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Molecular Mechanisms Underlying Differentiation and Maintenance of High Salt Taste Cells

Makoto Ohmoto

Takasaki University of Health and Welfare

Summary

Taste perception is initiated when chemical substances in food are detected by taste cells located within taste buds in the oral epithelium. Humans can recognize five basic taste qualities: sweet, umami, bitter, salty, and sour. Each of the sweet, umami, bitter, and sour tastes is detected by distinct populations of taste cells. Salty taste is mediated by two separate pathways: low-concentration sodium taste and high-concentration salt taste. The former is detected by a unique population of taste cells distinct from those sensing sweet, umami, bitter, and sour, whereas the latter is detected by bitter and sour taste cells. This study focuses on Eya1, a transcription factor expressed in bitter taste cells (i.e., taste cells that detect bitter taste and high-concentration salt taste) and undifferentiated taste bud cells, to investigate its role in the differentiation and maintenance of taste cells responsible for bitter and high-salt taste detection.

To analyze the functions of Eya1 in taste buds, we used Eya1-floxed mice in combination with two Cre-expressing lines: one expressing the tamoxifen-inducible CreERT2 recombinase in taste stem cells, and the other expressing Cre in mature sweet, umami, and bitter taste cells. In mice lacking Eya1 in taste stem cells, bitter/high-salt taste cells were replaced by sweet and umami taste cells, indicating that Eya1 is essential for the differentiation of bitter/high-salt taste cells. Similarly, in mice lacking Eya1 in mature taste cells, expression of bitter taste receptors was markedly reduced, and bitter/high-salt taste cells were replaced by sweet and umami taste cells. Behavioral assays revealed that mice lacking Eya1 in mature taste cells failed to avoid bitter substances such as denatonium and cycloheximide, as well as high concentrations of sodium chloride and calcium chloride. These findings suggest that Eya1 is required not only for the differentiation but also for the maintenance of bitter/high-salt taste cells. Overall, this study demonstrates that Eya1 is a key regulator of bitter and high-salt taste cell identity and function and that the Eya1-deficient mice generated here serve as a valuable model for investigating the molecular mechanisms underlying high-salt taste perception.