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The Neural Circuit Mechanism of the Synergic Effect of Salty and Umami on Food Palatability

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Summary

Facilitating effect of salty taste on our eating is important for the quality of our daily meals. Interestingly, umami taste, which is another sense of taste, has been known to enhance the palatability of salty food in humans. We previously reported that this facilitative effect of umami on salt palatability could be observed also in the experimental animal model such as mice. In the present study, we investigated the neural mechanisms underlying the synergistic effect between the salty and the umami tastes. In the experiment 1, we investigated the effect of chemogenetic inhibition of the prefrontal cortex on salt- and umami-seeking behavior. In the experiment 2, we tested the effect of pathway-specific inhibition between the prefrontal cortex and the ventral tegmental area on salt- and umami-seeking behavior. In the experiment 3, we investigated whether the activation of dopamine neurons in the ventral tegmental area that receives input from the prefrontal cortex induces dopamine release in the nucleus accumbens which is the main projection target of dopamine neurons in the ventral tegmental area by taking advantage of the optogenetics and fluorescent dopamine sensor. In the experiment 4, we investigated whether the optogenetic activation of the prefrontal cortex to the ventral tegmental area pathway has rewarding effects in the real-time conditioned place preference test.

As a result, we found that (1) the chemogenetic inhibition of the prefrontal cortex and its projection to the ventral tegmental area attenuated the facilitation effect of umami on salt-seeking behavior, (2) the optogenetic activation of the prefrontal cortex to the ventral tegmental area pathway induces the dopamine release in the nucleus accumbens and behavioral rewarding effect. Our results suggest that the prefrontal cortex to the ventral tegmental area pathway and dopaminergic circuit are important for the synergistic effect between the salty and the umami tastes.