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Information Processing and Mutual Regulation in the Neurons Relaying Attractive and Aversive Salt Tastes

Makoto Sugita

Graduate School of Biomedical & Health Sciences, Hiroshima University

Summary

Salt taste triggers two contrastive behavioral responses. Low concentrations of salt elicit appetitive and attractive responses, whereas high concentrations evoke aversive responses. The appetitive responses to low concentrations of salt are mediated by taste receptor cells expressing the epithelial sodium channel, ENaC. The aversive responses to high concentrations of salt is reported to be mediated by bitter and sour taste receptor cells. However, it remains elusive how information of the salty taste is translated in the brain into appropriate behavioral responses. Here we combined genetic tracing of aversive bitter taste pathways and immunohistochemical detection of high- and low-salt-responding cells to elucidate the coding mechanisms for aversive and appetitive salty taste in the brainstem. To visualize bitter taste neuronal circuitries, we applied a genetic approach to express the fluorescently labeled transneuronal tracer, tWGA-DsRed, in T2R5-expressing taste receptor cells in mice. tWGA-DsRed originating from bitter taste receptor cells reached the neurons in the posterior aspect of the solitary tract nuclei, and was further transferred to the neurons in the external-lateral and medial subdivisions of the parabrachial nuclei. To examine whether tWGA-DsRed-labeled neurons selectively process bitter taste information or receive the input of high or low concentrations of salt, we investigated the induction of the immediate early gene c-fos in the tracer-labeled neurons by oral stimulation with taste solution. Oral stimulation with the bitter solution induced c-fos expression in the tWGA-DsRed-labeled neurons in the solitary tract nuclei, and in the external-lateral and medial subdivisions of the parabrachial nuclei. The c-fos expression was also induced in the tWGA-DsRed-labeled neurons in the solitary tract nuclei and the parabrachial nuclei by oral stimulation with low concentrations of salt, suggesting that the tracer-labeled neurons may receive convergent input of bitter and salty taste.