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Drosophila in honeydew: an opportunistic resource.

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Drosophilids are small flies that usually breed on decaying vegetal material. They commonly feed on yeast and bacteria present during the fermentation process. The most studied genus, *Drosophila*, comprehends species that use mainly fruits, flowers, fungi, or cacti as feeding and breeding resources, although some other extreme niches are found (Carson, 1971).

In the last decade, there has been a sharp increase on the study of Neotropical *Drosophila* ecology. Temporal and spatial variation of groups and species has been a major theme (Tidon *et al*., 2006; Mateus *et al*., 2006; Bizzo *et al*., 2010, Schmitz *et al*., 2010; Poppe *et al*., 2012), and researchers are now moving towards the study of the mechanisms that determine the temporal and spatial patterns. One main topic in this area is resource use; decomposing material used by flies as feeding and breeding sites (Valadão *et al*., 2010). These observations are scattered among *Drosophila* literature, but were recently increasing on fruits (De Toni *et al*., 2007; Roque *et al*., 2009), fungi (Gottschalk *et al*., 2009), and flowers (Schmitz, personal communication). Here we report a new feeding resource for drosophilids: the honeydew of scale insects (Hemiptera: Coccoideae).

In the begining of July 2012, one of us (M.R.) observed a great mass of flies in a trunk of *Inga* sp. (Fabaceae) in an orchard at the campus of Universidade Federal de Santa Catarina (27°35'54"S; 48°30'54" W). The trunk was infested with scale insects that secreted a sugar-rich and sticky liquid that eventually dropped and soaked the ground. After being secreted, the honeydew started hardening, got waxy, and was covered by dark and green mould. We monitored the tree on the following week until the temperature dropped (it was mid winter) and no more flies were collected.

The mass of flies was most evident during the hottest hours of the day and consisted mainly of Milichiidae (Carnoideae) and were tentatively assigned to *Milichiella* Gigio-Tos and *Pholeomyia* Bilimek. Some Drosophilidae, Dolichopodidae, Mycetophilidae, and Syrphidae, as well as *Apismellifera* L. (Hymenoptera, Apidae), were also collected. Interestingly, flies were aggregated on places with direct sunshine and followed the sun movement. Initially we started to sweep for 10 minutes at morning, midday, and at noon, but it was clear that drosophilids occurred only in the morning. We swept the trunk and the soaked soil near the tree, as well as between its roots.

Table 1. Absolute (ni) and relative abundance (pi) of drosophilid species collected on honeydew.

					2-Jul	3-Jul	5-Jul	9-Jul	13-Jul	Sample	
Genus	**Subgenus**	**group**	**subgroup**	**species**	***ni***	***ni***	***ni***	***ni***	***ni***	***ni***	***pi***
Drosophila	*Dorsilopha*	*busckii*		*D. busckii* Coquillett, 1901			1			1	
	Drosophila	*cardini*	*cardini*	*D. cardinoides* Dobzhansky & Pavan, 1943		14		5	4	23	0.14
				D. neocardini Streisinger, 1946			1		1	2	
				D. polymorpha Dobzhansky & Pavan, 1943					2	2	
				unidentified	1		3			4	
		guarani	*guaramunu*	*D. griseolineata* Duda, 1927	4	5			3	12	0.07
				unidentified			3	5	7	15	0.09
		immigrans		*D. immigrans* Sturtevant, 1921			1			1	
		repleta	*mercatorum*	*D. mercatorum* Patterson & Wheeler, 1942		2	6			8	0.05
			repleta	*D. repleta* Wollaston, 1858			1			1	
				unidentified			3			3	
		tripunctata		*D. medioimpressa* Frota-Pessoa, 1954		1	1			2	
				D. paramediostriata Townsend & Wheeler, 1955		11	7			18	0.11
				unidentified			3	2	1	6	
	Sophophora	*bromeliae*		unidentified		1				1	
		melanogaster	*ananassae*	*D. malerkotliana* Parshad & Paika, 1964	1	1	4	6		12	0.07
			melanogaster	*D. melanogaster* Meigen, 1830	1					1	
				D. simulans Sturtevant, 1919	2	2	6	1		11	0.07
			montium	*D. kikkawai* Burla, 1954			7			7	
		saltans	*sturtevanti*	*D. sturtevanti* Duda, 1927				3		3	
		willistoni	*willistoni* Pavan, 1952				3			3	
		unidentified		unidentified		1				1	
Scaptodrosophila		*latifasciaeformis*		*S. latifasciaeformis* Duda, 1940			1			1	
Zaprionus	*Zaprionus*	*armatus*	*vittiger*	*Z. indianus* Gupta, 1970	1	14	10	2		27	0.16
TOTAL					10	52	61	24	18	165	1.00

With a modest number of drosophilids collected (165), up to 17 species were determined (Table 1). The flies collected consisted mostly of common species found in this urban environment when collecting with banana baited traps, which has a clear dominance of exotic flies such as *Zaprionus indianus* and *D. simulans* (Gottschalk *et al*., 2007). Within each species group, again we found mainly the most common and widely distributed species (*D. mercatorum* of the *repleta* group; *D. cardinoides* of the *cardini* group; *D. griseolineata* of the *guarani* group; and eventually *D. sturtevanti* of the *saltans* group). One of these, *D. cardinoides*, seems to have the widest niche within the *cardini* group, as it was found in many species of fruits (Blauth and Gottschalk, 2007; De Toni *et al*., 2007; Roque *et al*., 2009), flowers (Frota-Pessoa, 1952; Schmitz, personal communication), fungi (Gottschalk *et al*., 2009), and cacti (Bizzo, unpublished data).

Based on subtle differences of the morphology of the aedeagus, parameres, and decasternum, we believe *D.*aff. *paramediostriata* is potentially an undescribed species.

The reason why flies and bees where aggregating on this particular tree is not entirely clear, but with the exception of Syrphidae (known to be a predator of other flies), we believe they were feeding on this sweet secretion, the moulds, or even yeasts that are known to inhabit this kind of resource (Serjeant *et al*., 2008). Indeed, Brake (2012) reports that adult Milichiidae were observed feeding on honeydew. Flies clearly did not use the honeydew as a breeding site, since it hardens in few days and no larvae were seen. The honeydew of scale seem to be an opportunistic feeding resource for drosophilids and other close-related families of flies, especially in the winter, when there are fewer flowers, fungi, and fruits fermenting. Although we had a very limited collection time and captured mainly generalist common species, further collections in well preserved forests might show that honeydew is used by a greater diversity of drosophilids.

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Isolation of a long lifespan strain of *Drosophila melanogaster*.

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There is a substantial interest in the relationship between longevity and oxidative stress. It is well-known that longevity of an organism is a quantitative trait and is determined by the action of both genetic and environmental components. The longevity of an organism is thought to be evolved in relation to demands by the environment for fitness. The fruitfly *Drosophila melanogaster* has been used as a model in biological research on aging for exploring the longevity phenotypes, artificial and natural selection responses (Paaby and Schmidt, 2009). In the past decade or so, various groups have tried employing artificial selection to generate extended longevity strains and to use them as a tool to examine the mechanisms underlying aging. In *D. melanogaster*, much of the longevity research has been based on the artificial selection in the laboratory. The factors shown to be involved in longevity include coordinated and specific upregulation of different antioxidant genes, expression of heat shock proteins, mitochondrial differences, decreased ROS production or increased ROS scavenging activity, and calorie restriction (Arking, 2005). In *Drosophila*, energy metabolism and SOD account for less than 40% of the average difference in lifespan between long-lived and normal flies (Rose *et al*., 1992; Tyler *et al*., 1993). We have isolated a long lifespan (LLS) strain using laboratory population of *D. melanogaster*, which shows extended longevity when compared with their progenitor normal lifespan (NLS) flies. The LLS flies isolated will be a useful model to study the factors involved in the longevity of organisms.

D. melanogaster (Oregon K) was obtained from the Drosophila Stock Center, University of Mysore, Mysore, India. This stock was maintained in a vivarium at 22±1°C on standard wheat cream agar medium with 12:12 light and dark cycles. The virgin females and unmated males were collected within 6 h of eclosion. Isolation of LLS was carried out using this laboratory population of *D. melanogaster*. Freshly eclosed adults from vials set up with a density of about 25 eggs per vial were collected; the virgin females and unmated males were segregated within 6 h of their eclosion. Pair mating was conducted to obtain the progeny. Flies that lived longer than the NLS flies were selected, and the progenies of the same were monitored for further generations. The LLS lines were amplified further for future studies. The adult lifespan of reproducing flies was assessed by setting up 20 vials for each strain, with each vial containing 20 males or 20 females. Freshly eclosed NLS and LLS adults from vials set up with a density of about 25 eggs per vial were collected, and unmated flies of both the sexes were segregated within 6 h of eclosion. Flies were transferred to fresh food vials every