Octopamine Acts Antagonistically to Serotonin in the Modulation of Food-Dependent Behaviors

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Octopamine biosynthesis requires the tyrosine decarboxylase TDC-1 to convert tyrosine to tyramine and the tyramine beta-hydroxylase TBH-1 to convert tyramine to octopamine. *tdc-1* and *tbh-1* deletion mutants lack octopamine and have defects in several food-dependent behaviors: *tbh-1* and *tdc-1* mutants fail to properly inhibit egg laying and pharyngeal pumping in the absence of food. Food-deprived *tbh-1* and *tdc-1* mutants, much like mutants that have increased serotonin signaling because of a loss of function of the serotonin-reuptake transporter MOD-5, move much more slowly (hyperenhanced slowing response) than wild-type animals when they encounter a bacterial lawn. *tbh-1* and *tdc-1* mutants are also hypersensitive to exogenous serotonin in assays of locomotion, pharyngeal pumping and egg laying. We found that *mod-5* mutants, like *tbh-1* and *tdc-1* mutants, fail to properly decrease their pharyngeal pumping rates in the absence of food and are hypersensitive to exogenous serotonin in pharyngeal pumping assays. Mutations in *tdc-1* or *tbh-1*, but not in *mod-5*, increase the pharyngeal pumping rate of serotonin-deficient *tph-1* mutants. Our results suggest that octopaminergic signaling is stimulated in the absence of food and indicate that endogenous octopamine inhibits pharyngeal pumping and egg laying and stimulates locomotion. Thus, octopamine may act antagonistically to serotonin in the modulation of food-dependent behaviors.

We are seeking putative serotonin and octopamine receptors that function in serotonergic and octopaminergic neural circuits. We found that animals mutant for the G-protein-coupled serotonin receptor *ser-7* have a reduced pharyngeal pumping rate and are egg-laying defective. *ser-7* mutants are resistant to exogenous serotonin in egg laying and pharyngeal pumping assays. Animals mutant for the putative octopamine receptor *ser-3*/K02F2.6 are hypersensitive to exogenous serotonin in pharyngeal pumping assays and suppress the pharyngeal pumping defect of *tph-1* mutants. We hope to determine how octopamine and serotonin coordinately control food-dependent behaviors.