Description of *Eimeria motelo* sp. n. (Apicomplexa: Eimeriidae) from the Yellow Footed Tortoise, *Geochelone denticulata* (Chelonia: Testudinidae), and Replacement of *Eimeria carinii* Lainson, Costa & Shaw, 1990 by *Eimeria lainsoni* nom. nov.

Lada Hůrková, David Modrý*/+, Břetislav Koudela*, Jan Šlapeta

Department of Parasitology, University of Veterinary and Pharmaceutical Sciences, Brno, Czech Republic
*Institute of Parasitology, Academy of Sciences of the Czech Republic, Branišovská 31, 370 05 České Budějovice, Czech Republic

Eimeria motelo *sp. n. is described from faeces of the yellow-footed tortoise,* Geochelone denticulata *(L.). Oocysts are irregularly ellipsoidal or cylindrical, with slightly expressed lobed protrusions and irregularities at the poles, possibly caused by wrinkling of the oocyst wall, 17 (15-19) × 9.4 (8.5-11) µm, shape index (length/width) being 1.81 (1.45-2). The oocyst wall is smooth, single-layered, 0.5 µm thick with no micropyle. There are no polar bodies. Sporocysts are ellipsoidal, 8.9 (7.5-10) × 4.4 (4-5) µm, shape index 2.03 (1.7-2.5). A sporocyst residuum is present, composed of many granules of irregular size. The sporozoites are elongate, lying lengthwise in the sporocysts. Comparison with other species of the genus* Eimeria *parasitising members of family Testudinidae indicates that the presently described coccidium represents a new species. The name of* Eimeria carinii *Lainson, Costa & Shaw, 1990 is found to be preoccupied by a homonym,* Eimeria carinii *Pinto 1928 given to a coccidium from* Rattus norvegicus. *Therefore, it is replaced by* Eimeria lainsoni *nom. nov.*

Key words: *Eimeria motelo* sp. n. - *Eimeria lainsoni* nom. nov. - *Geochelone denticulata* - Peru

The yellow footed tortoise, *Geochelone denticulata* (L.), locally known as "jaboti", "motelo", "morrocoy" or "sigrilpatoe" is a middle sized herbivorous tortoise living in dense rain forests of South America. The yellow-footed tortoises are popular pets and as such are often kept in captivity. The only named coccidian parasites reported from this tortoise are *Eimeria jaboti* and *E. carinii* (Carini 1942, Lainson et al. 1990). Here we present a description of a new species of *Eimeria* originated from *Geochelone denticulata* from Peru.

MATERIALS AND METHODS

Four subadult yellow-footed tortoises captured by local people from Tamshiyacu in the Iquitos region of Peru, were recently imported by a private herpeto-keeper in the Czech Republic. The animals were quarantined separately in plastic cages and fed on various fruits and vegetables. Faecal samples were collected daily for routine parasitological examination. Individual samples were concentrated by centrifugation-flotation in modified Sheather's sugar solution (sp. gr. 1.3). Samples containing coccidian oocysts were mixed with 2.5% aqueous (w/v) potassium dichromate ($K_2Cr_2O_7$) solution and spread in a thin layer in covered Petri dishes at 20-23°C till the oocysts sporulated. Coccidian oocysts were examined and photographed using Nomarski interference-contrast microscopy (NIC). Measurements were made using a calibrated ocular micrometer and are reported in micrometers as means, followed by the ranges in parentheses.

RESULTS

Repeated coprological examination revealed the presence of oocysts of a previously undescribed coccidian species belonging to the genus *Eimeria* in two of the four tortoises, and described below.

Eimeria motelo sp. n.
Figs 1-7

Description: oocysts irregularly ellipsoidal, with slightly expressed lobed protrusions and irregularities at the poles, possibly caused by wrinkling of

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+Corresponding author. Fax: +420-5-748841. E-mail: modryd@vfu.cz.
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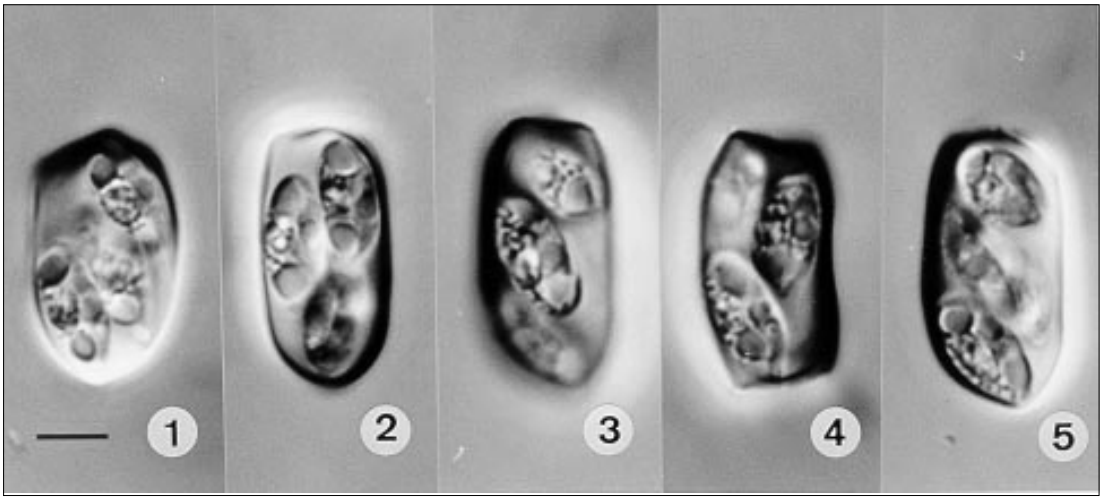

Figs 1-5: Nomarski interference contrast photographs of sporulated oocysts of *Eimeria motelo* sp. n. showing various oocyst shapes, all in the same scale. Bar = 5 μm

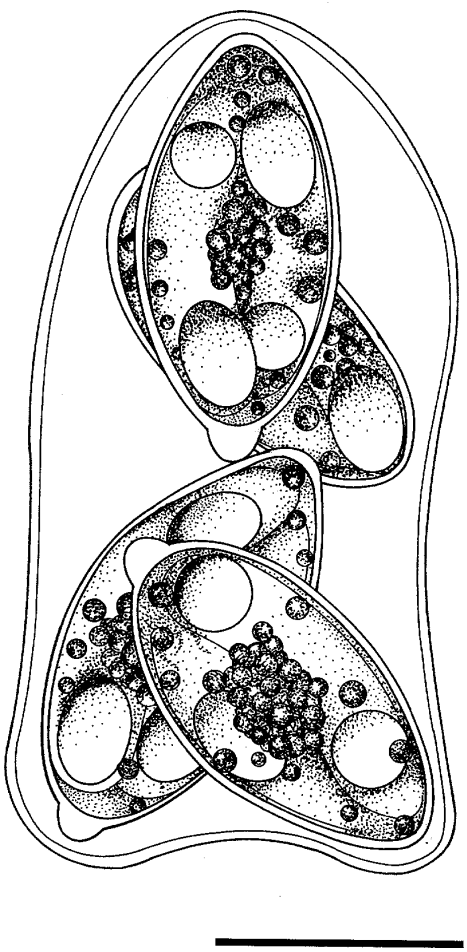

Fig. 6: composite line drawing of sporulated oocyst of *Eimeria motelo* sp.n. Bar = 5 μm

oocyst wall. Oocysts are 17 (15-19) × 9.4 (8.5-11), shape index (SI, length/width) 1.81 (1.45-2). Oocyst wall smooth, single-layered, ~0.5 thick. Micropyle, oocyst residuum and polar granules absent. Sporocysts ellipsoidal, 8.9 (7.5-10) × 4.4 (4-5); SI 2.03 (1.7-2.5). Stieda body present, domelike, ~1×1; substieda body indistinct. Sporocyst residuum present, composed of small granules of irregular size, organised either in a globular cluster, 3-3.5 in diameter, or scattered individually among sporozoites. Sporozoites elongate, with two refractile bodies.

Type-host: the yellow-footed tortoise, *Geochelone denticulata* (Linnaeus, 1766) (Reptilia: Chelonia: Testudinidae).

Type-locality: Tamshiyacu, Iquitos, Depertamento de Loreto, Peru (3°59'S; 73°10'W).

Prevalence: 2/4 (50%).

Sporulation: probably endogenous. Oocyst were sporulated 3-4 h after defecation.

Site of infection: unknown, oocysts recovered from faeces.

Type-material: phototypes are deposited at Institute of Parasitology, Academy of Sciences of the Czech Republic, Branišovská 31, České Budějovice, Czech Republic (No. R 111/99).

Etymology: the specific epithet *motelo* reflects the local name of the host "motelo" and is given, in accordance with International Code of Zoological Nomenclature (Article 31.1), as a noun in apposition (ICZN 1999).

DISCUSSION

To date, there are five species of *Eimeria* and one species of *Isospora* described and named from

TABLE

Comparative morphological data on species *Eimeria* and *Isospora* described to date from members of family Testudinidae (all measurements in µm)

Species	Type host	Oocysts	Sporocysts	Locality	Reference
E. brodeni	*Testudo graeca*	Ovoid, 30 (28-32) × 19 (18-20)	Ellipsoidal, 10 × 6-7	Greece	Cerruti 1930
E. geochelona	*Geochelone nigra*	Ellipsoidal-ovoid, 21.6 (18-25) × 18.1 (16.0–20.0), OW bi-layered smooth, PG+	Ellipsoidal, 10.7 (8-12) × 7 (5-8), SB+, SSB–	Ecuador Galápagos Isla Santa Cruz	Couch et al. 1996
E. jaboti	*G. denticulata*	Spherical-subspherical, 17-19 × 15-17, OW 3-layered, PG+	Oval, 10-11 × 6-6.6, SB–	Brazil	Carini 1942
E. lainsoni nom. nov.	*G. denticulata*	Spherical-subspherical, 19.2 (15-20) × 18.6 (14-19), OW single-layered, smooth, colourless, PG–	Ellipsoidal, 8.8 (8-9) × 7.3 (7-7.5), SB–	Brazil	Lainson et al. 1990
E. motelo sp. n.	*G. denticulata*	Irregularly elipsoidal, 17 (15-19) × 9.4 (8.5-11.0), OW single-layered, smooth, PG–	Ellipsoidal, 8.9 (7.5-10) × 4.4 (4-5), SB+	Tamshiyacu, Iquitos, Peru	This study
E. paynei	*Gopherus polyphemus*	Ellipsoidal, 23.2 (19-26) × 18.6 (16-20), OW bi-layered, PG+	Ovoid,13.2 (12-14) × 8.1 (7-9), SB+	USA, Georgia	Ernst et al. 1971
Isospora testudae	*T. horsfieldi*	Spherical, 25.6 (22.1-28.9), OW bi-layered, smooth, PG–	Ovoid, 15.3-18.7 × 10.2-15.3, SB–	Uzbekistan	Davronov 1985

OW: oocyst wall, PG: polar granule, SB: stieda body, SSB: substieda body

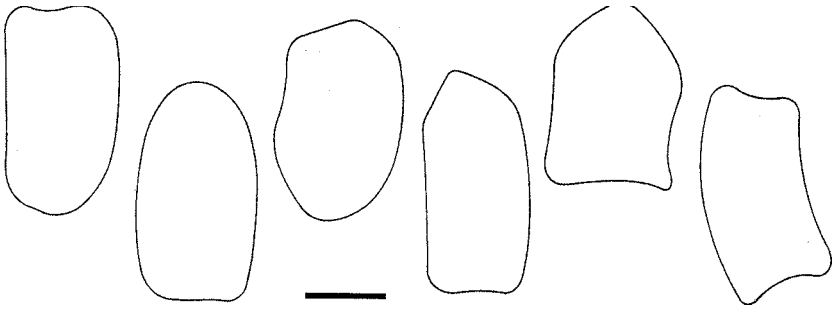

Fig. 7: schematic line drawings showing various shapes of sporulated oocyst of *Eimeria motelo* sp.n. Bar = 5 µm

Testudinidae (Cerruti 1930, Carini 1942, Ernst et al. 1971, Davronov 1985, Lainson et al. 1990, Couch et al. 1996): *Eimeria brodeni* Cerruti 1930 described from Greek tortoise, *Testudo graeca*; *E. geochelona* Couch, Stone, Duszynski, Snell & Snell 1996 from Galápagos tortoise, *Geochelone nigra*; *E. paynei* Ernst, Fincher & Stewart, 1971 from gopher tortoise, *Gopherus polyphemus*; *E. jaboti* Carini 1942 described from yellow-footed tortoise, *Geochelone denticulata*; *E. carinii* Lainson, Costa & Shaw, 1990 from yellow-footed tortoise, *Geochelone denticulata*; *Isospora testudae* Davronov 1985 from Horsfield's tortoise, *Testudo horsfieldi*. Additionally, an intranuclear coccidian was found and described in various tissues of the radiated tortoise, *Geochelone radiata* by Jacobson et al. (1994). Oocysts were not found in faeces and generic determination of this parasite therefore remains unknown.

Based on oocyst morphology, *E. motelo* differs significantly from all of these species (see Table) and is therefore considered as a new species.

Lainson et al. (1990) described *E carinii* from yellow-footed tortoise, *G. denticulata* from Brazil. However, we have found that the name given for this parasite is preoccupied by a homonym, *E. carinii* Pinto 1928 given to a coccidian from *Rattus norvegicus*. It is, therefore, proposed that *Eimeria carinii* Lainson, Costa & Shaw, 1990 be replaced by the name *Eimeria lainsoni* nom. nov., which is given in honour of Professor Ralph Lainson.

Except of above mentioned study of Jacobson et al. (1994) describing enteritis, hepatitis, nephritis and pancreatitis associated with a coccidian infection, there are no reports on pathogenicity of coccidian infection for tortoises. Both tortoises expelling coccidian oocysts during the present study showed no signs of alteration in their health status. However, the debilitating effect of coccidian infection on tortoises in captivity can not be excluded, particularly in juveniles.

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Additional literature cited on the coccidia of tortoises can be found at http://biology001.unm.edu/~coccidia/home.html.