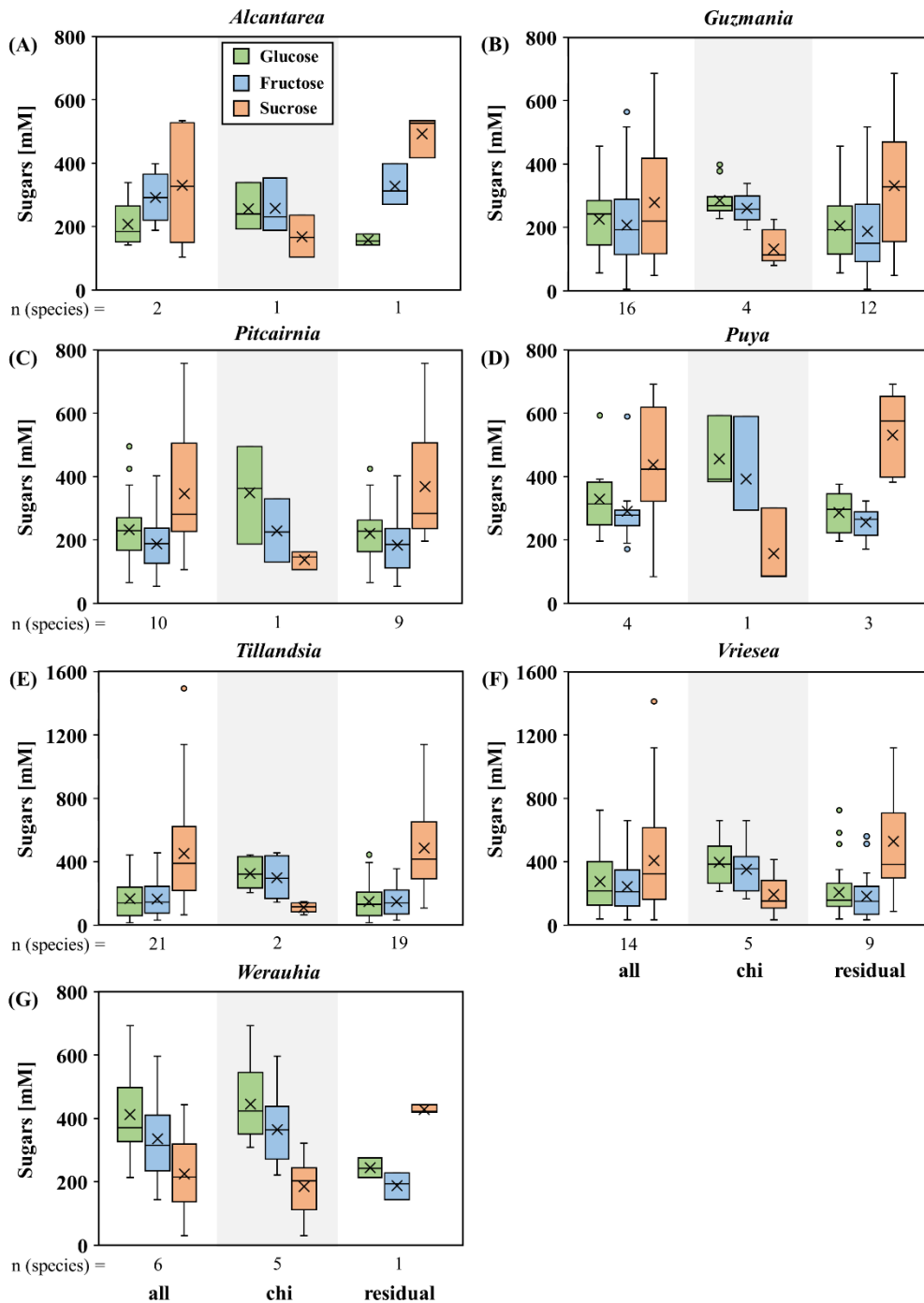


Supplementary Material

What do nectarivorous bats like? Nectar composition in Bromeliaceae with special emphasis on bat-pollinated species

Author: Thomas Göttlinger, Michael Schwerdtfeger, Kira Tiedge, Gertrud Lohaus*

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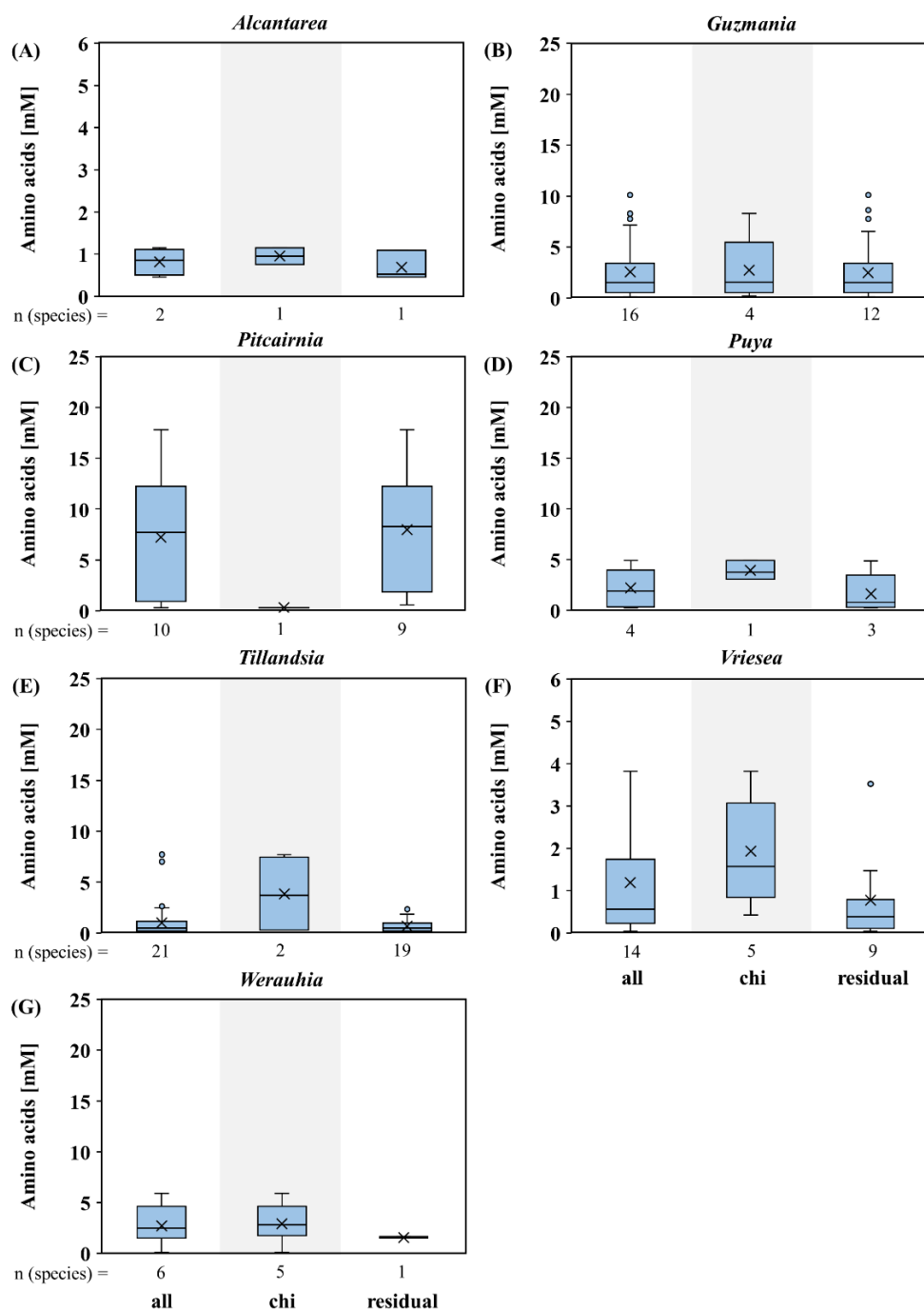
Supplementary Figure S1: Concentration of sugars (glucose, fructose, sucrose) in nectar of seven genera of Bromeliaceae (Alcantarea (A), Guzmania (B), Pitcairnia (C), Puya (D), Tillandsia (E), Vriesea (F), Werauhia (G)) which include bat-pollinated species. The box plots show medians (horizontal line in box) and means (x in box).

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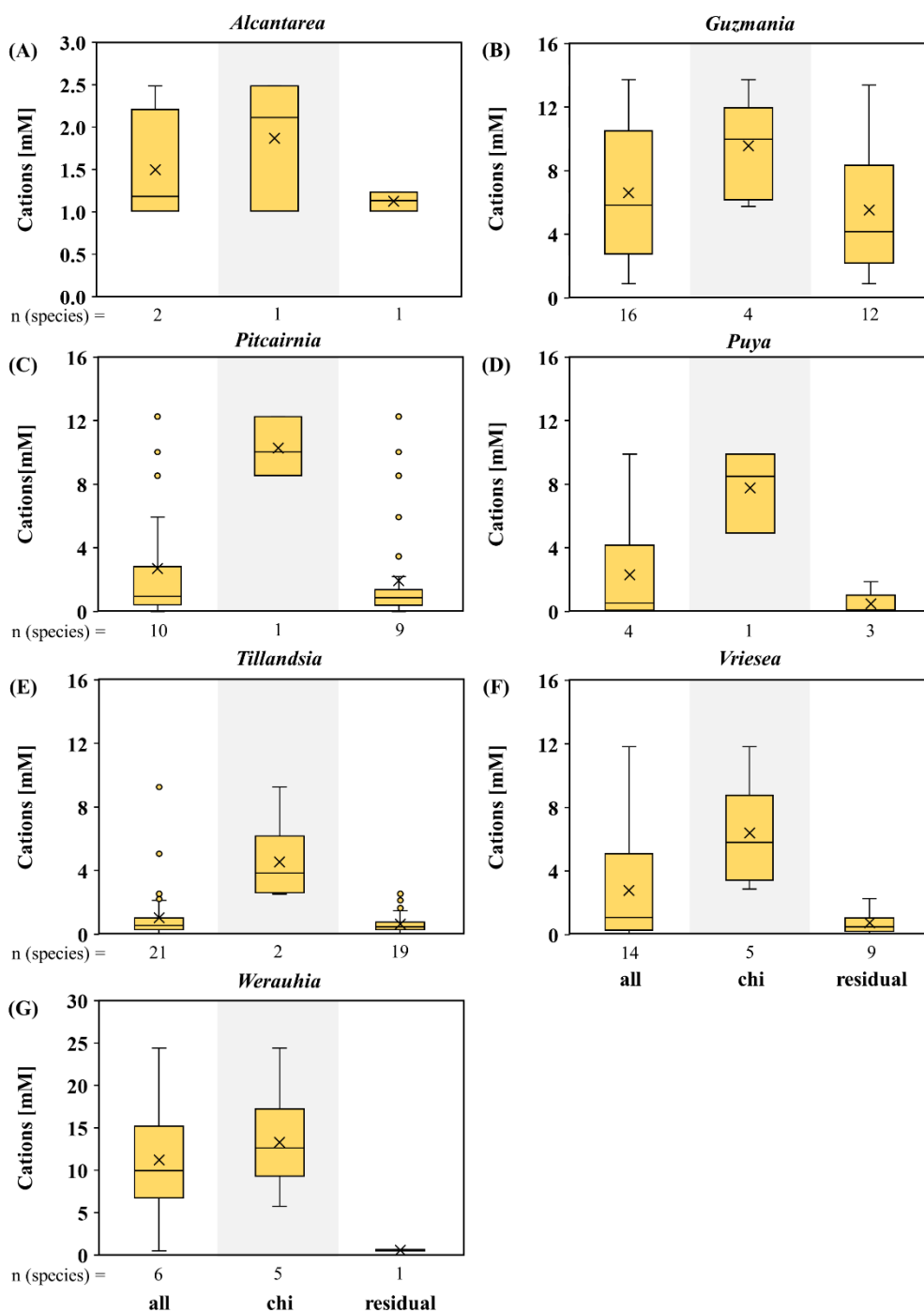
Supplementary Figure S2: Concentration of amino acids (ala, arg, asn, asp, gaba, gln, glu, gly, his, iso, leu, lys, met, phe, pro, ser, thr, trp, tyr, val) in nectar of seven genera of Bromeliaceae (*Alcantarea* (A), *Guzmania* (B), *Pitcairnia* (C), *Puya* (D), *Tillandsia* (E), *Vriesea* (F), *Werauhia* (G)), which include bat-pollinated species. The box plots show medians (horizontal line in box) and means (x in box).

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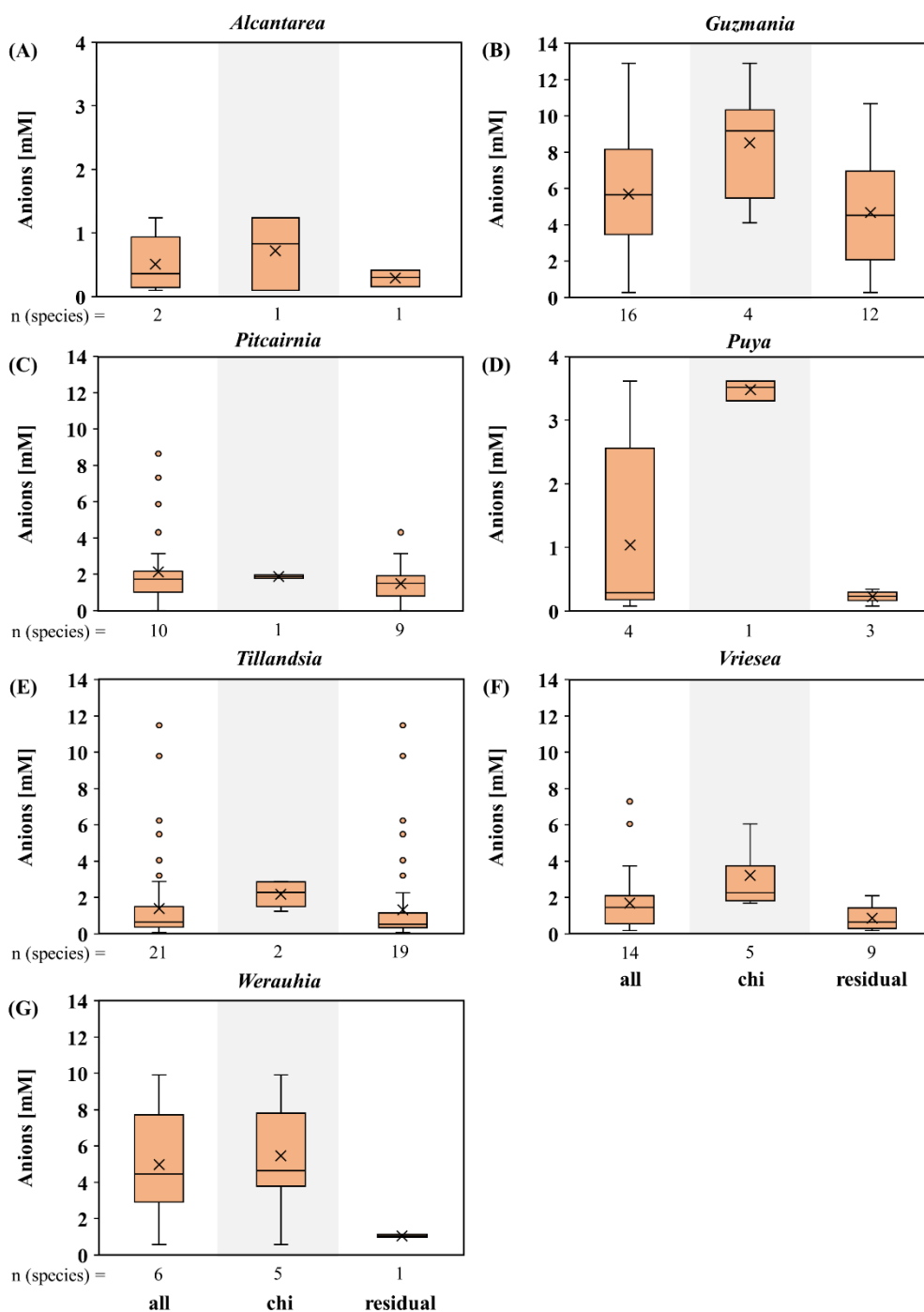
Supplementary Figure S3: Cation concentrations (Ca²⁺, K⁺, Na⁺, Mg²⁺) in nectar of seven genera of Bromeliaceae (*Alcantarea* (A), *Guzmania* (B), *Pitcairnia* (C), *Puya* (D), *Tillandsia* (E), *Vriesea* (F), *Werauhia* (G)), which include bat-pollinated species. The box plots show medians (horizontal line in box) and means (x in box).

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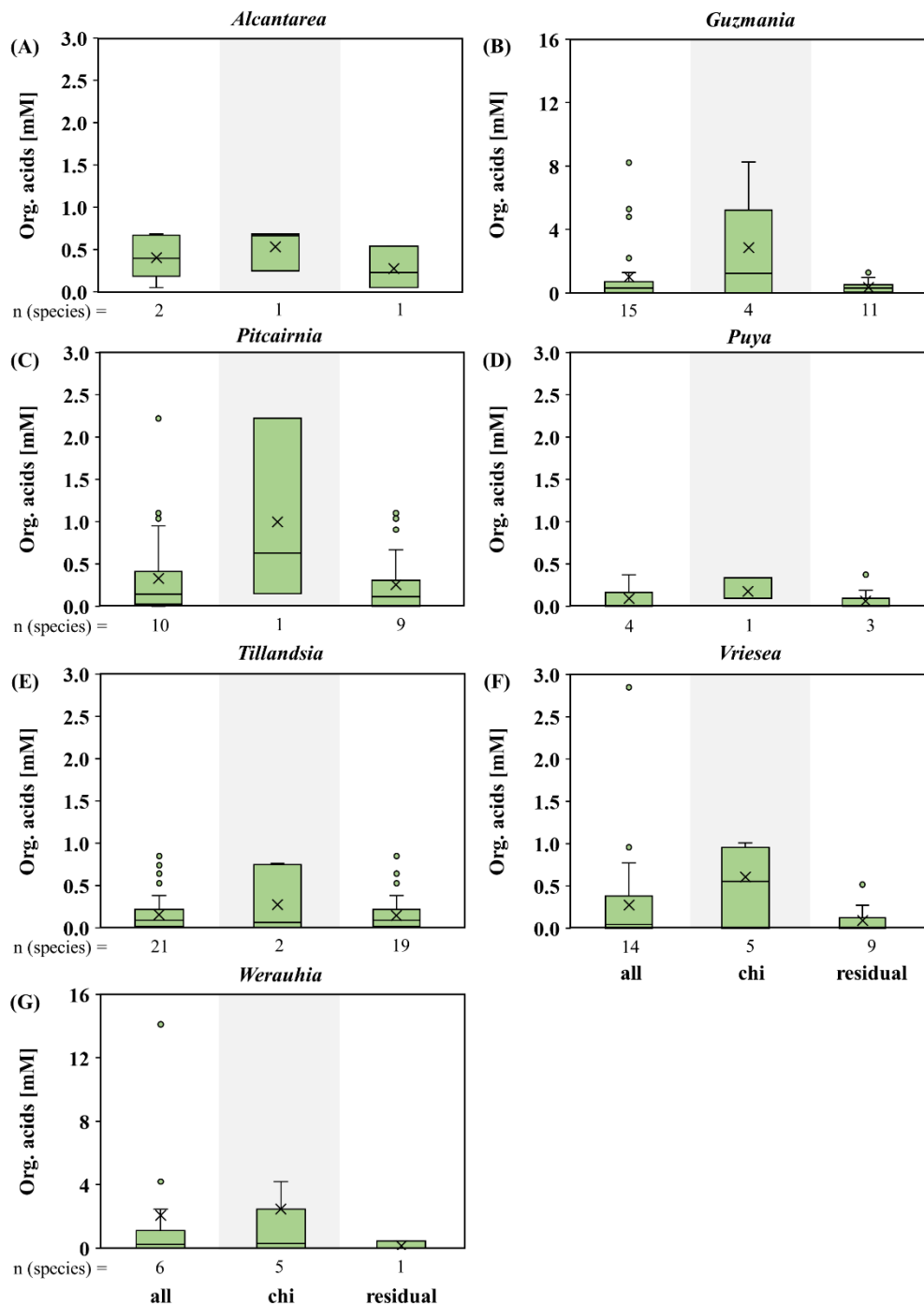
Supplementary Figure S4: Anion concentrations (Cl^- , PO_4^{3-} , SO_4^{2-}) in nectar of seven genera of Bromeliaceae (Alcantarea (A), Guzmania (B), Pitcairnia (C), Puya (D), Tillandsia (E), Vriesea (F), Werauhia (G)), which include bat-pollinated species. The box plots show medians (horizontal line in box) and means (x in box).

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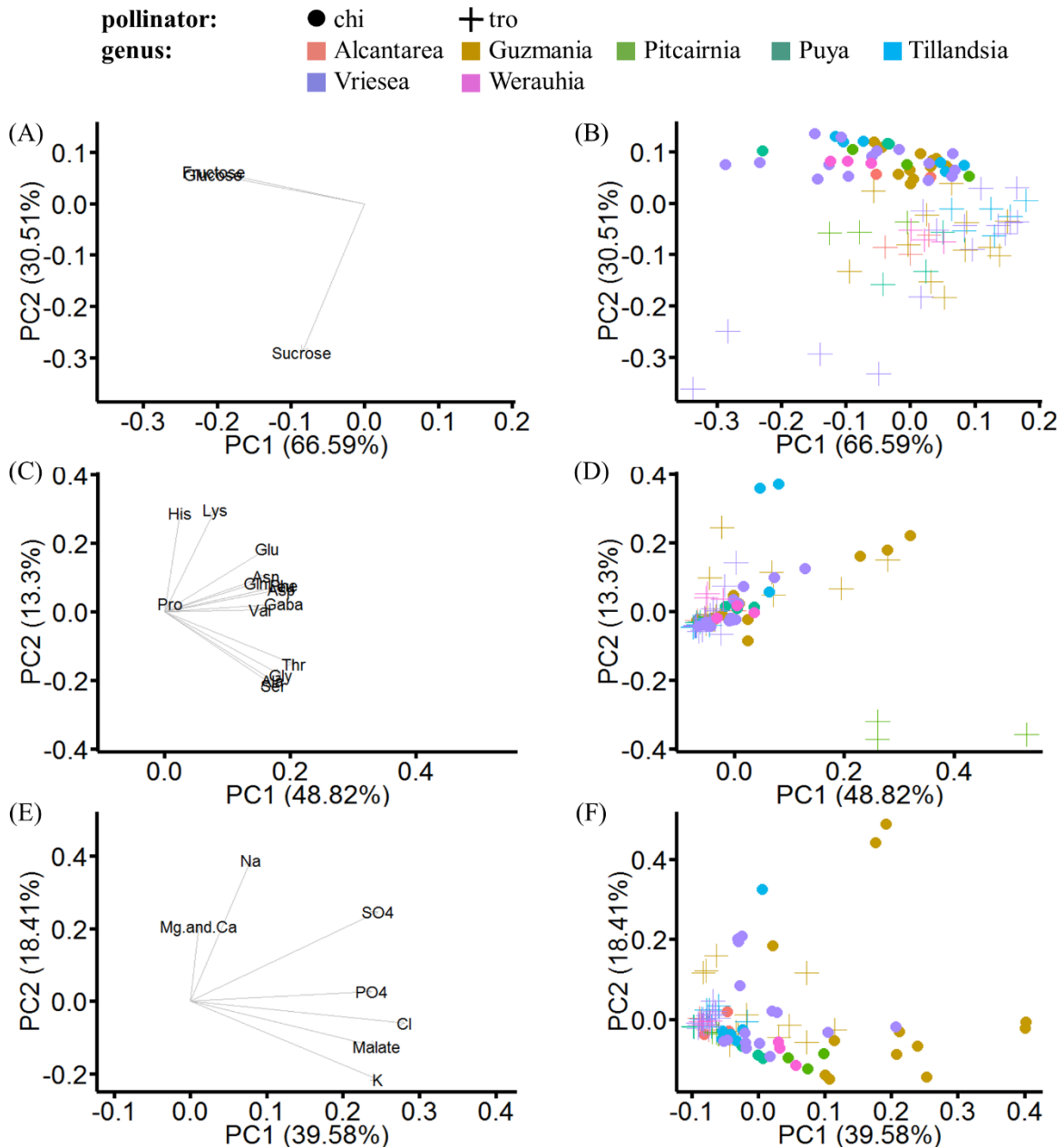
Supplementary Figure S5: Concentration of organic acids (malate, citrate) in nectar of seven Bromeliaceae genera (*Alcantarea* (A), *Guzmania* (B), *Pitcairnia* (C), *Puya* (D), *Tillandsia* (E), *Vriesea* (F), *Werauhia* (G)), which include bat-pollinated species. The box plots show medians (horizontal line in box) and means (x in box).

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Supplementary Figure S6: Loadings and scatterplot of PCA in rotated space (pollinator and taxonomic groups, growth site). In the PCA, the statistically analyzed samples were selected according to their pollinator and to their taxonomic groups (genera). A, C, E: Loading plot, which illustrate the original variables (A: sugars, C: amino acids, E: inorganic ions and organic acids) loaded as vectors in PCA space. B, D, F: Scatterplot of PCA, in which the data (B: sugars, D: amino acids, F: inorganic ions and organic acids) are grouped by pollinator (markings) and genus (colors).

Supplementary Material

What do nectarivorous bats like? Nectar composition in Bromeliaceae with special emphasis on bat-pollinated species

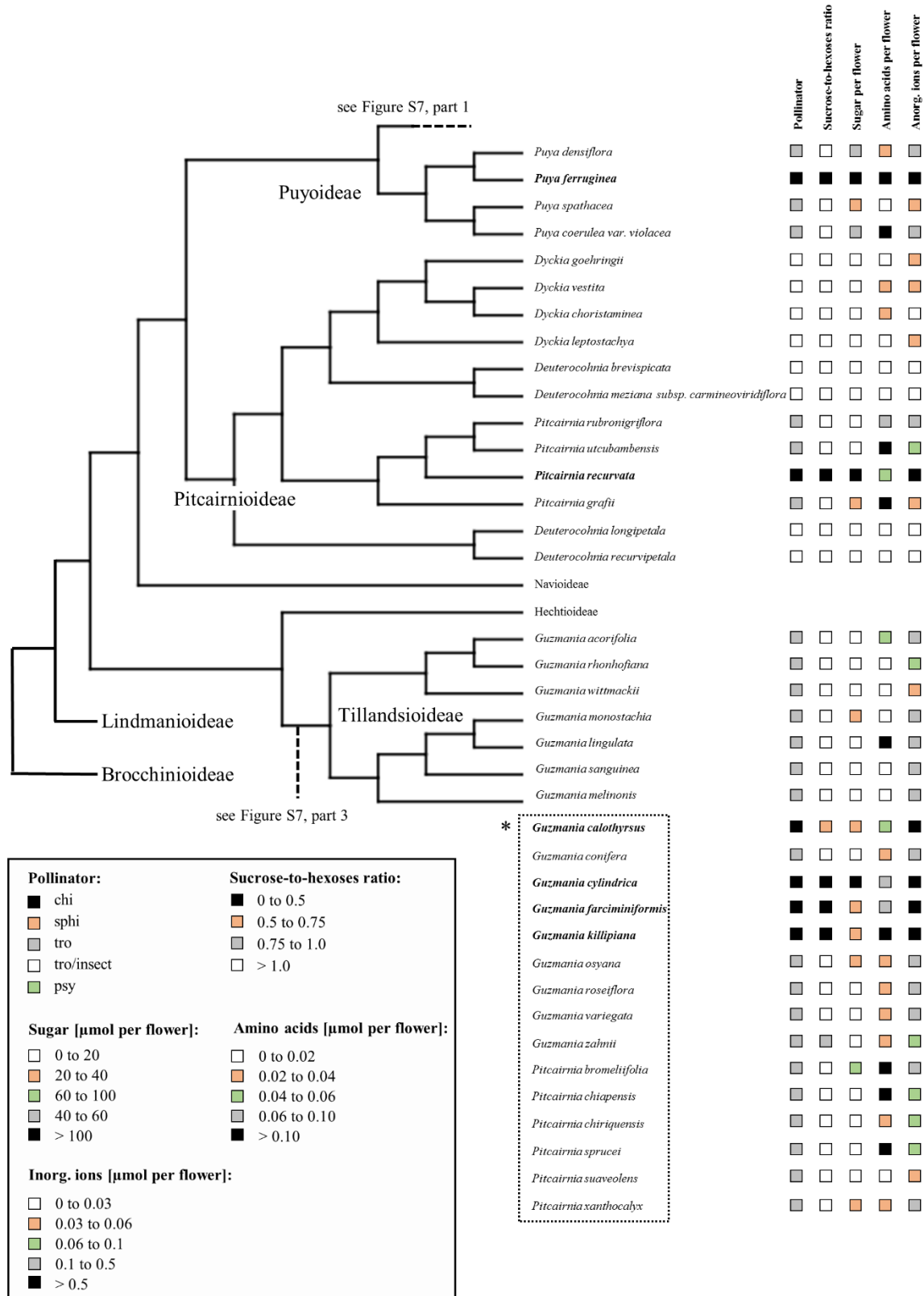
Author: Thomas Göttlinger, Michael Schwerdtfeger, Kira Tiedge, Gertrud Lohaus*

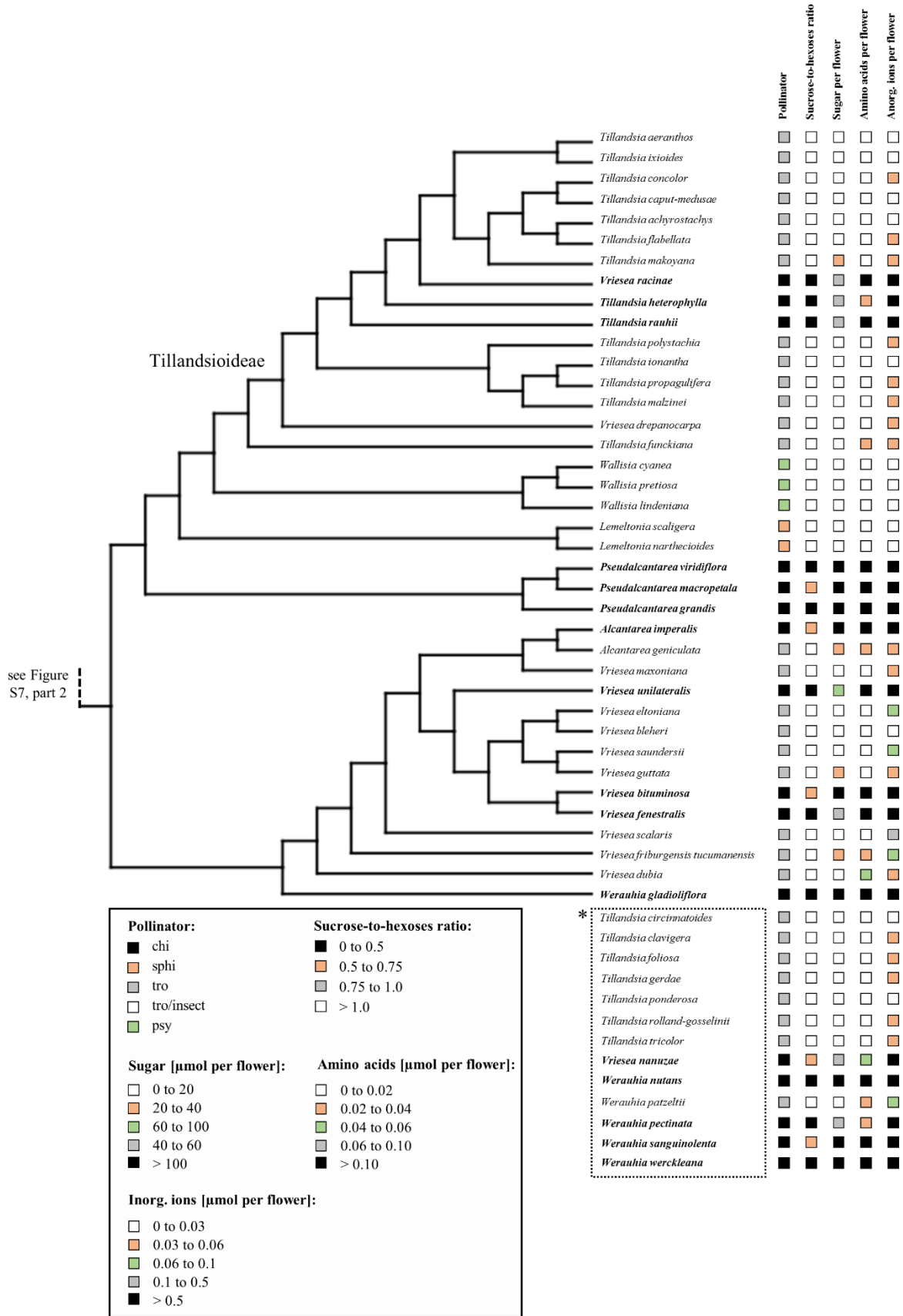
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Supplementary Figure S7: Simplified phylogram of all analyzed Bromeliaceae species combining molecular and morphological findings. The schematic phylogenetic tree is based on 23 different phylogenetic investigations

(Faria et al., 2004; Barfuss et al., 2005; Givnish, 2007; Horres et al., 2007; Hornung-Leoni et al., 2008; Almeida et al., 2009; Rex et al., 2009; Schulte et al., 2009; Chew et al., 2010; Jabaily and Sytsma, 2010; Sass and Specht, 2010; Givnish et al., 2011; Gomes-da-Silva et al., 2012; Versieux et al., 2012; Escobedo-Sarti et al., 2013; Givnish et al., 2014; Costa et al., 2015; Evans et al., 2015; Barfuss et al., 2016; Pinzón et al., 2016; Schütz et al., 2016; Gomes-da-Silva and Souza-Chies, 2018; Moura et al., 2018). The phylogenetic tree was created using Mesquite 3.51. * No molecular phylogenetic data available. Bold type = bat-pollinated bromeliads.





References

- Almeida, V.R., Ferreira da Costa, A., Mantovani, A., Gonçalves-Esteves, V., Oliveira, R., and Forzza, R.C. (2009). Morphological phylogenetics of *Quesnelia* (Bromeliaceae, Bromelioideae). *Systematic Botany* 34, 660–672. doi: 10.1600/036364409790139619
- Barfuss, M.H.J., Samuel, R., Till, W., and Stuessy, T.F. (2005). Phylogenetic relationships in subfamily Tillandsioideae (Bromeliaceae) based on DNA sequence data from seven plastid regions. *Am J Bot* 92, 337–351. doi: 10.3732/ajb.92.2.337
- Barfuss, M.H.J., Till, W., Leme, E., Pinzón, J. P., Manzanare, J. M., Halbritter, H., et al. (2016). Taxonomic revision of Bromeliaceae subfam. Tillandsioideae based on a multi-locus DNA sequence phylogeny and morphology. *Phytotaxa* 279, 1. doi: 10.11646/phytotaxa.279.1.1
- Chew, T., Luna, E. de, and González, D. (2010). Phylogenetic relationships of the Pseudobulbous *Tillandsia* species (Bromeliaceae) inferred from cladistic analyses of ITS 2, 5.8S ribosomal RNA gene, and ETS sequences. *Systematic Botany* 35, 86–95. doi: 10.1600/036364410790862632
- Costa, A.F., Gomes-da-Silva, J., and Wanderley, M.D. (2015). *Vriesea* (Bromeliaceae, Tillandsioideae): A cladistic analysis of eastern Brazilian species based on morphological characters. *Rodriguésia* 66, 429–440. doi: 10.1590/2175-7860201566211
- Escobedo-Sarti, J., Ramírez, I., Leopardi, C., Carnevali, G., Magallón, S., Duno, R., et al. (2013). A phylogeny of Bromeliaceae (Poales, Monocotyledoneae) derived from an evaluation of nine supertree methods. *Journal of Systematics Evolution* 51, 743–757. doi: 10.1111/jse.12044
- Evans, T.M., Jabaily, R.S., Faria, A.P., Sousa, L.O., Wendt, T., and Brown, G.K. (2015). Phylogenetic relationships in Bromeliaceae subfamily Bromelioideae based on chloroplast DNA sequence data. *Systematic Botany* 40, 116–128. doi: 10.1600/036364415X686413
- Faria, A.P., Brown, G.K., and Wendt, T. (2004). Cladistic relationships of *Aechmea* (Bromeliaceae, Bromelioideae) and allied genera. *Annals of the Missouri Botanical Garden* 91, 303–319.
- Givnish, T.J. (2007). Phylogeny, adaptive radiation and historical biogeography of Bromeliaceae inferred from ndhF sequence data. *Aliso: A Journal of Systematic and Evolutionary Botany*: Vol. 23: Iss. 1, Article 4.

- Givnish, T.J., Barfuss, M.H.J., Ee, B. V., Riina, R., Schulte, K., Horres, R., et al. (2011). Phylogeny, adaptive radiation, and historical biogeography in Bromeliaceae: Insights from an eight-locus plastid phylogeny. *Am J Bot* 98, 872–895. doi: 10.3732/ajb.1000059
- Givnish, T.J., Barfuss, M.H.J., van Ee, B., Riina, R., Schulte, K., Horres, R., et al. (2014). Adaptive radiation, correlated and contingent evolution, and net species diversification in Bromeliaceae. *Mol Phylogenet Evol* 71, 55–78. doi: 10.1016/j.ympev.2013.10.010
- Gomes-da-Silva, J., Alves da Costa Vargens, F., do Carmo de Oliveira Arruda, R., and Ferreira da Costa, A. (2012). A morphological cladistic analysis of the *Vriesea corcovadensis* group (Bromeliaceae: Tillandsioideae), with anatomical descriptions: New evidence of the non-monophyly of the genus. *Systematic Botany* 37, 641–654. doi: 10.1600/036364412X648599
- Gomes-da-Silva, J., and Souza-Chies, T.T. (2018). What actually is *Vriesea*? A total evidence approach in a polyphyletic genus of Tillandsioideae (Bromeliaceae, Poales). *Cladistics* 34, 181–199. doi: 10.1111/cla.12200
- Hornung-Leoni, C.T., Sosa, V., and Hornung-Leoni, C.T. (2008). Morphological phylogenetics of *Puya* subgenus *Puya* (Bromeliaceae). *Bot J Linn Soc* 156, 93–110. doi: 10.1111/j.1095-8339.2007.00740.x
- Horres, R., Schulte, K., Weising, K., and Zizka, G. (2007). Systematics of Bromelioideae (Bromeliaceae) - Evidence from molecular and anatomical studies. *Aliso* 23, 27–43. doi: 10.5642/aliso.20072301.05
- Jabaily, R.S., and Sytsma, K.J. (2010). Phylogenetics of *Puya* (Bromeliaceae): Placement, major lineages, and evolution of Chilean species. *Am J Bot* 97, 337–356. doi: 10.3732/ajb.0900107
- Moura, M.N., Forzza, R.C., and Cristiano, M.P. (2018). Reconstruction of ancestral genome size in Pitcairnioideae (Bromeliaceae): What can genome size tell us about the evolutionary history of its five genera? *Bot J Linn Soc* 186, 321–333. doi: 10.1093/botlinnean/box101
- Pinzón, J.P., Ramírez-Morillo, I.M., Carnevali, G., Barfuss, M.H.J., Till, W., Tun, J., et al. (2016). Phylogenetics and evolution of the *Tillandsia utriculata* complex (Bromeliaceae, Tillandsioideae) inferred from three plastid DNA markers and the ETS of the nuclear ribosomal DNA. *Bot J Linn Soc* 181, 362–390. doi: 10.1111/boj.12425
- Rex, M., Schulte, K., Zizka, G., Peters, J., Vásquez, R., Ibisch, P.L., et al. (2009). Phylogenetic analysis of *Fosterella* L.B. Sm. (Pitcairnioideae, Bromeliaceae) based on four chloroplast DNA regions. *Mol Phylogenet Evol* 51, 472–485. doi: 10.1016/j.ympev.2009.01.001

- Sass, C., and Specht, C.D. (2010). Phylogenetic estimation of the core Bromelioids with an emphasis on the genus *Aechmea* (Bromeliaceae). *Mol Phylogenet Evol* 55, 559–571. doi: 10.1016/j.ympev.2010.01.005
- Schulte, K., Barfuss, M.H.J., and Zizka, G. (2009). Phylogeny of Bromelioideae (Bromeliaceae) inferred from nuclear and plastid DNA loci reveals the evolution of the tank habit within the subfamily. *Mol Phylogenet Evol* 51, 327–339. doi: 10.1016/j.ympev.2009.02.003
- Schütz, N., Krapp, F., Wagner, N., and Weising, K. (2016). Phylogenetics of Pitcairnioideae s.s. (Bromeliaceae): Evidence from nuclear and plastid DNA sequence data. *Bot J Linn Soc* 181, 323–342. doi: 10.1111/boj.12403
- Versieux, L.M., Barbará, T., Wanderley, M.D., Calvente, A., Fay, M.F., and Lexer, C. (2012). Molecular phylogenetics of the Brazilian giant bromeliads (*Alcantarea*, Bromeliaceae): Implications for morphological evolution and biogeography. *Mol Phylogenet Evol* 64, 177–189. doi: 10.1016/j.ympev.2012.03.015

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Supplementary Table S1: Overview of some main features of all examined Bromeliaceae species.

Species	Subfamily	Locality	Pollination type	Flower Color	Length of corolla tube [mm]	CAM or C3 (1)
<i>Aechmea abbreviata</i> L.B.Sm.	Brom.	Gö	Tro (2)	yellow	15	CAM
<i>Aechmea aquilega</i> (Salisb.) Griseb.	Brom.	Gö	Tro (3)	yellow	20	CAM
<i>Aechmea bruggeri</i> Leme	Brom.	Heid	Tro (4)	purple	10	CAM
<i>Aechmea cylindrata</i> Lindm.	Brom.	Boc	Tro (5)	yellow	15	CAM
<i>Aechmea distichantha</i> Lem.	Brom.	Ber	Tro (6)	purple	10	CAM
<i>Aechmea eurycorymbus</i> Harms	Brom.	Ber	Tro (2)	orange	25	CAM
<i>Aechmea fasciata</i> (Lindl.) Baker	Brom.	Wup	Tro (7)	purple	35	CAM
<i>Aechmea gamosepala</i> Wittm.	Brom.	Wup	Tro (5)	blue	25	CAM
<i>Aechmea gracilis</i> Lindm.	Brom.	Gö	Tro (2)	purple	30	CAM
<i>Aechmea leptantha</i> (Harms) Leme & J.A.Siqueira	Brom.	Heid	Tro (8)	yellow	35	CAM
<i>Aechmea marauensis</i> Leme	Brom.	Heid	Tro (2)	purple	25	CAM
<i>Aechmea miniata discolor</i> (Beer) Beer ex Baker	Brom.	Wup	Tro (9)	blue	20	CAM
<i>Aechmea nudicaulis</i> (L.) Griseb.	Brom.	Boc	Tro (5)	yellow	15	CAM
<i>Aechmea penduliflora</i> Andre	Brom.	Heid	Tro (2)	orange	20	CAM
<i>Aechmea pyramidalis</i> Benth.	Brom.	Boc	Tro (2)	white	5	CAM
<i>Aechmea racinae</i> L.B.Sm.	Brom.	Wup	Tro (9)	yellow	15	CAM
<i>Aechmea recurvata</i> (Klotzsch) L.B.Sm.	Brom.	Gö	Tro (5)	purple	35	CAM
<i>Aechmea weilbachii</i> Didr.	Brom.	Gö	Tro (9)	purple	20	CAM
<i>Alcantarea geniculata</i> (Vell.) Harms	Till.	Heid	Tro (2)	yellow	40	C3
<i>Alcantarea imperialis</i> (Carriere) Harms	Till.	Heid	Chi (10)	matt-white	80	C3-CAM
<i>Billbergia amoena</i> (G.Lodd.) Lindl.	Brom.	Gö	Tro (5)	green	45	CAM
<i>Billbergia brasiliensis</i> L.B.Sm.	Brom.	Gö	Tro (2)	blue	25	CAM
<i>Billbergia buchholtzii</i> Mez	Brom.	Heid	Tro (2)	purple	35	CAM
<i>Billbergia distachia</i> (Vell.) Mez	Brom.	Gö	Tro 3	green	50	CAM
<i>Billbergia euphemiae</i> E.Morren	Brom.	Heid	Tro (11)	blue	40	C3
<i>Billbergia fosteriana</i> L.B.Sm.	Brom.	Gö	Tro (2)	blue	60	CAM
<i>Billbergia morelii</i> Brongn.	Brom.	Wup	Tro (8)	blue	50	CAM
<i>Billbergia nutans</i> H.Wendl. ex Regel	Brom.	Wup	Tro (2)	green	40	CAM
<i>Billbergia pyramidalis</i> (Sims) Lindl.	Brom.	Gö	Tro (8)	red	40	CAM
<i>Billbergia reichardtii</i> Wawra	Brom.	Heid	Tro (2)	purple	35	CAM
<i>Billbergia viridiflora</i> H.Wendl.	Brom.	Ber	Tro (3)	green	50	CAM
<i>Billbergia vittata</i> Brongn. ex C.Morel	Brom.	Gö	Tro (12)	blue	50	CAM
<i>Deuterocohnia brevispicata</i> Rauh & L.Hrom.	Pitc.	Ber	Tro /Ent (13)	pink	25	CAM
<i>Deuterocohnia longipetala</i> (Baker) Mez	Pitc.	Ber	Tro /Ent (2)	pink	40	CAM
<i>Deuterocohnia meziana</i> subsp. <i>carmineoviridiflora</i> (Rauh) N.Schutz	Pitc.	Heid	Tro /Ent (2)	green	50	CAM
<i>Deuterocohnia recurvipetala</i> E.Gross	Pitc.	Heid	Tro /Ent (2)	yellow	10	CAM
<i>Dyckia choristaminea</i> Mez	Pitc.	Heid	Tro /Ent (14)	yellow	10	CAM
<i>Dyckia goehringii</i> E.Gross & Rauh	Pitc.	Heid	Tro /Ent (14)	orange	10	CAM
<i>Dyckia leptostachya</i> Baker	Pitc.	Heid	Tro /Ent (14)	yellow	10	CAM
<i>Dyckia vestiata</i> Hassl.	Pitc.	Heid	Tro /Ent (14)	yellow	10	CAM
<i>Guzmania acorifolia</i> (Griseb.) Mez	Till.	Ber	Tro (2)	white	15	C3
<i>Guzmania calothyrsus</i> Mez	Till.	Wup	Chi (15)	matt-white	15	C3
<i>Guzmania conifera</i> (André) André ex Mez	Till.	Gö	Tro (2)	yellow	30	C3
<i>Guzmania cylindrica</i> L.B.Sm.	Till.	Gö	Chi (2)	matt-white	50	C3
<i>Guzmania farcimiformis</i> H.Luther	Till.	Gö	Chi (2)	matt-white	15	C3
<i>Guzmania killipiana</i> L.B.Sm.	Till.	Wup	Chi (9)	matt-white	30	C3
<i>Guzmania lingulata</i> (L.) Mez	Till.	Heid	Tro (16)	yellow	50	C3
<i>Guzmania melinonis</i> Regel	Till.	Gö	Tro (15)	yellow	30	C3
<i>Guzmania monostachia</i> (L.) Rusby ex Mez	Till.	Wup	Tro (3)	white	25	C3-CAM
<i>Guzmania osyana</i> (E.Morren) Mez	Till.	Gö	Tro (2)	yellow	35	C3
<i>Guzmania rhonhofiana</i> Harms	Till.	Wien	Tro (2)	white	25	C3
<i>Guzmania roseiflora</i> Rauh	Till.	Boc	Tro (2)	yellow	15	C3

<i>Guzmania sanguinea</i> (Andre) Andre ex Mez	Till.	Gö	Tro (2)	yellow	75	C3
<i>Guzmania variegata</i> L.B.Sm.	Till.	Ber	Tro (2)	red	30	C3
<i>Guzmania wittmackii</i> (Andre) Andre ex Mez	Till.	Gö	Tro (2)	white	90	C3
<i>Guzmania zahni</i> (Hook.f.) Mez	Till.	Wup	Tro (9)	yellow	30	C3-CAM
<i>Hohenbergia correia-araujo</i> E.Pereira & Moutinho	Brom.	Ber	Tro (2)	yellow	10	CAM
<i>Hohenbergia leopoldo-horstii</i> E.Gross. Rauh & Leme	Brom.	Gö	Tro (2)	purple	10	CAM
<i>Hohenbergia rosea</i> L.B.Sm. & Read	Brom.	Heid	Tro (2)	purple	10	CAM
<i>Hohenbergia stellata</i> Schult. & Schult.f.	Brom.	Ber	Tro (2)	purple	10	CAM
<i>Hohenbergia utriculosa</i> Ule	Brom.	Ber	Tro (2)	purple	10	CAM
<i>Lemeltonia narthecioides</i> (C.Presl) Barfuss & W.Till	Till.	Gö	Sphi (2)	white	10	C3-CAM
<i>Lemeltonia scaligera</i> (Mez & Sodiro) Barfuss & W.Till	Till.	Gö	Sphi (2)	white	20	C3
<i>Neoregelia ampullacea</i> (E.Morren) L.B.Sm.	Brom.	Boc	Tro (11)	purple	15	CAM
<i>Neoregelia carolinae</i> (Beer) L.B.Sm.	Brom.	Wup	Psy (2)	purple	35	CAM
<i>Neoregelia compacta</i> (Mez) L.B.Sm.	Brom.	Gö	Tro (11)	pink	15	CAM
<i>Neoregelia farinosa</i> (Ule) L.B.Sm.	Brom.	Gö	Psy (2)	purple	50	CAM
<i>Neoregelia fosteriana</i> L.B.Sm.	Brom.	Gö	Tro (2)	purple	20	CAM
<i>Neoregelia johannis</i> (Carrière) L.B.Sm.	Brom.	Ber	Tro (8)	white	25	CAM
<i>Neoregelia kautskyi</i> E.Pereira	Brom.	Gö	Tro (2)	white	20	CAM
<i>Neoregelia laevis</i> (Mez) L.B.Sm.	Brom.	Heid	Tro (2)	white	20	CAM
<i>Neoregelia martinellii</i> W.Weber	Brom.	Ber	Tro (2)	white	20	CAM
<i>Neoregelia olens</i> (Hook.f.) L.B.Sm.	Brom.	Gö	Psy (2)	purple	40	CAM
<i>Neoregelia pineliana</i> (Lem.) L.B.Sm.	Brom.	Ber	Psy (2)	purple	40	CAM
<i>Neoregelia seideliana</i> L.B.Sm. & Reitz	Brom.	Gö	Psy (2)	purple	40	CAM
<i>Neoregelia wilsoniana</i> M.B.Foster	Brom.	Gö	Tro (2)	white	30	CAM
<i>Nidularium amazonicum</i> (Baker) Linden & É.Morren ex Lindm.	Brom.	Wup	Tro (2)	white	20	C3-CAM
<i>Nidularium innocentii</i> Lem.	Brom.	Gö	Tro (5)	white	50	C3
<i>Nidularium procerum</i> Lindm.	Brom.	Wup	Tro (7)	blue	20	CAM
<i>Nidularium purpureum</i> Beer	Brom.	Wup	Tro (2)	pink	20	CAM
<i>Nidularium rutilans</i> É.Morren	Brom.	Gö	Tro (5)	pink	10	CAM
<i>Nidularium scheremetiewii</i> Regel	Brom.	Gö	Tro (11)	blue	55	CAM
<i>Nidularium utriculosum</i> Ule	Brom.	Wup	Tro (2)	blue	30	CAM
<i>Pitcairnia bromeliifolia</i> L'Heritier	Pitc.	Gö	Tro (2)	yellow	40	C3
<i>Pitcairnia chiapensis</i> Miranda	Pitc.	Gö	Tro (2)	yellow	40	C3-CAM
<i>Pitcairnia chiriquensis</i> L.B.Sm.	Pitc.	Ber	Tro (2)	orange	45	C3
<i>Pitcairnia grafii</i> Rauh	Pitc.	Ber	Tro (2)	orange	50	C3
<i>Pitcairnia recurvata</i> (Scheidw.) K.Koch	Pitc.	Ber	Chi (2)	matt-white	80	C3
<i>Pitcairnia rubronigriflora</i> Rauh	Pitc.	Ber	Tro (2)	red	50	C3
<i>Pitcairnia sprucei</i> Baker	Pitc.	Ber	Tro (5)	red	60	C3
<i>Pitcairnia suaveolens</i> Lindl.	Pitc.	Ber	Tro (2)	yellow	50	C3
<i>Pitcairnia utcubambensis</i> Rauh	Pitc.	Wien	Tro (2)	red	60	C3
<i>Pitcairnia xanthocalyx</i> Mart.	Pitc.	Ber	Tro (2)	yellow	45	C3
<i>Pseudalcantarea grandis</i> (Schltld.) Pinzón & Barfuss	Pitc.	Ber	Chi (17)	matt-white	90	C3
<i>Pseudalcantarea macropetala</i> (Wawra) Pinzón & Barfuss	Pitc.	Gö	Chi (18)	matt-white	30	C3-CAM
<i>Pseudalcantarea viridiflora</i> (Beer) Pinzón & Barfuss	Pitc.	Gö	Chi (7)	matt-white	50	C3
<i>Puya coerulea</i> var. <i>violacea</i> (Brongn.) L.B.Sm. & Looser	Pitc.	Heid	Tro (11)	blue	45	C3-CAM
<i>Puya densiflora</i> Harms	Pitc.	Heid	Tro (2)	purple	80	CAM
<i>Puya ferruginea</i> (Ruiz & Pav.) L.B.Sm.	Pitc.	Heid	Chi (15)	matt-white	80	C3-CAM
<i>Puya spathacea</i> (Griseb.) Mez	Pitc.	Heid	Tro (11)	blue	30	C3
<i>Quesnelia edmundoi</i> L.B.Sm.	Brom.	Gö	Tro (2)	white	20	CAM
<i>Quesnelia lateralis</i> Wawra	Brom.	Gö	Tro (2)	blue	35	CAM
<i>Quesnelia quesneliana</i> (Brongn.) L.B.Sm.	Brom.	Gö	Tro (19)	purple	30	CAM
<i>Tillandsia achyrostachys</i> E.Morren	Till.	Gö	Tro (20)	green	55	CAM
<i>Tillandsia aeranthos</i> (Loisel.) Desf.	Till.	Gö	Tro (21)	purple	20	CAM
<i>Tillandsia caput-medusae</i> E.Morren	Till.	Gö	Tro (2)	purple	40	CAM
<i>Tillandsia circinnatoides</i> Matuda	Till.	Gö	Tro (2)	purple	40	CAM
<i>Tillandsia clavigera</i> Mez	Till.	Heid	Tro (2)	purple	20	C3
<i>Tillandsia concolor</i> L.B.Sm.	Till.	Gö	Tro (2)	pink	60	CAM
<i>Tillandsia flabellata</i> Baker	Till.	Gö	Tro (9)	purple	50	CAM
<i>Tillandsia foliosa</i> M.Martens & Galeotti	Till.	Gö	Tro (2)	purple	40	CAM
<i>Tillandsia funckiana</i> Baker	Till.	Wien	Tro (2)	red	45	CAM
<i>Tillandsia gerdæ</i> Ehlers	Till.	Gö	Tro (2)	purple	45	CAM
<i>Tillandsia heterophylla</i> E.Morren	Till.	Gö	Chi (22)	matt-white	70	C3
<i>Tillandsia ionantha</i> Planch.	Till.	Gö	Tro (2)	purple	50	CAM
<i>Tillandsia ixioides</i> Griseb.	Till.	Gö	Tro (2)	yellow	25	CAM
<i>Tillandsia makoyana</i> Baker	Till.	Heid	Tro (2)	purple	35	CAM
<i>Tillandsia malzinei</i> (E.Morren) Baker	Till.	Gö	Tro (2)	white	50	C3
<i>Tillandsia polystachia</i> (L.) L.	Till.	Gö	Tro (2)	purple	40	CAM

<i>Tillandsia ponderosa</i> L.B.Sm.	Till.	Heid	Tro (9)	purple	65	C3-CAM
<i>Tillandsia propagulifera</i> Rauh	Till.	Heid	Tro (2)	purple	30	CAM
<i>Tillandsia rauhii</i> L.B.Sm.	Till.	Ber	Chi (2)	purple	90	C3-CAM
<i>Tillandsia roland-gosselinii</i> Mez	Till.	Boc	Tro (2)	purple	30	CAM
<i>Tillandsia tricolor</i> Schltdl. & Cham.	Till.	Ber	Tro (2)	purple	40	CAM
<i>Vriesea bituminosa</i> Wawra	Till.	Ber	Chi (9)	matt-white	55	C3
<i>Vriesea bleheri</i> Roeth & W. Weber	Till.	Gö	Tro (2)	yellow	55	C3
<i>Vriesea drepanocarpa</i> (Baker) Mez	Till.	Gö	Tro (8)	yellow	40	C3
<i>Vriesea dubia</i> (L.B.Sm.) L.B.Sm.	Till.	Gö	Tro (2)	white	20	C3
<i>Vriesea eltoniana</i> E.Pereira & Ivo	Till.	Gö	Tro (2)	yellow	30	C3
<i>Vriesea fenestralis</i> Linden & Andre	Till.	Gö	Chi (5)	matt-white	40	C3-CAM
<i>Vriesea friburgensis tucumanensis</i> (Mez) L.B.Sm.	Till.	Gö	Tro (5)	yellow	35	C3
<i>Vriesea guttata</i> Linden & Andre	Till.	Wup	Tro (2)	yellow	25	C3
<i>Vriesea maxoniana</i> (L.B.Sm.) L.B.Sm.	Till.	Ber	Tro (15)	yellow	50	C3
<i>Vriesea nanuzae</i> Leme	Till.	Heid	Chi (23)	matt-white	30	C3
<i>Vriesea racinae</i> L.B.Sm.	Till.	Ber	Chi (2)	matt-white	40	C3
<i>Vriesea saundersii</i> (Carriere) E.Morren	Till.	Heid	Tro (2)	yellow	50	C3
<i>Vriesea scalaris</i> E.Morren	Till.	Ber	Tro (9)	yellow	55	C3-CAM
<i>Vriesea unilateralis</i> (Baker) Mez	Till.	Gö	Chi (9)	matt-white	30	C3
<i>Wallisia cyanea</i> Barfuss & W.Till	Till.	Gö	Psy (2)	purple	55	C3
<i>Wallisia lindeniana</i> (Regel) E.Morren	Till.	Gö	Psy (2)	blue	45	C3
<i>Wallisia pretiosa</i> (Mez) Barfuss & W.Till	Till.	Gö	Psy (2)	purple	52	C3
<i>Werauhia gladioliflora</i> (H.Wendland) J.R.Grant	Till.	Gö	Chi (15)	matt-white	40	C3
<i>Werauhia nutans</i> (L.B.Sm.) J.R.Grant	Till.	Gö	Chi (9)	matt-white	35	C3
<i>Werauhia patzeltii</i> (Rauh) J.R.Grant	Till.	Gö	Tro (2)	white	15	C3
<i>Werauhia pectinata</i> (L.B.Sm.) J.R.Grant	Till.	Gö	Chi (2)	matt-white	35	C3
<i>Werauhia sanguinolenta</i> (Linden ex Cogniaux & Marchal) J.R.Grant	Till.	Gö	Chi (9)	matt-white	30	C3
<i>Werauhia werckleana</i> (Mez) J.R.Grant	Till.	Gö	Chi (2)	matt-white	40	C3

Subfamily: Brom. = Bromelioideae, Till. = Tillandsioideae, Pitc. = Pitcairnioideae. Botanical garden/University: Ber = Berlin (Germany), Boc = Bochum (Germany), Gö = Göttingen (Germany), Heid = Heidelberg (Germany), Wien (Austria), Wup = Wuppertal (Germany). Pollination type: Chi = chiropterophilous, Sphi = sphingophilous, Tro = trochilophilous, Ent = entomophilous, Psy = psychophilous. Bold type = bat-pollinated bromeliads.

References

1. Crayn, D.M., Winter, K., Schulte, K., Smith, J.A. (2015). Photosynthetic pathways in Bromeliaceae: Phylogenetic and ecological significance of CAM and C3 based on carbon isotope ratios for 1893 species. *Bot J Linn Soc* 178(2):169–221. doi:10.1111/boj.12275
2. classified via flower morphology and pollination syndrome.
3. Zanata, T.B. (2014). Macroecologia das interações entre plantas e aves nectarívoras. PhD thesis. Universidade Federal do Paraná.
4. Dias, L.C.D. (2014). Biologia reprodutiva de *Aechmea bruggeri* Leme (Bromeliaceae): uma espécie endêmica da Floresta Atlântica ameaçada de extinção. PhD thesis. Universidade Federal de Juiz de Fora.
5. Martín González, A.M., Dalsgaard, B., Nogués-Bravo, D., Graham, C.H., Schleuning, M., Maruyama, P.K., et al. (2015). The macroecology of phylogenetically structured hummingbird-plant networks. *Global Ecology and Biogeography* 24(11):1212–24. doi:10.1111/geb.12355

6. Pierce, S., Gottsberger, R. (2001). Observations of hummingbird visits to bromeliads at the Cerro Jefe cloud forest, Panama. *Journal of the Bromeliad Society*: 25–34.
7. Benzing, D.H. (2000). *Bromeliaceae: Profile of an adaptive radiation*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511565175
8. Tavares, D.C., Freitas, L., Gaglianone, M.C. (2016). Data compilation of hummingbird-pollinated plant species in the Brazilian Atlantic rain forest. *Journal of Tropical Ecology*. 32(04):335-339. doi:10.1594/PANGAEA.859056
9. Krömer, T., Kessler, M., Lohaus, G., Schmidt-Lebuhn, A.N. (2008). Nectar sugar composition and concentration in relation to pollination syndromes in Bromeliaceae. *Plant Biol (Stuttg)* 10(4):502–11. doi:10.1111/j.1438-8677.2008.00058.x
10. Santos, V.L., Versieux, L.M., Wanderley, M.D., Da Luz, C.F. (2017). Pollen morphology of *Alcantarea* giant bromeliads (Bromeliaceae, Tillandsioideae). *Grana* 57(1-2):117–36. doi:10.1080/00173134.2017.1310920
11. Martinelli, G. (1995). Reproductive biology of Bromeliaceae in the Atlantic rainforest of southeastern Brazil. PhD thesis. University of St Andrews.
12. Rodrigues, L.C., Rodrigues, M. (2014). Flowers visited by hummingbirds in the open habitats of the southeastern Brazilian mountaintops: Species composition and seasonality. *Braz J Biol* 74(3):659–76. doi:10.1590/bjb.2014.0097
13. Schütz, N. (2012). Systematics and evolution of the genus *Deuterocohnia* Mez (Bromeliaceae). PhD thesis. Universität Kassel.
14. Krapp, F., Barros Pinangé, D.S. de, Benko-Iseppon, A.M., Leme, E.M., Weising, K. (2014). Phylogeny and evolution of *Dyckia* (Bromeliaceae) inferred from chloroplast and nuclear sequences. *Plant Syst Evol* 100(17):597. doi:10.1007/s00606-014-0985-0
15. Krömer, T., Kessler, M., Herzog, S.K. (2006). Distribution and flowering ecology of bromeliads along two climatically contrasting elevational transects in the Bolivian Andes. *Biotropica* 38(2):183–95. doi:10.1111/j.1744-7429.2006.00124.x
16. Pierce, S., Winter, K., Griffiths, H. (2002). The role of CAM in high rainfall cloud forests: An *in situ* comparison of photosynthetic pathways in Bromeliaceae. *Plant Cell Environ* 25(9):1181–9. doi:10.1046/j.1365-3040.2002.00900.x
17. Mosti, S., Ross Friedman, C., Pacini, E., Brighigna, L., Papini, A. (2013). Nectary ultrastructure and secretory modes in three species of *Tillandsia* (Bromeliaceae) that have different pollinators. *Botany* 91(11):786–98. doi:10.1139/cjb-2013-0126

18. Aguilar-Rodríguez, P.A., MacSwiney G, M.C., Krömer, T., García-Franco, J.G., Knauer, A., Kessler, M. (2014). First record of bat-pollination in the species-rich genus *Tillandsia* (Bromeliaceae). *Annals of Botany* 113(6):1047–55. doi:10.1093/aob/mcu031
19. Fonseca, L.C., Vizentin-Bugoni, J., Rech, A.R., Alves, M.A. (2015). Plant-hummingbird interactions and temporal nectar availability in a restinga from Brazil. *An Acad Bras Cienc* 87(4):2163–75. doi:10.1590/0001-3765201520140349
20. González-Astorga, J., Cruz-Angón, A., Flores-Palacios, A., Vovides, A.P. (2004). Diversity and genetic structure of the Mexican endemic epiphyte *Tillandsia achyrostachys* E. Morr. ex Baker var. *achyrostachys* (Bromeliaceae). *Annals of Botany* 94(4):545–51. doi:10.1093/aob/mch171
21. Maruyama, P.K. (2015). Plant-hummingbird interactions = natural history and ecological networks = Interação entre plantas e beija-flores: História natural e redes ecológicas. PhD thesis. Universidade Estadual de Campinas.
22. Aguilar-Rodríguez, P.A., Krömer, T., García-Franco, J.G., MacSwiney G, M.C. (2016). From dusk till dawn: nocturnal and diurnal pollination in the epiphyte *Tillandsia heterophylla* (Bromeliaceae). *Plant Biol (Stuttg)* 18(1):37–45. doi:10.1111/plb.12319
23. Elton, M.C. (1997). Revision of the lithophytic *Vriesea* species from Minas Gerais State, Brazil: Part II. *Journal of the Bromeliad Society* (47):168–77.

Supplementary Material

What do nectarivorous bats like? Nectar composition in Bromeliaceae with special emphasis on bat-pollinated species

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Supplementary Table S2: Concentrations of the main three sugars in nectar of different Bromeliaceae species.

Species	Sum sugar [mM]	Percentages of sugars [%]			Sucrose-to-hexoses ratio
		Glucose	Fructose	Sucrose	
<i>Aechmea abbreviata</i>	1025 ± 312	24	22	54	1.3 ± 0.5
<i>A. aquilega</i>	1312 ± 108	19	20	61	1.6 ± 0.2
<i>A. bruggeri</i>	1290 ± 54	14	15	71	2.5 ± 0.1
<i>A. cylindrata</i>	1122 ± 209	19	13	68	2.4 ± 1.1
<i>A. distichantha</i>	1170 ± 90	17	14	69	2.3 ± 0.4
<i>A. eurycorymbus</i>	1803 ± 782	10	8	82	5.2 ± 2.5
<i>A. fasciata</i>	518 ± 13	21	21	58	1.4 ± 0.2
<i>A. gamosepala</i>	1127 ± 96	11	11	78	3.4 ± 0.1
<i>A. gracilis</i>	641 ± 57	12	18	70	2.3 ± 0.1
<i>A. leptantha</i>	1131 ± 27	21	22	57	1.3 ± 0.0
<i>A. marauensis</i>	1013 ± 277	23	26	51	1.1 ± 0.3
<i>A. miniata discolor</i>	1016 ± 23	15	17	68	2.1 ± 0.3
<i>A. nudicaulis</i>	620 ± 147	24	20	56	1.3 ± 0.1
<i>A. penduliflora</i>	1001 ± 58	15	19	66	2.0 ± 0.3
<i>A. pyramidalis</i>	1559 ± 142	11	7	82	4.6 ± 0.8
<i>A. racinae</i>	1177 ± 127	20	18	62	1.6 ± 0.3
<i>A. recurvata</i>	746 ± 73	21	13	66	2.0 ± 0.5
<i>A. weilbachii</i>	859 ± 75	19	20	61	1.6 ± 0.0
<i>Alcantarea geniculata</i>	978 ± 141	11	23	66	1.9 ± 0.2
<i>Alc. imperialis</i>	683 ± 226	31	31	38	0.6 ± 0.1
<i>Billbergia amoena</i>	430 ± 113	13	9	78	3.5 ± 0.3
<i>B. brasiliensis</i>	1011 ± 497	19	16	65	1.9 ± 0.7
<i>B. buchholtzii</i>	2289 ± 119	10	15	75	3.0 ± 0.7
<i>B. distachia</i>	1692 ± 598	12	18	70	2.3 ± 0.3
<i>B. euphemiae</i>	2022 ± 904	10	18	72	2.6 ± 0.3
<i>B. fosteriana</i>	1180 ± 189	16	16	68	2.2 ± 0.6
<i>B. morelii</i>	641 ± 55	15	15	70	2.4 ± 0.2
<i>B. nutans</i>	862 ± 39	8	9	83	4.8 ± 0.3
<i>B. pyramidalis</i>	1621 ± 168	17	18	65	1.9 ± 0.0
<i>B. reichardtii</i>	1396 ± 472	9	15	76	3.2 ± 0.2
<i>B. viridiflora</i>	1563 ± 393	21	20	59	1.5 ± 0.2
<i>B. vittata</i>	839 ± 181	8	9	83	4.8 ± 0.1
<i>Deuterocohnia brevispicata</i>	1444 ± 241	15	14	71	2.5 ± 0.4
<i>Deu. longipetala</i>	406 ± 235	9	9	82	5.5 ± 3.4
<i>Deu. meziana subsp. carmineoviridiflora</i>	504 ± 155	14	14	72	2.6 ± 0.1
<i>Deu. recurvipetala</i>	1020 ± 107	12	13	75	3.0 ± 0.1
<i>Dyckia choristaminea</i>	725 ± 286	20	14	66	2.0 ± 0.9
<i>D. goehringii</i>	736 ± 62	9	7	84	5.5 ± 0.5
<i>D. leptostachya</i>	1200 ± 38	21	17	62	1.7 ± 0.6
<i>D. vestita</i>	676 ± 272	14	11	75	2.9 ± 0.3
<i>Guzmania acorifolia</i>	296 ± 230	40	11	49	1.0 ± 0.2
<i>G. calothyrsus</i>	771 ± 33	29	30	41	0.7 ± 0.1
<i>G. conifera</i>	611 ± 25	15	18	67	2.1 ± 0.2
<i>G. cylindrica</i>	571 ± 52	41	33	26	0.4 ± 0.1
<i>G. farciminiformis</i>	583 ± 31	37	34	29	0.4 ± 0.1
<i>G. killipiana</i>	794 ± 56	39	35	26	0.4 ± 0.2
<i>G. lingulata</i>	667 ± 247	8	9	83	5.1 ± 1.3
<i>G. melinonis</i>	1048 ± 24	19	21	60	1.5 ± 0.2
<i>G. monostachia</i>	903 ± 61	17	18	65	1.8 ± 0.1
<i>G. osyana</i>	1409 ± 110	23	27	50	1.1 ± 0.4
<i>G. rhonhofiana</i>	248 ± 16	24	19	57	1.4 ± 0.4
<i>G. roseiflora</i>	772 ± 220	26	18	56	1.3 ± 0.5
<i>G. sanguinea</i>	996 ± 405	22	19	59	1.6 ± 0.6
<i>G. variegata</i>	513 ± 106	21	19	60	1.6 ± 0.4

<i>G. wittmackii</i>	673 ± 311	12	11	77	3.4 ± 0.5
<i>G. zahnii</i>	439 ± 39	31	22	47	0.9 ± 0.2
<i>Hohenbergia correia-araujoii</i>	1343 ± 147	21	17	62	1.7 ± 0.4
<i>H. leopoldo-horstii</i>	1598 ± 626	22	15	63	1.8 ± 0.6
<i>H. rosea</i>	1680 ± 200	27	25	48	0.9 ± 0.0
<i>H. stellata</i>	694 ± 183	27	19	54	1.2 ± 0.4
<i>H. utriculosa</i>	2147 ± 847	29	21	50	1.0 ± 0.2
<i>Lemeltonia nartheciooides</i>	378 ± 174	16	18	66	2.0 ± 0.3
<i>L. scaligera</i>	894 ± 288	18	15	67	2.0 ± 0.2
<i>Neoregelia ampullacea</i>	1431 ± 161	26	21	53	1.1 ± 0.1
<i>N. carolinae</i>	1176 ± 194	24	20	56	1.3 ± 0.1
<i>N. compacta</i>	1153 ± 245	12	13	75	3.0 ± 0.4
<i>N. farinosa</i>	1203 ± 426	18	14	68	2.1 ± 0.2
<i>N. fosteriana</i>	2064 ± 342	18	18	64	1.8 ± 0.1
<i>N. johannis</i>	1197 ± 78	15	14	71	2.4 ± 0.1
<i>N. kautskyi</i>	928 ± 172	21	21	58	1.4 ± 0.2
<i>N. laevis</i>	1669 ± 166	19	16	65	1.9 ± 0.0
<i>N. martinellii</i>	1034 ± 86	23	19	58	1.4 ± 0.2
<i>N. olens</i>	999 ± 60	27	19	54	1.2 ± 0.2
<i>N. pineliana</i>	1327 ± 566	17	15	68	2.2 ± 0.2
<i>N. seideliana</i>	1285 ± 85	24	16	60	1.5 ± 0.0
<i>N. wilsoniana</i>	2005 ± 660	25	25	50	1.0 ± 0.2
<i>Nidularium amazonicum</i>	1581 ± 86	14	15	71	2.5 ± 0.1
<i>Nid. innocentii</i>	917 ± 247	24	19	57	1.4 ± 0.3
<i>Nid. procerum</i>	1125 ± 104	11	13	76	3.2 ± 0.4
<i>Nid. purpureum</i>	1112 ± 168	13	14	73	2.7 ± 0.2
<i>Nid. rutilans</i>	768 ± 40	19	19	62	1.6 ± 0.2
<i>Nid. scheremetiewii</i>	2553 ± 629	15	17	68	2.1 ± 0.1
<i>Nid. utriculosum</i>	899 ± 13	20	20	60	1.5 ± 0.2
<i>Pitcairnia bromeliifolia</i>	981 ± 294	16	9	75	3.1 ± 0.6
<i>Pit. chiapensis</i>	397 ± 6	13	10	77	3.5 ± 0.9
<i>Pit. chiriquensis</i>	923 ± 204	19	12	69	2.4 ± 1.2
<i>Pit. grafii</i>	1170 ± 235	22	21	57	1.3 ± 0.1
<i>Pit. recurvata</i>	715 ± 282	40	27	33	0.5 ± 0.1
<i>Pit. rubronigriflora</i>	751 ± 81	25	23	52	1.1 ± 0.1
<i>Pit. sprucei</i>	832 ± 146	13	14	73	2.7 ± 0.5
<i>Pit. suaveolens</i>	693 ± 73	28	23	49	1.0 ± 0.1
<i>Pit. utcubambensis</i>	484 ± 62	22	18	60	1.5 ± 0.1
<i>Pit. xanthocalyx</i>	731 ± 43	25	23	52	1.1 ± 0.1
<i>Pseudalcantarea grandis</i>	844 ± 304	34	35	31	0.5 ± 0.1
<i>Pse. macropetala</i>	1081 ± 59	32	31	37	0.6 ± 0.1
<i>Pse. viridiflora</i>	732 ± 284	39	26	35	0.5 ± 0.1
<i>Puya coerulea</i> var. <i>violacea</i>	1027 ± 67	25	19	56	1.3 ± 0.0
<i>P. densiflora</i>	991 ± 252	16	14	70	2.3 ± 0.4
<i>P. ferruginea</i>	1007 ± 413	42	34	24	0.3 ± 0.1
<i>P. spathacea</i>	1204 ± 95	15	17	68	2.1 ± 0.0
<i>Quesnelia edmundoi</i>	1121 ± 797	30	24	46	0.9 ± 0.2
<i>Q. lateralis</i>	1125 ± 322	15	13	72	2.6 ± 0.6
<i>Q. quesneliana</i>	1096 ± 137	20	20	60	1.5 ± 0.0
<i>Tillandsia achyrostachys</i>	1148 ± 215	18	12	70	2.4 ± 0.4
<i>T. aeranthos</i>	1150 ± 286	22	18	60	1.5 ± 0.0
<i>T. caput-medusae</i>	816 ± 68	10	12	78	3.6 ± 0.2
<i>T. circinnatoides</i>	329 ± 145	8	12	80	4.0 ± 0.1
<i>T. clavigera</i>	455 ± 63	33	16	51	1.1 ± 0.2
<i>T. concolor</i>	551 ± 272	9	18	73	2.8 ± 0.4
<i>T. flabellata</i>	950 ± 24	22	20	58	1.4 ± 0.2
<i>T. foliosa</i>	1217 ± 261	10	13	77	3.5 ± 0.6
<i>T. funckiana</i>	389 ± 136	6	9	85	6.1 ± 1.8
<i>T. gerdae</i>	486 ± 87	7	5	88	8.1 ± 2.6
<i>T. heterophylla</i>	978 ± 75	38	39	23	0.3 ± 0.0
<i>T. ionantha</i>	483 ± 91	6	9	75	6.4 ± 2.3
<i>T. ixiooides</i>	1271 ± 42	12	13	75	3.0 ± 0.3
<i>T. makoyana</i>	1658 ± 312	5	9	86	6.0 ± 0.6
<i>T. malzinei</i>	652 ± 61	10	16	74	2.9 ± 0.4
<i>T. polystachia</i>	554 ± 128	20	15	65	1.9 ± 0.4
<i>T. ponderosa</i>	736 ± 20	16	15	69	2.2 ± 0.1
<i>T. propagulifera</i>	232 ± 51	13	15	72	2.6 ± 0.2
<i>T. rauhii</i>	496 ± 72	41	30	29	0.4 ± 0.1
<i>T. roland-gosselinii</i>	1042 ± 53	8	7	85	5.6 ± 0.4
<i>T. tricolor</i>	824 ± 211	7	7	86	6.1 ± 0.5
<i>Vriesea bituminosa</i>	1477 ± 291	33	31	36	0.6 ± 0.0
<i>V. bleheri</i>	703 ± 117	16	17	67	2.0 ± 0.4
<i>V. drepanocarpa</i>	1082 ± 479	11	14	75	3.3 ± 1.0
<i>V. dubia</i>	337 ± 124	18	19	63	2.0 ± 1.3
<i>V. eltoniana</i>	738 ± 82	19	15	66	2.2 ± 1.1
<i>V. fenestralis</i>	961 ± 155	37	37	26	0.4 ± 0.1

<i>V. friburgensis tucumanensis</i>	1300 ± 80	17	17	66	2.0 ± 0.1
<i>V. guttata</i>	2249 ± 408	18	13	69	2.2 ± 0.4
<i>V. maxoniana</i>	353 ± 53	9	7	84	5.2 ± 0.6
<i>V. nanuzae</i>	819 ± 402	33	26	41	0.7 ± 0.0
<i>V. racinae</i>	942 ± 192	40	32	28	0.4 ± 0.2
<i>V. saundersii</i>	530 ± 75	18	8	74	3.1 ± 1.0
<i>V. scalaris</i>	966 ± 108	7	8	85	5.4 ± 0.1
<i>V. unilateralis</i>	509 ± 84	41	33	26	0.4 ± 0.2
<i>Wallisia cyanea</i>	606 ± 266	18	16	66	2.0 ± 0.8
<i>W. lindeniana</i>	944 ± 384	14	13	73	2.9 ± 1.2
<i>W. pretiosa</i>	321 ± 99	10	9	81	5.0 ± 2.7
<i>Werauhia gladioliflora</i>	1035 ± 109	34	32	34	0.5 ± 0.0
<i>Wer. nutans</i>	1024 ± 402	37	30	33	0.5 ± 0.2
<i>Wer. patzeltii</i>	861 ± 74	20	15	65	1.9 ± 0.3
<i>Wer. pectinata</i>	632 ± 36	50	35	15	0.2 ± 0.1
<i>Wer. sanguinolenta</i>	1057 ± 205	36	26	38	0.6 ± 0.1
<i>Wer. werckleana</i>	1232 ± 256	41	35	24	0.3 ± 0.0

Bold type = bat-pollinated bromeliads.

Supplementary Material

What do nectarivorous bats like? Nectar composition in Bromeliaceae with special emphasis on bat-pollinated species

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Supplementary Table S3: Amino acid concentration, proportions of the most abundant amino acids and the ratio of sugars to amino acids in nectar of different Bromeliaceae species.

Species	Sum amino acids [mM]	Percentages of amino acids [%]				Sum sugars [mM]/Sum amino acids [mM]
		Asn & Gln	Pro	Essential	Residual	
<i>Aechmea abbreviata</i>	3.6 ± 2.4	65	1	14	20	281
<i>A. aquilega</i>	2.0 ± 0.2	6	31	38	25	666
<i>A. bruggeri</i>	0.2 ± 0.0	16	14	23	47	6589
<i>A. cylindrata</i>	0.3 ± 0.1	38	16	22	24	4063
<i>A. distichantha</i>	0.7 ± 0.3	44	8	21	27	1690
<i>A. eurycorymbus</i>	1.7 ± 1.2	41	1	30	28	1036
<i>A. fasciata</i>	0.5 ± 0.0	28	4	39	29	963
<i>A. gamosepala</i>	1.1 ± 0.1	64	15	8	13	1073
<i>A. gracilis</i>	2.1 ± 0.1	18	1	39	42	299
<i>A. leptantha</i>	0.9 ± 0.3	21	55	7	17	1198
<i>A. marauensis</i>	0.4 ± 0.2	12	4	31	53	2754
<i>A. miniata discolor</i>	1.7 ± 0.6	16	31	27	26	596
<i>A. nudicaulis</i>	0.4 ± 0.0	17	23	26	34	1617
<i>A. penduliflora</i>	0.2 ± 0.1	22	14	28	36	4660
<i>A. pyramidalis</i>	1.3 ± 0.4	30	4	25	41	1221
<i>A. racinae</i>	0.4 ± 0.1	62	2	16	20	3108
<i>A. recurvata</i>	0.9 ± 0.0	47	1	26	26	859
<i>A. weilbachii</i>	0.8 ± 0.1	45	0	28	27	1107
<i>Alcantarea geniculata</i>	0.7 ± 0.3	73	1	5	21	1413
<i>Alc. imperialis</i>	1.0 ± 0.2	34	12	30	24	715
<i>Billbergia amoena</i>	0.1 ± 0.1	66	1	18	15	2975
<i>B. brasiliensis</i>	0.1 ± 0.0	15	53	11	21	8544
<i>B. buchholtzii</i>	0.2 ± 0.0	40	0	17	43	9658
<i>B. distachia</i>	0.7 ± 0.2	46	13	20	21	534
<i>B. euphemiae</i>	0.2 ± 0.1	54	17	12	17	10044
<i>B. fosteriana</i>	0.6 ± 0.3	46	0	19	35	1608
<i>B. morelii</i>	0.6 ± 0.1	37	17	16	30	1112
<i>B. nutans</i>	0.4 ± 0.1	26	51	10	13	2392
<i>B. pyramidalis</i>	0.1 ± 0.1	32	3	16	49	14629
<i>B. reichardtii</i>	0.1 ± 0.0	35	7	21	37	24579
<i>B. viridiflora</i>	0.8 ± 0.6	27	3	36	34	2010
<i>B. vittata</i>	0.1 ± 0.0	29	27	18	26	11551
<i>Deuterocohnia brevispicata</i>	1.6 ± 0.2	55	1	24	20	885
<i>Deu. longipetala</i>	3.8 ± 0.2	70	0	12	18	108
<i>Deu. meziana subsp. carmineoviridiflora</i>	0.2 ± 0.1	21	0	24	55	2978
<i>Deu. recurvipetala</i>	0.7 ± 0.3	83	2	7	8	1559
<i>Dyckia choristaminea</i>	7.1 ± 0.1	57	1	25	17	102
<i>D. goehringii</i>	1.2 ± 0.4	24	11	30	35	634
<i>D. leptostachya</i>	0.3 ± 0.2	34	26	11	29	3391
<i>D. vestita</i>	2.7 ± 1.0	53	4	20	23	217
<i>Guzmania acorifolia</i>	6.6 ± 1.1	34	0	40	26	45
<i>G. calothyrsus</i>	1.2 ± 0.2	41	2	36	21	665
<i>G. conifera</i>	1.6 ± 0.0	17	36	27	20	371
<i>G. cylindrica</i>	0.3 ± 0.1	28	2	46	24	1601
<i>G. farciminiiformis</i>	2.1 ± 0.3	34	3	29	34	279
<i>G. killipiana</i>	7.3 ± 0.9	43	1	21	35	109
<i>G. lingulata</i>	7.8 ± 2.9	59	0	21	20	79
<i>G. melinonis</i>	3.1 ± 0.6	41	1	38	20	342
<i>G. monostachia</i>	0.1 ± 0.0	27	14	31	28	6512
<i>G. osyana</i>	2.3 ± 1.1	34	3	31	32	616
<i>G. rhonhofiana</i>	0.4 ± 0.5	26	28	25	21	563
<i>G. roseiflora</i>	1.9 ± 0.9	53	0	37	10	411
<i>G. sanguinea</i>	1.5 ± 1.6	44	1	24	31	674
<i>G. variegata</i>	1.0 ± 0.2	44	1	29	26	504

<i>G. wittmackii</i>	0.5 ± 0.1	13	6	35	46	1476
<i>G. zahnii</i>	2.1 ± 0.1	57	0	25	18	206
<i>Hohenbergia correia-araujoi</i>	0.2 ± 0.2	7	2	33	58	6148
<i>H. leopoldo-horstii</i>	0.6 ± 0.3	24	2	30	44	2815
<i>H. rosea</i>	0.2 ± 0.1	33	0	26	41	6945
<i>H. stellata</i>	1.4 ± 1.3	17	0	40	43	513
<i>H. utriculosa</i>	0.9 ± 0.5	40	0	27	33	2470
<i>Lemeltonia nartheciooides</i>	5.3 ± 3.4	79	0	11	10	71
<i>L. scaligera</i>	0.3 ± 0.0	49	1	18	32	3519
<i>Neoregelia ampullacea</i>	3.7 ± 1.6	28	2	35	35	386
<i>N. carolinae</i>	1.9 ± 0.3	24	1	29	46	637
<i>N. compacta</i>	2.2 ± 0.3	23	0	35	42	537
<i>N. farinosa</i>	0.2 ± 0.1	40	6	35	19	7176
<i>N. fosteriana</i>	0.7 ± 0.1	19	3	32	46	3190
<i>N. johannis</i>	0.4 ± 0.1	15	0	44	41	2786
<i>N. kautskyi</i>	0.2 ± 0.1	33	8	25	34	4010
<i>N. laevis</i>	1.6 ± 1.1	15	2	39	44	880
<i>N. martinellii</i>	0.8 ± 0.4	21	3	22	54	1360
<i>N. olens</i>	6.7 ± 0.9	21	0	44	35	150
<i>N. pineliana</i>	0.5 ± 0.3	2	19	12	67	2465
<i>N. seideliana</i>	0.1 ± 0.0	23	1	44	32	12880
<i>N. wilsoniana</i>	0.3 ± 0.0	43	0	29	28	5891
<i>Nidularium amazonicum</i>	1.8 ± 0.2	58	0	15	27	893
<i>Nid. innocentii</i>	1.5 ± 0.4	23	0	31	46	614
<i>Nid. procerum</i>	2.6 ± 0.9	59	0	15	26	441
<i>Nid. purpureum</i>	2.4 ± 0.9	13	0	30	57	466
<i>Nid. rutilans</i>	0.3 ± 0.0	30	0	42	28	2632
<i>Nid. scheremetiewii</i>	2.4 ± 0.7	39	0	28	33	1063
<i>Nid. utriculosum</i>	0.4 ± 0.0	36	2	32	30	2024
<i>Pitcairnia bromeliifolia</i>	16.2 ± 2.5	40	1	21	38	47
<i>Pit. chiapensis</i>	8.2 ± 0.5	11	0	32	57	49
<i>Pit. chiriquensis</i>	2.5 ± 0.6	24	1	24	51	371
<i>Pit. grafii</i>	12.6 ± 2.8	30	0	12	58	64
<i>Pit. recurvata</i>	0.3 ± 0.0	38	5	29	28	2533
<i>Pit. rubronigriflora</i>	6.6 ± 1.5	47	1	9	43	114
<i>Pit. sprucei</i>	13.0 ± 3.9	46	1	14	39	47
<i>Pit. suaveolens</i>	0.8 ± 0.2	32	5	31	32	909
<i>Pit. utubambensis</i>	11.3 ± 1.7	20	0	35	45	39
<i>Pit. xanthocalyx</i>	0.9 ± 0.0	33	1	24	42	819
<i>Pseudalcantarea grandis</i>	3.9 ± 1.4	32	0	18	50	219
<i>Pse. macropetala</i>	1.6 ± 0.3	22	1	34	43	678
<i>Pse. viridiflora</i>	0.7 ± 0.1	20	2	17	61	1002
<i>Puya coerulea</i> var. <i>violacea</i>	3.9 ± 1.0	24	0	35	41	261
<i>P. densiflora</i>	0.3 ± 0.0	24	1	44	31	3883
<i>P. ferruginea</i>	3.9 ± 0.9	15	57	15	13	256
<i>P. spathacea</i>	0.7 ± 0.2	26	0	48	26	1734
<i>Quesnelia edmundoi</i>	1.4 ± 0.3	41	1	29	29	776
<i>Q. lateralis</i>	0.4 ± 0.2	82	3	8	7	2647
<i>Q. quesneliana</i>	1.4 ± 0.3	24	2	26	48	799
<i>Tillandsia achyrostachys</i>	0.2 ± 0.0	56	2	18	24	7314
<i>T. aeranthos</i>	1.4 ± 0.1	30	1	29	40	814
<i>T. caput-medusae</i>	0.4 ± 0.1	43	0	26	31	2038
<i>T. circinnatoides</i>	0.3 ± 0.1	36	3	41	20	949
<i>T. clavigera</i>	0.7 ± 0.5	22	6	38	34	643
<i>T. concolor</i>	0.2 ± 0.1	47	3	7	43	2827
<i>T. flabellata</i>	1.3 ± 0.4	61	5	18	16	749
<i>T. foliosa</i>	0.5 ± 0.1	31	12	18	39	2670
<i>T. funckiana</i>	2.0 ± 1.0	40	1	37	22	197
<i>T. gerdae</i>	1.4 ± 0.5	61	1	13	25	341
<i>T. heterophylla</i>	0.3 ± 0.0	41	2	25	32	3048
<i>T. ionantha</i>	0.6 ± 0.0	29	7	11	53	800
<i>T. ixiooides</i>	1.4 ± 0.8	48	1	33	18	928
<i>T. makoyana</i>	0.2 ± 0.0	20	5	34	41	7260
<i>T. malzinei</i>	0.5 ± 0.1	5	0	56	39	1251
<i>T. polystachia</i>	0.1 ± 0.1	4	61	10	25	4390
<i>T. ponderosa</i>	0.1 ± 0.0	30	12	4	54	7907
<i>T. propagulifera</i>	0.2 ± 0.1	27	26	21	26	1083
<i>T. rauhii</i>	7.4 ± 0.3	59	0	24	17	68
<i>T. roland-gosselinii</i>	0.2 ± 0.0	25	4	39	32	5909
<i>T. tricolor</i>	1.3 ± 0.5	36	0	26	38	620
<i>Vriesea bituminosa</i>	2.8 ± 0.2	46	14	20	20	525
<i>V. bleheri</i>	0.1 ± 0.0	32	20	12	36	13338
<i>V. drepanocarpa</i>	0.2 ± 0.1	30	7	7	56	5516
<i>V. dubia</i>	3.6 ± 0.1	60	0	24	16	94
<i>V. eltoniana</i>	0.1 ± 0.0	43	1	20	36	7994
<i>V. fenestralis</i>	1.2 ± 0.4	22	8	47	23	863

<i>V. friburgensis tucumanensis</i>	1.4 ± 0.1	40	0	31	29	919
<i>V. guttata</i>	0.6 ± 0.1	36	1	20	43	4126
<i>V. maxoniana</i>	0.6 ± 0.3	16	0	39	45	574
<i>V. nanuzae</i>	0.5 ± 0.1	1	2	62	35	1666
<i>V. racinae</i>	1.6 ± 0.6	23	51	13	13	587
<i>V. saundersii</i>	0.3 ± 0.1	51	10	10	29	1941
<i>V. scalaris</i>	0.2 ± 0.2	19	9	20	52	3888
<i>V. unilateralis</i>	3.5 ± 0.3	15	27	33	25	144
<i>Wallisia cyanea</i>	0.1 ± 0.0	38	3	22	37	4264
<i>W. lindeniana</i>	0.7 ± 0.3	51	1	28	20	1439
<i>W. pretiosa</i>	0.2 ± 0.1	46	3	19	32	1696
<i>Werauhia gladioliflora</i>	2.9 ± 0.8	36	37	10	17	362
<i>Wer. nutans</i>	3.6 ± 1.0	50	5	33	12	283
<i>Wer. patzeltii</i>	1.6 ± 0.1	53	1	34	12	552
<i>Wer. pectinata</i>	0.2 ± 0.1	5	3	70	22	2402
<i>Wer. sanguinolenta</i>	2.9 ± 1.6	69	9	13	9	362
<i>Wer. werckleana</i>	5.1 ± 0.7	36	39	17	8	242

Bold type = bat-pollinated bromeliads. Essential amino acids = arg, his, ile, leu, lys, met, phe, thr, trp, val. Residual amino acids = ala, asp, gaba, glu, gly, ser, tyr.

Supplementary Material

What do nectarivorous bats like? Nectar composition in Bromeliaceae with special emphasis on bat-pollinated species

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Supplementary Table S4: Concentrations of inorganic cations, anions, malate, and the ion composition in nectar of different Bromeliaceae species.

Species	Sum cations [mM]	Percentages of cations [%]			Sum anions [mM]	Percentages of anions [%]			Malate [mM]
		K ⁺	Na ⁺	Mg ²⁺ & Ca ²⁺		Cl ⁻	PO ₄ ³⁻	SO ₄ ²⁻	
<i>Aechmea abbreviata</i>	0.4 ± 0.0	28	52	20	1.4 ± 0.0	88	9	3	0.13
<i>A. aquilega</i>	1.0 ± 0.2	79	17	4	1.2 ± 0.0	75	19	6	0.05
<i>A. bruggeri</i>	0.5 ± 0.0	73	11	16	0.4 ± 0.1	100	0	0	0.00
<i>A. cylindrata</i>	1.0 ± 0.8	46	36	18	0.7 ± 0.1	75	15	10	0.01
<i>A. distichantha</i>	1.0 ± 0.2	58	23	19	0.5 ± 0.2	69	10	21	0.01
<i>A. eurycorymbus</i>	1.0 ± 0.5	76	8	16	1.1 ± 0.3	87	2	11	0.01
<i>A. fasciata</i>	0.8 ± 0.1	76	11	13	1.3 ± 0.1	81	18	1	0.00
<i>A. gamosepala</i>	0.5 ± 0.1	64	22	14	0.9 ± 0.1	81	6	13	0.00
<i>A. gracilis</i>	0.6 ± 0.3	50	22	28	0.8 ± 0.3	54	32	14	0.07
<i>A. leptantha</i>	1.2 ± 0.4	82	10	8	0.2 ± 0.0	49	42	9	0.05
<i>A. marauensis</i>	1.4 ± 0.0	87	5	8	0.3 ± 0.1	65	15	20	0.23
<i>A. miniata discolor</i>	2.9 ± 0.5	71	15	14	4.1 ± 0.6	96	3	1	0.37
<i>A. nudicaulis</i>	2.1 ± 1.3	61	24	15	0.9 ± 0.1	75	16	9	0.08
<i>A. penduliflora</i>	0.6 ± 0.4	60	20	20	0.3 ± 0.1	72	0	28	0.00
<i>A. pyramidalis</i>	1.5 ± 0.4	59	20	21	n.d.	n.d.	n.d.	n.d.	0.00
<i>A. racinae</i>	1.7 ± 0.6	66	27	7	0.9 ± 0.1	81	4	15	0.03
<i>A. recurvata</i>	0.5 ± 0.2	18	70	12	0.4 ± 0.3	82	0	18	0.00
<i>A. weilbachii</i>	0.6 ± 0.4	40	38	22	0.7 ± 0.1	73	22	5	0.07
<i>Alcantarea geniculata</i>	1.1 ± 0.1	75	20	5	0.3 ± 0.1	66	33	1	0.27
<i>Alc. imperialis</i>	1.9 ± 0.8	85	8	7	0.7 ± 0.6	74	13	13	0.53
<i>Billbergia amoena</i>	0.3 ± 0.1	26	64	10	0.7 ± 0.2	98	0	2	0.01
<i>B. brasiliensis</i>	1.1 ± 0.2	65	28	7	0.7 ± 0.2	52	29	19	0.00
<i>B. buchholtzii</i>	0.7 ± 0.3	84	8	8	0.8 ± 0.1	43	40	17	0.03
<i>B. distachia</i>	0.3 ± 0.2	12	55	33	0.7 ± 0.1	73	25	2	0.20
<i>B. euphemiae</i>	0.7 ± 0.2	56	31	13	0.4 ± 0.0	89	1	10	0.01
<i>B. fosteriana</i>	1.2 ± 0.7	70	26	4	1.0 ± 0.5	79	9	12	0.17
<i>B. morelii</i>	1.2 ± 0.0	93	3	4	1.0 ± 0.2	97	1	2	0.23
<i>B. nutans</i>	0.1 ± 0.0	78	22	0	0.7 ± 0.1	85	13	2	0.02
<i>B. pyramidalis</i>	0.1 ± 0.0	23	44	33	n.d.	n.d.	n.d.	n.d.	0.00
<i>B. reichardtii</i>	0.3 ± 0.2	45	51	4	0.1 ± 0.0	60	19	21	0.06
<i>B. viridiflora</i>	0.1 ± 0.1	70	30	0	n.d.	n.d.	n.d.	n.d.	0.00
<i>B. vittata</i>	0.3 ± 0.3	53	28	19	0.2 ± 0.0	90	5	5	0.04
<i>Deuterocohnia brevispicata</i>	0.8 ± 0.1	62	30	8	0.8 ± 0.1	68	20	12	0.09
<i>Deu. longipetala</i>	1.4 ± 0.3	42	28	30	0.8 ± 0.2	78	0	22	0.02
<i>Deu. meziana subsp. carmineoviridiflora</i>	0.2 ± 0.0	51	18	31	0.3 ± 0.0	100	0	0	0.00
<i>Deu. recurvipetala</i>	0.6 ± 0.1	71	26	3	0.9 ± 0.4	83	0	17	0.04
<i>Dyckia choristaminea</i>	1.0 ± 0.7	32	35	33	0.7 ± 0.4	81	8	11	0.04
<i>D. goehringii</i>	3.1 ± 0.7	89	7	4	0.9 ± 0.3	21	70	9	0.19
<i>D. leptostachya</i>	2.1 ± 1.5	83	14	3	0.5 ± 0.3	40	46	14	0.01
<i>D. vestita</i>	0.8 ± 0.5	59	29	12	0.3 ± 0.1	43	42	15	0.03
<i>Guzmania acorifolia</i>	12.4 ± 0.8	85	2	13	6.1 ± 1.2	83	12	5	0.14
<i>G. calothyrsus</i>	9.9 ± 3.5	98	1	1	9.8 ± 0.5	94	5	1	0.09
<i>G. confifera</i>	7.0 ± 1.8	76	22	2	16.9 ± 0.9	91	5	4	0.32
<i>G. cylindrica</i>	12.2 ± 1.9	95	4	1	5.5 ± 1.8	85	1	14	7.09
<i>G. farciminiiformis</i>	6.3 ± 0.8	30	68	2	6.8 ± 2.5	80	4	16	0.08
<i>G. killipiana</i>	10.0 ± 1.1	95	2	3	11.9 ± 1.4	75	18	7	3.91
<i>G. lingulata</i>	3.5 ± 0.9	91	9	0	1.9 ± 0.5	84	11	5	0.39
<i>G. melinonis</i>	6.8 ± 1.4	94	2	4	7.7 ± 1.2	96	3	1	0.42
<i>G. monostachya</i>	2.0 ± 0.1	98	1	1	7.7 ± 0.9	96	1	3	0.18
<i>G. osyana</i>	7.6 ± 1.4	94	2	4	8.1 ± 2.5	86	8	6	0.52
<i>G. rhonhofiana</i>	3.8 ± 0.1	94	2	4	1.0 ± 0.5	100	0	0	0.17
<i>G. roseiflora</i>	12.3 ± 1.1	93	3	4	5.5 ± 2.2	96	0	4	0.49

<i>G. sanguinea</i>	4.9 ± 0.8	86	4	10	4.7 ± 1.0	82	12	6	0.33
<i>G. variegata</i>	4.1 ± 2.2	92	5	3	3.9 ± 0.6	93	2	6	0.65
<i>G. wittmackii</i>	2.1 ± 0.2	11	24	65	0.5 ± 0.2	60	28	12	0.06
<i>G. zahnii</i>	2.9 ± 0.6	91	3	6	4.2 ± 0.7	96	2	2	0.32
<i>Hohenbergia correia-araujoi</i>	0.7 ± 0.7	52	32	16	0.2 ± 0.0	82	12	6	0.01
<i>H. leopoldo-horstii</i>	2.7 ± 1.4	60	14	26	0.7 ± 0.2	83	14	3	0.26
<i>H. rosea</i>	0.5 ± 0.4	55	24	21	0.6 ± 0.2	70	15	15	0.19
<i>H. stellata</i>	0.6 ± 0.3	39	43	18	1.5 ± 1.3	87	5	8	0.08
<i>H. utriculosa</i>	0.5 ± 0.2	55	34	11	1.4 ± 0.2	83	9	8	0.02
<i>Lemeltonia nartheciooides</i>	0.5 ± .04	79	13	8	1.7 ± 0.8	98	0	2	0.02
<i>L. scalligera</i>	0.4 ± 0.2	23	66	11	0.3 ± 0.2	91	1	8	0.00
<i>Neoregelia ampullacea</i>	6.1 ± 1.5	77	17	6	3.0 ± 1.2	68	21	11	0.26
<i>N. carolinae</i>	3.7 ± 2.5	74	10	16	2.8 ± 1.3	80	12	8	0.09
<i>N. compacta</i>	1.5 ± 0.3	32	51	17	1.1 ± 0.3	43	13	44	0.38
<i>N. farinosa</i>	0.4 ± 0.1	2	68	30	3.9 ± 1.6	64	18	18	0.04
<i>N. fosteriana</i>	1.0 ± 0.2	85	9	6	0.6 ± 0.1	78	17	5	0.10
<i>N. johannis</i>	0.3 ± 0.1	47	31	22	0.3 ± 0.2	85	0	15	0.38
<i>N. kautskyi</i>	1.9 ± 0.7	67	19	14	0.3 ± 0.0	51	27	22	0.03
<i>N. laevis</i>	0.7 ± 0.2	74	11	15	0.6 ± 0.2	54	34	12	0.55
<i>N. martinellii</i>	0.8 ± 0.4	68	16	16	0.8 ± 0.1	68	19	13	0.71
<i>N. olens</i>	0.7 ± 0.3	45	29	26	0.7 ± 0.1	54	41	5	0.23
<i>N. pineliana</i>	0.9 ± 0.0	63	31	6	0.6 ± 0.2	75	0	25	0.27
<i>N. seideliana</i>	4.1 ± 0.5	28	48	24	0.4 ± 0.1	51	22	27	0.14
<i>N. wilsoniana</i>	0.3 ± 0.2	21	50	29	0.4 ± 0.1	76	14	10	0.07
<i>Nidularium amazonicum</i>	2.3 ± 0.4	75	15	10	2.7 ± 0.8	61	18	21	0.43
<i>Nid. innocentii</i>	4.1 ± 1.3	89	7	4	4.6 ± 0.8	57	10	33	0.29
<i>Nid. procerum</i>	4.8 ± 1.1	91	4	5	4.3 ± 1.2	58	31	11	0.22
<i>Nid. purpureum</i>	2.0 ± 0.2	90	4	6	1.1 ± 0.1	64	18	16	0.85
<i>Nid. rutilans</i>	0.5 ± 0.4	57	22	21	1.1 ± 0.0	61	30	9	0.18
<i>Nid. scheremetiewii</i>	2.4 ± 1.0	72	4	24	5.0 ± 0.3	78	19	3	1.80
<i>Nid. utriculosum</i>	0.6 ± 0.2	75	25	0	0.5 ± 0.1	86	10	4	0.00
<i>Pitcairnia bromeliifolia</i>	0.5 ± 0.3	58	42	0	2.0 ± 0.1	86	0	14	0.02
<i>Pit. chiapensis</i>	0.4 ± 0.0	80	14	6	1.7 ± 0.3	86	7	7	0.10
<i>Pit. chiriquensis</i>	0.9 ± 0.2	59	22	19	1.6 ± 0.2	91	0	9	0.03
<i>Pit. grafii</i>	0.2 ± 0.2	43	39	18	1.4 ± 0.3	97	3	0	0.96
<i>Pit. recurvata</i>	10.3 ± 1.9	95	3	2	7.3 ± 1.4	100	0	0	0.94
<i>Pit. rubronigriflora</i>	4.7 ± 1.2	92	5	3	3.1 ± 1.1	91	5	4	0.15
<i>Pit. sprucei</i>	0.3 ± 0.2	54	31	15	1.4 ± 0.7	97	1	2	0.08
<i>Pit. suaveolens</i>	1.1 ± 0.2	83	10	7	1.1 ± 0.4	94	2	4	0.10
<i>Pit. utubambensis</i>	0.6 ± 0.4	74	19	7	1.7 ± 1.5	77	4	19	0.34
<i>Pit. xanthocalyx</i>	1.3 ± 0.1	80	16	4	1.7 ± 0.1	96	0	4	0.00
<i>Pseudalcantarea grandis</i>	6.2 ± 1.2	98	2	0	5.8 ± 1.1	99	1	0	1.16
<i>Pse. macropetala</i>	6.7 ± 2.9	91	7	2	2.8 ± 0.8	74	18	8	0.73
<i>Pse. viridiflora</i>	2.8 ± 1.3	93	5	2	4.6 ± 1.4	98	1	1	2.23
<i>Puya coerulea var. violacea</i>	1.3 ± 0.5	91	6	3	0.1 ± 0.0	79	0	21	0.00
<i>P. densiflora</i>	0.1 ± 0.0	24	51	25	0.3 ± 0.1	100	0	0	0.00
<i>P. ferruginea</i>	7.8 ± 2.6	97	2	1	3.5 ± 0.2	100	0	0	0.11
<i>P. spathacea</i>	0.1 ± 0.0	29	54	17	0.3 ± 0.0	97	0	3	0.00
<i>Quesnelia edmundoi</i>	0.5 ± 0.1	46	51	3	2.8 ± 0.7	84	13	4	0.35
<i>Q. lateralis</i>	0.2 ± 0.2	54	26	20	0.1 ± 0.0	66	5	29	0.00
<i>Q. quesneliana</i>	0.2 ± 0.1	51	32	17	0.9 ± 0.2	67	25	8	0.32
<i>Tillandsia achyrostachys</i>	0.2 ± 0.0	13	66	21	0.5 ± 0.1	89	4	7	0.04
<i>T. aeranthes</i>	0.2 ± 0.1	0	94	6	9.2 ± 2.7	81	3	16	0.00
<i>T. caput-medusae</i>	0.1 ± 0.1	46	46	8	0.6 ± 0.3	83	8	9	0.09
<i>T. circinnatoides</i>	0.6 ± 0.4	59	10	31	2.0 ± 1.1	83	5	12	0.29
<i>T. clavigera</i>	0.5 ± 0.1	17	55	28	0.3 ± 0.1	87	0	13	0.00
<i>T. concolor</i>	0.5 ± 0.2	31	43	26	1.5 ± 0.4	83	4	13	0.28
<i>T. flabellata</i>	0.3 ± 0.2	30	44	26	1.7 ± 0.6	96	1	3	0.10
<i>T. foliosa</i>	0.6 ± 0.2	46	44	10	0.3 ± 0.1	80	8	12	0.03
<i>T. funkiana</i>	1.5 ± 0.7	79	15	6	0.3 ± 0.1	66	18	16	0.19
<i>T. gerdae</i>	0.4 ± 0.3	35	43	22	3.9 ± 1.7	90	3	7	0.28
<i>T. heterophylla</i>	2.6 ± 0.1	96	3	1	1.6 ± 0.3	95	2	3	0.50
<i>T. ionantha</i>	0.2 ± 0.1	65	24	11	0.5 ± 0.1	80	7	13	0.22
<i>T. ixiooides</i>	0.4 ± 0.1	2	77	21	0.7 ± 0.2	87	0	13	0.06
<i>T. makoyana</i>	1.4 ± 0.3	75	10	15	0.7 ± 0.2	70	24	6	0.41
<i>T. malzinei</i>	0.3 ± 0.2	51	38	11	0.5 ± 0.1	84	4	12	0.10
<i>T. polystachia</i>	0.4 ± 0.2	13	65	22	0.6 ± 0.3	63	4	33	0.04
<i>T. ponderosa</i>	0.6 ± 0.1	88	9	3	0.2 ± 0.1	87	0	13	0.09
<i>T. propagulifera</i>	1.1 ± 0.6	39	32	29	0.2 ± 0.0	100	0	0	0.14
<i>T. rauhii</i>	6.5 ± 2.4	75	23	2	2.8 ± 0.1	98	0	2	0.00
<i>T. roland-gosselinii</i>	0.5 ± 0.1	43	41	16	0.4 ± 0.1	97	0	3	0.02
<i>T. tricolor</i>	2.1 ± 0.6	50	42	8	0.9 ± 0.2	92	4	4	0.08
<i>Vriesea bituminosa</i>	9.6 ± 3.3	74	25	1	2.4 ± 0.4	100	0	0	0.65
<i>V. bleheri</i>	0.1 ± 0.0	23	54	23	0.5 ± 0.2	78	1	21	0.00
<i>V. drepanocarpa</i>	0.5 ± 0.5	37	43	20	1.4 ± 0.2	93	0	7	0.00
<i>V. dubia</i>	1.0 ± 0.3	89	9	2	0.2 ± 0.1	65	3	32	0.09

<i>V. eltoniana</i>	1.3 ± 0.8	52	42	6	0.6 ± 0.1	66	6	28	0.08
<i>V. fenestralis</i>	7.4 ± 1.8	95	3	2	6.9 ± 0.7	86	9	5	1.39
<i>V. friburgensis tucumanensis</i>	2.1 ± 0.1	94	6	0	1.4 ± 0.1	55	14	31	0.13
<i>V. guttata</i>	0.3 ± 0.2	11	48	41	1.2 ± 0.3	90	4	6	0.44
<i>V. maxoniana</i>	0.1 ± 0.1	18	54	28	0.5 ± 0.1	80	4	16	0.00
<i>V. nanuzae</i>	4.6 ± 1.1	97	2	1	1.9 ± 0.3	96	0	4	0.09
<i>V. racinae</i>	3.0 ± 0.1	13	30	57	3.1 ± 0.6	90	1	9	0.00
<i>V. saundersii</i>	0.3 ± 0.1	5	64	31	0.2 ± 0.1	93	4	3	0.00
<i>V. scalaris</i>	1.0 ± 0.0	50	22	28	1.7 ± 0.4	90	1	9	0.04
<i>V. unilateralis</i>	7.4 ± 1.4	93	5	2	1.7 ± 0.1	96	4	0	0.88
<i>Wallisia cyanea</i>	0.4 ± 0.2	26	35	39	0.6 ± 0.3	87	11	2	0.00
<i>W. lindeniana</i>	0.2 ± 0.0	17	43	40	0.7 ± 0.4	76	14	10	0.03
<i>W. pretiosa</i>	0.7 ± 0.2	68	32	0	1.2 ± 0.2	87	0	13	0.07
<i>Werauhia gladioliflora</i>	8.7 ± 1.5	94	5	1	4.6 ± 0.7	95	4	1	0.95
<i>Wer. nutans</i>	8.1 ± 2.0	94	5	1	8.2 ± 0.8	89	7	4	0.00
<i>Wer. patzeltii</i>	0.6 ± 0.1	46	43	11	0.9 ± 0.3	86	14	0	0.15
<i>Wer. pectinata</i>	14.0 ± 3.5	97	2	1	8.5 ± 1.3	82	16	2	10.78
<i>Wer. sanguinolenta</i>	13.2 ± 0.6	95	3	2	4.2 ± 1.0	88	2	10	0.30
<i>Wer. werckleana</i>	22.5 ± 1.8	97	2	1	3.4 ± 1.4	100	0	0	0.25

Bold type = bat-pollinated bromeliads. n.d. = not detectable.

Supplementary Material

What do nectarivorous bats like? Nectar composition in Bromeliaceae with special emphasis on bat-pollinated species

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Supplementary Table S5: Results of the PERMANOVA taking into account the individual components of nectar (corresponding Table 1). R^2 describes the influence of the pollinator, the genus and the botanical garden on the nectar composition.

	Degrees of freedom (df)	Pseudo-F (F)	R^2	<i>p</i> -value
<i>Sugar [mM]</i>				
Pollinator	1	85.90	0.41	0.001 ***
Genus	6	2.13	0.06	0.019 *
Bot. garden	3	1.68	0.02	0.125
Pollinator x Genus	6	2.52	0.07	0.007 **
Pollinator x Bot. garden	3	1.92	0.03	0.079
Genus x Bot. garden	1	2.85	0.01	0.064
Pollinator x Genus x Bot. garden	1	14.38	0.07	0.001 ***
Residuals	68		0.32	
Total	89		1.00	
<i>Amino acids [mM]</i>				
Pollinator	1	26.35	0.03	0.001 ***
Genus	6	54.20	0.37	0.001 ***
Bot. garden	3	8.62	0.03	0.001 ***
Pollinator x Genus	6	61.05	0.42	0.001 ***
Pollinator x Bot. garden	3	6.65	0.02	0.001 ***
Genus x Bot. garden	1	21.11	0.02	0.001 ***
Pollinator x Genus x Bot. garden	1	19.24	0.02	0.001 ***
Residuals	68		0.08	
Total	89		1.00	
<i>Inorganic ions and organic acids [mM]</i>				
Pollinator	1	73.03	0.34	0.001 ***
Genus	6	6.28	0.18	0.001 ***
Bot. garden	3	5.06	0.07	0.002 **
Pollinator x Genus	6	2.21	0.06	0.011 *
Pollinator x Bot. garden	3	1.49	0.02	0.198
Genus x Bot. garden	1	1.97	0.01	0.144
Pollinator x Genus x Bot. garden	1	1.20	0.01	0.266
Residuals	68		0.32	
Total	89		1.00	

Supplementary Material

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Supplementary Table S6: Sugar-ratios in nectar of bromeliad species collected during fieldwork in Bolivia and Mexico or in botanical gardens in Germany. Data from field plants were derived from (Krömer et al., 2008) and data from greenhouse plants were derived from Supplementary Table S2 (this work).

	Field plants		Greenhouse plants	
Species	<i>n</i>	Sucrose-to-hexoses ratio	<i>n</i>	Sucrose-to-hexoses ratio
chiropterophilus				
<i>Guzmania killipiana</i>	1	0.6	3	0.4 ± 0.2
<i>Tillandsia heterophylla</i>	2	0.3 ± 0.0	3	0.3 ± 0.0
<i>Tillandsia viridiflora</i> (<i>Pseudalcantarea viridiflora</i>)	7	0.3 ± 0.1	3	0.5 ± 0.1
<i>Werauhia nutans</i>	5	0.6 ± 0.1	3	0.5 ± 0.2
trochilophilus				
<i>Guzmania melinonis</i>	1	2.6	3	1.5 ± 0.2

References

Krömer, T., Kessler, M., Lohaus, G., and Schmidt-Lebuhn, A.N. (2008). Nectar sugar composition and concentration in relation to pollination syndromes in Bromeliaceae. *Plant Biol (Stuttg)* 10, 502–511. doi: 10.1111/j.1438-8677.2008.00058.x