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Article

Fruits as Food Resource for Social Wasps (Vespidae: Polistinae) in Brazil

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ABSTRACT
Social wasps exhibit a diversified diet, primarily composed of protein sources and plant-derived sugar-rich substances. In this study, we document new records of fruit consumption by these insects and conduct a survey of this feeding behavior within Brazilian territory. Records were obtained between 2023 and 2026 in both natural and anthropized environments in the states of Minas Gerais and Paraná, Brazil. The literature review was conducted between May and July 2025 using scientific manuscript search platforms. Our study reports 22 novel records of social wasps consuming fruit pulp, including the first record of this behavior for *Agelaia centralis* and *Mischocyttarus flavoscutellatus*. Based on bibliographic review and occasional records, we identified 37 species of social wasps feeding on fruit pulp from 29 plant species across 15 botanical families in different Brazilian biomes. Nevertheless, the number of wasp species recorded represents only about 10% of the species richness known for Brazil, although it is likely that the majority exploit this resource. Therefore, further studies are required to investigate this feeding behavior in both natural and altered environments, in order to better understand its ecological and agricultural implications.
Keywords: Diet; frugivory; behavioral ecology; insect–plant interactions.

RESUMO
As vespas sociais apresentam dieta diversificada, composta principalmente por fontes de proteínas e substâncias ricas em açúcares de origem vegetal. Neste estudo, documentamos novos registros de consumo de polpa de frutos por esses insetos e realizamos um levantamento desse comportamento alimentar em território brasileiro. Os registros foram obtidos entre 2023 e 2026, em ambientes naturais e antropizados, nos estados de Minas Gerais e Paraná, Brasil. A revisão da literatura foi conduzida entre maio e julho de 2025, utilizando plataformas de busca de manuscritos científicos. Nosso estudo relata 22 novos registros de vespas sociais consumindo polpa de frutos, incluindo o primeiro registro desse comportamento para *Agelaia centralis* e *Mischocyttarus flavoscutellatus*. Com base na revisão bibliográfica e nos registros ocasionais, identificamos 37 espécies de vespas sociais alimentando-se de polpa de frutos de 29 espécies vegetais pertencentes a 15 famílias botânicas, em diferentes biomas brasileiros. No entanto, o número de espécies de vespas registradas representa apenas cerca de 10% da riqueza de espécies conhecida para o Brasil, embora seja provável que a maioria desses insetos explore esse recurso. Portanto, são necessários estudos adicionais para investigar esse comportamento alimentar em ambientes naturais e alterados, a fim de compreender melhor suas implicações ecológicas e agrícolas.
Palavras-chave: Dieta; frugivoria; ecologia comportamental; interações inseto-planta.

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Introduction

Social wasps (Vespidae: Polistinae) have a diversified diet, consisting primarily of proteins - e.g., various invertebrates (Picanço et al. 2010; Prezoto et al. 2019; Oliveira et al. 2024), some vertebrates (Frankhuizen et al. 2020), and carrion (Somavilla et al. 2019). It also includes products high in sugar such, either of animal origin, such as honeydew (Oliveira et al. 2025a), or of plant origin, such as floral nectar (Brock et al. 2021), extrafloral nectar (Oliveira et al. 2023), and fruit pulp, from either native (Renne et al. 2024), or exotic species (Aragão & Brito 2025).

These insects likely locate fruits through orientation guided by rewarding stimuli resulting from successful behavioral experiences (Papaj 1993). The initial contact with food is likely mediated by nonspecific searching behavior that involves the detection of food-related odors. From this point onward, an associative learning process is established: upon encountering a suitable food source, the insects begin to respond to the stimuli linked to that reward (Elmquist & Landolt 2018). This robust form of short-term learning is commonly associated with sugar rewards and may involve the perception of colors (Shafir 1996; Lozada & D'Adamo 2009; Balamurali et al. 2021), shapes and olfactory cues (Elmquist & Landolt 2018; Balamurali et al. 2021).

Owing to their diversified feeding behavior, these social insects provide important ecosystem services such as pollination, biological control (Brock et al. 2021), and seed dispersal (Watanabe-Toma & Ohi-Toma 2024). They also inhabit a wide range of environments and biomes in Brazil, from agricultural and urban areas (Prezoto et al. 2019; Medeiros et al. 2019) to priority biomes for conservation, such as the Cerrado and the Atlantic Forest (Jacques et al. 2024), making them crucial organisms for ecosystem functioning.

Therefore, understanding how these insects exploit available resources across different environments is essential to identify the factors influencing their distribution, ecological success (Brown et al. 2014), and, in some cases, their invasive potential (Beggs 2001; Cranshaw et al. 2011), particularly in ecosystems with high plant diversity that can serve as food resources. Such knowledge may contribute to the development of management and control strategies for species that cause negative agricultural or ecological impacts (Beggs 2001; Elmquist & Landolt 2018).

In this context, the aim of this study was to document new records of fruit consumption in the diet of social wasps and to provide a comprehensive overview of this feeding behavior in Brazilian territory.

Materials and Methods

Records were obtained between 2023 and 2026 in both natural and anthropized environments (agricultural and urban ecosystems) across different regions of the state of Minas Gerais and in the municipality of Santa Helena, western Paraná, Brazil. It is important to highlight that the new records presented here were obtained opportunistically, therefore, future studies with specific methodological procedures are suggested to gather more robust data on fruit consumption by social wasps.

In addition, a literature review was conducted between May and July 2025 to search for information, analyzing manuscripts related to social wasps available online, using keywords combined with Boolean operators such as "Polistinae AND fruits," "Vespidae AND fruits," "Vespidae AND feeding behavior," and "Vespidae AND diet." The search was performed in both Portuguese and English, across the following platforms: Google Scholar, Periódicos Capes, ResearchGate, SciELO, and Scopus. To standardize the dataset, only wasps identified at the species level were considered in the bibliographic survey. The identified studies were read in full; only articles and books discussing native or exotic fruits consumed by social wasps in Brazil were used, while abstracts from scientific events, theses, and undergraduate capstone projects were excluded. In this procedure, 18 studies were found, and 14 were considered as data sources.

The collected species were identified using dichotomous keys (Richards 1978; Andena et al. 2009; Brito et al. 2024), by Professor Dr. Marcos Magalhães de Souza and subsequently incorporated into the Biological Collection of Social Wasps (Coleção Biológica de Vespas Sociais - CBVS) of the Federal Institute of Education, Science and Technology of Southern Minas Gerais, Inconfidentes campus.

Results

Through the literature review conducted in search platforms and the opportunistic records, 38 species of social wasps distributed across nine genera were documented utilizing fruits from 29 angiosperm species (13 native and 16 exotic) belonging to 15 different families as a food resource in the Amazon, Caatinga, Cerrado, and Atlantic Forest biomes. Among native species, the families with the highest number of fruits consumed were Cactaceae (six) and Myrtaceae (five) (Supplementary Material - S1).

Within these records, the present study reported 22 interactions, 20 of which represent novel records of pulp consumption from fruits (west indian cherry, mulberry, banana, persimmon, sugar apple, java plum, papaya, tangerine, white flesh dragon fruit, pomegranate, and uvaia) by social wasps (Table 1).

Table 1. Records of new interactions involving the consumption of fruit pulp by social wasps in the states of Minas Gerais and Paraná, southeastern and southern Brazil.

Species	Fruit	Family	Locality	Biome
Agelaia centralis (Cameron, 1907)	Jaboticaba *Plinia cauliflora* (Mart.) Kausel	Myrtaceae	Capelinha, MG	Cerrado/Atlantic Forest
Mischocyttarus flavoscutellatus Zikán, 1935	West indian cherry *Malpighia emarginata* (Sessé & Moc.) DC	Malpighiaceae	Capelinha, MG	Cerrado/Atlantic Forest
Mischocyttarus cf. *bahiaensis* Zikán, 1949	Banana *Musa* sp.	Musaceae	Ritápolis, MG	Cerrado/Atlantic Forest
Polistes ferreri Saussure, 1853	Persimmon *Diospyrus kaki* L	Anacardiaceae	Inconfidentes, MG	Atlantic Forest
	White flesh Dragon fruit *Hylocereus undatus* (Haw.) Britton & Rose	Myrtaceae	Inconfidentes, MG	Atlantic Forest
Polistes versicolor (Olivier, 1791)	Banana *Musa* sp.	Musaceae	Ritápolis, MG	Cerrado/Atlantic Forest
Polybia dimidiata (Olivier, 1791)	Tangerine *Citrus reticulata* Blanco	Rutaceae	Capelinha, MG	Cerrado/Atlantic Forest
	Papaya *Carica papaya* L. Jaboticaba *P. cauliflora*	Caricaceae Myrtaceae	Capelinha, MG Capelinha, MG	Cerrado/Atlantic Forest
	Banana *Musa* sp.	Musaceae	Capelinha, MG	Cerrado/Atlantic Forest
Polybia ignobilis (Haliday, 1836)	Banana *Musa* sp	Musaceae	Ritápolis, MG	Cerrado/Atlantic Forest
Polybia platycephala Richards, 1978	Banana *Musa* sp.	Musaceae	Ritápolis, MG	Cerrado/Atlantic Forest
Polybia sericea (Olivier, 1791)	Banana *Musa* sp.	Musaceae	Ritápolis, MG	Cerrado/Atlantic Forest
Synoeca cyanea (Fabricius, 1775)	Persimmon *Diospyrus kaki* L.	Ebenaceae	Inconfidentes, MG	Atlantic Forest
	Uvaia *Eugenia pyriformis* Camb.	Myrtaceae	Inconfidentes, MG	Atlantic Forest
	Pomegranate *Punica granatum* L.	Punicaceae	Inconfidentes, MG	Atlantic Forest
	Sugar apple *Annona squamosa* L.	Annonaceae	Inconfidentes, MG	Atlantic Forest
	Surinam cherry *Eugenia uniflora* L.	Myrtaceae	Inconfidentes, MG	Atlantic Forest

	Mulberry *Morus nigra* L.	Moraceae	Inconfidentes, MG	Atlantic Forest
	Java plum *Syzygium cumini* L.	Myrtaceae	Santa Helena, PR	Atlantic Forest
Synoeca surinama (Linnaeus, 1767)	West indian cherry *M. emarginata*	Malpighiaceae	Capelinha, MG	Cerrado/Atlantic Forest
	Tangerine *C. reticulata*	Rutaceae	Capelinha, MG	Cerrado/Atlantic Forest

Source: Prepared by the authors (2026).

The most representative genus of social wasps in fruit consumption was *Polybia*, with 74 records, accounting for nearly half of all records (~46%).

Among the species, *Synoeca cyanea* (Fabricius, 1775) was the most notable, with 17 records, corresponding to 10.69% of the total records and 68% of the records within the genus, seven of which represent novel wasp–fruit interaction records.

Twelve species were recorded only once, with particular emphasis on *Mischocyttarus flavoscutellatus* Zikán, 1935, for which this study reports the first record of fruit pulp (west indian cherry) being used as a food resource (Fig. 1B) and *Agelaia centralis* (Cameron, 1907) recorded consuming jaboticaba fruit.



Fig. 1. Some new records of fruit pulp consumption by social wasps. *Mischocyttarus* cf. *bahiaensis*, banana (a); *Mischocyttarus flavoscutellatus*, west indian cherry (b); *Polistes ferreri*, persimmon (c) and white flesh dragon fruit (d); *P. versicolor*, banana (e); *Polybia dimidiata*, tangerine (f) and papaya (g); *P. ignobilis*, banana (h); *P. platycephala*, banana (i); *P. sericea*, banana (j); *Synoeca cyanea, persimmon (k)* and java plum (l). Source: Prepared by the authors (2026).

Discussion

The presence of fruits in the diet of different species of social wasps may be explained by the fact that adults feed primarily on carbohydrate-rich foods, whereas proteins are directed to the larvae (Spradbery 1973). Furthermore, the predictability of a highly energetic and easily accessible food resource, such as cultivated fruits, may account for the diversity of vespids exploiting these resources in different regions and biomes of Brazil,

the world's third largest fruit producer (Ministério da Agricultura e Pecuária MAPA 2024; Silva et al. 2025). In altered environments, such as urban areas, the consumption of this carbohydrate source may serve as an alternative nutritional resource when food availability is limited in the natural habitats of these wasps (Souza et al. 2010; Brugger et al. 2011).

The high number of Cactaceae fruits consumed by social wasps results from a single study conducted in the Caatinga biome (Santos et al. 2007), which harbors the greatest number of species of this family in Brazil and represents the third largest center of Cactaceae diversity worldwide (Zappi & Taylor 2020). As this biome remains poorly studied in terms of the ecology and behavior of social wasps (Santos et al. 2006, 2007; Moura et al. 2022), the number of plant species used as food by these insects is likely underestimated.

A similar condition is expected for Myrtaceae, one of the largest families in terms of species richness in Brazil, comprising approximately 1,000 species distributed across 23 genera (Forzza et al. 2010). Many species of this family are exploited economically, either on a commercial scale or in urban orchards (Campos Filho & Sartorlli 2015). In this context, they may represent an important alternative nutritional source for social wasps in altered environments with limited resources, as observed in some studies conducted in urban areas (Souza et al. 2013; Renne et al. 2024; Oliveira et al. 2025b).

The economic implications of this consumption remain uncertain. For example, Renne et al. (2024) observed that fruit consumption by social wasps occurred when fruits were already ripe and thus lacked commercial value in natura. On the other hand, other studies have shown that some vespid species may damage and/or destroy fruits at the commercialization stage in natura (Hickel & Schuck 1995; Oliveira et al. 2019; Elisei et al. 2021; Rocha et al. 2023; Oliveira et al. 2025c), or even intimidate farmers (Elisei et al. 2021), which may negatively affect commercial fruit production. However, few studies have quantified production losses in commercial fruits due to attacks by social wasps (Rocha et al. 2023). Therefore, further studies are needed to quantify such losses in Brazilian fruit production and to determine whether they warrant the implementation of population control management strategies (Picanço et al. 2024).

A study conducted in the United States reported that the invasive social wasp *Polistes dominula* (Christ 1791) can cause yield losses of up to 75%, even leading some producers to abandon cherry cultivation (Cranshaw et al. 2011). In this context, understanding the behavioral ecology of social wasps during foraging—particularly in the identification and consumption of food is important, as it contributes to clarifying how these insects exploit new food resources and establish themselves in novel habitats (Brown et al. 2014). Moreover, such knowledge may support the development of management and control strategies for species with the potential to become agricultural pests (Elmquist & Landolt 2018), or to generate negative ecological impacts (Beggs 2001).

It is important to note that these insects also provide a variety of ecosystem services, e.g., biological pest control and pollination (Brock et al. 2021). Therefore, the benefits of social wasps in agricultural systems may outweigh the potential damage caused to fruits. For this reason, simple deterrence of these insects at specific stages of fruit ripening is recommended, in order to avoid colony destruction while ensuring the maintenance of the ecosystem services provided by vespids (Rocha et al. 2023; Oliveira et al. 2025b).

The genus *Polybia* comprises species with opportunistic and generalist feeding habits (Prezoto et al. 2005; Brügger et al. 2019). It is the second most species-rich genus in Brazil (Somavilla et al. 2021), with some species being synanthropic and frequently found in agricultural ecosystems (Oliveira et al. 2017; Medeiros et al. 2019; Palandi et al. 2025), which may account for the higher number of records of fruit pulp consumption.

Synoeca cyanea occurs across 12 states in all five Brazilian regions (Somavilla et al. 2021), and has the ability to break through the skin of certain fruits (Hickel & Schuck 1995; Souza et al. 2010; Rocha et al. 2023; Oliveira et al. 2025b). This ability may facilitate pulp consumption by other social wasp species that lack this capacity (Oliveira et al. 2025b), which could explain the observed data. Furthermore, this species has also been reported to cause floral damage in fruit-bearing species of commercial interest (Oliveira et al. 2025c). Conversely, it also forages on fruits for the predation of larvae, such as fig fly larvae, which are recognized as causing commercial losses (Prezoto & Braga 2013). Thus, *S. cyanea* warrants further investigation to evaluate whether its role in fruit crops results in net damage or potential benefits.

The present study provides preliminary information on the diet of *M. flavoscutellatus*, and expands its known geographic range to the Cerrado, as this species had previously been reported only in the Atlantic Forest, in the states of Minas Gerais, Rio de Janeiro, and São Paulo (Richards 1978; Souza et al. 2020; Somavilla et al. 2021). Additionally, we provide the first evidence of fruit pulp consumption by *A. centralis*. This species has a broad geographic distribution in Brazil (Richards 1978); however, its feeding biology remains poorly known, although its diet apparently consists mainly of different types of prey (Poveda-Marroquin et al. 2026).

In summary, considering the generalist behavioral traits of social wasps and their dietary dependence on carbohydrate-rich resources, it is plausible that most of the 386 species occurring in Brazil (Somavilla et al.

2021) consume fruits, both native and exotic. Consequently, this interaction is likely underestimated, as all available records account for only about 10% of the vespid species present in Brazilian territory. Therefore, further investigation is warranted, both in altered environments such as urban areas and crop systems, as well as in natural habitats. Given the relevance of the topic, studies are needed to examine the effect of seasonality on fruit consumption behavior in social wasps, as abiotic variations can influence these insect populations (Brito & Zanella, 2022) and food resource availability, thereby affecting the feeding behavior of vespids, including to assess whether there is economic damage to the fruits of the agricultural species listed here as food resources for social wasps.

Conclusion

The present study reports 22 novel records of fruit consumption, both native and exotic, in Brazil by social wasps, including the first account of this behavior for *A. centralis* and *M. flavoscutellatus*. The number of wasp species recorded represents only about 10% of the known species richness in Brazil, yet it is likely that most species exploit this resource. Given the relevance of the topic, we suggest conducting further studies to better evaluation the economic damage caused to these fruits by social wasps.

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