

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

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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@ufrj.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, $37.6 \times 31.4 \mu\text{m}$, 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, $9.1 \times 8.5 \mu\text{m}$. 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, predation, 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 adeliídeo 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, $37,6 \times 31,4 \mu\text{m}$, com parede lisa e dupla. Micrópila, resíduo e grânulo polar estavam ausentes. O número de esporocistos por oocisto variou de

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14 a 21. Os esporocistos foram subesféricos, $9,1 \times 8,5 \mu\text{m}$. 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 pseudo-parasita 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 ($23^{\circ} 04' \text{ S}$, $43^{\circ} 53' \text{ W}$) 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 ($\text{K}_2\text{Cr}_2\text{O}_7$) 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 $\text{K}_2\text{Cr}_2\text{O}_7$ 2.5% solution in Petri plates and incubated at $23\text{-}28^{\circ}\text{C}$ 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, $37.6 (33\text{-}41) \times 31.4 (29\text{-}34) \mu\text{m}$, with shape-index of 1.2 (1.1-1.2). Oocyst wall bi-layered and smooth, $1.2 \mu\text{m}$ thick. Micropyle, oocyst residuum and polar granule were absent. The number of sporocysts per oocyst varied from 14 to 21. Sporocysts predominantly subspherical, $9.1 (8\text{-}9) \times 8.5 (8\text{-}9) \mu\text{m}$, 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

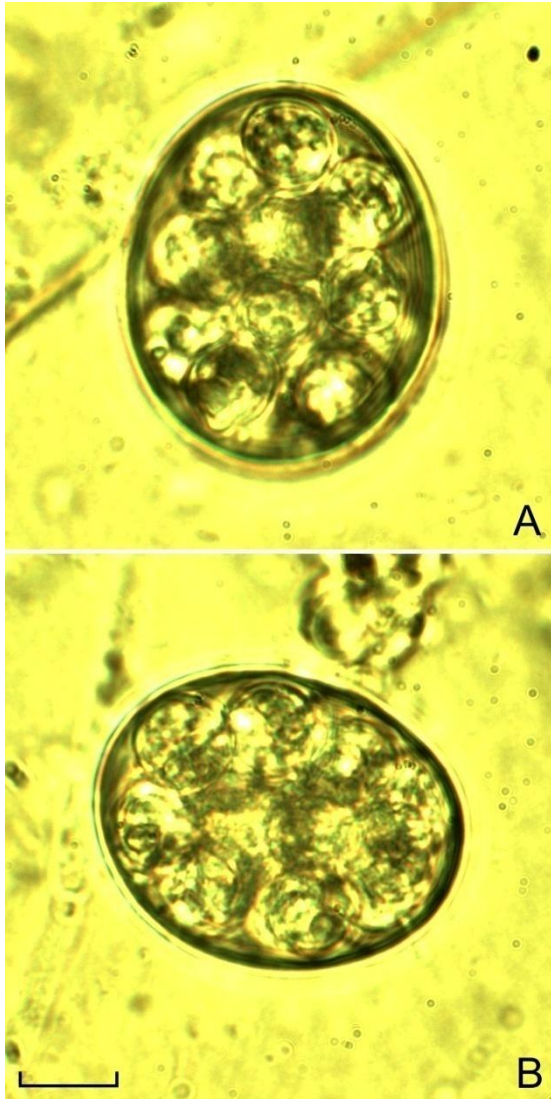


Fig. 1. Sporulated oocysts of *Adelina* sp., a pseudoparasite recovered from feces of the frog *Thoropa miliaris*. Scale-bar: 10 μ m.

sporocysts. The genus *Adelea* also has these characteristic features; however, this genus have discoidal sporocysts, rather than sub-spherical 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 polysporo-

cystid 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.

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

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

^aPseudoparasites;^bReported in Brazil.

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