What can we learn from honeybees? The role of calcium in long-term memory formation

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Synaptic plasticity associated with an important wave of gene transcription and protein synthesis underlies long-term memory (LTM) processes. Calcium (Ca^{2+}) plays an important role in a variety of neuronal functions and indirect evidences suggest that it may be involved in synaptic plasticity and in the regulation of gene expression correlated to LTM formation. The aim of this study was to determine whether Ca^{2+} plays a role in LTM formation and which Ca^{2+}-dependent genes are involved in this process. To address this question we used the honeybee *Apis mellifera,* which is a well-established model to study the molecular basis of memory formation. It presents important learning and memory capacities[1] and genomic analysis is now possible since its genome has been sequenced[2]. Experiments are possible on a large number of animals, allowing the screening of new potential therapeutics. We used the Pavlovian appetitive conditioning of the proboscis extension reflex in the honeybee to establish that Ca^{2+} is necessary and sufficient to induce LTM formation. Furthermore, microarray analysis has been done to determine which Ca^{2+}-dependent genes are involved in LTM formation.

Decline in memory and cognitive performances marks neurodegenerative diseases such as Alzheimer's disease[3]. Some studies have shown the importance of Ca^{2+} in neurodegenerative deseases[4], it is thus crucial to better understand the link between Ca^{2+} and LTM processes to find new therapeutics.

[1]Menzel R. (2001) *Learn. Mem.* **8**: 53-62
[2]Honeybee Sequencing Consortium (2006) *Nature* **443**: 931-949
[3]Cummings J. L. (2004) *N. Engl. J. Med.* **351**: 56-67
[4]Bezprozvanny I. (2009) *Trends Mol. Med.* **15**(3): 89-100