

A Drosophila model for nicotine reward

The last 20 years of Drosophila addiction research has revealed remarkable similarities between flies and mammals in alcohol and drug-induced behavior and the neural and molecular mechanisms underlying these behaviors. Drosophila show parallels to mammals in nicotine-induced behavior and the neural and molecular mechanisms underlying this. Low doses of volatilized nicotine induce an acute startle and hyperactivity responses whereas larger doses decrease locomotion in adult Drosophila. Nicotine consumption during development increases heart rate, reduces survival to adulthood, and increases brain size. Like in mammals, nicotine induces dopamine release during both larval and adult stages, and nicotine-dependent changes in locomotion are dopamine dependent. However, there is a gap in our knowledge about whether nicotine is rewarding, and what the genetic and epigenetic mechanisms underlying this response might be. We developed a new conditioned odor preference assay to test the reward responses to nicotine in Drosophila, and found that flies reveal appetitive behavioral dynamics favoring an odor previously paired with doses of nicotine that induce acute locomotor hyperactivity. Furthermore, we conducted multiomic analysis of the Drosophila mushroom body, a structure required for memory formation, and determined complexity in expression of multiple nicotinic acetylcholine receptors, suggesting that nicotine has strong synergistic effects on cue-induced olfactory memory. Together, our data suggest Drosophila is a strong model to test the mechanisms underlying the addictive properties of nicotine.

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