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Molecular Mechanism of Olfactory Transduction: As Viewed from the Dynamics in Cytoplasmic Free Calcium

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Recent studies have gradually revealed the molecular mechanism of transduction in olfactory sensory neurons. In this paper, we attempt to summarize evidence on the molecular mechanism of olfactory transduction and discuss it in the study of odorant-induced increases in cytoplasmic free calcium concentration ($[Ca^{2+}]_i$): dynamics of increases in $[Ca^{2+}]_i$, two pathways of increases in $[Ca^{2+}]_i$, contribution of Ca^{2+} influx to adaptation, and odor selectivity.

1. Introduction

Olfaction, which is a very important sense for animal survival and reproduction, can chemically and distantly inform us of environmental conditions. Surprisingly, the olfactory system can quickly detect and discriminate numerous odor molecules with a very high degree of sensitivity. This odor discrimination is performed by a neural information processing system composed of receptors (sensor) and the central nervous system (information processor), as with other sensory organs. At the first step of olfactory information processing, olfactory receptor neurons transduce chemical signals of odorants into neural signals which are transferred to the brain, working as a chemical/electrical signal transducer (odorant→receptor potentials) and an analog/digital converter (receptor potentials→spike trains) (Fig. 1). Olfactory cilia, which are specialized odor sensory parts, are on the apical dendrite project-