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An Analysis of Mechanism Underlying Sex Difference of Sensitivity to Additive Salty Taste Induced by Neutralizing a Basic Amino Acid, Arginine

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Summary

A basic amino acid, arginine (Arg) represents complex taste qualities including sweet, bitter and umami. Furthermore, the additive salty taste is induced by neutralization of arginine (nArg). We examined responses of taste bud cells to Arg and nArg using Ca^{2+}-imaging method applied not only to slice preparations of mouse circumvallate papillae but also to taste bud derived cell line (TBD cells). Arg-induced responses obtained in all taste bud cells from female mice were completely suppressed by U73122, a phospholipase C (PLC) inhibitor, but Arg-induced responses in 20% of the taste bud cells from male mice were not suppressed, suggesting the presence of PLC–independent transduction mechanism of Arg-induced response only in male mice. In most of TBD cells, the verapamil-sensitive $[Ca^{2+}]_i$ elevation was elicited not only by NaCl but also by nArg, but not by Arg. The results of cross adaptation suggest the presence of a common transduction mechanism between NaCl and nArg responses.

The sensory rating experiments revealed that human sensitivity to salty taste of nArg is divided into the sensitive and insensitive types rather than sex difference. The sensitive subjects showed gradual increase of the sensitivity to saltiness induced by nArg in the dose-dependent manner and its enhancement by inosine monophosphate (IMP). Both the dose-dependent increase of bitterness and the dose-dependent decrease of pleasantness induced by nArg were suppressed by addition of IMP to nArg. The measurement of change of oxy-hemoglobin (oxy-Hb) using a near-infrared spectroscopy (NIRS) also represented similar tendency to the rating experiments in the prefrontal brain region. Significant correlations between the rating values and changing amount of oxy-Hb for saltiness and bitterness as well as pleasantness induced by nArg appeared chiefly in the lateral area of the prefrontal brain region, but the correlated area moved from the lateral area to the central area after addition of IMP to nArg. These results suggest a possibility that enhancement of saltiness and pleasantness are due to suppression of bitterness by synergic enhancing effect by addition of IMP to nArg through the interaction between different processing pathways for nArg and IMP respectively in the prefrontal brain region rather than due to differential pathways.