Chemical sensing in intestinal mucosa

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Intestinal fluid transport is one of the most important functions for nutrient digestion and host defense, and regulated by diverse mediators: neurotransmitters, a variety of gut hormones, and cytokines. These mediators act in responding to mechanical and chemical stimuli, however, mechanism of chemical sensing is not defined. Recently, the same transduction molecules as taste and olfactory senses were reported to be expressed in the intestine. In eating behavior, bitter taste and olfactory sense are considered as repellent signals. Therefore, we examined the effect of bitter tastants and odors on ion transport as an indicator of fluid transport in human and rat colon.

Intestinal mucosa-submucosal preparations were used to measure trans-epithelial ion transport under Üssing chamber technique. Human colorectal tissues obtained by surgical resection from Shizuoka Saiseikai general hospital and rat colon were used. The addition of thymol or eugenol to mucosal bathing solution evoked an increase in short circuit current (I_{sc}) in both human and rat large intestine with increasing tissue conductance (G_t). Thymol-evoked I_{sc} and G_t increases were almost completely abolished by Cl^- free solution. The effect of thymol did not affect EFS-evoked anion secretion, and was not inhibited by tetrodotoxin. Neither serotonin nor prostaglandins, which are well known secretagogues in the intestine, were involved in thymol-evoked Cl^- secretion. On the other hand, bitter tastant 6-n-propyl-thiouracil (6-PTU) induced both Cl^- and HCO_3^- secretions depending on prostaglandin level. Additionally, a non-specific cyclooxygenase (COX) inhibitor piroxicam and a COX-2 specific inhibitor NS-398 greatly reduced the response to 6-PTU, but not COX-1 inhibitors: resveratrol and SC-560.

The present results indicate that the odors and bitter tastants are able to modify the epithelial ion transport by distinct pathways in both human and rat large intestine. It is hypothesized that these chemosensing systems may be novel mechanism in the colon to maintain intestinal homeostasis.