WIKIPEDIA

Ambrosia

In the ancient Greek myths, ***ambrosia*** (/æmˈbroʊʒə/, Ancient Greek: ἀμβροσία, "immortality") is the food or drink of the Greek gods,[1] often depicted as conferring longevity or immortality upon whoever consumed it.[2] It was brought to the gods in Olympus by doves and served by either Hebe or Ganymede at the heavenly feast.[3][4]

The Food of the Gods on Olympus (1530), majolica dish attributed to Nicola da Urbino

Ambrosia is sometimes depicted in ancient art as distributed by a nymph labeled with that name and a nurse of Dionysus.[5] In the myth of Lycurgus, the king attacked Ambrosia and Dionysus' entourage, causing the god to drive Lycurgus insane.

Contents

Definition

Ambrosia is very closely related to the gods' other form of sustenance, *nectar*. The two terms may not have originally been distinguished;[6] though in Homer's poems nectar is usually the drink and ambrosia the food of the gods; it was with ambrosia Hera "cleansed all defilement from her lovely flesh",[7] and with ambrosia Athena prepared Penelope in her sleep,[8] so that when she appeared for the final time before her suitors, the effects of years had been stripped away, and they were inflamed with passion at the sight of her. On the other hand, in Alcman,[9] nectar is the food, and in Sappho[10] and Anaxandrides, ambrosia is the drink.[11] A character in Aristophanes' *Knights* says, "I dreamed the goddess poured ambrosia over your head—out of a ladle." Both descriptions could be correct, as ambrosia could be a liquid considered a food (such as honey).

The consumption of ambrosia was typically reserved for divine beings. Upon his assumption into immortality on Olympus, Heracles is given ambrosia by Athena, while the hero Tydeus is denied the same thing when the goddess discovers him eating human brains. In one version of the myth of Tantalus, part of Tantalus' crime is that after tasting ambrosia himself, he attempts to steal some to give to other mortals.[12] Those who consume ambrosia typically have ichor, not blood, in their veins.[13]

Both nectar and ambrosia are fragrant, and may be used as perfume: in the *Odyssey* Menelaus and his men are disguised as seals in untanned seal skins, "...and the deadly smell of the seal skins vexed us sore; but the goddess saved us; she brought ambrosia and put it under our nostrils."[14] Homer speaks of ambrosial raiment, ambrosial locks of hair, even the gods' ambrosial sandals.

Among later writers, ambrosia has been so often used with generic meanings of "delightful liquid" that such late writers as Athenaeus, Paulus and Dioscurides employ it as a technical terms in contexts of cookery,[15] medicine,[16] and botany.[17] Pliny used the term in connection with different plants, as did early herbalists.[18]

Additionally, some modern ethnomycologists, such as Danny Staples, identify ambrosia with the hallucinogenic mushroom *Amanita muscaria*: "...it was the food of the gods, their ambrosia, and nectar was the pressed sap of its juices", Staples asserts.[19]

W. H. Roscher thinks that both nectar and ambrosia were kinds of honey, in which case their power of conferring immortality would be due to the supposed healing and cleansing powers of honey,[1] and because fermented honey (mead) preceded wine as an entheogen in the Aegean world; on some Minoan seals, goddesses were represented with bee faces (compare Merope and Melissa).

Etymology

The concept of an immortality drink is attested in at least two ancient Indo-European languages: Greek and Sanskrit. The Greek ἀμβροσία (*ambrosia*) is semantically linked to the Sanskrit अमृत (*amṛta*) as both words denote a drink or food that gods use to achieve immortality. The two words appear to be derived from the same Indo-European form **n̥-mr̥-tós*, "un-dying"[20] (*n*-: negative prefix from which the prefix *a*- in both Greek and Sanskrit are derived; *mr̥*: zero grade of **mer*-, "to die"; and *-to*-: adjectival suffix). A semantically similar etymology exists for nectar, the beverage of the gods (Greek: νέκταρ *néktar*) presumed to be a compound of the PIE roots **nek*-, "death", and -**tar*, "overcoming".

Other examples in mythology

- In one version of the story of the birth of Achilles, Thetis anoints the infant with ambrosia and passes the child through the fire to make him immortal but Peleus, appalled, stops her, leaving only his heel unimmortalised (*Argonautica* 4.869–879).
- In the *Iliad* xvi, Apollo washes the black blood from the corpse of Sarpedon and anoints it with ambrosia, readying it for its dreamlike return to Sarpedon's native Lycia. Similarly, Thetis anoints the corpse of Patroclus in order to preserve it. Ambrosia and nectar are depicted as unguents (xiv. 170; xix. 38).
- In the *Odyssey*, Calypso is described as having "spread a table with ambrosia and set it by Hermes, and mixed the rosy-red nectar." It is ambiguous whether he means the ambrosia itself is rosy-red, or if he is describing a rosy-red nectar Hermes drinks along with the ambrosia. Later, Circe mentions to Odysseus[21] that a flock of doves are the bringers of ambrosia to Olympus.
- In the *Odyssey* (ix.345–359), Polyphemus likens the wine given to him by Odysseus to ambrosia and nectar.

Thetis anoints Achilles with ambrosia, by Johann Balthasar Probst (1673–1748)

- One of the impieties of Tantalus, according to Pindar, was that he offered to his guests the ambrosia of the Deathless Ones, a theft akin to that of Prometheus, Karl Kerenyi noted (in *Heroes of the Greeks*).[22]
- In the Homeric hymn to Aphrodite, the goddess uses "ambrosial bridal oil that she had ready perfumed."[23]
- In the story of *Cupid and Psyche* as told by Apuleius, Psyche is given ambrosia upon her completion of the quests set by Venus and her acceptance on Olympus. After she partakes, she and Cupid are wed as gods.[24]
- In the *Aeneid*, Aeneas encounters his mother in an alternate, or illusory form. When she became her godly form "Her hair's ambrosia breathed a holy fragrance." [25]

Lycurgus of Thrace and Ambrosia

Lycurgus, king of Thrace, forbade the cult of Dionysus, whom he drove from Thrace, and attacked the gods' entourage when they celebrated the god. Among them was Ambrosia, who turned herself into a grapevine to hide from his wrath. Dionysus, enraged by the king's actions, drove him mad. In his fit of insanity he killed his son, whom he mistook for a stock of ivy, and then himself.

Lycurgus attacking the nymph Ambrosia (mosaic from Herculaneum, 45–79 AD)

See also

- Amrita, of Hindu mythology, a drink which confers immortality on the gods, and a cognate of ambrosia
- Elixir of life, a potion sought by alchemy to produce immortality
- Ichor, blood of the Greek gods, related to ambrosia
- Iðunn's apples in Norse mythology
- Manna, food given by God to the Israelites
- Peaches of Immortality in Chinese mythology
- Pill of Immortality
- Silphium
- Soma (drink), a ritual drink of importance among the early Indo-Iranians, and the subsequent Vedic and greater Persian cultures

References

1. Chisholm, Hugh, ed. (1911). "Ambrosia" (https://en.wikisource.org/wiki/1911_Encyclop%C3%A6dia_Britannica/Ambrosia). *Encyclopædia Britannica*. **1** (11th ed.). Cambridge University Press. p. 800.
2. Griffiths, Alan H. (1996), "Ambrosia", in Hornblower, Simon; Spawforth, Anthony (eds.), *Oxford Classical Dictionary* (3rd ed.), Oxford: Oxford University Press, ISBN 0-19-521693-8
3. Homer, *Odyssey* xii.62
4. Cicero. *De Natura Deorum*. p. 1.40.

5. Ruth E. Leader-Newby, *Silver and Society in Late Antiquity: Functions and Meanings of Silver Plate in the Fourth to Seventh Centuries* (Ashgate, 2004), p. 133; Christine Kondoleon, *Domestic and Divine: Roman Mosaics in the House of Dionysos* (Cornell University Press, 1995), p. 246; Katherine M. D. Dunbabin, *Mosaics of the Greek and Roman World* (Cambridge University Press, 1999), pp. 136, 142, 276–277.
6. "Attempts to draw any significant distinctions between the functions of nectar and ambrosia have failed." Clay, p. 114.
7. Homer, *Iliad* xiv.170
8. Homer, *Odyssey* xviii.188ff
9. Alcman, fragment 42
10. Sappho, fragment 141 LP
11. When Anaxandrides says "I eat nectar and drink ambrosia", though, Wright, p. 5, suggested he was using comic inversion.
12. Pindar, *Olympian Odes* 1. 50. ff.
13. Homer, *Iliad* v. 340, 416.
14. Homer, *Odyssey* iv.444–46
15. In Athenaeus, a sauce of oil, water and fruit juice.
16. In Paulus, a medicinal draught.
17. Dioscurides remarked its Latin name was *ros marinus*, "sea-dew", or rosemary; these uses were noted by Wright 1917:6.
18. "Ambrosia" in *Chambers's Encyclopædia*. London: George Newnes, 1961, Vol. 1, p. 315.
19. Carl A.P. Ruck and Danny Staples, *The World of Classical Myth* 1994:26.
20. Mallory, J. P. (1997). "Sacred drink". In Mallory, J. P.; Adams, Douglas Q. (eds.). *Encyclopedia of Indo-European Culture*. Taylor & Francis. p. 538. Mallory also connects to this root an Avestan word, and notes that the root is "dialectally restricted to the IE southeast".
21. *Odyssey* xii.62: "the trembling doves that carry ambrosia to Father Zeus."
22. Kerényi, Carl. *Prometheus: Archetypal Image of Human Existence* (https://books.google.com/books?id=ouOmOC6Z1HkC&pg=PA42). p. 42.
23. West, Martin L. (2014). *Homeric hymns; Homeric apocrypha; Lives of Homer* (https://archive.org/details/homerichymnshome0000home). Cambridge: Harvard University Press. ISBN 9780674996069.
24. Rogers, Mark (2014). *The Esoteric Codex: Magic Objects I*. ISBN 978-1312114562.
25. Harmer; Burder; Paxton & Roberts (1839). *Illustrations of the Holy Scriptures, derived principally from the manners, customs, rites, traditions and works of art and literature, of the eastern nations*. Brattleboro Typographic Company.

Sources

- Clay, Jenny Strauss, "Immortal and ageless forever", *The Classical Journal* **77**.2 (December 1981:pp. 112–117).
- Ruck, Carl A.P. and Danny Staples, *The World of Classical Myth* 1994, p. 26 et seq. [1] (https://web.archive.org/web/20120415105236/http://csp.org/chrestomathy/world_of.html)
- Wright, F. A., "The Food of the Gods", *The Classical Review* **31**.1, (February 1917:4–6).

External links

- Media related to Ambrosia (beverage) at Wikimedia Commons

WIKIPEDIA

Nectar

Nectar is a sugar-rich liquid produced by plants in glands called **nectaries** or **nectarines**, either within the flowers with which it attracts pollinating animals, or by **extrafloral nectaries**, which provide a nutrient source to animal mutualists, which in turn provide herbivore protection. Common nectar-consuming pollinators include mosquitoes, hoverflies, wasps, bees, butterflies and moths, hummingbirds, honeyeaters and bats. Nectar plays a crucial role in the foraging economics and evolution of nectar-eating species; for example, nectar foraging behavior is largely responsible for the divergent evolution of the African honey bee, *A. m. scutellata* and the western honey bee.

Nectar of camellia

Nectar is an economically important substance as it is the sugar source for honey. It is also useful in agriculture and horticulture because the adult stages of some predatory insects feed on nectar. For example, a number of parasitoid wasps (e.g. the social wasp species *Apoica flavissima*) rely on nectar as a primary food source. In turn, these wasps then hunt agricultural pest insects as food for their young.

An Australian painted lady feeding on a flower's nectar

Nectar secretion increases as the flower is visited by pollinators. After pollination, the nectar is frequently reabsorbed into the plant.[1]

Contents

Etymology

Nectar is derived from Greek *nektar*, the fabled drink of eternal life.[2] The word is derived as a compound of *nek*, meaning death, and *tar*, meaning the ability to overcome.[2] The common use of nectar refers to the "sweet liquid in flowers", first recorded in AD 1600.[2]

Floral nectaries

Gymnadenia conopsea flowers with nectar-filled spur

A nectary or nectarine is floral tissue found in different locations in the flower, and is one of several secretory floral structures, including elaiophores and osmophores, producing nectar, oil and scent respectively. The function of these structures is to attract potential pollinators, which may include insects, including bees and moths, and vertebrates such as humming birds and bats. Nectaries can occur on any floral part, but they may also represent a modified part or a novel structure.[3] The different types of floral nectaries include;[4]

- receptacle (receptacular: extrastaminal, intrastaminal, interstaminal)
- hypanthium (hypanthial)
- tepals (perigonal, tepal)
- sepals (sepal)
- petal (petal, corolla)
- stamen (staminal, androecial: filament, anther, staminodal)
- pistil (gynoecial: stigmatic, stylar)
  - pistillodes (pistillodal, carpellodial)
  - ovaries (ovarian: non-septal, septal, gynopleural)

Most members of Lamiaceae have a nectariferous disc which surrounds the ovary base and derived from developing ovarian tissue. In most Brassicaceae the nectary is at the base of the stamen filament. Many monocotyledons have septal nectaries, which are at the unfused margins of the carpels. These exude nectar from small pores on the surface of the gynoecium. Nectaries may also vary in color, number, and symmetry.[5] Nectaries can also be categorized as structural or non-structural. Structural nectaries refer to specific areas of tissue that exude nectar, such as the types of floral nectaries previously listed. Non-structural nectaries secrete nectar infrequently from non-differentiated tissues.[6] The different types of floral nectaries coevolved depending on the pollinator that feeds on the plant's nectar. Nectar is secreted from epidermal cells of the nectaries, which have a dense cytoplasm, by means of trichomes or modified stomata. Adjacent vascular tissue conducts phloem bringing sugars to the secretory region, where it is secreted from the cells through vesicles packaged by the endoplasmic reticulum.[7] The adjacent subepidermal cells may also be secretory.[3] Flowers that have longer nectaries sometimes have a vascular strand in the nectary to assist in transport over a longer distance.[8][3]

Pollinators feed on the nectar and depending on the location of the nectary the pollinator assists in fertilization and outcrossing of the plant as they brush against the reproductive organs, the stamen and pistil, of the plant and pick up or deposit pollen.[9] Nectar from floral nectaries is sometimes used as a reward to insects, such as ants, that protect the plant from predators. Many floral families have evolved a nectar spur. These spurs are projections of various lengths formed from different tissues, such as the petals or sepals. They allow for pollinators to land on the elongated tissue and more easily reach the nectaries and obtain the nectar reward.[5] Different characteristics of the spur, such as its length or position in the flower, may determine the type of pollinator that visits the flower.[10]

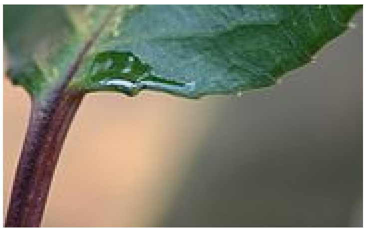
Defense from herbivory is often one of the roles of extrafloral nectaries. Floral nectaries can also be involved in defense. In addition to the sugars found in nectar, certain proteins may also be found in nectar secreted by floral nectaries. In tobacco plants, these proteins have antimicrobial and antifungal properties and can be secreted to defend the gynoecium from certain pathogens.[11]

Floral nectaries have evolved and diverged into the different types of nectaries due to the various pollinators that visit the flowers. In Melastomataceae, different types of floral nectaries have evolved and been lost many times. Flowers that ancestrally produced nectar and had nectaries may have lost their ability to produce nectar due to a lack of nectar consumption by pollinators, such as certain species of bees. Instead they focused on energy allocation to pollen production. Species of angiosperms that have nectaries use the nectar to attract pollinators that consume the nectar, such as birds and butterflies.[12] In Bromeliaceae, septal nectaries (a form of gynoecial nectary) are common in species that are insect or bird pollinated. In species that are wind pollinated, nectaries are often absent because there is no pollinator to provide a reward for.[13] In flowers that are generally pollinated by a long-tongued organism such as certain flies, moths, butterflies, and birds, nectaries in the ovaries are common because they are able to reach the nectar reward when pollinating. Sepal and petal nectaries are often more common in species that are pollinated by short-tongued insects that cannot reach so far into the flower.[14]

Extrafloral nectaries

Extrafloral nectaries (also known as extranuptial nectaries) are specialised nectar-secreting plant glands that develop outside of flowers and are not involved in pollination, generally on the leaf or petiole (foliar nectaries) and often in relation to the leaf venation.[15][16] They are highly diverse in form, location, size, and mechanism. They have been described in virtually all above-ground plant parts—including stipules, cotyledons, fruits, and stems, among others. They range from single-celled trichomes to complex cup-like structures that may or may not be vascularized. Like floral nectaries, they consist of groups of glandular trichomes (e.g. *Hibiscus* spp.) or elongated secretory epidermal cells. The latter are often associated with underlying vascular tissue. They may be associated with specialised pockets (domatia), pits or raised regions (e.g. Euphorbiaceae). The leaves of some tropical eudicots (e.g. Fabaceae) and magnoliids (e.g. Piperaceae) possess pearl glands or bodies which are globular trichomes specialised to attract ants. They secrete matter that is particularly rich in carbohydrates, proteins and lipids.[15][17]

Extrafloral nectaries on the petiole of a wild cherry (*Prunus avium*) leaf



Extrafloral nectaries on a red stinkwood (*Prunus africana*) leaf

While their function is not always clear, and may be related to regulation of sugars, in most cases they appear to facilitate plant insect relationships.[15] In contrast to floral nectaries, nectar produced outside the flower generally have a defensive function. The nectar attracts predatory insects which will eat both the nectar and any plant-eating insects around, thus functioning as 'bodyguards'.[18] Foraging predatory insects show a preference for plants with extrafloral nectaries, particularly some species of ants and wasps, which have been observed to defend the plants bearing them. *Acacia* is one example of a plant whose nectaries attract ants, which protect the plant from other insect herbivores.[15][16] Among passion flowers, for example, extrafloral nectaries prevent herbivores by attracting ants and deterring two species of butterflies from laying eggs.[19] In many carnivorous plants, extrafloral nectaries are also used to attract insect prey.[20]

Ants on extrafloral nectaries in the lower surface of a young *Drynaria quercifolia* frond

Darwin understood that extrafloral nectar "though small in quantity, is greedily sought by insects" but believed that "their visits do not in any way benefit the plant".[21] Instead, he believed that extrafloral nectaries were excretory in nature (hydathodes). Their defensive functions were first recognized by the Italian botanist Federico Delpino in his important monograph *Funzione mirmecofila nel regno vegetale* (1886). Delpino's study was inspired by a disagreement with Charles Darwin, with whom he corresponded regularly.[21]

Loxura atymnus butterflies and yellow crazy ants consuming nectar secreted from the extrafloral nectaries of a *Spathoglottis plicata* bud

Extrafloral nectaries have been reported in over 3941 species of vascular plants belonging to 745 genera and 108 families, 99.7% of which belong to flowering plants (angiosperms), comprising 1.0 to 1.8% of all known species. They are most common among eudicots, occurring in 3642 species (of 654 genera and 89 families), particularly among rosids which comprise more than half of the known occurrences. The families showing the most recorded occurrences of extrafloral nectaries are Fabaceae, with 1069 species, Passifloraceae, with 438 species, and Malvaceae, with 301 species. The genera with the most recorded occurrences are *Passiflora* (322 species, Passifloraceae), *Inga* (294 species, Fabaceae), and *Acacia* (204 species, Fabaceae).[17] Other genera with extrafloral nectaries include *Salix* (Salicaceae), *Prunus* (Rosaceae) and *Gossypium* (Malvaceae).[19]

Nylanderia flavipes ant visiting extrafloral nectaries of *Senna*

Foliar nectaries have also been observed in 39 species of ferns belonging to seven genera and four families of Cyatheales and Polypodiales.[17] They are absent, however, in bryophytes, gymnosperms, early angiosperms, magnoliids, and members of Apiales among the eudicots.[17] Phylogenetic studies and the wide distribution of extrafloral nectaries among vascular plants point to multiple independent evolutionary origins of extrafloral nectaries in at least 457 independent lineages.[17]

Components

The main ingredients in nectar are sugars in varying proportions of sucrose, glucose, and fructose.[22] In addition, nectars have diverse other phytochemicals serving to both attract pollinators and discourage predators.[23][6] Carbohydrates, amino acids, and volatiles function to attract some species, whereas alkaloids and polyphenols appear to provide a protective function.[23]

The *Nicotiana attenuata*, a tobacco plant native to the US state of Utah, uses several volatile aromas to attract pollinating birds and moths. The strongest such aroma is benzylacetone, but the plant also adds bitter nicotine, which is less aromatic, so may not be detected by the bird until after taking a drink. Researchers speculate the purpose of this addition is to discourage the forager after only a sip, motivating it to visit other plants, therefore maximizing the pollination efficiency gained by the plant for a minimum nectar output.[6][24] Neurotoxins such as aesculin are present in some nectars such as that of the California buckeye.[25] Nectar contains water, carbohydrates, amino acids, ions and numerous other compounds.[1][6][26]

Other floral secretory structures

Some insect pollinated plants lack nectaries, but attract pollinators through other secretory structures. Elaiophores are similar to nectaries but are oil secreting. Osmophores are modified structural structures that produce volatile scents. In orchids these have pheromone qualities. Osmophores have thick domed or papillate epidermis and dense cytoplasm. *Platanthera bifolia* produces a nocturnal scent from the labellum epidermis. *Ophrys* labella have dome-shaped, papillate, dark-staining epidermal cells forming osmophores. *Narcissus* emit pollinator specific volatiles from the corona.[3]

See also

- Nectar guide
- Nectar source
- Nectarivore
- Northern American nectar sources for honey bees

References

1. Thornburg 2001.
2. "Nectar" (https://www.etymonline.com/word/nectar). Online Etymology Dictionary, Douglas Harper. 2018. Retrieved 28 May 2018.
3. Rudall 2007, pp. 96–98.
4. Nicolson et al 2017, p. 41.
5. Willmer, Pat. Pollination and floral ecology. Princeton University Press, 2011.
6. Nicolson et al 2017.
7. Fahn, Abraham. “On the Structure of Floral Nectaries.” Botanical Gazette, vol. 113, no. 4, 1952, pp. 464–470. JSTOR, JSTOR, https://www.jstor.org/stable/2472434.
8. Wallace, Gary D. "Studies of the Monotropoideae (Ericaceae). Floral nectaries: anatomy and function in pollination ecology." American Journal of Botany (1977): 199-206.
9. Heil, Martin. "Nectar: generation, regulation and ecological functions." Trends in plant science 16.4 (2011): 191-200.
10. Pacini, E. N. M. V. J., M. Nepi, and J. L. Vesprini. "Nectar biodiversity: a short review." Plant Systematics and Evolution 238.1-4 (2003): 7-21.
11. Thornburg, Robert W., et al. "A major function of the tobacco floral nectary is defense against microbial attack." Plant Systematics and Evolution 238.1-4 (2003): 211-218.
12. Stein, Bruce A., and Hiroshi Tobe. "Floral nectaries in Melastomataceae and their systematic and evolutionary implications." Annals of the Missouri Botanical Garden (1989): 519-531.
13. Floral anatomy of Bromeliaceae, with particular reference to the evolution of epigyny and septal nectaries in commelinid monocot, Sajo, M. G., P. J. Rudall, and C. J. Prychid. "Floral anatomy of Bromeliaceae, with particular reference to the evolution of epigyny and septal nectaries in commelinid monocots." Plant Systematics and Evolution 247.3-4 (2004): 215-231.
14. Rudall, Paula J., John C. Manning, and Peter Goldblatt. "Evolution of floral nectaries in Iridaceae." Annals of the Missouri Botanical Garden (2003): 613-631.
15. Rudall 2007, pp. 66–68.
16. Heil, M.; Fiala, B.; Baumann, B.; Linsenmair, K.E. (2000). "Temporal, spatial and biotic variations in extrafloral nectar secretion by *Macaranga tanarius*" (https://doi.org/10.1046%2Fj.1365-2435.2000.00480.x). *Functional Ecology*. **14** (6): 749. doi:10.1046/j.1365-2435.2000.00480.x (https://doi.org/10.1046%2Fj.1365-2435.2000.00480.x).

17. Weber, M. G.; Keeler, K. H. (2012). "The phylogenetic distribution of extrafloral nectaries in plants" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3662505). *Annals of Botany*. **111** (6): 1251–1261. doi:10.1093/aob/mcs225 (https://doi.org/10.1093%2Faob%2Fmcs225). PMC 3662505 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3662505). PMID 23087129 (https://pubmed.ncbi.nlm.nih.gov/23087129).
18. Plant-Provided Food for Carnivorous Insects - Cambridge University Press (http://www.cambridge.org/uk/catalogue/catalogue.asp?isbn=0521819415)
19. Sezen, Uzay. "Ants defending extrafloral nectaries of the passion flower (*Passiflora incarnata*)" (https://vimeo.com/34448448). Retrieved 6 January 2012.
20. Merbach, M. 2001. Nectaries in *Nepenthes*. In: C.M. Clarke *Nepenthes of Sumatra and Peninsular Malaysia*. Natural History Publications (Borneo), Kota Kinabalu.
21. Mancuso, S. (2010). "Federico Delpino and the foundation of plant biology" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3115070). *Plant Signaling & Behavior*. **5** (9): 1067–1071. doi:10.4161/psb.5.9.12102 (https://doi.org/10.4161%2Fpsb.5.9.12102). PMC 3115070 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3115070). PMID 21490417 (https://pubmed.ncbi.nlm.nih.gov/21490417).
22. Chalcoff, Vanina (March 2006). "Nectar Concentration and Composition of 26 Species from the Temperate Forest of South America" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2803636). *Annals of Botany*. **97** (3): 413–421. doi:10.1093/aob/mcj043 (https://doi.org/10.1093%2Faob%2Fmcj043). PMC 2803636 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2803636). PMID 16373370 (https://pubmed.ncbi.nlm.nih.gov/16373370).
23. González-Teuber, M.; Heil, M. (2009). "Nectar chemistry is tailored for both attraction of mutualists and protection from exploiters" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2802787). *Plant Signaling & Behavior*. **4** (9): 809–813. doi:10.4161/psb.4.9.9393 (https://doi.org/10.4161%2Fpsb.4.9.9393). PMC 2802787 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2802787). PMID 19847105 (https://pubmed.ncbi.nlm.nih.gov/19847105).
24. Chemical & Engineering News, Vol. 86 No. 35, 1 Sept. 2008, "Two-Faced Flowers", p. 11
25. C.Michael Hogan (2008) *Aesculus californica*, Globaltwitcher.com, ed. N. Stromberg (http://www.globaltwitcher.com/artspec_info.asp?thingid=82383)
26. Park & Thornburg 2009.

Bibliography

Books

- Baker, H.G. and Baker, I. (1975) Studies of nectar-constitution and pollinator-plant coevolution. In Coevolution of animals and plants. Gilbert, L.E. and Raven, P.H. ed. Univ. of Texas Press, Austin, 100–140.
- Esau, K. (1977) Anatomy of seed plants. John Wiley & Sons, New York.
- Nicolson, Susan W.; Nepi, Massimo; Pacini, Ettore, eds. (2007). *Nectaries and Nectar* (https://books.google.com/books?id=0L1cTNozMw8C). Dordrecht: Springer Publications. ISBN 978-1-4020-5937-7.
- Roshchina, V.V. and Roshchina, V.D. (1993) The excretory function of higher plants. Springer-Verlag, Berlin.
- Rudall, Paula J. (2007). *Anatomy of flowering plants: an introduction to structure and development* (https://books.google.com/books?id=cSO8HOKyabgC) (3rd ed.). Cambridge: Cambridge University Press. ISBN 9780521692458.

Articles

- Baker, H.G.; Baker, I. (1973). "Amino acids in nectar and their evolutionary significance". *Nature*. **241** (5391): 543–545. Bibcode:1973Natur.241..543B (https://ui.adsabs.harvard.edu/abs/1973Natur.241..543B). doi:10.1038/241543b0 (https://doi.org/10.1038%2F241543b0). S2CID 4298075 (https://api.semanticscholar.org/CorpusID:4298075).
- Baker, H.G. and Baker, I. (1981) Chemical constituents of nectar in relation to pollination mechanisms and phylogeny. In Biochemical aspects of evolutionary biology. 131–171.
- Beutler, R. (1935) Nectar. Bee World 24:106–116, 128–136, 156–162.
- Burquez, A.; Corbet, S.A. (1991). "Do flowers reabsorb nectar?". *Funct. Ecol*. **5** (3): 369–379. doi:10.2307/2389808 (https://doi.org/10.2307%2F2389808). JSTOR 2389808 (https://www.jstor.org/stable/2389808).
- Carter, C.; Graham, R.; Thornburg, R.W. (1999). "Nectarin I is a novel, soluble germin-like protein expressed in the nectar of Nicotiana sp". *Plant Mol. Biol*. **41** (2): 207–216. doi:10.1023/A:1006363508648 (https://doi.org/10.1023%2FA%3A1006363508648). PMID 10579488 (https://pubmed.ncbi.nlm.nih.gov/10579488). S2CID 18327851 (https://api.semanticscholar.org/CorpusID:18327851).
- Deinzer, M.L.; Tomson, P.M.; Burgett, D.M.; Isaacson, D.L. (1977). "Pyrrolizidine alkaloids: Their occurrence in honey from tansy ragwort (Senecio jacobaea L.)". *Science*. **195** (4277): 497–499. Bibcode:1977Sci...195..497D (https://ui.adsabs.harvard.edu/abs/1977Sci...195..497D). doi:10.1126/science.835011 (https://doi.org/10.1126%2Fscience.835011). PMID 835011 (https://pubmed.ncbi.nlm.nih.gov/835011).
- Ecroyd, C.E.; Franich, R.A.; Kroese, H.W.; Steward, D. (1995). "Volatile constituents of Dactylanthus taylorii flower nectar in relation to flower pollination and browsing by animals". *Phytochemistry*. **40** (5): 1387–1389. doi:10.1016/0031-9422(95)00403-t (https://doi.org/10.1016%2F0031-9422%2895%2900403-t).
- Ferreres, F., Andrade, P., Gil, M.I. and Tomas Barberan, F.A. (1996) Floral nectar phenolics as biochemical markers for the botanical origin of heather honey. Zeitschrift für Lebensmittel Untersuchung und Forschung. 202:40–44.
- Frey-Wyssling, A. (1955) The phloem supply to the nectaries. Acta Bot. Neerl. 4:358–369.
- Griebel, C.; Hess, G. (1940). "The vitamin C content of flower nectar of certain Labiatae". *Zeit. Untersuch. Lebensmitt*. **79**: 168–171. doi:10.1007/BF01662427 (https://doi.org/10.1007%2FBF01662427).
- Heinrich, G (1989). "Analysis of cations in nectars by means of a laser microprobe mass analyser (LAMMA)". *Beitr. Biol. Pflanz*. **64**: 293–308.
- Heslop-Harrison, Y.; Knox, R.B. (1971). "A cytochemical study of the leaf-gland enzymes of insectivorus plants of the genusPinguicula". *Planta*. **96** (3): 183–211. doi:10.1007/bf00387439 (https://doi.org/10.1007%2Fbf00387439). PMID 24493118 (https://pubmed.ncbi.nlm.nih.gov/24493118). S2CID 24535933 (https://api.semanticscholar.org/CorpusID:24535933).
- Jeiter, Julius; Hilger, Hartmut H; Smets, Erik F; Weigend, Maximilian (November 2017). "The relationship between nectaries and floral architecture: a case study in Geraniaceae and Hypseocharitaceae" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5691401). *Annals of Botany*. **120** (5): 791–803. doi:10.1093/aob/mcx101 (https://doi.org/10.1093%2Faob%2Fmcx101). PMC 5691401 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5691401). PMID 28961907 (https://pubmed.ncbi.nlm.nih.gov/28961907).
- Park, Sanggyu; Thornburg, Robert W. (27 January 2009). "Biochemistry of Nectar Proteins" (https://www.researchgate.net/publication/226277343). *Journal of Plant Biology*. **52** (1): 27–34. doi:10.1007/s12374-008-9007-5 (https://doi.org/10.1007%2Fs12374-008-9007-5). S2CID 9157748 (https://api.semanticscholar.org/CorpusID:9157748).
- Peumans, W.J.; Smeets, K.; Van Nerum, K.; Van Leuven, F.; Van Damme, E.J.M. (1997). "Lectin and alliinase are the predominant proteins in nectar from leek (Allium porrum L.) flowers". *Planta*. **201** (3): 298–302. doi:10.1007/s004250050070 (https://doi.org/10.1007%2Fs004250050070). PMID 9129337 (https://pubmed.ncbi.nlm.nih.gov/9129337). S2CID 28957910 (https://api.semanticscholar.org/CorpusID:28957910).

- Rodriguez-Arce, A.L.; Diaz, N. (1992). "The stability of beta-carotene in mango nectar". *J. Agric. Univ. P.R. Rio Piedras, P.R.* **76**: 101–102.
- Scala, J.; Iott, K.; Schwab, W.; Semersky, F.E. (1969). "Digestive secretion of Dionaea muscipula (Venus's-Flytrap)" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC396093). *Plant Physiol*. **44** (3): 367–371. doi:10.1104/pp.44.3.367 (https://doi.org/10.1104%2Fpp.44.3.367). PMC 396093 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC396093). PMID 16657071 (https://pubmed.ncbi.nlm.nih.gov/16657071).
- Smith, L.L.; Lanza, J.; Smith, G.C. (1990). "Amino acid concentrations in extrafloral nectar of Impatiens sultani increase after simulated herbivory". *Ecol. Publ. Ecol. Soc. Am*. **71** (1): 107–115. doi:10.2307/1940251 (https://doi.org/10.2307%2F1940251). JSTOR 1940251 (https://www.jstor.org/stable/1940251).
- Vogel, S. (1969) Flowers offering fatty oil instead of nectar. Abstracts XIth Internatl. Bot. Congr. Seattle.

Websites

- Thornburg, Robert (4 June 2001). "Nectar" (https://web.archive.org/web/20030910162730/http://www.bb.iastate.edu/necgex/Nectar.htm). *Nectary Gene Expression Index*. Department of Biochemistry, Biophysics and Molecular Biology,Iowa State University. Archived from the original (http://www.bb.iastate.edu/necgex/Nectar.htm) on 10 September 2003. Retrieved 11 January 2020.

External links

- Overview and summary of the honey bee (and Nectar) information. (News, Economy, Trade, Problems, etc) (https://web.archive.org/web/20140323210940/http://en.lamieldeabejas.com/la-miel.html)
- Hummingbird Plants Database (http://cubits.org/hummingbirdgardening/db/hummingbirdplants/index.php)