REDESCRIPTION OF *APOLONIA TIGIPIOENSIS* TORRES AND BRAGA, 1938 (TROMBIDIFORMES: LEEUWENHOEKIIDAE)

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ABSTRACT: The genus *Apolonia* is only known from the single species, *Apolonia tigipioensis* Torres et Braga, occurring in Venezuela and northeastern Brazil. The larval stage is primarily a parasite of birds, but they may parasitize mammals, including humans. This species can cause nodular lesions in birds. In the present study, we are redescribing the species *A. tigipioensis* based on the slides deposited at the Acari Collection of the Butantan Institute. Furthermore, we designate a lectotype and paralectotype for this species.

KEY WORDS: Chiggers, ectoparasites, birds, Brazil.

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INTRODUCTION

Apolonia Torres et Braga, 1938 is a monotypic genus represented by the species *Apolonia tigipioensis* Torres et Braga, 1938, which has been reported from Venezuela and northeastern Brazil. This species parasitizes birds, yet it may also parasitize mammals, including humans (Ornelas-Almeida *et al.* 2007). *Apolonia* was first cited parasitizing *Gallus gallus domesticus* (Galliformes: Phasianidae) by Torres and Braga (1938). A year later, this genus and its respective type species, *Apolonia tigipioensis* Torres and Braga, 1938, were formally described (Torres and Braga 1939). Torres and Braga (1938, 1939) and Carneiro (1949, 1952) reported this species as potential pests on poultry farms, causing nodular lesions, which could lead to the death of their hosts.

According to Torres and Braga (1938), the name of the genus was given in honor of the Secretary of Agriculture of the state of Pernambuco, Brazil, Apolônio Jorge de Faria Sales (1904–1982). The name of the species refers to the place where this chigger was collected—the district of Tejipió, in the municipality of Recife, state of Pernambuco (Torres and Braga 1938). This species was recorded three more times parasitizing wild birds in Pernambuco state. Carneiro (1952) recorded *A. tigipioensis* parasitizing *Nothura maculosa cearensis* (Passeriformes: Tinamiformes), as well as biting humans in the municipality of Limoeiro. Ornelas-Almeida

et al. (2007) reported this chigger parasitizing *Struthio camelus* (Struthioniformes: Struthionidae) and *Passer domesticus* (Passeriformes: Passeridae) in the municipality of Petrolina.

The only records of *A. tigipioensis* parasitizing mammals were made in Venezuela by Brennan and Reed (1975). These authors found the above species on *Leptonycteris curasoae* (Chiroptera: Phyllostomidae), *Mus musculus* (Rodentia: Muridae) and *Sylvilagus floridanus* (Lagomorpha: Leporidae).

A description of *A. tigipioensis* was needed because the original description omitted some characters and did not provide sufficient detail for other characters. More specifically, the following items were omitted from the original description: setae between the coxal fields II and III; tarsus of the legs I without a companion seta and ϵ distal to ω . Here, we are redescribing the species *A. tigipioensis* based on the slides deposited on the Acari Collection of the Instituto Butantan (IBSP). Furthermore, we designate a lectotype and paralectotype for this species.

MATERIAL AND METHODS

An examination of the Acari Collection of the Instituto Butantan was carried out, and two specimens of the type series (IBSP 1954) of *Apolonia tigipioensis* were found. The material was recovered according to the technique described by Jaci-

navicius *et al.* (2013), and then it was slide-mounted with Hoyer's medium according to Walter and Krantz (2009). In addition, materials from the Ohio State Acarology Laboratory (OSAL) and the United States National Museum collection (the latter housed at the Systematic Entomology Laboratory—USDA-ARS, BARC) were examined to confirm the identification. The morphological illustrations were made using Leica DFC 500 digital camera attached to an optical microscope Leica DM4000B. Extended focal range images were composed with Leica Application Suite v. 2.5.0. The images were prepared with Adobe Photoshop v. 13.0 and Inkscape v. 2.

For descriptions of the specimens, we relied on the terminology of Goff *et al.* (1982) with adaptations (Stekolnikov 2008, Stekolnikov and Daniel 2012). For the description of specialized and opisthosomal setae, as well as prodorsal sclerite setae, we adopted the nomenclature proposed by Kethley (1990), Wohltmann *et al.* (2006, 2007) and Bassini-Silva *et al.* (2017).

SYSTEMATICS

Family Leeuwenhoekiidae Womersley, 1944 Genus *Apolonia* Torres et Braga, 1938

Apollonia Torres et Braga, 1938: 171; Carneiro 1949: 111 misspelling.

Apolonia Torres et Braga, 1938: 172; 1939: 37; Ewing 1944: 347; Womersley, 1945: 97; Wharton 1947: 381; Wharton *et al.* 1951: 26; Wharton and Fuller 1952: 90; Carneiro 1952: 9; Brennan and Reed 1975: 48; Goff 1983: 5; Brennan and Goff 1977: 556; Goff *et al.* 1989: 486; Kudryashova 1998: 28; Brown 2006: 217; Ornelas-Almeida *et al.* 2007: 375; Jacinavicius *et al.* 2018: 4; Zajkowska *et al.* 2018: 151.

Type species: *Apolonia tigipioensis* Torres et Braga, 1938

Diagnosis. Palptarsus with seven branched setae (plus ω and ζ), odontus trifurcate; prodorsal sclerite with nasus and two *vi* setae; a pair of *se* (=PL) off the prodorsal sclerite; a pair of sternal setae (2a); femur legs I–III each divided into a basifemur and telofemur; each leg terminated with a pair of claws and a clawlike empodium with onychotriches, genu of the legs I each with two σ .

Apolonia tigipioensis Torres et Braga, 1938

Figs. 1–2

Apollonia tegipioensis Torres et Braga, 1938: 171; Carneiro, 1952: 1949: 111 misspelling.

Apolonia tigipioensis Torres et Braga, 1938: 171; 1939: 37; Womersley, 1945: 97; Wharton 1947: 381; Wharton *et al.* 1951: 26; Wharton and Fuller 1952: 90; Carneiro 1952: 9; Brennan and Reed 1975: 48; Goff 1983: 5; Goff *et al.* 1989: 486; Kudryashova 1998: 28; Brown 2006: 217; Ornelas-Almeida *et al.* 2007: 375; Jacinavicius *et al.* 2018; Zajkowska *et al.* 2018: 151.

Diagnosis. All palp setae branched, galeal setae branched; ventral podosoma with setae between the coxal field II and III; tarsus of the legs I with a famulus positioned distal to ω and without companion seta; tarsus of the leg III without mastisetae.

Redescription: Larva (Lectotype and Paralectotype). *Gnathosoma*—palp setal formula B/B/BBB/7B $\zeta\omega$; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate (Figs. 1A–B); galeal setae branched (Fig. 1B).

Idiosoma—eyes 2/2 set in an ocular plate, anterior eye larger; prodorsal sclerite with 1 pair of flagelliform internal scapular setae or trichobothria (*si*), 1 pair of *vi* (=AM), 1 pair of *ve* (=AL) seta and 1 pair of *se* (=PL) off the prodorsal sclerite; *si*>*se*>*ve*>*vi*; half of the *si* with long and slender setules (Fig. 1C); the anterior margin of the prodorsal sclerite undulating with nasus, and the lateral margins slightly concave, posterior margin concave (Fig. 1C). The idiosoma hypertrichous with 127 setae, 38 dorsal opisthosomal setae not arranged in rows; ventral idiosoma with 89 setae, 2 pairs of sternal setae (2a and 3a), 26 setae between the coxal fields II and III, 30 setae located anterior to the anus and 29 setae located posterior to the anus (Figs. 2A–B).

Legs—femur legs I–III each divided into a basifemur and telofemur, each leg terminated with a pair of claws and a clawlike empodium, with onychotriches, coxal fields not striate. Leg I—coxal field with 1 branched seta 1b (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 2 σ , with κ ; tibia 8B, 2 ϕ , with κ ; tarsus 23B, with ω , ε , dorsal eupathid (ζ) without a companion seta (*z*) and terminating with a subterminal eupathid (ζ), famulus (ϵ) distal to ω (Fig. 1D). Leg II—coxal field seta 2b (1B); trochanter 1B; basifemur 2B; telofemur 4B; genu 4B, σ ; tibia 6B, 2 ϕ ; tarsus 16B, with ω , ε , and a subterminal eupathid (ζ), base of ε proximal to ω (Fig. 1E). Leg III—coxal field seta 3b (1B) on anterior margin, trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ ; tibia 6B, ϕ ; tarsus 15B (Fig. 1F).

Fig. 1. Morphological details of *Apolonia tigipioensis*. A—ventral view of palp tarsus; B—dorsal view of gnathosoma; C—prodorsal sclerite; D—Leg I; E—Leg II; F—Leg III. Symbols: ζ—eupathid of palp tarsus; ω—solenidion of palp tarsus; Od—odontus; vi—internal vertical setae; ve—external vertical setae; se—external scapular setae; si—internal scapular setae or trichobothria; σ—solenidia on genu of the legs I, II and III; κ—microsetae on genu and tibia of the legs I and II; φ—solenidia on tibia of the legs I, II and III; ω—solenidion on tarsus of the legs I and II; ε—famulus on tarsus of the legs I and II; ζ—dorsal eupathid on the tarsus of the leg I, subterminal eupathid on tarsus of the legs I and II; 1b—seta of the coxal field of the leg I; 2b—seta of the coxal field of the leg II; 3b—seta of the coxal field of the leg III. Scale bars=50 μm (A–F).

Fig. 2. Morphological details of *Apolonia tigipioensis*. A—dorsal view of idiosoma; B—ventral view of idiosoma. Black spots—ventral setae of the idiosoma; white spots—dorsal setae of the idiosoma. Symbols: 1b—seta of the coxal field of the leg I; 2b—seta of the coxal field of the leg II; 3b—seta of the coxal field of the leg III; 2a—setae between the coxal fields of the leg II; 3a—setae between the coxal fields of the leg III; Scale bars=100 μ m (A and B).

Distribution (Fig 3). *Brazil*—Tejipió, Recife, Pernambuco, 8°05'21.0" S, 34°57'35.6" W (Torres and Braga 1938); Limoeiro, Pernambuco, 7°52'30" S, 35°27'0" W (Carneiro 1949); and Petrolina, Pernambuco, 9°23'34" S, 40°30'28" W (Ornelas-Almeida *et al.* 2007). *Venezuela*—Barbacoas, Aragua, 9°28'56.09" N, 66°58'34.13" W; Coro, Falcón, 11°25'0" N, 69°40'0" W; Capatárida, Falcón, 11°10'27" N, 70°37'0" W; Penin-

sula of Paraguaná, Falcón, 12°0'0" N, 70°0'0" W; Guarico, 8°42'0" N, 66°36'36" W; and Nueva Esparta, 10°57'0" N, 64°0'36" W (Brennan and Reed 1975).

Type material. 1 larva lectotype (IBSP 1954), ex. *Gallus gallus domesticus* (Galliformes: Phasianidae), Brazil: Tejipió, Recife, Pernambuco, May 1937, coll. S. Torres and W. Braga. 1 larva paralectotype (IBSP 1954), same data.

Fig. 3. Geographical distribution of *Apolonia tigipioensis* Torres et Braga, 1938. The red spots are the literature records.

Non-type material. OSAL: 16 larvae, Recife, Pernambuco, Brazil, *G. g. domesticus* (Galliformes: Phasianidae), V-1940, Sylvio Torres coll.; 2 larvae (RML 52788—OSAL), Coro city, Falcón state, Venezuela, 15.VI.1968, *Sylvilagus floridanus* (Lagomorpha: Leporidae), Smithsonian army coll. USDA-ARS, BARC: 16 larvae (RML 52833), Barbacoas city, Aragua state, Venezuela, 2-III-1966, *Sylvilagus floridanus* (Lagomorpha: Leporidae), Smithsonian army coll.; 19 larvae (RML 52788), Coro city, Falcón state, Venezuela, 15-VII-1968, same host; 10 larvae (RML 53291), same locality and host, 11.VII.1968; 12 larvae (RML 53292), same data; 10 larvae (RML 53293), same

data; 10 larvae (RML 53294), same locality and host, 17.VII.1968; 10 larvae (RML 53295), Falcón, Venezuela, 13-VII-1968, same host; 10 larvae (RML 53296), same data; 5 larvae (RML 53494), same locality and host, 17.VII.1968; 5 larvae (RML 53304), same data; 5 larvae (RML 53298), same locality and host, 15.VII.1968; 9 larvae (RML 53299), same data; 10 larvae (RML 53300), same data; 5 larvae (RML 53301), same data; 10 larvae (RML 53302), same data; 5 larvae (RML 53358), same date; 8 larvae (RML 53359), same locality and host, 16.VII.1968; 10 larvae (RML 53303), same data; 1 larva (RML 53297), same locality, 15.VII.1968, *Oryzomys* sp.; 3 larvae (RML 53574),

Capatárida city, Falcón state, Venezuela, 20. VI.1968, *Sylvilagus brasiliensis* (Lagomorpha: Leporidae); 2 larvae (RML 53575), same date; 3 larvae (RML 53576), same locality and host, 1. VII.1968; 9 larvae (RML 53577), same data; 4 larvae (RML 53578), Falcón, Venezuela, same data and host; 4 larvae (RML 52503), Nueva Esparta state, Venezuela, 30.I.1967, same host.

DISCUSSION

The original description did not establish a holotype for *A. tigipioensis* and, according to the recommendation of the ICZN (1999, Articles 72.1 and 74), “all the specimens of the type series are automatically syntypes if neither a holotype nor lectotype has been fixed”. In this way, the specimens that were deposited in the Acari Collection of the Butantan Institute are syntypes. Nevertheless, we are assigning a lectotype and paralectotype for this species. Besides that, the redescription of *A. tigipioensis* by Vercammen-Grandjean and Kolebonova (1968) only declared presence of the holotype in the United States National Museum collection. However, this slide, cited by the authors, was not listed in the list of primary or secondary types by Goff (1989), nor was it physically present in the United States National Museum collection.

The genus *Apolonia* is unique due to the combination of the following characters: palptarsus with seven branched setae (plus ω and ζ); prodorsal sclerite with nasus and two *vi* setae; a pair of *se* off the prodorsal sclerite; genu legs I each with two σ . *Apolonia* is similar to *Womersia* Wharton, 1947 in having the prodorsal sclerite with nasus and the *se* off the prodorsal sclerite. However, *Womersia* differs in having each genu leg I with only one σ (vs. two σ); palptarsus with five branched setae without ζ (vs. seven branched setae with ζ); and one *vi* setae (vs. two *vi* setae).

Apolonia is closer to *Vargatula* Brennan et Yunker, 1966, *Straelensia* Vercammen-Grandjean et Kolebinova, 1968 and *Afropolonia* Goff, 1983 in the following: ζ on the palptarsus, all palptibia setae branched, odontus trifurcate and *se* off the prodorsal sclerite. However, they differ from *Apolonia* in having only one (vs. two) σ on genu of legs I.

The genera *Straelensia* and *Afropolonia* do not have onychotriches or a dorsal eupathid on tarsus leg I (*Apolonia* have both of these structures). In addition, in genera *Straelensia* and *Vargatula*, the palptarsus has five branched setae without the ζ (in

Apolonia, the palptarsus has seven branched setae with ζ).

The redescription of *A. tigipioensis* by Vercammen-Grandjean and Kolebinova (1968), equivocately reported nude lateral setae on the palptibia and branched companion setae on the tarsus of leg I. Our examination of the types and other materials revealed the lateral setae of the palptibia to be branched and the branched companion setae are only normal setae on the tarsus of the leg I.

Unfortunately, no material of *A. tigipioensis* was available for molecular preparations. However, future samples from the type locality will be used to acquire molecular sequences.

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