MICROFLUIDICS-ON-A-TONGUE IMAGING CHAMBER FOR FUNCTIONAL TASTE MAPPING *IN VIVO*

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KEY WORDS: Taste, Tongue, *In vivo* calcium imaging, microfluidics, screening

Taste sensation is initiated by taste cells on the tongue, which translate ingested chemicals into cellular-level activity. Current understanding on this cellular encoding process has relied on studies using *ex vivo* model systems, which cannot fully recapitulate natural cellular microenvironment *in vivo*. To resolve this methodological limitation, we develop a novel microfluidics-on-a-tongue imaging chamber which integrates a microscopic imaging window for the taste cells and a multichannel microfluidic interface for controlled delivery of various tastants. We also introduce a dual-color ratiometric calcium imaging, which provides microscopic stability of taste cells even under time-varying fluidic stimuli. Using the devised methodology, we demonstrate real-time calcium imaging of fungiform taste cells *in vivo* in response to the five basic tastes, which provides a comprehensive cellular-level taste map. By screening over 100 taste cells, we reveal that ~70% of taste cells are single-tuned but the remaining ~30% are mostly tuned to dual taste qualities with several distinct modes of crosstalk. Notably, we found a strong crosstalk between the two favored tastes: sweet and umami. Consistently, single mRNA imaging show that a significant portion of the fungiform taste cells indeed expresses the both sweet and umami receptors. By opening a new opportunities to observe functional activity of taste cells in natural living milieu, our novel tool will contribute to deepening our understanding on the taste coding logic.

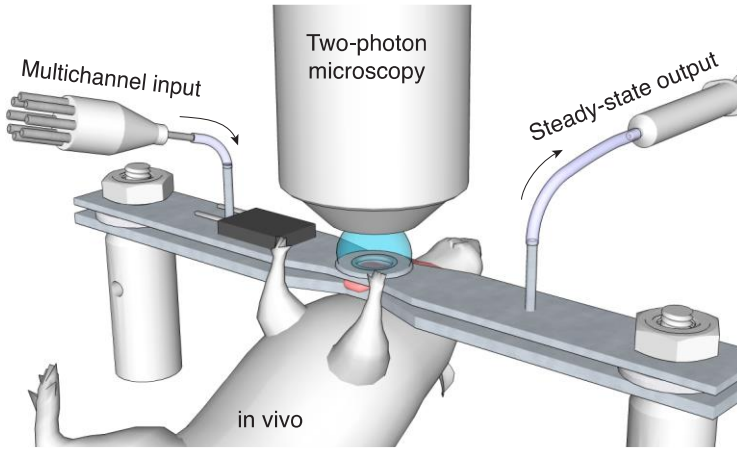

Figure 1: Illustration of microfluidics-on-a-tongue device.