Scientists identify 36 genes, 100 neuropeptides in honey bee brains

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From humans to honey bees, neuropeptides control brain activity and, hence, our behaviors. Understanding the roles these peptides play in the life of a honey bee will assist researchers in understanding the roles they play in their human counterparts.

There are a million neurons in the brain of a honey bee (Apis mellifera), a brain not much larger than the size of the period at the end of this sentence. The activities of these neurons are influenced by the sea of peptides they are bathed in.

"Neuropeptides undoubtedly play a role in the bees' shift from working in the hive to foraging, displaying and interpreting dance language, and in defending the hive," said Jonathan Sweedler, a William H. and Janet Lycan Professor of Chemistry and the director of the Roy J. Carver Biotechnology Center at the University of Illinois at Urbana-Champaign.

"To use the honey bee as a model for sociogenomics, and to link molecular information to neurochemical and physiological data, we first must know the identities of the peptides used in the brain and the genes they are encoded by," Sweedler said.

Using a combination of the newly available honey bee genome sequence, as well as bioinformatics and mass spectrometry, Sweedler and collaborators from the United States and Belgium inferred the sequences of more than 200 possible neuropeptides and confirmed the sequences of 100 neuropeptides from the brain of the honey bee.

"This study lays the groundwork for future molecular studies of honey bee neuropeptides with the identification of 36 genes, 33 of which were previously unreported," the researchers write in the Oct. 27 issue of the journal *Science*.

"Neuropeptides come in a bewildering range of shapes and sizes, and are notoriously hard to predict from a genome alone," Sweedler said. "Even if you find a gene, it is hard to say what particular peptide it will create, because neuropeptide precursors undergo extensive post-translational processing."

Some of the neuropeptides the researchers discovered were a result of direct measurements of bee brains using an extremely sensitive mass spectrometer. Some of the genes were found because they resembled genes discovered in other species, such as the fruit fly (Drosophila melanogaster). And, because genes that produce neuropeptides often have repeating sequences, some of the genes were found by a computer algorithm that scanned the honey bee genome for such telltale sequences.

"We found 36 genes, from which we detected 100 peptides by mass spectrometry," said Sweedler, who also is a researcher at the university's Beckman Institute for Advanced Science and Technology and an affiliate of the university's Institute for Genomic Biology. "By combining other techniques, from bioinformatics to proteomics, we inferred an additional 100 peptides."

Some of the inferred peptides may not have been measured because they were present at too low a level to be detected, Sweedler said. Others may have been missed because they are present only during particular developmental stages. Future work will no doubt find and confirm more of the brain's peptides.

"The potential of our blended technology approach to facilitate

discovery of these peptides is not only significant for advancing honey bee research," the researchers wrote, "it demonstrates promise for neuropeptide discovery in the large number of other new genomes currently being sequenced."

Source: University of Illinois at Urbana-Champaign