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ANATOMY AND PHYSIOLOGY OF THE TASTE SYSTEM IN SEA LAMPREYS

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ABSTRACT:

Taste is a specialized chemosensory modality fundamentally associated with feeding behavior. Taste systems are present in both vertebrates and invertebrate species. The basic function of taste in animals, from invertebrates to humans, is to distinguish and favor energy-dense nutrients (sweet and umami stimuli) appropriate to the species' diet and to help avoid toxins (bitter stimuli) and spoiled food (acid stimuli). The sea lamprey gustatory system includes pharyngeal taste buds, cranial nerves serving as sensory input to the brain, and specific neural circuits for central processing and neural control of movements. Study of the distribution and chemosensory responses along the length of the sea lamprey's pharynx, which is located caudal to oral cavity revealed the location of these taste buds along the lateral surface of the pharynx, between the seven lateral brachiopores. Using electrophysiology, recordings from these pharyngeal regions containing taste buds revealed chemosensory neural responses to sucrose, nacl, alanine, arginine, denatonium, bile acids and atp. Each region of the pharynx between the seven brachiopores was tested and was responsive to the application of taste stimuli. Larval pharyngeal chemosensory responses were observed to tastants and to detritus collected from locations in ontario that sustain larval sea lamprey populations. This study shows that gustatory chemosensory responses may contribute to recruitment to larval habitat. Morphological and physiological study show a loss of pharyngeal gustatory responses during migration and spawning in adult (spawner) phase. There was a lack of structural integrity of the taste buds and chemosensory responses to tastants were absent during this stage, compared to robust chemosensory responses recorded during the earlier life stages.

We have examined the anatomical pathways responsible for the transmission of taste signals to the brainstem. More precisely, we have examined both anatomically and physiologically the connections between the tastebuds and different regions of the brainstem involved in producing locomotor movements or feeding behavior. We have found that gustatory inputs from the periphery travel through two cranial nerves, the glossopharyngeal and the vagal nerves. We have developed a new preparation in which we can stimulate individual tastebuds and record neural responses in the brainstem. This has allowed us to demonstrate that the command neurons for locomotion, the reticulospinal neurons receive strong synaptic inputs from the tastebuds. We have shown that these inputs are relayed in a specific nucleus in the brainstem, the nucleus of the solitary tract. When we stimulate the primary afferents fibres and record intracellularly in reticulospinal neurons, the responses are reduced significantly by injecting glutamate receptor antagonists in the nucleus of the solitary tract. Interestingly, the stimulation of a single tastebud in the periphery is sufficient to activate many reticulospinal neurons in the hindbrain. This indicates that there is a very strong link

between gustation and motor activity. We have also uncovered a connection from the tastebuds to the trigeminal motor neurons that are involved in feeding behavior. Our results demonstrate for the first time a link between the gustatory system and the motor systems controlling locomotion and feeding.