Functional gustatory receptors in Drosophila wings reveal their role in guidance and exploration associated to flight

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FUNCTIONAL GUSTATORY RECEPTORS IN DROSOPHILA WINGS REVEAL THEIR ROLE IN GUIDANCE AND EXPLORATION ASSOCIATED TO FLIGHT

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Chemoreception in insects is capable to detect highly diverse families of molecules like sugars, various bitter molecules, toxins, water, carbon dioxide and also a large panel of “xenobiotics”, which guide exploration for ecological niches. The taste neuronal elements are amazingly present in insect wings and this feature appears highly conserved in all the winged species of insect taxa. The functionality of the taste organs in wings is presently unknown and this topology suggests an intriguing role that is not documented up to date. In this report we describe that the wing anterior margin neuronal nerve responds to sugars and bitter molecules through an increase of the cytosolic Ca^{2+} concentration that occurs in both pathways. As expected, the effects on AMPc levels are divergent for sugar and bitter signal transduction. This sensory modality strongly suggests that the pollinator insects “taste” molecules nebulized in the air vortex created by the wing beat during flight in close vicinity to flowers. This evolutionary conserved sensory organ dissociates advantageously taste from ingestion avoiding toxicity by noxious substances.

TRIACYLGLYCERIDES (TAGS) – A NOVEL CLASS OF COURTSHIP-RELATED COMPOUNDS IN A DROSOPHILA SPECIES COMPLEX

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In *Drosophila melanogaster*, long chain hydrocarbons serve as pheromones that are involved in complex social behaviours such as courtship and aggression. However, two closely-related desert-dwelling drosophilids, *D. arizonae* and *D. mojavensis*, express a novel class of compounds that is likely to be involved in courtship. These triacylglycerides (TAGs) are expressed exclusively in the male ejaculatory bulb and are transferred from males to females during mating.

Behavioural studies show that mated *D. arizonae* females are less attractive to conspecific males than virgin females. In addition, *D. arizonae* virgin females “perfumed” with extracts from the ejaculatory bulb are less attractive, suggesting that TAGs are candidate courtship-inhibiting compounds. In contrast, males of the sister species, *D. mojavensis*, do not exhibit a preference for virgins despite the transfer of TAGs during copulation. The difference in behaviour suggests an evolutionary role for the TAGs in speciation where *D. mojavensis* might have lost receptors to the TAGs, resulting in its early divergence from *D. arizonae*.

Initial comparative expression analysis between young and mature ejaculatory bulbs from both species have identified some candidate genes that are species-specific, male reproductive tract-specific, and have age-specific expressions that correlate with TAG production.

Mass spectrometry analyses of the TAGs indicate an unusual structure consisting of one long chain and two very short chain fatty acyl moeities. Interestingly, the short chain fatty acids are branched structures.

Further studies and tracing of the candidate speciation genes in the phylogeny could give us insight into the evolution of the TAGs as courtship-related compounds.