



## ANIMAL SCIENCE

# First record of *Brachymeria amenocles* (Hymenoptera: Chalcididae) associated with larvae of *Peckia (Peckia) chrysostoma* (Diptera: Sarcophagidae) in Brazil

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**Abstract:** In this work, we report for the first time the occurrence of the parasitoid wasp *Brachymeria amenocles* (Walker, 1846) (Hymenoptera: Chalcididae) associated with the larvae of the flesh fly, *Peckia (Peckia) chrysostoma* (Wiedemann, 1830) (Diptera: Sarcophagidae), in Brazil. This parasitoid species was collected together with the species *Brachymeria podagrica* (Fabricius, 1787), in the municipality of Rio de Janeiro, geographically located in the Southeast region of Brazil, in larvae of the same host species reared in the same attraction substrate, behaving as solitary parasitoids. A trap containing putrefying sardine was exposed for 48 h, in the upper part of a house, located in Vila Isabel, an urban area. The larvae collected were reared in the laboratory without control of environmental conditions. A total of three adult parasitoid wasps of the species *B. podagrica*, and nine adult parasitoid wasps of the species *B. amenocles* emerged from 12 host pupae, resulting in a prevalence of parasitoidism of 4.8% and 14.5%, respectively. Developing parasitoids at the pupal phase were observed in another 34 host pupae dissected.

**Key words:** flesh flies, natural enemy, Neotropical fauna, parasitoid wasp, urban entomology.

## INTRODUCTION

The Chalcididae family is currently organized into eight subfamilies (Brachymeriinae, Phasgonophorinae, Chalcidinae, Cratocentrinae, Dirhininae, Epitraninae, Haltichellinae and Smicromorphinae), and nine tribes (Phasgonophorini, Stypiurini, Chalcidini, Belaspidiini, Haltichellini, Hybothoracini, Notaspidiini, Tropimeridini and Zavoyini), which includes 94 genera and more than 1500 parasitoid species known worldwide (Cruaud et al. 2021). Although widely distributed, the greatest diversity of species observed in tropical regions (Noyes 2019).

Wasps of the family Chalcididae play a key functional role in ecosystems because they 85 are natural regulators of other insect populations (Godfray 1994, Cruaud et al. 2021). *Brachymeria* Westwood, 1829 one of the genera with the greatest diversity of species of Chalcididae (Trjapitzin & Tselikh 2019), including currently about 350 described species, found in all zoogeographic regions (Noyes 2019, Khaliq et al. 2016), with 37 species known for the Neotropical Region (Delvare & Huchet 2017). Species in the genus are primary parasitoids of many insect families, including Sarcophagidae (Noyes 2019).

The family Sarcophagidae is currently classified into three subfamilies:

Paramacronychiinae, Miltogramminae and Sarcophaginae (Brown et al. 2009, Pape et al. 2011), where 173 genera are distributed, which include more than 3000 species known worldwide (Pape 1996, Pape et al. 2011). Of this total, about 800 species are described for the Neotropical Region (Brown et al. 2009, Pape et al. 2011).

The genus *Peckia* Robineau-Desvoidy, 1830 contains 72 species described in the world, most of which are known from the Neotropical Region (Pape 1996, Buenaventura & Pape 2013). Species of the genus are commonly found inside or close to households located in urban environments, attracted by domestic waste, or, in households located in rural environments, attracted by feces produced by farm animals, highlighting the sanitary importance of the species as they become potential vectors of bacteria, viruses, protozoa and helminth eggs (Couri et al. 2000), or even, composing the entomofauna associated with decomposition of carcasses (Linhares 1981, D'Almeida 1989, Carvalho et al. 2000, Barros et al. 2008), becoming an important tool in estimating the minimum post-mortem interval ( $t_{min}$  IPM) by the entomological method (Oliveira-Costa 2007).

Although the habits and lifestyle of the species are generally well discussed, reports on the interaction of species of the genus *Peckia* with their natural enemies for Brazil and the Neotropical region are still incipient. Therefore, flesh flies were attracted and stimulated to larviposition in a household located in an urban area, in the municipality of Rio de Janeiro, Southeast region of Brazil, with the intention of evaluating the presence of parasitoid species, behaving as natural enemies.

## MATERIALS AND METHODS

### Exposure of attraction traps

A 2.5 L trap made of Polyethylene Terephthalate (PET) was installed on the terrace of a house located in the neighborhood of Vila Isabel, north zone of Rio de Janeiro municipality, 22°54'40.2"S 43°14'23.1"W (DDM), positioned 1.5 m from the ground. At the base of the trap, 150 g of putrefying sardine with an attractive substrate were introduced.

After 48 hours of exposure, the colonized substrate were removed from the site and taken to the Laboratório de Estudo de Dípteros (LED), located at the Universidade Federal do Estado do Rio de Janeiro (UNIRIO).

### Experimental phase

The larvae were transferred individually from the attraction substrate, with the aid of anatomical tweezers, to 500 mL Polyethylene (PP) container (9.5 cm x 7 cm x 7.5 cm), containing 200 g of chicken gizzard, used as rearing diet and introduced into 2 L container (PP) (12 cm x 13.4 cm x 18 cm), placed on 1.0 cm of sterilized wood shavings, to enable the pupariation of the larvae after abandoning the diet.

The larger container was sealed with a chiffon cloth and secured with an elastic band. The set was kept in wood fume hood an exhaust described by Carneiro et al. (2020), without control of environmental conditions, with observation every 24 h. After formation, the pupae were removed from the rearing container and transferred to a smaller container (9.5 cm x 7 cm x 7.5 cm) containing sterilized wood shavings, stored inside a rearing cage.

After the emergence of the parasitoids, 48 pupae were kept under refrigeration at -18°C for 24 hours. Removed from refrigeration, the pupae were dissected with the aid of a hypodermic needle (25 × 0.7 mm (22G × 1") and 0.36 × 0.13

mm (28G ½)) to investigate the stage at which pupal development was arrested, and record a possible immature development of parasitoids.

The identification of the Sarcophagidae host was performed under a stereomicroscope Olympus SZ51, following the taxonomic key of Buenaventura & Pape (2013). The identification of the species of genus *Brachymeria* was carried out by PhD. Marcelo Teixeira Tavares, from the Universidade Federal do Espírito Santo (UFES), and the vouchers were deposited at the UFES Entomological Collection (CEUFES) (at Vitoria campus).

The image of the insect were obtained using a Canon EOS Rebel T6 camera, attached to a Digilab DI-152T stereoscopic microscope, and edited in Adobe Photoshop CC 2014® software.

The prevalence of parasitoidism of the adults was calculated following the formula:

$$P = \left( \frac{\text{no. pupae with emerged parasitoids}}{\text{no. pupae collected}} \right) \times 100.$$

## RESULTS AND DISCUSSION

During winter, between August 9th and September 23rd, 2019, we obtained a total of 62 pupae of *Peckia* (*Peckia*) *chrysostoma* (Wiedemann, 1830), from which they emerged after 16 days of total development, time between the first instar larvae to the adult, a total of two adult flies, one male and one female.

After 25 days, nine adult females of *Brachymeria amenocles* (Walker, 1846) (Figure 1) and three adult females of *Brachymeria podagrica* (Fabricius, 1787) emerged from the host pupae, representing, respectively, a prevalence of parasitoidism of 4.8% and 14.5%. We observed different phases of parasitoid development in 34 puparium and the presence of flies with paralyzed development in the



**Figure 1.** *Brachymeria amenocles* (Walker), ♀. Habitus in lateral view.

pharate adult and imago phases in 14 pupae, which were frozen.

This is the first mention of the *B. amenocles* for a country in the Neotropical Region, and there are still few reports of this parasitoid species in the world. The taxonomy of the species was well discussed by Delvare & Huchet (2017), but information about its distribution and hosts is still scarce. The species previously synonymized as *B. podagrica* by Bouček (1952), which was revalidated by Delvare & Huchet (2017). Therefore, it is possible that in some cases, the biology and distribution of the species has been attributed to *B. podagrica*. According to material analyzed by these authors, the species was found in Namibia and Zimbabwe, having as hosts larvae of *Sarcophaga inzi* Curran, 1834 and *Glossina morsitans* Westwood, 1851. But according to the Universal Database of Chalcidoidea (Noyes 2019), the distribution of the species includes three other African countries: Somalia (Masi 1929), Ghana (Thompson 1955), and South Africa (Walker 1871), featuring a restricted distribution to the Afrotropical region.

*B. podagrica* is a cosmopolitan species, recorded in countries located in temperate and tropical regions of the world (Tavares & Araujo 2007, Delvare & Huchet 2017). The species

attacks the host in the larval stage, generally in the third instar of development, when the larvae are more developed, but they can also attack pupae (Delvare 2017). They are classified as endoparasitoids with a coinobiont lifestyle, that is, the paralysis of the host is temporary, it occurs only for the adult female to introduce the egg inside the host larva or pupa, where it will develop as a solitary individual (Vinson & Iwantsch 1980, Wahl & Sharkey 1993). In the Neotropical Region, the species occurs in Argentina, Brazil, Colombia, Cuba, Haiti, Jamaica, Mexico, Peru and Venezuela (Tavares & Araujo 2007, Delvare & Huchet 2017, Ramírez-Mora & Durango-Manrique 2021).

In Brazil, the records of the occurrence of *B. podagrica* as a parasitoid of *P. (P.) chrysostoma* pupae are limited to the states of Goiás, Central-West region, where the Cerrado biome predominates, and Minas Gerais, Southeast region, inserted in the biome Atlantic forest.

In the municipality of Caldas Novas, Goiás, Marchiori et al. (2005) collected *B. podagrica* in pupa created in human feces. In the municipality of Itumbiara, Goiás, Marchiori et al. (2003a) collected *B. podagrica* in pupae of *P. (P.) chrysostoma* reared in human feces and chicken viscera. Marchiori et al. (2006) collected the parasitoid specie associated with the same host, in bovine liver in the same locality, in this substrate, the authors obtained the highest prevalence of parasitoidism (20.3%) compared to studies that reported this parasitoid-host association, obtaining a total of 69 individuals in 340 pupae over 7 months of collections. In the municipality of Lavras, Minas Gerais, Bonani et al. (2006) collected *B. podagrica* in pupae of *P. (P.) chrysostoma* raised in bovine kidney.

Regarding the presence of *B. podagrica* in localities located in the state of Rio de Janeiro, Southeast region, according to CEUFES records compiled in the speciesLink database ([https://](https://specieslink.net/search/)

[specieslink.net/search/](https://specieslink.net/search/)), the species was collected in pupae of Sarcophagidae, in an undetermined species, in the municipality of Vassouras, and in the municipality of Rio de Janeiro, in the district of Deodoro, in an undetermined host.

As for the presence of the species in other Brazilian states within the Atlantic Forest biome, according to CEUFES records in the same database, *B. podagrica* was collected in two states in the Southeast region, in Espírito Santo, in the municipalities of Santa Teresa and Vitória, and in São Paulo, in the municipality of São Carlos, without reports of hosts, and has only one record for the Northeast region, in the municipality of Una, state of Bahia, also without reports of hosts.

On the association of *B. podagrica* with other species of Sarcophagidae, Silva et al. (2012) reported *Peckia (Sarcodexia) lambens* (Wiedemann, 1830) [= *Sarcodexia lambens* (Wiedemann, 1830) n. comb. according to Buenaventura & Pape (2013)], and *Oxysarcodexia thornax* (Walker 1849), as host species, in a study carried out in the municipality of Chapadinha, state of Maranhão, northern Brazil, Cerrado biome.

Pupae of *O. thornax* have also been reported as hosts of *B. podagrica* in Goiás state, municipalities of Caldas Novas and Itumbiara, and of *P. (Sarcodexia) lambens*, in Minas Gerais state, municipality of Tupaciguara (Marchiori et al. 2003a, 2005, 2006, 2007, Silva et al. 2012).

*B. podagrica* has also been reported in Brazil in association with pupae of other dipteran species of sanitary and forensic importance, *Chrysomya albiceps* (Wiedemann, 1819), *Chrysomya megacephala* (Fabricius, 1794) and *Hemilucilia flavifacies* Enderlein, 1931 (Diptera: Calliphoridae) (Marchiori et al. 2002, 2003a, 2006), and *Ophyra aenescens* (2003b) and *Philornis* sp. (Diptera: Muscidae) (Couri et al. 2006).

Therefore, we included Brazil and the Neotropical region in the distribution of *B. amenocles* and reported for the first time its association with the host *P. (P.) chrysostoma*. Furthermore, we extended the occurrence of *B. podagrica* as a parasitoid of *P. (P.) chrysostoma* to the municipality of Rio de Janeiro, updating the distribution of this parasitoid species to the Southeast region of Brazil.

We believe that studies related to the interaction between natural enemies and host flies of sanitary and medical importance, commonly found in rural and urban environments, enrich the knowledge of urban entomology, increasingly impacted by urbanization, which in most Brazilian locations occurs without planning, and contribute to understanding how the natural control of immature stages of host populations is established in the urban environment, without the intervention of insecticides, a usual option in this scenario, with the objective of enabling biological control strategies also in urban environments.

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M.S.S. collected, created, photographed the species, and wrote the manuscript. J.M.A. mentor of the experimental phase. M.S.G, V.M.A. and D.F. discussed the results and contributed to its final version.

