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Molecular Mechanisms Underlying Differentiation of High Salt Taste Cells

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Summary

The sense of taste occurs when chemical substances in food are detected by taste cells in the taste buds located in the epithelium of the oral cavity. The five basic tastes that humans can recognize are sweet, umami, bitter, salty, and sour. Sweet, umami, bitter, and sour tastes are each detected by different taste cells. It has been shown that salty tastes have two different detection pathways (low-concentration sodium taste and high-concentration salt taste), and that the former is detected by different taste cells from those that detect sweet, umami, bitter, and sour tastes, while the latter is detected by bitter and sour taste cells. Regarding the molecular mechanism underlying the generation of diverse taste cell types, the transcription factor Skn-1a (Pou2f3) plays a crucial role. Skn-1a is expressed in sweet, umami, and bitter taste cells, as well as in taste cells responsible for detecting low concentrations of sodium tastes. It has been previously demonstrated that Skn-1a is essential for the development and differentiation of these specific taste cells. In this study, we hypothesized that Eya1, a transcription factor specifically expressed in bitter taste cells responsible for detecting bitter substances and high concentrations of salt, plays a role in the differentiation of these taste cells. Thus, our aim was to test this hypothesis.

To investigate the function of Eya1 in taste buds, we generated conditional knock-out mice lacking the Eya1 gene specifically in taste buds. This was achieved by crossing a knock-in mouse line expressing CreERT2, a drug-inducible Cre recombinase, in taste bud stem cells (Krt5-CreERT2), with an Eya1-flox mouse line. The expression of taste-related genes in the taste buds of the circumvallate papilla of Eya1 cKO mice showed that the signal frequency of bitter taste receptors was greatly reduced compared to that of control mice. On the other hand, the signal frequency of sweet and umami taste receptors was increased in Eya1 cKO mice compared to control mice. Furthermore, preference tests conducted on Eya1 cKO mice revealed a decrease in aversive behavior towards the bitter substance denatonium and high concentrations of sodium chloride, as compared to control mice. Based on these results, it can be inferred that Eya1 plays a role in the differentiation of taste cells responsible for detecting bitter tastes and high concentrations of salty tastes.