COCCIDIA
ISSN 2318-9673
r1.ufrrj.br/lcc/Coccidia

Adelina sp. (Apicomplexa: Adeleidae), a pseudoparasite of *Thoropa miliaris* Spix (Amphibia: Cycloramphidae) in Southeastern Brazil

Bruno do Bomfim Lopes | Caroline Spitz dos Santos | Hermes Ribeiro Luz | Bruno Pereira Berto | Carlos Wilson Gomes Lopes

Submitted in 01.12.2013
Accepted in 11.12.2013

Abstract Lopes B doB, Santos CS, Luz HR, Berto BP, Lopes CWG. 2013. ***Adelina* sp. (Apicomplexa: Adeleidae), a pseudoparasite of *Thoropa miliaris* Spix (Amphibia: Cycloramphidae) in Southeastern Brazil.** [*Adelina* sp. (Apicomplexa: Adeleidae), um pseudoparasita de *Thoropa miliaris* Spix (Amphibia: Cycloramphidae) no Sudeste do Brasil] *Coccidia* 1, 26-31. Departamento de Biologia Animal, Instituto de Biologia, Universidade Federal Rural do Rio de Janeiro. BR-465 km 7, 23897-970 Seropédica, RJ, Brasil. E-mail: bertobp@ufrrj.br

The insectivorous habit of some vertebrates is essential for the life cycle of some coccidia of invertebrates because they depend of the feeding habits of vertebrates which ingest invertebrate hosts to ensure that the adeleid oocysts will be dispersed. This study reports adeleid polysporocystic oocysts from feces of the frog *Thoropa miliaris* Spix in Marambaia Island, State of Rio de Janeiro, Brazil. This sporulated oocysts belong to the genus *Adelina*, which was parasitizing an invertebrate ingested by *T. miliaris*. The oocysts were ellipsoidal, 37.6 × 31.4 µm, with a smooth, bilayered wall. Micropyle, oocyst residuum and polar granule were absent. The number of sporocysts per oocyst varied from 14 to 21. The sporocysts were subspherical, 9.1 × 8.5 µm. Stieda and substieda bodies absent. Sporocyst residuum composed of scattered granules. Sporozoites present subspherical refractile bodies at both ends. This is the first report of a pseudoparasite in amphibians. Comparative morphology of 29 *Adelina* spp. is presented in tabulated data.

Keywords pseudoparasite, predaction, invertebrate, habit, coccidia, morphology, oocysts, polysporocystic, Adeleorina.

Resumo O hábito insetívoro de alguns vertebrados é essencial para alguns coccídios de invertebrados, pois estes dependem dos hábitos alimentares de vertebrados que predam invertebrados para garantir que serão dispersos. Este estudo relata a presença de oocistos polisporocísticos de um adelídeo nas fezes de *Thoropa miliaris* Spix na Ilha da Marambaia, Estado do Rio de Janeiro, Brasil. Esta espécie pertence ao gênero *Adelina*, a qual estava parasitando um invertebrado ingerido por *T. miliaris*. Os oocistos foram elipsoidais, 37,6 × 31,4 µm, com parede lisa e dupla. Micrópila, resíduo e grânulo polar estavam ausentes. O número de esporocistos por oocisto variou de

BB Lopes
Programa de Pós-Graduação em Ciência, Tecnologia e Inovação em Agropecuária, Universidade Federal Rural do Rio de Janeiro (UFRRJ). BR-465 km 7, 23897-970 Seropédica, RJ, Brasil.
E-mail: biolopesbb@hotmail.com

CS Santos | HR Luz
Curso de Pós-Graduação em Ciências Veterinárias, UFRRJ. BR-465 km 7, 23897-970 Seropédica, RJ, Brasil.
E-mail: carolinespitz@yahoo.com.br
hermes@ufrrj.br

BP Berto ✉
Departamento de Biologia Animal, Instituto de Biologia, UFRRJ. BR-465 km 7, 23897-970 Seropédica, RJ, Brasil.
E-mail: bertobp@ufrrj.br

CWG Lopes
Departamento de Parasitologia Animal, Instituto de Veterinária, UFRRJ. BR-465 km 7, 23897-970 Seropédica, RJ, Brasil. CNPq fellowship.
E-mail: lopescwg@ufrrj.br

14 a 21. Os esporocistos foram subesféricos, 9,1 × 8,5 µm. Corpos de Stieda e substieda ausentes. Resíduo do esporocisto formado por grânulos dispersos. Esporozoítos com corpos refráteis sub-esféricos em ambas as extremidades. Este é o primeiro relato desse pseudoparasita em anfíbios. A morfologia comparativa de 29 *Adelina* spp. é apresentada em dados tabelados.

Palavras-chave pseudoparasita, predação, invertebrados, hábito, coccidia, morfologia, oocistos, polisporocístico, Adeleorina

Introduction

The amphibians of the genus *Thoropa* are endemic to Eastern and Southeastern Brazil. Five species are grouped in this genus, including *Thoropa lutzi* Cochran and *Thoropa petropolitana* Wandolleck, which are listed respectively as Endangered and Vulnerable by the IUCN (International Union for Conservation of Nature and Natural Resources). In contrast, *Thoropa miliaris* Spix is not threatened. This species from southern and eastern Brazil ranges from the southern part of the State of Rio de Janeiro, north to the State of Bahia, inland to the eastern part of the State of Minas Gerais. It is found in rocky areas in forest, above forest, or near forest, living on wet rock walls near streams or waterfalls. The species feeds mostly on invertebrates, especially ants, beetles, grasshoppers, caterpillars, and spiders (Feio et al. 2006, Siqueira et al. 2006, Silva et al. 2008, Frost 2013, IUCN 2013).

The insectivorous habit of some vertebrates, as amphibians, is essential for some coccidia of invertebrates because they depend of the feeding habits of vertebrates, which ingest its invertebrate hosts to ensure that will be dispersed. In other words, the vertebrate that ingests an invertebrate parasitized by a coccidium should shed its oocysts encountered in coelomic cavity of invertebrates, after be digested (Berto et al. 2010).

The aim of this study was to report oocysts of an invertebrate coccidium *Adelina* sp. from feces of *T. miliaris* at Marambaia Island in the State of Rio de Janeiro, Brazil.

Materials and methods

Three specimens of *T. miliaris* were collected at Marambaia Island (23° 04' S, 43° 53' W) in the State of Rio de Janeiro. They were kept in individual vials, and feces were collected immediately after defecation. Fecal samples were placed in plastic vials containing 2.5% potassium dichromate solution ($K_2Cr_2O_7$) 1:6 (v/v). Samples were carried to the Laboratório de Coccídios e Coccidioses, Universidade Federal do Rio de Janeiro. Samples were placed in a thin layer (c.5 mm) of $K_2Cr_2O_7$ 2.5% solution in Petri plates and incubated at 23-28°C for 10 days or until 70% of the oocysts were sporulated. Oocysts were recovered by flotation in Sheather's sugar solution (S.G. 1.20) and examined microscopically using the technique described by Duszynski & Wilber (1997). Morphological observations, photomicrographs and measurements, given in micrometers, were made using a Olympus BX binocular microscope coupled to a digital camera Eurocam 5.0. Size ranges are in parentheses following the means.

Results and discussion

Three specimens of *T. miliaris* were examined; being that one was positive for sporulated polysporocystic oocysts of coccidia. This species belong to the genus *Adelina*, which was parasitizing an invertebrate ingested by *T. miliaris*.

The identified oocysts (Figure 1) were ellipsoidal, 37.6 (33-41) × 31.4 (29-34) µm, with shape-index of 1.2 (1.1-1.2). Oocyst wall bi-layered and smooth, 1.2 µm thick. Micropyle, oocyst residuum and polar granule were absent. The number of sporocysts per oocyst varied from 14 to 21. Sporocysts predominantly subspherical, 9.1 (8-9) × 8.5 (8-9) µm, with shape-index of 1.1 (1.0-1.1). Stieda and substieda bodies absent. Sporocyst residuum composed of scattered granules. Sporozoites present sub-spherical refractile bodies at both ends.

The oocysts recovered from *T. miliaris* were identified as *Adelina* sp., because they have polysporocystic oocysts with dizoic

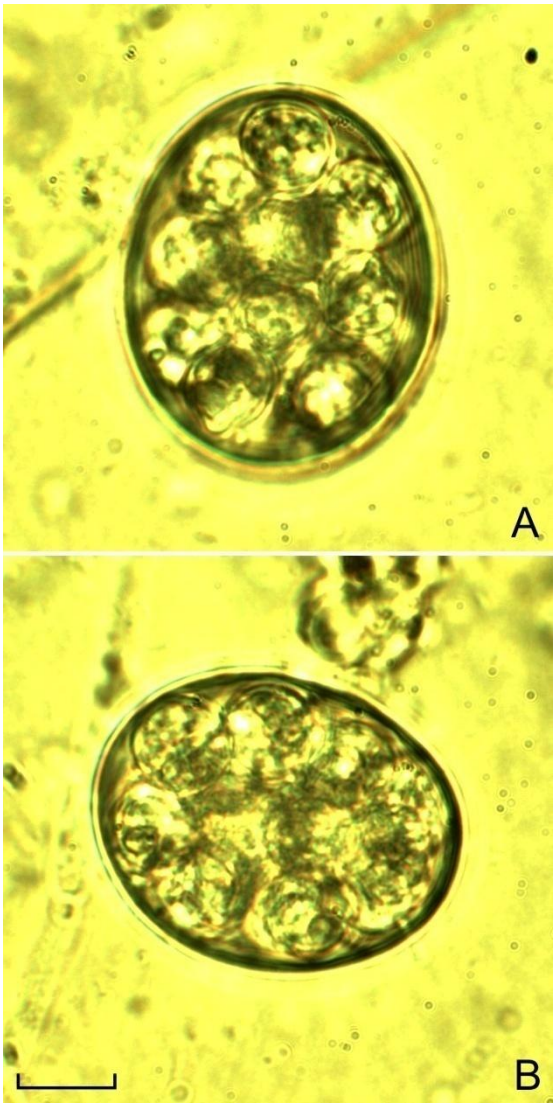

Fig. 1. Sporulated oocysts of *Adelina* sp., a pseudoparasite recovered from feces of the frog *Thoropa miliaris*. Scale-bar: 10 µm.

sporocysts. The genus *Adelea* also has these characteristic features; however, this genus have discoidal sporocysts, rather than subspherical sporocysts as in the current work (Wenyon 1926, Ghosh 2000). Table 1 compares the morphology and morphometry of the oocysts of the current work with the main reports of *Adelina* spp. in the world.

Importantly, the finding of adeleid oocysts in the feces vertebrates, which feeding habit is the ingestion of larvae or adults of invertebrates, indicates that these are not its parasites. Berto et al. (2010) emphasize some studies describing new genera and species, which were subsequently invalidated because they were carried out from adeleid polysporocystid oocysts in the feces of vertebrates.

Finally, in the current study, a *Adelina* sp. is reported from feces of *T. miliaris* in Brazil, becoming the first description of this pseudoparasite in amphibians.

Acknowledgements

We thank Dr. Hélio Ricardo da Silva (Departamento de Biologia Animal, Instituto de Biologia, Universidade Federal Rural do Rio de Janeiro) for the identification of the amphibians. We also thank the Brazilian Navy, in special to the command of CADIM (Centro de Adestramento da Ilha da Marambaia) that allowed us to access the Marambaia Island, located in Rio de Janeiro State, Brazil, and use some of the facilities of CADIM during the field work.

References

Berto BP, Lopes B doB, Flausino W, Teixeira-Filho WL, Lopes CWG. Contribution on the study of *Isospora hemidactyli* Carini, 1936 and a report of an adeleid pseudoparasite of the house gecko *Hemidactylus mabouia*, from the Rio de Janeiro metropolitan region, Brazil. Revista Brasileira de Parasitologia Veterinária, 17, 150-154, 2008.

Berto BP, Lopes B doB, Teixeira-Filho WL, Flausino W, Lopes CWG. Coccídios de invertebrados associados ao hábito alimentar de vertebrados: uma breve revisão dos gêneros *Adelea*, *Adelina* e *Barroussia*. Revista Brasileira de Medicina Veterinária, 32, 33-41, 2010.

Duszynski DW, Wilber PG. A guideline for the preparation of species descriptions in the Eimeridae. *Journal of Parasitology*, 83, 333-336, 1997.

Feio RN, Napoli MF, Caramaschi U. Considderações taxonômicas sobre Thoropa milaris (Spix, 1824), com revalidação e redescrição de Thoropa tapophora (Miranda-Ribeiro, 1923) (Amphibia, Anura, Leptodactylidae). *Arquivos do Museu Nacional*, 64, 41-60, 2006.

Frost DR. *Thoropa*. Amphibian Species of the World: an Online Reference. American Museum of Natural History, New York. 2013. http://research.amnh.org/vz/herpeto

Table 1. Comparative morphology of *Adelina* spp. reported from true and false hosts.

Species	Hosts	References	Oocysts		Sporocysts	
			Shape	Diameter (µm)	Number per oocyst	Diameter µm
Adelina simplex Schneider, 1875	*Gyrinus* sp. (Insecta: Gyrinidae)	Malone & Dhana (1988)	-	25-40	8-16	-
Adelina tipulae Schneider, 1875	*Tipula sp.* (Insecta: Tipulidae)	Malone & Dhana (1988)	-	35-40	4-10	-
Adelina dimidiata Schneider, 1885	*Scolopendra* spp. (Chilopoda: Scolopendridae)	Wenyon (1926), Purrini (1984), Malone & Dhana (1988)	-	-	13-17	15
Adelina mesnili Pérez, 1899	*Tineola biseliella* Hummel (Insecta: Tineidae)	Purrini (1984), Malone & Dhana (1988)	-	-	6-8	15
Adelina akidum Leger, 1900	*Olocrates abbreviatus* Reitter (Insecta: Tenebrionidae)	Wenyon (1926), Malone & Dhana (1988)	-	30-40	12-20	10
Adelina transita Leger, 1904	*Haploembia solieri* Rambur (Insecta: Oligotomidae)	Wenyon (1926), Purrini (1984), Malone & Dhana (1988)	-	30-40	6-20	10-11
Adelina zonula Moroff, 1906	*Blaps mortisaga* L. (Insecta: Tenebrionidae)	Wenyon (1926), Purrini (1984), Malone & Dhana (1988)	-	-	8	-
Adelina octospora Hesse, 1911	*Slavina appendiculata* d'Udekem (Oligochaeta: Naididae)	Purrini (1984)	-	19-20	8	8 × 5-9
Adelina tenebrionis Sautet, 1930	*Tenebrio molitor* L. (Insecta: Tenebrionidae)	Purrini (1984), Malone & Dhana (1988), Ghosh et al. (2000)	-	20-35	2-12	10-12
Adelina cryptocerci Yarwood, 1937	*Cryptocercus punctulatus* Scudder (Insecta: Cryptocercidae)	Purrini (1984), Malone & Dhana (1988)	-	24-51	5-21	10-12
Adelina tribolli Bhatia, 1937	*Tribolium* spp. Fabricius (Insecta: Tenebrionidae)	Purrini (1984), Malone & Dhana (1988), Žizka (1969)	subspherical or ovoidal	26-50 × 22.5-36.5	2-14	-
Adelina schellacki Ray, Dasgupta, 1940	*Cormocephalus dentipes* Pocock (Chilopoda: Scolopendridae)	Purrini (1984)	-	30-35 × 20-25	8	15-18
Adelina deronis Hauschka, Penny, 1942	*Dero limosa* Leidy (Oligochaeta: Naididae)	Purrini (1984)	-	-	-	-
Adelina sericesthis Weiser, Beard, 1959	*Sericesthis pruinosa* Dalman (Insecta: Scarabaeidae)	Purrini (1984), Malone & Dhana (1988)	-	-	4-8	-

Adelina melolonthae Tuzet, Vago, Ormieres, Robert, 1965	*Melolontha melolontha* L. (Insecta: Scarabaeidae)	Kharazi-Pakdel & Amargier (1973), Purrini (1984), Malone & Dhana (1988)	-	30-35	6-14	11
Adelina riouxi Levine, 1977	*Phlebotomus ariasi* Tonnoir (Insecta: Psychodidae)	Malone & Dhana (1988)	-	30-40	8-18	7-10
Adelina rayi Narasimhamurti, 1977	*Rhysida longipes* Newport (Chilopoda: Scolopendridae)	Narasimhamurti (1977)	-	20.0-22.0 × 18.0-20.0	8	12.0-14.0 × 2.0-2.5
Adelina acarinae Purrini, 1984	*Nothrus silvestris* Nicolet (Arachnida: Nothridae)	Purrini (1984)	-	15-25	8-12	7-7.5
Adelina collembolae Purrini, 1984	*Neanura muscorum* Templeton (Entognatha: Neanuridae	Purrini (1984)	-	40	24	7.5-8
Adelina grylli Butaeva, 1996	*Gryllus bimaculatus* de Geer (Insecta: Gryllidae)	Sokolova (1999)	subspherical	36.3	4-10	13.3
Adelina castana Ghosh, Choudhur, Misra, 2000	*Tribollium castaneum* Herbst (Insecta: Tenebrionidae)	Ghosh et al. (2000)	ovoidal	29.3 × 25.4	4-12	8.2
Adelina picei Ghosh, Choudhur, Misra, 2000	*Alphitobius piceus* Olivier (Insecta: Tenebrionidae)	Ghosh et al. (2000)	subspherical	33.9 × 29.9	8-18	8.5
Adelina palori Ghosh, Choudhur, Misra, 2000	*Palorus ratzeburgi* Wissmann (Insecta: Tenebrionidae)	Ghosh et al. (2000)	ovoidal	30.3 × 24.6	4-12	8
Adelina sp.[a]	*Anolis trinitatis* Reinhardt, Lütking (Reptilia: Dactyloidae)	Daszak & Ball (1998)	subspherical	30.5-39.2 × 26.5-31.7	7-16	30.5-39.2 ×26.5-31.7
Adelina sp.	*Anurogryllus muticus* de Geer (Insecta: Gryllidae)	Lange & Wittenstein (2001)	subspherical	24	3-12	-
Adelina sp.[a, b]	*Didelphis aurita* Wied-Neuwied (Mammalia: Didelphidae)	Teixeira et al. (2003)	subspherical	34.7 × 31.6	6-12	11.0 × 10.7
Adelina sp.[a, b]	*Nasua nasua* L. (Mammalia: Procyonidae)	Lopes et al. (2006)	subspherical	23.9 × 21.5	8-12	10.3 × 8.6
Adelina sp.[a, b]	*Hemidactylus mabouia Moreau de Jonnès* (Reptilia: Gekkonidae)	Berto et al. (2008)	ellipsoidal	36.3 × 30.9	8- 15	12.4 × 11.2
Adelina sp.[a, b]	*Thoropa miliaris* Spix (Amphibia: Cycloramphidae)	current study	ellipsoidal	37.6 × 31.4	14-21	9.1 × 8.5

[a]Pseudoparasites;
[b]Reported in Brazil.

logy/amphibia/?action=references&id=9270 [19-11-2013]

Ghosh C, Choudhur Y, Misra KK. Life histories of three new coccidian parasites from three coleopteran stored-grain pests of India. *Acta Protozoologica*, 39, 233-240, 2000.

IUCN. International Union for Conservation of Nature and Natural Resources. 2013. http://www.iucnredlist.org [19-11-2013]

Kharazi-Pakdel A, Amargier A. La pathogénèse des infections simultanées a *Adelina melolonthae* et a *Nosema melolonthae* chez *Melolontha melolontha*. *Entomophaga*, 18, 229-235, 1973.

Lange CE, Wittenstein E. An *Adelina* sp. (Apicomplexa: Coccidia) found in *Anurogullus muticus* (De Geer) (Orthoptera: Gryllidae). *Journal of Invertebrate Pathology*, 77, 83-84, 2001.

Lopes B doB, Souza JD, Lopes CWG. Coccídios pseudoparasitos do quati do focinho preto (*Nasua nasua*). Revista Universidade Rural: Ciência e Vida, 26, 53-54, 2006.

Malone LA, Dhana S. Life cycle and ultrastructure of *Adelina tenebrionis* (Sporozoea: Adeleidae) from *Heteronychus arator* (Coleoptera: Scarabaeidae). *Parasitology Research*, 74, 201-207, 1988.

Narasimhamurti CC. Observations on the morphology and sporogony of a coccidian *Adelina rayi* n. sp. from the gut of the centipede, *Rhysida longipes*. *Proceedings of the Indian Academy of Sciences*, 86, 239-244, 1977.

Purrini K. Two New Coccidian Parasites of the Genus *Adelina* (Adeleidae, Coccidia) Parasitizing Oribatid Mite *Nothrus Silvestris* (Oribatei, Acarina) and Springtail *Neanura Muscorum* (Collembola, Apterygota) in Forest Soils. *Archiv für Protistenkunde*, 128, 99-107, 1984.

Silva HR, Carvalho ALGD, Bittencourt-Silva GB. Frogs of Marambaia: a naturally isolated Restinga and Atlantic Forest remnant of southeastern Brazil. Biota Neotropica, 8, 167-174, 2008

Siqueira CC, Van Sluys M, Ariani CV, Rocha CFD. Feeding ecology of *Thoropa miliaris* (Anura, Cycloramphidae) in four areas of Atlantic rain forest, southeastern Brazil. *Journal of Herpetology*, 40, 520-525, 2006.

Sokolova YY. Light and electron microscopic observation on life cycle stages of *Adelina grylli* Butaeva 1996 (Sporozoa, Adeleidae) from the fat body of the cricket *Gryllus bimaculatus*. *Protistology*, 1, 34-42, 1999.

Teixeira M, Albuquerque GR, Lopes CWG, Florentino MVN. An adeleid coccidia, a pseudoparasite of *Didelphis aurita* (Marsupialia: Didelphoidea). Revista Brasileira de Parasitologia Veterinária, 12, 33-35, 2003.

Wenyon CM. *Protozoology*. New York: William, Wood and Company, 1926.

Žizka Z. The fine structure of the macrogametocytes of *Adelina tribolii* Bhatia, 1937 (Eucoccidia, Telosporea) from the fat body of the beetle *Tribolium castaneum* Hbst. *Journal of Protozoology*, 16, 111-120, 1969.