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2019 Fall International Conference of

KSAE

Korean Society of Applied Entomology

24-25 October 2019

Phoenix Pyeongchang Hotel

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Korean Society of Applied Entomology

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How dose honey bee detect amino acid nutrients: Umami taste sensor in the western honey bee, *Apis mellifera*

Sooho Lim, Giyoun Han, Sujin Lee, Rustem Ilyasov and Hyung Wook Kwon*

Department of Life Sciences & Convergence Research Center for Insect Vectors, Incheon National University

In honey bees, taste is responsible for choosing profitable food sources and for nest mate recognition. Taste detection for food sources occurs within cuticular hairs located on the antennae, on the mouthparts, and on the tarsi of the forelegs. Among food sources, umami taste perception indicates the presence of amino acids, which are essential nutrients along with sugar and fat. Although the physiology of umami perception has been described in mammals, how insects detect amino acids remains unclear. Here, we functionally characterized a gustatory receptor responding to L-amino acids in the western honey bee, *Apis mellifera*. Using a calcium-imaging assay and two-voltage clamp recording, we found that one of the honey bee's gustatory receptors, AmGr10, functions as a broadly tuned amino acid receptor responding to glutamate, aspartate, asparagine, arginine, lysine, and glutamine, but not to other sweet or bitter compounds. Furthermore, the sensitivity of AmGr10 to these L-amino acids was dramatically enhanced by inosine-5'-monophosphate (IMP). Contact sensory hairs in the mouthpart of the honey bee responded strongly to glutamate and aspartate, which house gustatory receptor neurons expressing AmGr10. This functional organization of the umami receptor of the honey bee strongly indicates the correlation of internal and external sensing of amino acids. Surprisingly, AmGr10 protein is highly conserved among hymenoptera but not other insects, implying unique functions in social insects.

Key words: Honey bee, *Apis mellfiera*, amino acid nutrient, umami, gustatory recetor, AmGr10

Lim S.H., Han G.Y., Lee S.J., Ilyasov R.A., Kwon H.W. How does honey bee detect amino acid nutrients: Umami taste sensor in the western honey bee, Apis mellifera // Proceedings of Fall International Conference of Korean Society of Applied Entomology, 24-25 October 2019. South Korea, Pyeongchang-gun: Korean Society of Applied Entomology KSAE. P. 27.