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ARCYRIA CINEREA (BULL.) PERS. (MYXOMYCETES, TRICHIACEAE) ENCONTRADA EM FEZES DE MOCÓ (*KERODON RUPESTRIS* WIED-NEUWIED, 1820, RODENTIA: CAVIIDAE)

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Resumo: *Kerodon rupestris* Wied-Neuwied, 1820 (Caviidae, Rodentia), conhecido localmente como mocó, é um pequeno roedor nativo da região semiárida do Brasil e seu ambiente natural é a vegetação do domínio Caatinga. Foram realizadas 17 excursões, com quatro dias de duração cada, a fim de inventariar espécies coprófilas de mixomicetos no Parque Nacional Serra da Capivara, município de São Raimundo Nonato, Piauí, Brasil (8º26'-8º54'S, 42º19'- 42º45'W, 600 m alt.). As coletas foram realizadas em diferentes estações do ano em áreas de caatinga arbórea densa, caatinga arbustiva alta, caatinga arbustivo-arbórea densa baixa, caatinga arbustivo-arbórea densa média e caatinga arbustiva baixa. As amostras de fezes de mocó foram coletadas em buracos nas rochas e sítios arqueológicos e cultivadas em 100 câmaras-úmidas. Apenas 25% dos cultivos foram positivos para mixomicetos, resultando em 24 espécimes, todos eles pertencentes a *Arcyria cinerea* (Bull.) Pers. (Myxogastromycetidae, Trichiales). Este é o primeiro registro de mixomicetos em fezes de *K. rupestris*, assim como de *A. cinerea* em ambiente de caatinga no Parque Nacional Serra da Capivara.

Palavras-chave: Caatinga; coprófilo; fimícola; microbiota; Parque Nacional Serra da Capivara.

ARCYRIA CINEREA (BULL.) PERS. (MYXOMYCETES, TRICHIACEAE,) FOUND ON DUNG OF ROCK CAVY (*KERODON RUPESTRIS* WIED-NEUWIED, 1820, RODENTIA: CAVIIDAE)

Abstract: The rock cavy, *Kerodon rupestris* Wied-Neuwied, 1820 (Caviidae, Rodentia), known locally as mocó, is a small rodent native to the semi-arid region of Brazil and its natural environment is the vegetation of the Caatinga dominium. A total of 17 four-day field trips were carried out in order to inventory coprophilous species of myxomycetes in the Serra da Capivara National Park, São Raimundo Nonato municipality, Piauí state,

Brazil (8º26'-8º54'S, 42º19'- 42º45'W, 600 m alt.). Collections were carried out in different seasons of the year in areas of dense arboreal caatinga, high brush caatinga, low dense arboreal brush caatinga, dense medium arboreal brush caatinga and low brush caatinga. Dung samples were collected from cracks in rocks and archeological sites and cultured in 100 moist chambers. Only 25% of the cultures were positive for myxomycetes, resulting in 24 specimens, all of them belonging to *Arcyria cinerea* (Bull.) Pers. (Myxogastromycetidae, Trichiales). This is the first record of myxomycetes on dung of *K. rupestris* as well as of *A. cinerea* in the caatinga environment at the Serra da Capivara National Park.

Keywords: Caatinga, coprophilous, fimicolous, myxobiota, Serra da Capivara National Park.

1. INTRODUCTION

The rock cavy, *Kerodon rupestris* Wied-Neuwied, 1820 (Caviidae, Rodentia) is a small rodent native to semi-arid region of Brazil, naturally distributed from the state of Piauí to the state of Minas Gerais, with gregarious, diurnal habits, reaching about 1 kg and 40 cm in adulthood. The natural environment of the rock cavy is the dry brush-land characteristic of the Caatinga of the northeastern region of the country in outcrops of granite, where it finds shelter in small caves (ZOGNO et al., 2004).

The rock cavy lives primarily among rocks, but also behaves as a terricolous and arboricolous species and is capable of climbing rocks and trees. It feeds on practically any part of plants and favors the dispersal of seeds when feeding on fruit. However, it causes damage when chewing on the base of trees, which may than fall, The species makes up part of the diet of many wild carnivores and its meat and pelt are also appreciated by humans (ALMEIDA et al., 2008). Despite the large number of natural predators and being hunted by humans, the rock cavy is included in the category of least concern in the most recent red list of threatened species published in 2017 by the International Union for Conservation of Nature (CATZEFLIS et al., 2017).

Due to the social habits of the species, the rock cavy uses its feces to mark its territory, defecating in collective latrines at strategic points of the SCNP and especially in its dens among the rocks (CHAME, 2003). Fossilized remnants are often found at archeological sites in the SCNP along with cave paintings belonging to the Northeastern Brazilian Tradition of the Pleistocene through to the Holocene. In a chrono-stratographic and cultural analysis of three archeological sites, Melo (2004) reported the frequent finding of a black crust resulting from the impregnation of rock cavy feces on a large number of sandstone blocks, which leave a kind of dark, shiny concrete mass on the lytic

material. Recent deposits of feces are also found in different parts of the SCNP – many on the invaluable cave paintings.

Characteristics such as size and amount of feces produced by a single individual vary due to the influence of a number of different factors. When feeding on fibrous plants, the feces of the rock cavy are hard and compact. Rock cavy feces can be distinguished by the shape and significantly larger size when compared to feces produced by other rodents that inhabit northeastern Brazil, such as *Galea spixii* Wagler, 1831, *Thrichomys apereoides* Lund, 1839 and *Oryzomys subflavus* Wagner, 1842 (CHAME, 2003).

The composition of the feces of wild animals includes hair, teeth, scales, chitin from arthropods, seeds, vegetal tissue, pollen, and a significant amount of living or dead microorganisms as well as the eggs and larvae from parasites. Souza et al. (2012) analyzed coprolites of *K. rupestris* collected in the SCNP, and recorded, for the first time, the occurrence of *Syphacia* (Nematoda: Oxyuridae) in rodent coprolites for the Americas. A comparative study on parasites in rock cavy feces and coprolites found at archeological sites of the SCNP found that the passage from the savanna landscape interlaced with forest zones under a much wetter climate than the current climate and vegetation of the SCNP region, led to the extinction of helminthes, which are found in coprolites but absent from fresh feces today (ARAÚJO et al., 1989, 1993; ALMEIDA et al., 2008). The change to a semi-arid climate may have affected other groups of organisms that require a greater degree of moisture, such as fungi and myxomycetes.

Eliasson & Lundqvist (1979) reported the occurrence of 34 species of myxomycetes in the feces of herbivores – some representatives from the rodent group, such as lemmings, rats, desert rats and porcupines - and cite *Arcyria cinerea* (Bull.) Pers. among the common species found in dung from hares, capercailles, moose, cows, horses and deer. Twenty years later, Eliasson & Keller (1999) compiled a list of 99 species of myxomycetes occurring in the feces of herbivores, representing 23 genera recorded in the literature, one of which being *Arcyria* with seven species. Based on bibliographic surveys and correspondence with foreign colleagues, Meyer (2008) cites 19 species she considers clearly coprophilous, but does not include *A. cinerea*.

In the literature on Brazilian microbiota, there are few studies on fungal and myxomycete species that inhabit the dung of herbivores (RICHARDSON, 2001; BEZERRA et al., 2008a; 2008b.; TENORIO *et al.*, 2009; SILVA & CAVALCANTI, 2012; CALAÇA et al., 2014;).. Aiming to contribute to the knowledge on the myxomycetes that occur on dung of native animals of the Caatinga dominium this paper reports, for the first

time, their occurrence on feces of *K. rupestris*, in the Serra da Capivara National Park, Northeastern Brazil.

2. MATERIALS AND METHODS

A total of 17 four-day field trips were carried out in order to inventory species of myxomycetes in the SCNP, located in the municipality of São Raimundo Nonato, Piauí state, Brazil (geographical coordinates 8º26'-8º54'S, 42º19'- 42º45'W, 600 m alt.). Collections were carried out during different seasons of the year in areas of dense arboreal caatinga, high brush caatinga, low dense arboreal brush caatinga, dense medium arboreal brush caatinga and low brush caatinga.

The rock cavy produces isolated cylindrical, curved fecal units with generally rounded ends and a typical furrow along the length of the concave face, 0.9 to 1.7cm long and 0.4 to 0.6cm diam. (CHAME, 2003); samples were collected from dens in the rocks and at archeological sites of the SCNP in the rainy season, dry season and intermediate periods and placed in paper bags for the preparation of 100 moist chambers cultures (STEPHENSON et al., 1999). Five to six fecal units were placed on a Petri dish (9 cm diam.) lined with filter paper and moistened with distilled water. After 24 hours of moist chamber assembly, pH values were taken and the excess water drained. The cultures were kept under room light and temperature (± 27˚C) and observed at 48 to 72 h intervals for a minimum of three months and maximum of five months. After sporulation, the sporocarps were collected and prepared as herbarium specimens, recording the amount of sporangia formed on rock cavy feces as well as on the filter paper lining the moist chamber (BEZERRA et al., 2008 a)

Identification of the specimens was based on Farr (1976) and Lado & Pando (1997). Representative specimens are deposited at the UFP Herbarium in the city of Recife (Pernambuco state, Brazil).

3. RESULTS AND DISCUSSION

Initial pH of the cultures prepared with samples of the dung of *K. rupestris* indicated a tendency toward an acidic substrate (pH 4.5-6.0). The sporulation occurred between 90 and 120 days after the preparation of the moist chambers, and 25% of the cultures were positive for myxomycetes, with a total of 24 specimens (Tab. 1).

In the positive moist chambers, between 1- 43 sporangia were counted appearing on the entire surface of one or two fecal units, as well as on the paper filter lining the Petri dish (Fig. 1). A larger number of specimens were obtained in the moist chambers

prepared with material collected in high brush caatinga at the end of the rainy season for which there was also a greater coverage of sporocarps per unit (Tab. 1).

Five of the six orders of Myxomycetes include coprophilous species, some of them known predominantly from dung and associated litter (KRUG et al., 2004). Studies on the occurrence of coprophilous myxomycetes often report a few species, nearly always represented by a few specimens, with a lower percentage of positive results in cultures than that recorded for Serra da Capivara National Park. Surveying the myxobiota of the dung from 60 horses in Chile, Piontelli *et al.* (1981), for example, reported 35 specimens of myxomycetes (*Badhamia* sp.) among the 1367 specimens obtained in the study. Studying the coprophilic myxobiota in an arid environment in the Sultanate of Oman, Elshafie (2005) reported an unidentified species of *Physarum* considered very rare (2 to 5%) among the fungi obtained from culturing 110 samples of different types of feces. Kosheleva et al. (2008) reported that the poorest myxobiota of the Stolby Reserve (Siberia, Russia), was found in the feces of herbivores and soil litter, although they were quite characteristic in their composition. In moist chambers prepared with 136 samples of feces from herbivores, collected in the steppes and cold deserts of Russia and Kazakhstan, Novozhilov *et al*. (2006) obtained 98 positive cultures, with 14 species of Physarales and nine species of Trichiales; two species (five specimens) represented the genus *Arcyria* (Trichiaceae), with four specimens of *A. cinerea* collected in substrates with a mean pH of 5.9 (range: 3.8 to 7.4). The taxonomic diversity index for coprophilous (2.5) was similar to that found for lignicolous species (2.6), although species diversity was lower.

Krug *et al.* (2004) refer *A. cinerea* as an opportunistic species on dung. In the present study, all of the specimens belonged to *A. cinerea*, that is included in the list of myxomycetes published for the state of Piauí by Cavalcanti et al. (2006), occurring in the Low and Medium Parnaíba microregions. The 24 specimens had the following characteristics:

Sporangium stalked, isolated to grouped; sporotheca elongated cylindrical to sub-cylindrical, rarely ovoid, pure white, grayish white, gray, light brown to pinkish beige, 2.5 to 3.5 mm; peridium single, persistent at the base in the majority of sporocarps, forming a shallow to deep funnel or in the shape of a cup, plicate with pearly sheen, persisting to near the apex in pinkish beige sporocarps; hypothallus reddish brown, brown to light brown, membranous, shiny; stalk light brown, reddish brown or more rarely dark reddish brown, (102) 122.4 to 183.96 (204) µm in width at base x (91.8) 102 to 153 (236.52) µm in width at apex; capillitium attached to the edge of the calyculus, filaments

hyaline to light brown, of greater diameter, smooth or slightly spinescent at base, narrower and more densely spiny at apex (at times with larger spines or with rounded or clavate ends), ramified, with some free tips; spore globose, hyaline, (6.0) 8.0 (9.0) µm in diameter with sparse warts, scattered over the entire surface..

The majority of specimens had the typical characteristics of the species, but some exhibited variations in the color of the sporocarps, persistence of the peridium, ornamentation of the capillitium and spores; some sporangia were grouped by the stalks, similar to the var. *digitata*, exhibiting grayish brown to pinkish coloration (Fig. 2).

In some specimens, the capillitium was quite fragmented and atypical, with a regular edge and quite attached to the calyculus, which was infundibuliform, not very deep, plicate and at times quite elastic, with densely spiny ornamentation or with delicate to acute spines (Parente, M. P. M., 30 and 34). The peridium was persistent until the apex in the majority of the samples with a pinkish coloration similar to *A. cinerea* f. *rubella* Y. Yamam., not yet recorded in Brazil. The inner face of the peridium was reticulate, quite evident on the Parente, M. P. M., 26 specimen, similar to the illustration by Lado & Pando (1997). The stalk was furrowed, twisted and quite clear (Parente, M. P. M., 33 and 37). The globose spores ranged from slightly smooth to ornamented, with sparse warts.

In the study on coprophilous myxomycetes in Sergipe State, Northeast Brazil, *A. cinerea* was included among the 10 species that represented the class in sporulated material on the dung of *Sylvilagus brasiliensis* L., the Brazilian wild rabbit (BEZERRA et al., 2008b). This is the first record of myxomycetes on dung of *K. rupestris* and of *A. cinerea* at the Serra da Capivara National Park. Eliasson (2013) comments that the majority of studies on coprophilous myxomycetes have been based on dung from domestic animals and it is difficult to compare these data with those from wild animals.

Although myxomycetes have been studied in several Brazilian states and ecossystems, there are only a few reports of them in the Caatinga dominium. Considering that dung is an important substratum for myxomycetes in desert ecosystems, due to the slow decomposition process that occur in dry climate (STEPHENSON, 2011), the Brazilian semi-arid region, with its diversified native fauna, could be expected to harbour a coprophilous myxobiota, so far unexplored. The present work, besides contributing to the knowledge about the diversity of microorganisms present in dung of *K rupestris*, a native rodent, is a pioneering study on coprophilous myxomycetes in the Caatinga dominium.

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APPENDIX

Table

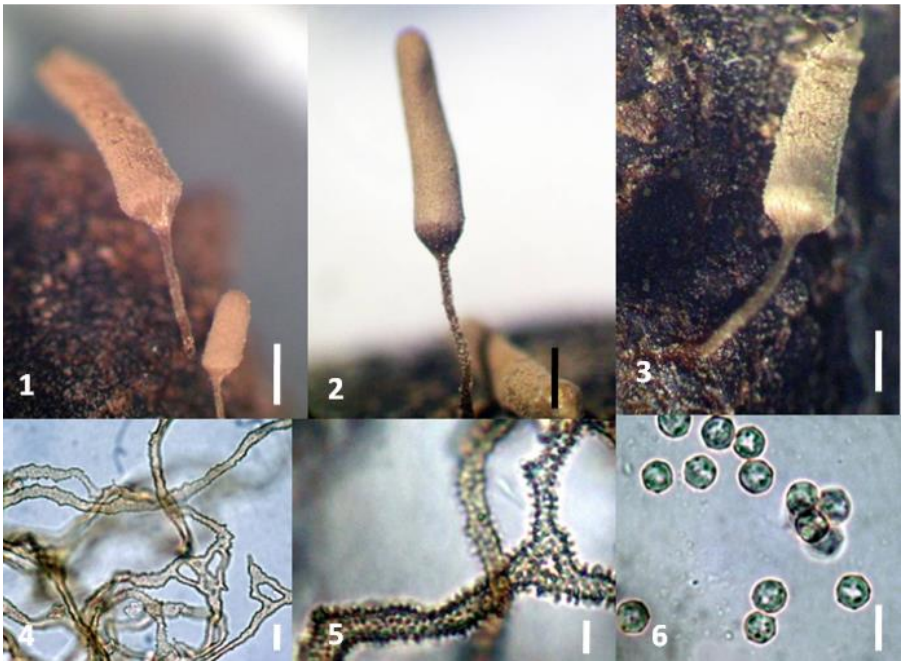
Table 1 - Incidence of *Arcyria cinerea* (Bull.) Pers. on dung of rock cavy (*Kerodon rupestris* Wied - Neuwied, 1820) collected in different phytophysiognomies of the caatinga at the Serra da Capivara National Park (São Raimundo Nonato municipality, Piaui State, Brazil).

Locality	**Season**	**Caatinga (phytophysiognomy)**	**Specimens/sporocarps**
Baixa Grande (Caldeirão da Onça)	Rainy	Low brush	1/4
Boqueirão da Pedra Furada (Toca do arame do Sansão)	Rainy	Dense arboreal	3/30
Boqueirão da Pedra Furada (Sítio do Meio)	Rainy	Dense arboreal	0/0 (phaneroplasmodium)
Jurubeba (Quinta)	Rainy	Low brush	1/6
São João Vermelho (Toca do Veredão)	Dry	Dense medium arboreal brush	1/11
Serra Branca	Dry (onset)	Low dense arboreal brush	1/23
Serra Branca (Toca do Peba)	Dry (end)	Low dense arboreal brush	3/67
Zabelê (Toca da Baixa do Cipó)	Rainy (end)	High brush	14/215

Figures

Figure 1. Fecal units of rock cavy (*Kerodon rupestris* Wied-Neuwied, 1820) with the surface covered by *Arcyria cinerea* (Bull.) Pers. sporangia developed in moist chamber culture.

Figure 2. *Arcyria cinerea* (Bull.) Pers. 1-3: Sporangia developed in moist chamber cultures prepared with feces of rock cavy (*Kerodon rupestris* Wied—Neuwied, 1820) collected in different phytophysiognomies of the caatinga at the Serra da Capivara National Park. Barr= 0,5 mm; 4-5: Capillitium. Barrs= 10 µm µm 6: Spores. Barr= 10 µm.



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