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EDITORIAL

## Edible ants: exploring species and their utilisation

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### Abstract

Various ant species and their products serve as food sources across different regions of the world. Notable examples include *Carebara* spp. from Africa, *Atta* spp. and *Liometopum* sp. from Latin America, *Formica rufa* from Europe, and *Oecophylla* spp. from Asia. In addition to being consumed directly, ants are used as flavouring agents and incorporated into a variety of culinary recipes. Humans also harvest cereals and honey gathered by ants.

### Keywords

*Atta* spp. – *Carebara* spp. – *Formica rufa* – *Oecophylla* spp. – recipes – seasoning

### 1 Introduction

Ants are eusocial insects belonging to the family Formicidae within the order Hymenoptera. They live in colonies with a queen and consist of different castes: workers and soldiers and drones (males). According to GBIF (2024) there are 15,376 species recognised worldwide. During specific periods winged queens and winged males (alates) have their nuptial flight. Various ant species are utilised for food, medicinal purposes or as aphrodisiacs. This editorial focuses primarily on their role as a food source and the edible products they provide, such as cereals and honey.

### 2 Edible ant species

For a comprehensive list of edible ant species from around the world, including references, see Paoletti *et al.* (2005). This editorial focuses on the most relevant species.

#### *Carebara in Africa*

*Carebara vidua* is an Afrotropical ant species native to eastern and southern Africa (Antwiki, 2024). In Kenya, alates emerge for their nuptial flight following the short rains (November) or long rains (April), rising from small, inconspicuous soil openings. After mating, females shed their wings, burrow into the soil, and construct chambers 10–15 cm below the surface. Nests can grow up to 40 × 40 × 20 cm and are often located near mound-building termites such as *Macrotermes michaelseni* (Lepage and Darlington, 1984). The workers of this ‘thief ant’ prey on termites likely due to their small size or neutral odour (Wheeler, 1965). This behaviour, known as lestophagy, involves living in the nests of other species to steal food. There is a significant size dimorphism between workers (approximately 2 mm) and reproductives (about 2 cm). Female alates weigh 3,400 to 4,600 times heavier than workers (Lepage and Darlington, 1984). During nuptial flights, female alates are caught and consumed, with their abdomen particularly prized. They are eaten raw, fried or roasted across East and southern Africa (Ayieko *et al.*, 2012; van

Huis, 2021). In the Lake Victoria region of Kenya, the Luo people consume both males and females, valuing them not only for their high protein content, but also for their medical properties (Ayieko *et al.*, 2012).

#### ***Atta* spp. in Latin America**

*Atta* spp. are estimated to be responsible for the decomposition of 15–20% of all leaves in South America (DeFoliart, 2005; Wikipedia, 2024), contributing to soil fertility (Farji-Brener and Tadey, 2009).

In Mexico, three *Atta* spp. are consumed: *A. cephalotes*, *A. mexicana* and *A. texana*, a practice going back to pre-Hispanic times (Katz, 2016). The general name is ‘chicatanas’ but this applies to the reproductive phase and is derived from the name in náhuatl (Aztek) language and means ‘ant bag’ (tzicatl = ant, and tanatli = palm bag), again referring to the large abdomen of the future queens (Landero-Torres *et al.*, 2005). They are caught during their nuptial flights in May and June, when they emerge from their nest holes. They are emptied in a recipient with hot water. They are roasted but also used in sauces called ‘salsattas’. To conserve them they are often toasted and smoked. In rural areas, *A. mexicana* is a common food, for example according to Gallardo-López *et al.* (2023), consumed by 75% of the population of a region in Veracruz, the main reason being the taste. The Tucano people of the northwestern Amazon (Colombia, Brazil) consume about 1.5 kg per person of *A. cephalotes*, *A. laevigata*, *A. sexdens* per year (Paoletti *et al.*, 2000). Nutritional values of different forms of processing of *A. mexicana* (Paniagua-Martínez *et al.*, 2022; Piña-Domínguez *et al.*, 2023) have been investigated. In Peru even a cereal bar from *A. sexdens* has been prepared (Lozada-Urbano *et al.*, 2023).

In the Amazonas State of Venezuela, soldiers of *A. cephalotes* are used to prepare a spicy sauce ‘catara’, made with cassava and hot pepper (Paoletti *et al.*, 2005). Similarly, the Tatuyo people of Colombia harvest soldiers of *A. cephalotes*, *A. laevigata*, *A. sexdens*, by inserting a stripped palm leaf rib into a nest entrance. The attached ants are then collected in a container (Dufour, 1987). In Brazil’s Mato Grosso State, the Enawenê people mix crushed ant soldiers into cassava paste as part of their traditional cuisine (Katz, 2016). An advantage of using soldier ant is their availability year-round.

*Atta laevigata*, a species of leafcutter ant, ranges in habitat from Venezuela to Paraguay (Granados *et al.*, 2013). In northern South America, it is commonly known as ‘hormiga culona,’ meaning ‘big-bottomed ant,’ referring to the large abdomen of the future queens, which are the only individuals used as food. During

nuptial flights (March–April and May–June in Colombia), future queens are captured using suction tubes (Granados *et al.*, 2013). After collection, they are beheaded and their wings and legs removed before being salted, roasted or fried. The ants’ own oil is used during cooking, enabling preservation for over a year (Motte-Florac, 2016). Historically, the indigenous Guane people of the Santander Department, Colombia, even reared these ants as a food source (Katz, 2016). By the 18th century, *A. laevigata* was sold in local markets, and it continues to be available today in Colombia’s capital, Bogotá, and through online vendors. Its nutritional composition has been studied in detail by Giron *et al.* (2017).

#### ***Liometopum* sp. in Latin America**

*Liometopum apicalatum*, a member of the subfamily Dolichoderinae, is commonly known as ‘escamoles,’ a term originating from the Náhuatl word *term* ‘azcamolli’ (‘azcatl’ meaning ant and ‘molli’ meaning puree). Often referred to as ‘Mexican caviar,’ this delicacy consists of the immature stages of the reproductive ants, a traditional food consumed since Aztec times (Ramos-Elorduy and Morales, 1996). In Mexico, escamoles are sustainably harvested from February to May, with one to three collection cycles per season. Additionally, workers can be gathered year-round (Ramos-Elorduy and Morales, 1989), ensuring preservation and continuity of ant colonies.

#### ***Oecophylla* spp. in Asia**

The Asian weaver ant (*Oecophylla smaragdina*) is distributed across Asia, Australia, and the Western Pacific (Wetterer, 2017) and is highly valued for its pharmacological and nutritional properties (Alagappan *et al.*, 2021). It ranks among the most popular edible insects in the Lao PDR and Thailand (Pattarayingsakul *et al.*, 2017; Van Itterbeeck *et al.*, 2014), as well as in India (Chakravorty *et al.*, 2016; Megu *et al.*, 2019; Mitra *et al.*, 2020; Raza *et al.*, 2021; Vidhu and Evans, 2015). Weaver ants build nests in trees by pulling leaves together. Their large larvae and pupae, which develop into winged reproductive females known as virgin queens, are particularly prized. In Lao PDR, virgin queens are typically collected from February to April by piercing tree nests with a long bamboo stick (4–6 m) fitted with a basket near the tip. The contents of the nest, including all castes and developmental stages, fall into the basket and are either consumed or sold. The queen brood is often mistakenly referred to as ‘ant eggs.’ In India, certain tribes prepare a sour sauce by crushing worker ants (Vidhu and Evans, 2015) or make a spicy chutney by mixing them with

other ingredients (Raza *et al.*, 2021). Weaver ants are rich in protein and fatty acids (Adam Mariod, 2020; Dolo and Basumatari, 2024). Given their nutritional potential, farming *O. smaragdina* using artificial methods has been proposed (Offenberg, 2011).

### **Formica rufa in Europe**

Many ants produce formic acid as a defence mechanism, a trait that gives the family Formicidae its name. *Formica rufa* (subfamily Formicinae) is characterised by a sharp acidity reminiscent of caramelised lemon rind, while *Lasius fuliginosus* (subfamily Formicinae) has a milder acidity with a distinct aroma of Kaffir lime (Evans *et al.*, 2017, p. 84). In Sweden, *F. rufa* was historically used not only for medical purposes, but also as a flavouring agent for aquavit (Pérez-Lloréns, 2024; Svanberg and Berggren, 2019). Live ants were placed in a bottle filled with liquor distilled from grain or potatoes and left to infuse for several weeks. The resulting schnapps was valued both as a medicinal remedy and a flavourful drink. A traditional recipe featuring ants, known as ‘ant tears,’ using *F. rufa*, is detailed in Evans *et al.* (2017, p. 264).

A traditional yoghurt-making technique from south-eastern Europe (such as Bulgaria) involves using live ants (*F. rufa*) as a fermentation starter. The ants supply the necessary bacteria and acid to trigger the milk’s fermentation process (Sinotte *et al.*, 2024). This works because ants produce formic acid as a defence mechanism, which can cause milk to coagulate. Adding just four live ants to a container of milk introduces enough lactic acid bacteria, enzymes, and acids to initiate the transformation into yoghurt.

While ants are occasionally featured on the menus of select Western restaurants, ants of the genus *Formica* are known to frequently harbour the metacercariae of the lancet liver fluke (*Dicrocoelium dendriticum*), a parasitic trematode with a complex life cycle involving snails and ants as intermediate hosts. Consequently, Jensen *et al.* (2017) advise against consuming *Formica* ants raw if they are collected from the wild. To ensure safety, ants should be frozen, boiled, or treated with ethanol prior to consumption.

### **3 Using ants for seasoning**

At a recent meeting of the American Chemical Society (ACS, 2024) researchers presented findings on the distinct flavours of various ant species. Common black ants (*Lasius niger*) were noted for their acidic,

vinegary aroma, attributed to their high formic acid content. In contrast, chingatana ants (*Atta* spp.) lack formic acid but exhibit a nutty, woody, and fatty scent due to the presence of aldehydes, while their roasted, nutty aroma comes from pyrazines. These ants are commonly consumed in parts of Mexico to enhance the texture and flavour of dishes and sauces. Female and worker chingatana ants are particularly rich in 2,5-dimethylpyrazine, a key trail-marking pheromone, responsible for their characteristic nutty, woody scent (Runwal, 2024). Weaver ants (*Oecophylla* spp.) were described as having a nutty, sweet, and caramel-like aroma due to various pyrazines and pyrroles. However, researchers also detected hay- and urine-like off-flavours, likely resulting from high concentrations of amines. Additionally, African hunter-gatherers such as the IGui and IlGana of the Kalahari Desert use *Camponotus* spp. ants to season their food (Nonaka, 1996).

## **4 Recipes with ants**

Pérez-Lloréns (2024) highlights various culinary creations featuring ant-based ingredients from around the world. In Mexico, *L. apicalatum* appears in numerous dishes, including ‘Elotes’ (baby corn) with powdered chingatana ants, coffee, and costeño chile mayonnaise, as well as ‘Monkfish aguachile with tomato, avocado, and crushed chingatana ants.’ In the United States, ‘Bistec con mole de chingatana’ features grilled prime Black Angus ribeye served with a black bean tamal and chingatana ant mole.

From Brazil, a notable dish includes *Atta* spp.: ‘Raw Amazonian leaf-cutter ant on a pineapple cube.’ In Europe, *F. rufa* is featured in ‘Beef Tartare with Ants,’ consisting of lightly cured beef tartare (cured in kelp seaweed) paired with celeriac oil and wood ants. In Thailand, *Oecophylla* spp. are used in ‘Grilled Sea Bass with Ant Caviar,’ served in beurre blanc sauce topped with pan-fried queen ants and corn salsa.

## **5 Ant products being consumed**

In Mexico, two ants species of the subfamily Formicinae, *Myrmecosistus* and *M. mexicanus*, commonly known as honeypot ants, are harvested for their honey-filled abdomens (Katz, 2016; Ramos-Elorduy and Morales, 1989). Worker ants care for specialised repletes, whose swollen abdomens store large quantities of nutrient-rich fluid to sustain the colony during periods of scarcity.

Indigenous communities harvest these ants, with approximately 1,000 ants producing one kilogram of honey. In some regions, the honey is allowed to ferment, producing an alcoholic beverage (Ramos-Elorduy and Morales, 1989). Similarly, in Australia, *Camponotus inflatus*, another Formicinae species, is also classified as a honeypot ant (Conway, 1991).

During drought and famine in the Sahel region, harvesting stored grains from ant nests is a common survival strategy. Grain-harvesting ants such as *Meganopora* sp. and *Messor* spp. (including *M. aegyptiacus*) build extensive underground nests used for storing seeds (Malaisse, 2005; van Huis, 1996). This traditional practice is also documented among indigenous Australians (Sweeney, 1947) cited by Tommaseo Ponzetta (2003).

## 6 Conclusions

Edible ants are primarily harvested from the wild, though some references suggest the potential for farming certain species. While reproductive ants are most consumed, workers and soldiers are also eaten in some cultures. Species with notably large, nutrient-rich abdomens, such as *Atta* spp. and *Carebara* spp., are particularly valued. Additionally, some ant species are used as seasoning due to their high formic acid content, which imparts a distinctive flavour. Beyond the ants themselves, humans can also harvest the products they collect, such as seeds and honey-like substances stored in specialized ants.

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