BRILL
WAGENINGEN
ACADEMIC

JOURNAL OF INSECTS AS FOOD AND FEED 11 (2025) 429–434

Journal of Insects as Food and Feed
brill.com/jiff

EDITORIAL

Edible ants: exploring species and their utilisation

*A. van Huis**

Laboratory of Entomology, Wageningen University & Research, Droevendaalsesteeg 1, 6708 PB Wageningen, the Netherlands; *arnold.vanhuis@wur.nl

Received 14 December 2024 | Accepted 14 December 2024 |
Published in issue 14 February 2025

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 lestobiosis, 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

 | DOI: 10.1163/23524588-110301ED
 | ISSN: 2352-4588 (online)

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-Dominguez *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; Doloi 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 *Lansius 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 southeastern 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, chicatana 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 chicatana 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 llGana 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 chicatana ants, coffee, and costeño chile mayonnaise, as well as 'Monkfish aguachile with tomato, avocado, and crushed chicatana ants.' In the United States, 'Bistec con mole de chicatana' features grilled prime Black Angus ribeye served with a black bean tamal and chicatana 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.

References

ACS, 2024. The many flavors of edible ants. PressPacs American Chemical Society, Washington, DC, USA. Available at: https://www.acs.org/pressroom/presspacs/2024/march/the-many-flavors-of-edible-ants.html

Alagappan, S., Chaliha, M., Sultanbawa, Y., Fuller, S., Hoffman, L.C., Netzel, G., Weber, N., Rychlik, M., Cozzolino, D., Smyth, H.E. and Olarte Mantilla, S.M., 2021. Nutritional analysis, volatile composition, antimicrobial and antioxidant properties of Australian green ants (*Oecophylla smaragdina*). Future Foods 3: 100007. https://doi.org/10.1016/j.fufo.2020.100007

Antwiki, 2024. *Carebara vidu*. Available at: https://antwiki.org/wiki/Carebara_vidua

Ayieko, M.A., Kinyuru, N., Ndong'a, M.F. and Kenji, G.M., 2012. Nutritional value and consumption of black ants (*Carebara vidua* Smith) from the Lake Victoria Region in Kenya. Advance Journal of Food Science and Technology 4: 39-45. Available at: https://www.maxwellsci.com/print/ajfst/v4-39-45.pdf

Chakravorty, J., Ghosh, S., Megu, K., Jung, C. and Meyer-Rochow, V.B., 2016. Nutritional and anti-nutritional composition of *Oecophylla smaragdina* (Hymenoptera: Formicidae) and *Odontotermes* sp. (Isoptera: Termitidae): two preferred edible insects of Arunachal Pradesh, India. Journal of Asia-Pacific Entomology 19: 711-720. http://dx.doi.org/10.1016/j.aspen.2016.07.001

Conway, J.R., 1991. The biology and aboriginal use of the honeypot ant, '*Camponotus inflatus*' Lubbock, in Northern Territory, Australia. Australian Entomologist Mafazine 18: 49-56. Available at: https://www.cabidigitallibrary.org/doi/full/10.5555/19921175368

DeFoliart, G.R., 2005. Overview of role of edible insects in preserving biodiversity. In: Paoletti, M.G. (ed.) Ecological implications of minilivestock: potential of insects, rodents, frogs, and snails. Science Publishers, Inc., Enfield, NH, USA, pp. 123-140.

Doloi, D. and Basumatari, D., 2024. Proximate analysis of *Oecophylla smaragdina*, an edible weaver ant consumed by certain tribes of Assam, India. Ttar Pradesh Journal of Zoology 45: 208-213. https://doi.org/10.56557/upjoz/2024/v45i33893

Dufour, D.L., 1987. Insects as food: a case study from the Northwest Amazon. American Anthropologist 89: 383-397. https://doi.org/10.1525/aa.1987.89.2.02a00070

Evans, J., Flore, R., Frøst, M.B. and Nordic Food Lab, 2017. On eating insects: essays, stories and recipes. Phaidon, London, UK.

Farji-Brener, A.G. and Tadey, M., 2009. Contributions of leaf-cutting ants to soil fertility: causes and consequences. In: Lucero, D.P. and Boggs, J.E. (eds.) Soil fertility. Nova Science Publishers, Inc., New York, NY, USA, pp. 81-91.

Gallardo-López, F., Rendón-Martínez, A., Ramírez-Sandoval, G., Ozuna, C., Paniagua-Martínez, I. and Ramírez-Martínez, A., 2023. Consumption of *Atta mexicana* (chicatanas) in two regions of Veracruz, Mexico – a multifactorial study of the consumption of chicatanas. Journal of Insects as Food and Feed 9: 525-539. https://doi.org/10.3920/JIFF2022.0054

GBIF, 2024. Free and open access to biodiversity data. Global Biodiversity Information Facility, Copenhagen, Denmark. Available at: https://www.gbif.org/

Giron, R.J.C., Hidalgo, G.G., Garcia, J.E.B., Hernández, E.P. and Villa, P.M., 2017. Exploring the food and nutritional potential of three edibles Amazonian arthropods. Etnobiológía 15: 26-31.

Granados, C.C., Acevedo, C.D. and Guzman, L.E., 2013. Tostado y harina de la hormiga santandereana '*Atta laevigata*'. Biotecnología en el Sector Agropecuario y Agroindustrial 11: 68-74.

Jensen, A.B., Malagocka, J., Eilenberg, J. and Fredensborg, B.L., 2017. Viability of *Dicrocoelium dendriticum* metacercariae in *Formica polyctena* ants after exposure to different treatments. Journal of Insects as Food and Feed 3: 15-20. https://doi.org/10.3920/jiff2016.0042

Katz, E., 2016. Les insectes comestibles en Amérique latine: de nourritures d'Indiens a patrimoine alimentaire. In: Le Gall, P. and Motte-Florac, E. (eds.) Savoureux insectes: d'aliment traditionelles à l'innovation gastronomique. Presses universitaires de Rennes/Institut de Recherche pour le développement, pp. 89-117.

Landero-Torres, I., Murguia-González, J. and Ramos-Elorduy, J., 2005. Ethnographic study of "chicatanas" ants consumption (Hymenoptera: Formicidae) at Huatusco, Veracruz, Mexico. Folia Entomológica Mexicana 44: 109-113.

Lepage, M.G. and Darlington, J.P.E.C., 1984. Observations on the ant *Carebara vidua* F. Smith preying on termites in Kenya. Journal of Natural History 18: 293-302.

Lozada-Urbano, M., Bendezú Ccanto, J., Condori Chura, J., Rivera-Lozada, O. and Yañez, J.A., 2023. Development and acceptability of a cereal bar with *Atta sexdens* ant flour. F1000Research 12: 849. https://doi.org/10.12688/f1000research.135516.1

Malaisse, F., 2005. Human consumption of Lepidoptera, termites, Orthoptera, and ants in Africa. In: Paoletti, M.G. (ed.) Ecological implications of minilivestock. Science Publishers, Inc., Enfield, NH, USA, pp. 175-230.

Mariod, A.A., 2020. Nutrient composition and bioactive components of ants (*Oecophylla smaragdina* Fabricius). In: Mariod, A.A. (ed.) African edible insects as alternative source of food, oil, protein and bioactive components. Springer International Publishing, Cham, Switzerland, pp. 225-229. https://doi.org/10.1007/978-3-030-32952-5_15

Megu, K., Tukshipa, S.D., Yasung, P. and Chkaravorty, J., 2019. Protein composition of *Oecophylla smaragdina* (Hymenoptera: Formicidae) based on altitudinal variation from Arunachal Pradesh, India. Dera Natung Government College Research Journal 4: 33-40. https://doi.org/10.56405/dngcrj.2019.04.01.05

Mitra, A., Chanda, A. and Raut, S.K., 2020. On the use of red ant *Oecophylla smaragdina* by the indigenous people of Binpur, Jhargram, West Bengal. International Research Journal of Basic and Applied Sciences 5: 67-71.

Motte-Florac, E., 2016. Des insectes aphrodisiaques au menu, entre mets délivats et remèdes. In: Le Gall, P. and Motte-Florac, E. (eds.) Savoureux insectes: d'aliment traditionelles à l'innovation gastronomique. Presses universitaires de Rennes/Institut de Recherche pour le développement, pp. 148-196.

Nonaka, K., 1996. Ethnoentomology of the Central Kalahari San. African Study Monographs 22: 29-46.

Offenberg, J., 2011. *Oecophylla smaragdina* food conversion efficiency: prospects for ant farming. Journal of Applied Entomology 135: 575-581. https://doi.org/10.1111/j.1439-0418.2010.01588.x

Paniagua-Martínez, I., Morales-Trejo, F., Rendón-Martínez, A., Gallardo-López, F. and Ramírez-Martínez, A., 2022. Acceptance and physicochemical properties of raw and roasted ants (*Atta mexicana*). Journal of Insects as Food and Feed 8: 65-74. https://doi.org/10.3920/JIFF2020.0168

Paoletti, M.G., Buscardo, E. and Dufour, D.L., 2005. Edible invertebrates among Amazonian Indians: a critical review of disappearing knowledge. Environment, Development and Sustainability 2: 195-225.

Paoletti, M.G., Dufour, D.L., Cerda, H., Torres, F., Pizzoferrato, L. and Pimentel, D., 2000. The importance of leaf- and litter-feeding invertebrates as sources of animal protein for the Amazonian Amerindians. Proceedings of the Royal Society of London. Series B, Biological Sciences 267: 2247-2252. https://doi.org/10.1098/rspb.2000.1275

Pattarayingsakul, W., Nilavongse, A., Reamtong, O., Chittavanich, P., Mungsantisuk, I., Mathong, Y., Prasitwuttisak, W. and Panbangred, W., 2017. Angiotensin-converting enzyme inhibitory and antioxidant peptides from digestion of larvae and pupae of Asian weaver ant, *Oecophylla smaragdina*, Fabricius. Journal of the Science of Food and Agriculture 97: 3133-3140. https://doi.org/10.1002/jsfa.8155

Pérez-Lloréns, J.L., 2024. Chapter 12 – Entomogastronomy, a step beyond just eating insects. In: García-Vaquero, M. and Álvarez García, C. (eds.) Insects as food and food ingredients. Academic Press, Cambridge, MA, USA, pp. 191-214. https://doi.org/10.1016/B978-0-323-95594-2.00005-7

Piña-Dominguez, I.A., Ruiz-May, E., Hernández-Rodriguez, D., Zepeda, R.C. and Melgar-Lalanne, G., 2024. Bioactivity of the edible part of Chicatana ant (*Atta mexicana*, Smith 1858) and its protein concentrate. Journal of Insects as Food and Feed 10: 689-697. https://doi.org/10.1163/23524588-20230171

Ramos-Elorduy, J. and Morales, J.M.P., 1989. Los insectos comestibles en el México antiguo (estudio etnoentomológico). A.G.T. México.

Ramos-Elorduy, J. and Morales, J.M.P., 1996. El consumo de insectos entre los Aztecas. In: Long, J. (ed.) Conquista et comida: consecuencias del Encuentro de Dos Mundos. Universidad Nacional Automomia de México, pp. 89-101.

Raza, M., Tukshipa, S.D. and Chakravorty, J., 2021. *Oecophylla smaragdina* (Hymenoptera: Formacidae) and *Odontotermes* sp. (Isoptera: Termitidae) a potential source of antiox-

odant: the two most preferred edible insects of Arunachal Pradesh, India. Discover Food. https://doi.org/10.21203/rs.3.rs-1057539/v1

Runwal, P., 2024. Color-changing cookies and appetizing ants: Sunflower-seed butter and chicatana ants bring unusual chemistry to cooking. Chemical and Engineering News 102. Available at: https://cen.acs.org/food/Color-changing-cookies-appetizing-ants/102/i38

Sinotte, V.M., Ramos Viana, V., Vasquez, D.P., Sirakova, S.M., Valeron, N.R., Cuesta Mate, A., Taylor Parkins, S.K., Giecko, J., Velasco, E.M., Zilber, D., Munk, R., Andersen, S.B., Dunn, R.R. and Jahn, L.J., 2024. Making yogurt with the ant holobiont uncovers bacteria, acids, and enzymes for food fermentation. BioRxiv. https://doi.org/10.1101/2024.09.16.613207

Svanberg, I. and Berggren, Å., 2019. Ant schnapps for health and pleasure: the use of *Formica rufa* L. (Hymenoptera: Formicidae) to flavour aquavit. Journal of Ethnobiology and Ethnomedicine 15: 68. https://doi.org/10.1186/s13002-019-0347-7

Sweeney, G., 1947. Food supplies of a desert tribe. Oceania 17: 289-299. https://doi.org/10.1002/j.1834-4461.1947.tb00154.x

Tommaseo Ponzetta, M., 2016. Rôle alimentaire des insectes dans l' évolution humaine. In: Le Gall, P. and Motte-Florac, E. (eds.) Savoureux insectes: d'aliment traditionelles à l'innovation gastronomique. Presses universitaires de Rennes/Institut de Recherche pour le développement, pp. 241-255.

Van Huis, A., 1996. The traditional use of arthropods in Sub Saharan Africa. In: Proceedings of the Section Experimental and Applied Entomology of the Netherlands. Entomological Society (N.E.V.), Amsterdam, the Netherlands, pp. 3-20.

Van Huis, A., 2021. Cultural aspects of ants, bees and wasps, and their products in sub-Saharan Africa. International Journal of Tropical Insect Science 41: 2223-2235. https://doi.org/10.1007/s42690-020-00410-6

Van Itterbeeck, J., Sivongxay, N., Praxaysombath, B. and Huis, A. van, 2014. Indigenous knowledge of the edible weaver ant *Oecophylla smaragdina* Fabricius Hymenoptera: Formicidae from the Vientiane Plain, Lao PDR. Ethnobiology Letters 5: 4-12. https://doi.org/10.14237/ebl.5.2014.125

Vidhu, V.V. and Evans, D.A., 2015. Ethnoentomological values of *Oecophylla smaragdina* (Fabricius). Current Science 109: 572-579. Available at: https://www.jstor.org/stable/24906112

Wetterer, J.K., 2017. Geographic distribution of the weaver ant *Oecophylla smaragdina*. Asian Myrmecology 9: 1-12. https://doi.org/10.20362/am.009004

Wheeler, W.M., 1965. Ants: their structure, development and behaviour. Columbia University Press, New York, NY, USA and London, UK.

Wikipedia, 2024. *Atta* (ant). Available at: https://en.wikipedia.org/wiki/Atta_(ant)#Ecological_effects