Laboratory for Molecular Recognition Biology

Institute for Protein Research

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Senses, such as vision, hearing, touch, taste, and smell, serve as the sole “windows” to the outside world. They are crucial functions that allow living organisms to perceive, identify, and interpret various information from the environment and other individuals. An organism's “worldview” can be said to be shaped by the information recognized by proteins located at the interface with the outside world. Our research focuses on the receptors and transporters at this interface, aiming to elucidate the mechanisms of information recognition and transmission through structural biology, biochemistry, and biophysics. Ultimately, our goal is to reveal how organisms perceive and interpret the world around them.

Structural Biology of Taste Receptors

Taste is a chemical sense that detects substances in food and identifies whether they are essential nutrients for survival or harmful substances. In this process, taste receptor proteins play a key role in the recognition of chemical substances. These receptors have molecular functions that help animals determine what to eat and what to avoid for survival. Although taste is a familiar physiological phenomenon we experience daily, the molecular functions and mechanisms of taste receptors are still not fully understood. One reason for this is the difficulty in preparing taste receptor protein samples, which makes structural and functional analysis at the molecular level challenging.

We have successfully prepared a medaka (*Oryzias latipes*) taste receptor protein, which belongs to the same family as sweet and umami receptors, in a physiological state for the first time. We are using this protein as a model for structural and functional analysis of taste receptors. Our ongoing research focuses on analyzing the structures and functions of taste receptors in various animals, including humans. Ultimately, we aim to elucidate the mechanisms by which different taste substances are recognized and how this information is transmitted into the body.

Analysis of the Physiological Functions of Taste Receptors

Taste receptors are expressed not only in the oral cavity but also in various organs and tissues throughout the body. As a result, it is believed that they may play a physiological role in each tissue by utilizing their ability to respond to chemicals. However, many of their physiological functions remain unknown. Using medaka, a model animal also employed in receptor structure analysis, we are investigating the physiological responses induced by taste receptors in vivo and the types of phenotypes that emerge, from the molecular level to the animal level.

Structural Biology of Transporters in Gut Microbes

In the gut, which serves as our "inner outside world," the gut microbiota, comprising far more cells than those in our own body, lives and influences our health by exchanging various substances through transporters in the bacterial cell membrane. For example, we consume oxalate in our daily diet, but its excessive accumulation can lead to kidney stone formation. An oxalate-degrading bacterium in the gut, which uses oxalate as its sole carbon source, contributes to oxalate homeostasis in our body. By studying the structural biology of its transporter protein, we aim to understand the mechanism by which the bacterium selectively recognizes and absorbs only oxalate from a variety of nutrients in the gut, while efficiently excreting the metabolite into the gut.

Research is an exciting adventure—setting sail into uncharted waters to uncover the mysteries of the world. Why not join us on a journey to places yet unexplored, where no one has ventured before?

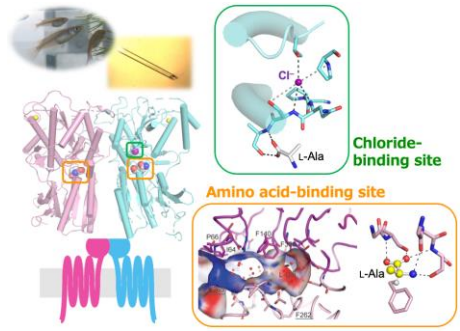

Fig 1.
Crystal structure of the ligand-binding domain of the taste receptor T1r2a/T1r3 from medaka fish

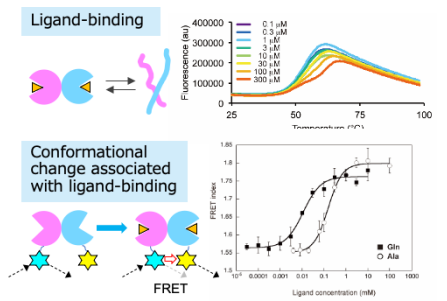

Fig 2.
Ligand-binding assays by use of a recombinant taste receptor protein

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