Abstract: The olfactory system is able to discriminate a large array of odor molecules and to translate olfactory stimuli into complex sensory information. The initial stage in olfactory discrimination involves the interaction of odor molecules to specific receptors on the surface of olfactory sensory neurons. This ligand-receptor interaction initiates a cascade of signal transduction events that involves opening of ion channels, membrane depolarization, and generation of action potentials. These signals are transmitted to the olfactory bulb in vertebrates and to the antennal lobe in insects, where the axons from the olfactory neurons form synapses with the dendrites of secondary neurons and interneurons within structures called glomeruli. The secondary neurons integrate the inputs from the sensory neurons and relay the olfactory information to central areas of the brain.

The olfactory receptors (OR) were first identified in the rat, through cloning of their genes. To date, OR genes have been isolated from several vertebrate species and, recently, from Drosophila. The identification of the OR genes has been instrumental in studying the molecular mechanisms of olfactory discrimination. This review summarizes the rapid advancement in our understanding of odor discrimination since the discovery of the OR gene family.

Olfactory recognition is mediated by a large number of receptors sharing a common membrane topology. Individual olfactory neurons express only one OR gene, so that neurons are functionally distinct. Sensory neurons expressing a given receptor synapse at the same glomerulus in the olfactory bulb of vertebrates or the antennal lobe of
insects. The pattern of convergence is invariant in all individuals of a species.
Cognate ligands of some OR have been positively identified, paving the way to a detailed molecular understanding of ligand-receptor interactions. The results of structure-function relationship studies should allow in the future the generation of OR endowed with new and predetermined selectivity.

Keywords: olfactory system, receptors.