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Eimeria idmii sp. n. (Apicomplexa: Eimeriidae) from the Arabian Mountain Gazelle, *Gazella gazella*, in Saudi Arabia

O. B. MOHAMMED[1] AND H. S. HUSSEIN[2,3]

[1] King Khalid Wildlife Research Center at Thumamah,
National Commission for Wildlife Conservation and Development, P.O. Box 61681,
Riyadh 11575, Saudi Arabia and
[2] Department of Zoology, College of Science, King Saud University,
P.O. Box 2455, Riyadh 11451, Saudi Arabia

ABSTRACT: Fecal examination of 47 idmi, the Arabian or dark-colored mountain gazelle, *Gazella gazella* Pallas, 1766, at King Khalid Wildlife Research Center in Thumamah, Riyadh Province, Saudi Arabia, yielded oocysts of an undescribed coccidian, *Eimeria idmii* sp. n. Sixteen of the 47 idmi (34%) were infected. Sporulated oocysts of *E. idmii* sp. n. are ellipsoidal, flattened at micropylar end, 42 × 30 (36–48 × 27–37) μm, length/width ratio 1.4 (1.2–1.6), with smooth, double-layered oocyst wall, the inner yellow, the outer green, with micropyle covered with dome-shaped micropylar cap, 9 (2–15) μm wide, 2 (1–4) μm high. Sporocysts elongate, ovoidal, 18 × 10 (10–23 × 8–13) μm with Stieda body and sporocyst residuum. Sporozoites elongate, 15 × 6 (10–18 × 4–9) μm, each with a large and a small refractile body, 5 (3–8) μm and 3 (1–5) μm in diameter, respectively. Sporulation time 7–8 days at 25 ± 2°C.

KEY WORDS: antelope, Coccidia, *Eimeria idmii* sp. n., gazelle, oocyst, sporocyst, sporozoite, Stieda body.

Eimeria infections are common in both domestic and wild animals in Saudi Arabia. Several species were reported from camels (Kawasmeh and El Bihari, 1983; Kasim et al., 1985; Hussein et al., 1987), sheep (Kasim and Al-Shawa, 1985a), cattle (Kasim and Al-Shawa, 1985b), rabbits (Kasim and Al-Shawa, 1987), the Arabian oryx (Kasim and Al-Shawa, 1988a), the rock agama, *Agama sinaita* (Kasim and Al-Shawa, 1988b), the Arabian quail, *Coturnix delegorguei* (Amoudi, 1987), the Indian peacock, *Pavo cristatus* (Amoudi, 1988), and the grey monitor, *Varanus griseus* (Amoudi, 1989). However, none is yet reported from Saudi Arabian gazelles.

Herds of antelopes indigenous to the Kingdom of Saudi Arabia including the 3 main species of gazelles, *Gazella gazella, Gazella subgutturosa,* and *Gazella dorcas* (Groves and Lay, 1985; Groves, 1989), and the Arabian oryx, *Oryx leucoryx,* are kept at King Khalid Wildlife Research Center (KKWRC) of the National Commission for Wildlife Conservation and Development (NCWCD) in Thumamah, some 80 km N of Riyadh, the capital of Saudi Arabia, for research, breeding, and later reintroduction to their now protected natural habitats in the Kingdom. During the course of parasitological assessment of these animals, oocysts of various *Eimeria* species were detected in the feces of these animals. Those recovered from the feces of the idmi, the Arabian or dark-colored mountain gazelle, *G. gazella,* proved to be a new species that is described in the present study.

Materials and Methods

Fresh fecal samples were collected into wide-mouth, screw-cap, plastic containers directly from the rectum of each of 47 idmi (2–36 mo old) sedated by darts at KKWRC. These animals were born in Thumamah and are the descendants of a herd collected by the late King Khalid Ibn Abdul Aziz. In the laboratory, the fecal samples were subjected to various parasitological examinations, including direct smear, sedimentation, and floatation over saturated sodium chloride solution (Anonymous, 1977). The parasitic burden carried by each animal was assessed by the modified McMaster technique (Anonymous, 1977).

Samples with eimerian oocysts were ground up in a mortar, thoroughly mixed with 2.5% (w/v) aqueous solution of potassium dichromate ($K_2Cr_2O_7$), strained with a fine-mesh wire strainer, and suspended in shallow layers of the solution in petri dishes at room temperature (25 ± 2°C) for sporulation. These were examined daily and the sporulation time was recorded. Measurements were made by a calibrated ocular micrometer, photomicrographs were taken by a Nikon camera (Nikon Company, Japan) attached to a Zeiss compound microscope (Karl Zeiss, Jena, Germany), and drawings were made using an attached Zeiss camera lucida. All measurements are in micrometers (μm): means followed by the range in parentheses.

Results

Sixteen of the 47 idmi (34%) were infected with a single species of *Eimeria.* The numbers of oocysts per gram of feces shed by these animals were 50–9,000. The oocysts (Figs. 1–4) are dif-

[3] To whom reprint requests should be addressed.

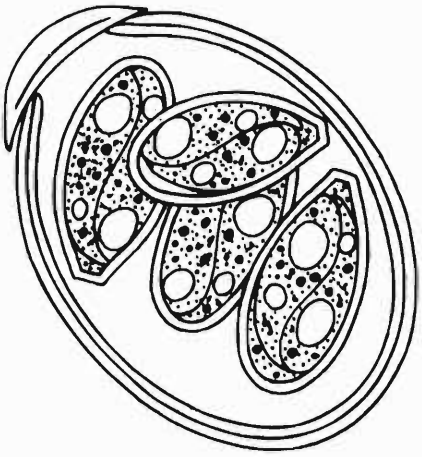


Figure 1. Camera lucida drawing of a sporulated oocyst of *Eimeria idmii* sp. n.

ferent from any of those described from gazelles or from any other antelope species. Hence, they represent a new species of *Eimeria* that is described below.

Eimeria idmii sp. n. (Figs. 1–4, Table 1)

DESCRIPTION: Oocysts ellipsoidal, flattened at micropylar end. Oocyst wall 1.9 (1–2) thick, smooth, double-layered, each of about the same thickness, outer layer green, inner layer yellow, with wide micropyle covered by dome-shaped micropylar cap 9 (2–15) wide, 2 high.

Sporulated oocysts ($N = 105$) 42 × 30 (36–48 × 27–37), length/width ratio 1.4 (1.2–1.6). Oocyst residuum, oocyst polar granule both absent. Sporocysts elongate, ovoidal ($N = 500$) 18 × 10 (10–23 × 8–13); length/width ratio 1.8 (1–2). Stieda body present, substieda body absent. Sporocyst residuum present, consists of diffuse, coarse, refractile granules. Sporozoites elongate ($N = 500$), 15 (10–18), each with a large refractile body at wide end, 5 (3–8) in diameter, and a smaller one at narrow end, 3 (1–5) in diameter.

TYPE HOST: The idmi, Arabian or dark-colored mountain gazelle, *Gazella gazella* Pallas.

TYPE LOCALITY: Thumamah, north of Riyadh, Saudi Arabia.

PREVALENCE: Found in 16 of 47 idmi (34%).

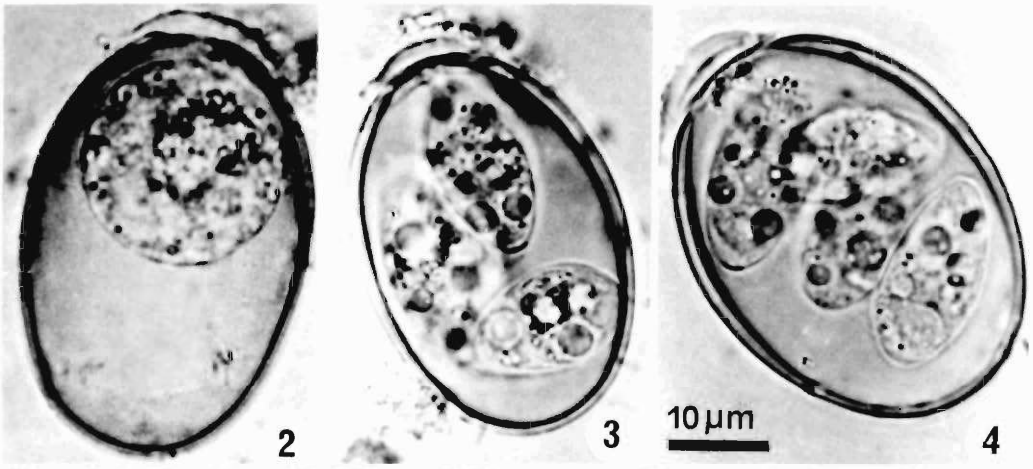
SITE OF INFECTION: Unknown, oocysts recovered from feces.

SPORULATION: Exogenous, within 7–8 days at 25 ± 2°C in 2% $K_2Cr_2O_7$.

TYPES: Phototypes and preserved materials in authors' collection at KKWRC and at the Zoology Department, College of Science, King Saud University.

PHOTOTYPES: Deposited in National Parasite Collection, U.S. National Museum, USNM No. 82006.

ETYMOLOGY: The specific name is derived from the common Arabic name of the type host.



Figures 2–4. Photomicrographs of *Eimeria idmii* sp. n. oocysts. 2. An unsporulated oocyst. 3. A narrower, ellipsoidal sporulated oocyst. 4. A wider, ellipsoidal sporulated oocyst. Scale bar is for all figures.

Table 1. Morphometric comparison between *Eimeria idmii* sp. n. and *Eimeria* species described from gazelles and other antelopes.

Eimeria species	Oocyst: Mean size (range) (μm)	Oocyst: Micropyle	Oocyst: Micropylar cap	Oocyst: Polar granule	Sporocyst: Stieda body	Sporocyst: Residuum	Type host
E. idmii sp. n.	42 × 30 (36–48 × 27–37)	+	+	−	+	+	The idmi, *Gazella gazella*
E. abenovi Svanbaev, 1979	32 × 23 (24–27 × 19–26)	+	−	−	−	−	Goitered gazelle, *Gazella subguttrosa*
E. chinkari Pande, Bhatia, Chauhan, and Garg, 1970	25 × 22 (24–27 × 19–26)	−	−	−	+	+	The chinkara, *Gazella gazella*
E. dorcadis Montovani, 1966	29 × 18 (26–31 × 15–26)	−	−	−	−	+	Dorcas gazelle, *Gazella dorcas*
E. elegans Yakimoff, Gousseff, and Rastegaieff, 1932	(23–45 × 16–25)	+	−	±	−	+	Goitered gazelle, *Gazella subguttrosa*
E. gazella Musaev, 1970, emend. Svanbaev, 1970	24 × 20 (20–28 × 17–25)	−	−	−	−	+	Goitered gazelle, *Gazella subguttrosa*
E. saudiensis Kasim and Al-Shawa, 1988	31 × 25 (24–37 × 20–28)	+	+	+	+	+	Arabian oryx, *Oryx leucoryx*
E. canna Triffitt, 1924	(23–24 × 16–20)	+	−	+	+	+	The eland, *Taurotragus oryx*
E. triffittae Yakimoff, 1934, emend. Levine and Ivens, 1970	21 × 18 (21–24 × 15–19)	−	−	−	−	−	The eland, *Taurotragus oryx*
E. yakimovi Rastegaieff, 1929	(27–41 × 20–29)	+	−	−	±	±	The nilgai, *Boselaphus tragocamelus*
E. chausinghi Pande, Bhatia, Chauhan, and Garg, 1970	25 × 18 (20–27 × 15–21)	−	−	−	+	+	The 4-horned antelope, *Tetracerus quadricornis*
E. congolensis Ricci-Bitti, Pampiglione, and Kabala, 1973	30 × 22 (27–33 × 19–24)	+	−	−	+	−	The waterbuck, *Kobus defassa*
E. kobi Ricci-Bitti, Pampiglione, and Kabala, 1973	38 × 28 (34–41 × 26–30)	+	−	−	+	+	The waterbuck, *Kobus defassa*
E. macieli Yakimoff and Matchulski, 1938	30 × 21 (24–34 × 20–24)	+	−	−	−	−	The waterbuck, *Kobus defassa*
E. talboti Prasad and Narayan, 1963	36 × 25 (35–38 × 22–28)	−	−	−	−	−	The hartbeeste, *Alcalaphus cokei*
E. gorgonis Prasad, 1960	23 × 17 (20–26 × 15–18)	−	−	+	+	+	The wildebeest, *Connochaetus taurinus*
E. connochaetei Levine and Ivens, 1970	22 × 14 (20–27 × 13–15)	−	−	−	+	+	The wildebeest, *Connochaetus taurinus*
E. mirgai Chauhan, Bhatia, and Arora, 1972	49 × 30 (39–55 × 26–32)	+	+	+	+	+	The blackbuck, *Antelope cervicapra*
E. impalae Prasad and Narayan, 1972	33 × 22 (30–36 × 20–24)	+	−	−	±	−	The impala, *Aepyceros melampus*
E. neitzi McCully, Basson, DeVos, and DeVos, 1970	32 × 30 (29–34 × 28–33)	−	−	+	+	+	The impala, *Aepyceros melampus*
E. walleri Prasad, 1960	29 × 24 (27–30 × 22–25)	+	−	−	+	+	The gerenuk, *Litocranus walleri*
E. ismailovi Musaev, 1970	29 × 22 (23–33 × 18–24)	−	−	−	−	+	The saiga, *Saiga tatarica*
E. manafovae Musaev, 1970	37 × 20 (29–47 × 17–26)	+	−	+	−	+	The saiga, *Saiga tatarica*
E. saiga Svanbaev, 1958	31 × 30 (28–34 × 27–32)	−	−	+	−	+	The saiga, *Saiga tatarica*
E. sajanica Machulskii, 1974	21 × 18 (18–23 × 16–20)	−	−	−	−	+	The saiga, *Saiga tatarica*
E. tatarica Musaev, 1970	30 × 24 (25–35 × 19–30)	+	±	−	−	+	The saiga, *Saiga tatarica*
E. tekenovi Svanbaev, 1979	29 × 22 (23–33 × 18–24)	+	+	−	−	+	The saiga, *Saiga tatarica*

+ = present; ± = present or absent; − = absent.

Discussion

Levine and Ivens (1986) have listed only 5 species of *Eimeria* from members of the antelope genus *Gazella* Blainville, 1816, of the family Bovidae, and *E. idmii* sp. n. is very much different from all of these parasites. It has the largest and the only oocyst with a micropylar cap among gazelle eimerians (Table 1). It can also be differentiated from *E. chinkari, E. dorcadis,* and *E. gazella* by having a micropyle and from both *E. dorcadis* and *E. gazella* by having a micropyle and Stieda bodies (Table 1). Similar to other gazelle eimerians, *E. idmii* lacks oocyst residuum and polar granules, though some oocysts of *E. elegans* have polar granules (Yakimoff et al., 1932; Levine and Ivens, 1970, 1986; Pellérdy, 1974). Moreover, with the exception of *E. abenovi,* all gazelle eimerians, including *E. idmii,* have sporocyst residuum (Svanbaev, 1979; Levine and Ivens, 1986). Similar to *E. abenovi* and *E. chinkari* (Pande et al., 1970; Svanbaev, 1979; Levine and Ivens, 1986), sporozoites of *E. idmii* have refractile bodies that are absent from those of *E. elegans* and *E. gazella* (Yakimoff et al., 1932; Montovani, 1966; Levine and Ivens, 1970, 1986; Pellérdy, 1974; Svanbaev, 1979).

Of the other antelopes kept at KKWRC in Thumamah, both the rheem (*G. subgutturosa*) and the Arabian oryx were each infected with a different species of *Eimeria,* whereas no eimerian oocysts were recovered from the Dorcas gazelle. The rheem was infected with an *Eimeria* species that has a small oocyst devoid of a micropylar cap and the Arabian oryx with the recently described *E. saudiensis.* There are indications that the species of *Eimeria* found in the rheem could well be yet another undescribed species that is currently under investigation. On the other hand, oocysts of both *E. saudiensis* and *E. idmii* have a dome-shaped micropylar cap, but that of the former is very much smaller than that of the latter. Moreover, each *E. saudiensis* oocyst has an average of 5 (1–8) polar bodies that were considered by Kasim and Al-Shawa (1988b) to represent an oocyst residuum. The sporulation times of the 2 species are also different: *E. saudiensis* is 5 days at 25 ± 2°C, whereas *E. idmii* is 7–8 days at the same temperature. Oocysts of *E. idmii* have smooth, double-layered walls, whereas the outer layer of the *E. saudiensis* oocyst is finely pitted (Kasim and Al-Shawa, 1988b).

Eimeria saudiensis is the only species of *Eimeria* described from the antelope genus *Oryx* Blainville, 1816 (Kasim and Al-Shawa, 1988b). However, about 20 other species of *Eimeria* have been described from other antelope genera (Levine and Ivens, 1970, 1986; Pellérdy, 1974). A morphometric comparison that sets *E. idmii* apart from all of these species is shown in Table 1. As far as size is concerned, oocysts of *E. idmii* are second only to those of *E. mirgai*; both, together with *E. saudiensis, E. tekenovi,* and rarely *E. tatarica,* are the only antelope eimerians that have micropylar caps. Moreover, *E. mirgai* also differs from *E. idmii* in having oocyst residuum and polar granules; its oocyst wall is thicker and its micropylar cap is transparent and helmet-shaped. *Eimeria idmii* can also be differentiated from *E. tekenovi, E. tatarica,* and *E. macieli,* as well as from all *Eimeria* species described from the saiga and from most of the sporocysts of both *E. impalae* and *E. yakimovi,* by having Stieda bodies. It can also be differentiated from *E. triffittae* and *E. talboti* by having a micropyle, Stieda body, and sporocyst residuum. The micropyle is also absent from *E. chausinghi, E. gorgonis, E. connochaeti, E. neitzi, E. ismailovi, E. saiga,* and *E. sajanica,* and the sporocyst residuum from *E. congolensis, E. impalae,* and *E. yakimovi.* Oocysts of *E. idmii* lack polar granules that are present in those of *E. canna, E. gorgonis, E. manafovae, E. mirgai, E. neitzi,* and *E. saiga* (Table 1).

Two of the antelope eimerians, *E. neitzi* and *E. triffittae,* have single-layered oocyst walls (Yakimoff, 1934; McCully et al., 1970; Levine and Ivens, 1970, 1986; Pellérdy, 1974), those of *E. canna* and *E. walleri* are triple-layered (Triffitt, 1924; Prasad, 1960; Levine and Ivens, 1970, 1986; Pellérdy, 1974), and the rest, including *E. idmii,* are double-layered. Both outer and inner layers of *E. idmii* oocysts are smooth, firmly clinging to each other, the outer is green and the inner yellow, and both are penetrated by the micropyle. Oocysts with double-layered walls also occur in *E. saiga* and *E. sajanica*; however, both of their walls are colorless and are thinner than those of *E. idmii.* Oocysts of both species are smaller than those of *E. idmii,* both lack a micropyle as well as a micropylar cap and Stieda bodies. Polar granules and oocyst residuum occur in *E. saiga* oocysts, but both are absent from the other 2 species (Svanbaev, 1958; Levine and Ivens, 1970, 1986; Pellérdy, 1974). *Eimeria congolensis* and *E. kobi* oocysts have rough, granular, brown-colored outer oocyst walls that can easily peel off their inner counterparts and their micropyles do not penetrate their inner walls (Ricci-Bitti et al., 1973; Levine and Ivens, 1986).

Oocysts of *E. macieli* are also double-layered, but both of their walls are radially striated (Yakimov and Matchuski, 1938; Levine and Ivens, 1970, 1986; Pellérdy, 1974).

From the many structural differences discussed, it is clear that *E. idmii* is a distinct and hitherto undescribed species.

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