# ABSTRACT

The olfactory systems of vertebrates are able to discriminate and identify complex odor mixture. This process begins with the transduction of the information carried by odor stimulation into electrical signals in sensory neurons. The activation of different subsets of sensory neurons with different degree is the basis for neural encoding of the complex mixture. However, it is still unclear how mixture of odorants is represented in olfactory receptor neurons. This is mainly because odor inhibitory effect arises when odorants are applied simultaneously, which has been known as termed 'mixture suppression' or 'masking'. Although many studies have suggested that the odor inhibitory effect might have a role in forming representations of mixture odor, the mechanisms that underlie this inhibition has been unclear in vertebrate.

The first aim in this study is to examine the inhibitory effect of odorants on newt olfactory receptor neurons. Odor stimulation could suppress IBMX-, cAMP-, and 8-Br-cGMP-induced current. This result shows that odorants can directly suppress CNG-channels, and further comparison of the ratio of current suppression suggests that odor suppression of the transduction current be mainly due to direct suppression of CNG-channels. This odor inhibitory effect was discovered in various odorants (anisole, isoamyl acetate, cineole, limonene, and isovaleric acid) in dose-dependent manner. Furthermore, one odorant could suppress the depolarization caused by another odorant. The depolarization caused by isoamyl acetate was inhibited by anisole in cells that responded excitatory to isoamyl acetate but not by anisole. These results indicated that odorants can hyperpolarize cells that were depolarized by cAMP-induced conductace. This is thought to be an underlying mechanism of inhibition by odorant.

The second aim in this study is to know how the odor inhibitory effect is

involved in the mixture suppression. To answer this question, it is essential to know the odorant- and the cell-specificity of inhibitory effect, and examine the interplay between the inhibitory and excitatory effect. Comparisons of cell's profiles of odor suppression in my study show that inhibitory effect had little cell-specificity, which is significantly different from specificity in the excitatory effect. Moreover, the odor suppression of cAMP-induced current was antagonized by an increase in intracellular cAMP, which means that the inhibitory effect was antagonized by excitatory effect. This is consistent with the result obtained by comparison between responses to individual odorants and those to the mixture; addition of an odorant led to suppression of responses to another odorant more strongly as the added odorant caused less excitatory response. Finally, to check that such a mutual suppression certainly takes place in intact olfactory epithelium, I compared individual odor responses to the mixture odor response. The result of EOG recording supports the result obtained by my whole-cell recording. I further discussed a representation of mixture odorant and a relation to the mixture suppression observed in psychology.