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Neural Circuits and Olfactory Responses to Neurotropic Viruses in Trout

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Abstract

Vertebrate olfactory receptors (OR) are directly exposed to microorganisms, such as viruses, due to their direct contact with the external environment. A previous study showed that nasal delivery of rhabdovirus IHNV (Infectious hematopoietic necrosis virus) in fish activate nasal immune responses marked by an increase of chemokine CCL19 and prostaglandin synthase expression in olfactory epithelia (OE), and infiltration of $CD8^+$ cells in the OE.

We hypothesize that nasal immune responses are activated by action potential signals generated by activated olfactory receptor (OR) neurons in the OE and olfactory bulb (OB). Moreover, this neural circuit can be traced from a specific OR cell type (crypt cell) in the nose to a specific site in the olfactory bulb. We tested our hypothesis by measuring olfactory responses to live attenuated IHNV virus by electro-olfactogram (EOG). We also visualized the IHNV neural circuit after activation of specific OR, and consequent internalization of molecular receptor and IHNV mixed with Alexa dextran 488 3000 MW.

Our results showed different EOG olfactory responses to live attenuated IHNV and to the medium where the virus was grown (negative control) in rainbow trout. Olfactory responses followed a dose-response pattern typical of OR. Cross adaptation studies also showed that live attenuated IHNV activates a set of receptors different from those activated by virus-free supernatants. Recordings of the OB responses by electroencephalogram are under

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development. Preliminary tracings show fluorescent oval shaped OR in the apical border of the olfactory lamella (putative crypt cells) that extended to the ventral side of the olfactory bulb. This neural circuit differs from those visualized after exposure of trout OE to the food odorant serine.

Combined, our results adds evidence for a new olfactory function in trout, which serves as a first layer of pathogen detection in vertebrates.

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