

The common periwinkle, *Littorina littorea*, Linne, attracted by sugars

Richard G. Woodbridge 3rd

Transpace Laboratory, Box 111, Princeton Junction (New Jersey 08550, USA) 4 April 1978

Summary. In its natural habitat this marine snail was found to be very strongly attracted to an agar gel containing glucose. Sucrose and galactose were less but about equally attractive; manose barely attractive and fructose and manitol not attractive.

The appearance of large masses of periwinkles feeding together on pieces of decaying sea weed which have been washed up on the shore is matter of frequent observation. The similarity of this to the phenomena of the congregation of moths which takes place in 'sugaring for moths', occurred to the writer. Consideration of the naturally occurring constituents of living kelp (*Laminaria longicruris*) and other sea weeds, and materials which might be released in a decaying process, led to the possible consideration that sugar and sugar-like substances might constitute attractants¹. The first test of this concept was spectacularly successful. A solution made by dissolving a teaspoon of common table sugar in a hot agar-agar solution was poured into a petri dish and allowed to solidify. At low tide the petri dish was taken to the shore, placed in the water and weighted with a stone. On visiting the dish on the next low tide, the petri dish was found to be partially hidden under a large mass of writhing periwinkles.

Attractiveness of sugars to periwinkles

Sugars	Number of trials	Periwinkles attracted (average)*
Glucose	5	25
Sucrose	17	9
Galactose	17	8
Mannose	5	3
Fructose	5	2
Mannitol	5	2
Corn syrup (Karo Dark)	17	32
Control (agar alone)	6	2
Control (empty dish)	5	2

*Units are: periwinkles per 100 cm² per tide. Figures are rounded.

Subsequent, quantitative experiments were conducted as follows: A 5% agar-agar gel containing 5% of the sugar under consideration was prepared. This was poured, while hot into shallow weighted containers and allowed to solidify. The containers were then exposed on a flat location among the rocks near the low tide waterline in the waters of Northwest Harbor, Deer Isle, Maine, in an area where periwinkles abound. The containers were left submerged through the rise and fall of the tide and visited during the subsequent low tide period and the number of periwinkles in each dish was counted. For comparison purposes the count was converted into number of periwinkles attracted per 100 cm² of agar-agar surface per tide, with the results shown in the table. In conclusion: It has been shown that certain water soluble substances will act to attract the periwinkle *Littorina littorea* materials, certain sugars act as strong attractants. Periwinkles can differentiate one sugar-like attractant from another. The experimental method devised makes it possible to study in a quantitative way the behavior of such mollusks towards attractants. It would be of great interest to ascertain whether sugar and sugar-like substances could be used as attractants (i.e. 'baits') for other algae consuming mollusks, e.g., the abalone (*Haliotis*).

1 The only reference to investigations pertaining to the behavior of marine mollusks towards sugar substances appears to be that of J. Henschel, 'Untersuchungen über den chemischen Sinn von *Nassa reticulata*'. Wiss. Meeresunters. Abt. Kiel 26, 133 (1933). Henschel found that *Nassa reticulata* was positively (+) attracted towards soluble starch, sucrose, fructose, maltose and glycogen.

What distinguishes cosmopolitan and endemic *Drosophila* species?¹

P.A. Parsons and Janice McDonald

Australian *Drosophila* Research Unit, Department of Genetics and Human Variation, La Trobe University, Bundoora (Victoria 3083, Australia), 28 April 1978

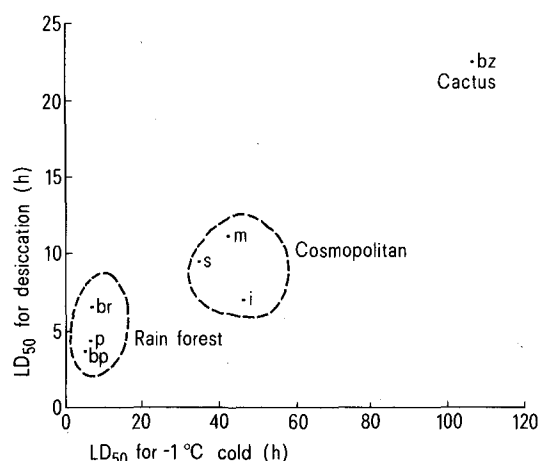
Summary. Cosmopolitan *Drosophila* species can survive wide ecological tolerances measured by resistance to desiccation/temperature extremes compared with endemic rain forest species. This, rather than any genetic features, is important in helping to explain the widespread distributions of cosmopolitan species.

8 *Drosophila* species occur in the 6 commonly recognized faunal realms of the world; they are referred to as cosmopolitan species². While not one is truly cosmopolitan³, it is clear that their distributions have been attained with man's aid, and so are domestic, colonizing species or 'animal weeds' utilizing generalist resources. They are not normally in undisturbed habitats such as rain forests where many endemic species occur. Are there any common genetic features associated with the apparent ecological versatility of the cosmopolitan species? Carson⁴ classified them in relation to degrees of chromosomal morphism and found no generalizations or answers to this question.

The cosmopolitan sibling species *D. melanogaster* and *D. simulans* respond rather similarly to 2 extreme stresses, desiccation at 0% rel.hum. at 25 °C and exposure to -1 °C, although as expected *D. melanogaster* from given sympatric populations survives these extremes somewhat better than *D. simulans*^{5,6}. This is shown in the figure where we plot LD₅₀ values (in terms of the number of h at which 50% of flies died) for the 2 stresses for strains of the 2 species from Melbourne, Victoria. The cosmopolitan species *D. immigrans* from the same population is somewhat more sensitive to desiccation and more resistant to cold than the sibling species. This agrees with our observations that *D. immigrans*

can be readily collected in mid-winter in Victoria but not the sibling species⁷, conversely the sibling species both occur in the heat stressful urban regions of tropical north Queensland but not apparently *D. immigrans*⁸. These and other observations⁹ show that the effects of the stresses under discussion can be directly related to species continuity in nature. This is reasonable, since insects such as cosmopolitan *Drosophila* species are presumably subject to r-selection rather than K-selection so that mortalities are expected to be largely density-independent, nondirected, and directly relatable to variations of the physical environment^{7,10}.

2 endemic species (*D. bipectinata* and *D. birchii*) from the rain forests of the humid tropics of north Queensland and *D. paulistorum* from the rain forests of tropical America¹¹ are extremely sensitive to environmental extremes by comparison with the cosmopolitan species (figure). This is predictable given the small seasonal and diurnal climatic (temperature) changes in tropical rain forests compared with those in the temperate climate of Victoria. We conclude that natural selection has built up high levels of physiological tolerance to temperature/desiccation stresses in temperate region cosmopolitan *Drosophila* species. Indeed there is direct evidence for natural selection from demonstrated interpopulation variability for tolerance to these stresses in *D. melanogaster* and *D. simulans* which is



LD₅₀ values expressed as number of h at which 50% of flies died for desiccation and -1°C stress plotted against each other for various *Drosophila* species: bp, *bipectinata*; br, *birchii*; bz, *buzzatii*; i, *immigrans*; m, *melanogaster*; p, *paulistorum*; s, *simulans*. The *D. paulistorum* results are for the mean of 2 semi-species, 1 transitional and 1 Andean¹¹, which were combined being very similar. In general males were more sensitive to stresses than females as expected⁵, but sexes were combined since no large sex × species interactions were detected.

directly relatable to habitats^{5,6} in eastern Australia (as well as from analogous results for the Queensland fruit fly, *Dacus tryoni*, which occurs over a wide latitudinal range of eastern Australia¹²).

Assuming that tolerance to these stresses is relatable to intensities of natural selection, the extreme tolerance of an introduced species (to Australia) *D. buzzatii* (figure), which originated in Argentina in association with 1 or more species of the cactus genus *Opuntia* is predictable, since its only known breeding sites are rot pockets in the cactus itself¹³. This absolute association in nature means that flies are far less able to avoid environmental extremes by habitat selection than cosmopolitan species, and so there would necessarily be extremely intense natural selection for resistance to environmental extremes in this species simply because of the highly specific nature of resources utilized. High tolerances to environmental extremes may also be adaptive in such species, where migration to new exposed rot pockets is necessary for species continuity. The figure clearly shows the contrast between the 3 groups of species according to the ecological categories of tropical rain forest species, cosmopolitan species and cactus species.

In conclusion, cosmopolitan *Drosophila* species can tolerate reasonably wide desiccation/temperature extremes and utilize generalist resources. Cosmopolitan species do not appear to have unique genetic features, but may have genotypes capable of adapting to greater environmental extremes than tropical rain forest endemics at least. This does not preclude certain species being highly resistant to stresses, but this is likely to be associated with more specialist resource utilization as in *D. buzzatii*.

- 1 We thank Dr Lee Ehrman for cultures of *D. paulistorum*, and the Australian Research Grants Committee for financial support.
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Prostaglandin-like substances in *Propionibacterium acnes*

S. Abrahamsson, L. Hellgren and J. Vincent

Department of Structural Chemistry, Faculty of Medicine, University of Göteborg, and Department of Dermatology, Sahlgren's Hospital, Göteborg (Sweden), 21 April 1978

Summary. The presence of prostaglandin-like substances in *Propionibacterium acnes* is reported for the first time.

The factors responsible for inflammatory reactions in acne vulgaris are not yet completely understood. The rupture of the comedone wall results in a leakage of the intrafollicular content into surrounding dermis, which elicits the inflammatory response. The *Propionibacterium acnes* is consid-

ered to be a substantial source of intrafollicular lipases¹ and to mediate the lipolysis of sebaceous triglycerides to comedogenic fatty acids². Recently, it was stated that hyaluronidase is able to decompose the intracellular material of the pilosebaceous duct wall, and in this way facilitate the