iScience, Volume *24*

Supplemental information

Sucrose digestion capacity in birds shows convergent coevolution with nectar composition across continents

Todd J. McWhorter, Jonathan A. Rader, Jorge E. Schondube, Susan W. Nicolson, Berry Pinshow, Patricia A. Fleming, Yocelyn T. Gutiérrez-Guerrero, and Carlos Martínez del Rio

Table S1. Sample sizes, body mass (m_b), gut nominal (smooth bore tube) surface area and total enzymatic activity measured under standardized assay conditions for species used in comparative analyses. Related to Figure 2, Figure 3, Figure 4 and Methods. **Trichoglossus haematodus, Phytotoma rara* and *Diglossa baritula* were not included in phylogenetic corrected analyses (see methods for justification). The N column provides the sample size. In the diet column, N indicates nectar-specialist lineages, I indicates insectivores, O indicates omnivores (including seeds, fruit, and insects), IF indicates insects and fruit, SI indicates seeds and insects, IFN indicates insects, fruit, and nectar, L indicates leaves, and FL indicates fruits and leaves (diet data after Del Hoyo et al. 2013). 'c' after the sample size reflects animals that were sampled after a known period (>2 weeks) in captivity, and fed an artificial diet. Data are represented as mean ± SEM. *The sucrase values in Sturnidae, Turdidae, and Mimidae are not significantly different from 0 and appear to be the result of small amounts of contamination in the assay, which is done on intestinal homogenates.

Table S1.

Species	Diet	N	m_b (g)	Gut nominal surface area (cm^2)	Total SUCRASE activity ($\mu mol \cdot min^{-1}$)	Total MALTASE activity ($\mu mol \cdot min^{-1}$)	Source
Order: PSITTACIFORMES							
Loriidae							
Trichoglossus haematodus	N	5	135.6 ± 6.5	32.3 ± 3.1	23.88 ± 3.11	154 ± 13.77	This study
Order: Apodiformes							
Trochilidae							
Selasphorus rufus	N	3	3.3 ± 0.1	2.11 ± 0.25	4.82 ± 0.9	7.7 ± 1.38	Schondube and Martínez del Rio 2004
Selasphorus platycercus	N	2	3.4 ± 0.1	1.52 ± 0.08	4.43 ± 0.76	6.55 ± 1	McWhorter and Martínez del Rio 2000; McWhorter & Martínez del Rio, unpublished data
Archilochus alexandri	N	2	3.2 ± 0.1	2.19 ± 0.01	4.15 ± 0.83	9.07 ± 1.71	Martínez del Rio, unpublished data
Archilochus colubris	N	5	3.7 ± 0.2	1.6	9.1 ± 0.9	18.7 ± 1.3	Martínez del Rio, unpublished data
Lampornis clemenciae	N	2	8.4 ± 0.3	3.67 ± 0.03	13.65 ± 0.1	35.73 ± 1.6	McWhorter, unpublished data
Eugenes fulgens	N	4	7.1 ± 0.1	3.35 ± 0.23	9.16 ± 1.1	19.48 ± 1.71	Schondube and Martínez del Rio 2004; unpubl. data
Amazilia rutila	N	4	4.5 ± 0.6	2.2	8.26 ± 0.9	20.75 ± 3.51	Martínez del Rio 1990
Hylocharis leucotis	N	3	3.6 ± 0.1	2.7 ± 0.17	5.42 ± 0.72	9.03 ± 1.08	Schondube and Martínez del Rio 2004
Cynanthus latirostris	N	5	2.9 ± 0.1	1.7	5.56 ± 0.45	14.02 ± 1.3	Martínez del Rio 1990
Chlorostilbon canivetti	N	4	2.1 ± 0.1	1.2	4.48 ± 0.36	8.49 ± 0.27	Martínez del Rio 1990
Colibri thalassinus	N	3	4.8 ± 0.2	3 ± 0.03	8.48 ± 1.05	22.01 ± 2.19	Schondube and Martínez del Rio 2004
Order: PASSERIFORMES							
TYRANNI							
Tyrannidae							
Pitangus sulphuratus	IF	3	73.3 ± 5.7	21.7	6.94 ± 1.01	39.91 ± 6.2	Martínez del Rio 1990
Myiozetetes similis	IF	3	28.9 ± 2.6	11.3	3.09 ± 0.47	29.74 ± 4.13	Martínez del Rio 1990
Empidonax difficilis	I	2	10.9 ± 1.3	4.7	0.33 ± 0.12	7.15 ± 2.51	Martínez del Rio 1990
Cotingidae							
Phytotoma rara *	L	5	45.6 ± 0.9	18.2	119	419.9	Meynard et al. 1999
PASSERI							
Meliphagidae							
Phylidonyris novaehollandiae	N	5c	23.2 ± 0.4	7.41 ± 0.11	16.68 ± 2.46	50.64 ± 5.94	This study
Lichmera indistincta	N	5	11.2 ± 0.6	3.58 ± 0.24	2.61 ± 0.67	16.4 ± 3.31	This study
Lichenostomus virescens	N	4	31.6 ± 1.6	9.22 ± 0.32	18.72 ± 3.69	125.71 ± 14.96	This study

Anthochaera carunculata	N	5c	106.6 ± 4.7	14.09 ± 1.2	54.6 ± 8.18	277.82 ± 42.48	This study
Bombycillidae							
Bombycilla cedrorum	F	4	36.3 ± 1.5	22.3	20.2 ± 1.15	145.3 ± 13.45	Witmer and Martínez del Rio 2001
Turdidae*							
Catharus guttatus	IF	1	33	11.2	0.2	26.9	Witmer and Martínez del Rio 2001
Catharus ustulatus	IF	1	37	12.6	0.05	31.1	Witmer and Martínez del Rio 2001
Catharus minimus	IF	1	43.5	14.8	0.2	23.6	Witmer and Martínez del Rio 2001
Catharus aurantiirostris	IF	2	25.2 ± 2	9.1	0	5.47 ± 1.12	Witmer and Martínez del Rio 2001
Hylocichla mustelina	IF	3	61.8 ± 2.1	22.2	0.3 ± 0.02	29.9 ± 2.66	Witmer and Martínez del Rio 2001
Turdus migratorius	IF	3	67.5 ± 1.1	22.9	0.4 ± 0.12	60 ± 8.78	Witmer and Martínez del Rio 2001
Turdus rufopalliatus	IF	3	70.4 ± 5.8	24.2	0	9.45 ± 2.15	Witmer and Martínez del Rio 2001
Sturnidae*							
Sturnus vulgaris	O	8	75 ± 1.2	25.7 ± 0.3	0	67.7 ± 4.9	Martínez del Rio et al. 1995
Mimidae*							
Dumetella carolinensis	O	3	36.6 ± 1.3	12.22	0.04 ± 0.03	28.96 ± 8.15	Malcarney et al. 1994
Fringillidae							
Diuca diuca	SI	13	32.7 ± 0.8		5.93 ± 0.2	66.33 ± 2.7	Sabat et al. 1998
Zonotrichia capensis	SI	13	20.6 ± 0.3		3.62 ± 0.3	37.43 ± 2.9	Sabat et al. 1998
Parulidae							
Dendroica pinus	I	7	11.6 ± 0.4	6	2.19 ± 0.13	17.3 ± 2.72	Levey et al. 1999
Dendroica coronata	IF	7	12.5 ± 0.3	5.83 ± 0.14	4.2 ± 0.1	43.3 ± 1.6	Afik et al. 1995
Vermivora ruficapilla	IF	3	8 ± 0.2	6 ± 0.1	3.2 ± 0.8	20.5 ± 2.6	Schondube and Martínez del Rio 2004
Vermivora celata	IF	3	8.2 ± 0.3	5.4 ± 0.1	2.1 ± 0.9	17.2 ± 3.1	Schondube and Martínez del Rio 2004
Icteria virens	IF	3	21.9 ± 2	10.8	3.33 ± 0.27	58.77 ± 0.8	Martínez del Rio 1990
Thraupidae							
*Diglossa baritula **	N	4	8.1 ± 0.1	3.7 ± 0.1	3.25 ± 0.31	30.1 ± 2	Schondube and Martínez del Rio 2004
Cardinalidae							
Saltator coerulescens	FL	3	45.6 ± 0.3	16.4	4.03 ± 0.37	67.39 ± 0.5	Martínez del Rio 1990
Passerina leclancherii	SI	2	15 ± 2.1	5.5	3.83 ± 0.2	47.7 ± 0.25	Martínez del Rio 1990
Icteridae							
Icterus pustulatus	IF	3	28.2 ± 4.1	7.3	8.49 ± 0.92	60.76 ± 6.27	Martínez del Rio 1990
Icterus spurius	IFN	3	18.5 ± 2.6	6.6	13.63 ± 0.46	104.38 ± 3.29	Martínez del Rio 1990

Agelaius phoeniceus	SI	8	57.5 ± 2	15.5 ± 0.5	4.6 ± 0.07	106.6 ± 1.3	Martínez del Rio et al. 1995; Martínez del Rio, unpublished data
Molothrus ater	SI	8	40.8 ± 1.7	12.9 ± 0.6	4.12 ± 0.1	83.3 ± 6.3	Martínez del Rio, unpublished data
Quiscalus mexicanus	SI	3	95.9 ± 5	30.4 ± 1.8	10 ± 0.9	195.4 ± 3.9	Martínez del Rio, unpublished data
Cacicus melanicterus	IFN	3	84.9 ± 18	23.4	18.46 ± 5.06	223.85 ± 4.5	Martínez del Rio 1990
Passeridae							
Passer domesticus	SI	7	26.7 ± 0.9	10.7	9.9 ± 0.5	110 ± 8.09	Caviedes-Vidal et al. 2000
Nectariniidae							
Cinnyris oseus	N	4c	6.1 ± 0.1	2.31 ± 0.36	5 ± 1.04	20.12 ± 4	This study; McWhorter unpublished data
Cinnyris talatala	N	4	9 ± 0.7	3.27 ± 0.25	8.31 ± 1.09	41.03 ± 3.95	This study
Chalcomitra amethystina	N	5	14.2 ± 0.5	4 ± 0.17	13.3 ± 0.94	59.25 ± 1.86	This study

Table S2. Number of copies of the sucrose-isomaltase gene (*SI*) in parenthesis following species names in a sample of bird genomes. Related to Figure 2. The number is in bold for species where two copies were found.

Struthioniformes: *Struthio camelus* (1); **Apterygiformes:** *Apteryx rowi* (1); **Casuariiformes:** *Dromaius novaehollandiae* (1); **Tinamiformes:** *Nothoprocta perdicaria* (1); **Galliformes:** *Coturnix japonica* (1), *Gallus gallus* (**2**), *Phasianus colchicus* (**2**), *Meleagris gallopavo* (1); **Anseriformes:** *Anas platyrhynchos* (1), *Anser cygnoides* (1), *Aythya fuligula* (1) **Apodiformes:** Calypte anna (**2**), *Oreotrochilus melanogaster* (1); **Cuculiformes:** *Cuculus canorus* (1); **Charadriiformes**: *Calidris pugnax* (1), *Charadrius vociferus* (1); **Phaetontiformes:** *Phaethon lepturus*; **Sphenisciformes***:* *Aptenodytes forsteri* (**2**), *Pygoscelis adeliae* (1); **Pelecaniformes***:* *Nipponia nippon* (1); **Ophistocomiformes:** *Ophistocomus hoazin* (1); **Accipitriformes:** *Aquila chrysaetos* (1); **Strigiformes:** *Tyto alba* (1), *Athene cunicularia* (1); **Piciformes:** *Picoides pubescens* (1); **Falconiformes**: *Falco cherrug*; **Psittaciformes**: *Melopsittacus undulatus* (1); **Passeriformes:** *Chiroxiphia lanceolata* (1), *Manacus vitellinus* (1), *Neopelma chrysocephalum* (1), *Corapipo altera* (1), *Lepidothrix coronata* (1), *Corvus brachyrhynchos* (1), *Corvus moneduloides* (1), *Catharus ustulatus* (1), *Sturnus vulgaris* (1), *Fidecula albicollis* (1), *Lonchura striata* (1), *Parus major* (1), *Pseudopodoces humilis* (1), *Camarhynchus parvulus* (1), *Taeniopygia guttata* (**2**), *Serinus canaria* (1), *Zonotrichia albicollis* (1)

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