* species in birds from the same family (Table 1). Two coccidian species from *Fulica atra* in Russia were identified: *E. mongolica*, it does not possess the characteristic micropyle and *E. alakuli*, larger oocysts than those of *E. paludosa* [8]. The main characteristics of *E. porphyrulae* from *Porphyrio martinica* in Brazil, is larger oocysts and sporocysts, much smaller micropyle, a sub-micropyle granule, and a much shorter sporulation time of only two days [6]. The sporulated oocysts obtained in this study, are clearly distinct from all other *Eimeria* species reported from gruiform birds (Table 1). To confirm this finding, further genomic studies based on partial mitochondrial cytochrome c oxidase subunit I (COI) and 18S rDNA sequences [9], are needed.

In conclusion, the description of *E. paludosa* from *G. galeata* is the third description of a coccidian infecting Rallidae in the Americas.

ACKNOWLEDGMENTS. We acknowledge to Dra. Angélica Espinoza-Ortega and Dr. Carlos Manuel Arriaga-Jordán, for submitting this common gallinule to our laboratory. This study was funded by Institute for Biodiversity Research, Development & Sustainability (iBIRDS, Mexico). Research project 4699/2019SF registered at Universidad Autónoma del Estado de México.

Table 1. Comparative morphology of *Eimeria* spp. recorded from species of the Rallidae

Species	*E. paludosa*	*E. alakuli* Rakmatullina-Batyshrina & Svanbaev, 1972	*E. mongolica* Matschoulsky, 1941	*E. paludosa* Léger & Hesse, 1922	*E. porphyrulae* Lainson, 1994
Host	*Gallinula galeata* (Lichtenstein)	*Fulica atra* (Linnaeus)	*Fulica atra* (Linnaeus)	*Fulica americana* (Gmelin), *Fulica atra* (Linnaeus), *Gallinula chloropus* (Linnaeus), *Porphyrio porphyrio* (Linnaeus)	*Porphyrula martinica* (Linnaeus)
Locality	Toluca, México	Russia	Russia	France; India; Russia; USA	State of Pará, Brazil
Reference	This study	McAllister & Upton (1990)	McAllister & Upton (1990)	McAllister & Upton (1990)	Lainson (1994)
Oocyst					
Shape	Ovoid			Ovoid	Ellipsoidal to oval
Wall	One-layer (0.8)			One-layered (*ca*. 1.0)	Bi-layered (1.25)
Length (L)	18–23.9 (20.7)			15–23 (16.5)	20–23.7 (22.4)
Width (W)	13–16.5 (14.9)			11–14 (12.6)	16.2–28.7 (17.7)
L/W ratio	1.2–1.6 (1.3)	Aprox. 1.3		1.2–1.6 (1.3)	1.1–1.4 (1.3)
Polar granules	One large to several small granules			One large to 20 small granules	One granule
Oocyst residuum	Absent			Absent	Absent
Micropyle	Present (5.4)		Absent	Present (5.3)	Present
Sporocyst					
Shape	Elongate-ovoid			Elongate-ovoid	Elongate pear-shaped
Length (L)	9.6–13.1 (11.4)			10–12 (10.8)	17–19 (17.5)
Width (W)	5.9–6.7 (6.4)			5–7 (6.2)	8–10 (9.0)
L/W ratio	1.5–2 (1.7)			1.5–2 (1.7)	1.8–2.1 (1.9)
Stieda body	Nipple-like (0.5 high × 1.5 wide)			Present (0.6 high × 1.5 wide)	Delicate
Sub-Stieda body	Rounded irregular (1.1 high × 2.0 wide)			Present (1.2 high × 2.0 wide)	Present (1.5 high × 2.0 wide)
Residuum	Scattered spherules of different sizes (up to 1.0)			Very fine faint granules scattered among the sporozoites or, rarely, as a spherical mass (3.5)	Refractile granules scatted widely around the sporozoites
Sporozoite					
Shape	Vermiform			Elongate	

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