No. 2039

Structural and Biophysical Analysis of Sweet and Umami Taste Receptor Regulation by Chloride Ion

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Summary

Since a salty taste is most strongly perceived with chloride as the counterion, it is considered that chloride is involved in taste sensation. However, how chloride is recognized in the taste system has been remained elusive. In the taste buds, taste receptors play key roles in the recognition of taste substances. Among them, taste receptor type 1 (T1r) is responsible for sweet and umami taste perceptions. Previously, we solved the crystallographic structure of the ligand-binding domain (LBD) of T1r for amino-acid perception from medaka fish, T1r2a/T1r3. In the structure, we found that a chloride ion specifically binds in the close vicinity of the amino-acid binding site in the T1r3 subunit. Nevertheless, whether the binding of chloride ion to T1r has affects sweet or umami perception is unknown. In this study, we analyzed the binding and action of chloride ion to T1r by use of medaka T1r2a/T1r3LBD, a currently sole sample with successful recombinant protein preparation amenable to structural and biophysical analyses, as a representative. Firstly, we confirmed the binding of a chloride ion to T1r2a/T1r3LBD by isothermal titration calorimetry. Furthermore, the chloride binding was found to thermally stabilize the T1r2a/T1r3LBD protein. On the other hand, the affinity of an amino acid to the receptor protein and its effective concentration for the conformational change of the receptor protein concomitant with binding did not show a significant difference in the presence or absence of chloride ion. These results suggest that the binding of a chloride ion to T1r2a/T1r3 does not significantly affect the receptor responses to taste substance amino acids.