

蜜蜂的磁鐵沉積及磁場感應

MAGNETITE BIOMINERALIZATION AND MAGNETORECEPTION IN HONEYBEES (APIS MELLIFERAS)

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[摘要]

蜜蜂已知能夠在細胞內沉積鐵礦。在蜜蜂腹節的營養細胞內會形成許多鐵囊胞，在這之前的實驗顯示鐵囊胞內含有超順磁磁鐵奈米顆粒，並且有可能適合作為磁場感應之用。然而其生物化學、生物物理及磁性性質仍然不清楚。許多理論試圖闡釋動物的磁場感應，但其真正機制仍未明。瞭解蜜蜂磁鐵奈米顆粒的性質，是為研究動物如何偵測磁場和傳遞訊息的先決條件。在這項研究中，蜜蜂的磁性物質利用磁性管柱被分離出。利用電子順磁共振的方法來分析該磁性物質的磁各向異性，結果直徑為 15.8 nm 的磁鐵奈米顆粒被鑑定出。電子力/磁力顯微鏡也被利用來為蜜蜂營養細胞的磁鐵顆粒定位。此外，SDS-PAGE 被利用來研究與磁鐵生物礦化有關的蛋白質。

關鍵字: 蜜蜂 honeybees、磁鐵 magnetite、超順磁 super paramagnetic、磁場感應 magneto reception、電子順磁共振 electron paramagnetic resonance、磁力顯微鏡 magnetic force microscopy、生物礦化 biomineralization、電子顯微鏡 electron microscopy

[摘要]

The honeybee can deposit iron materials intracellularly. Numerous iron granules are formed in the trophocytes, which are located in abdomen. Previous study showed that iron granules contain superparamagnetic magnetite nanoparticles which were identified as suitable for magnetoreception, but biochemical, biophysical and magnetic properties of these nanoparticles are still lacking. Several theories of magnetoreception in animal have been proposed, but the mechanism still remains elusive. Understanding the characteristics of the magnetite nanoparticles in honeybee is one of the prerequisites for learning how the signal of magnetic sense is detected and transmitted. In this study, the magnetic material of honeybees was isolated by using a magnetic column. Electron paramagnetic resonance was used to analyze the anisotropic fields in magnetic nanoparticles of honeybees. Isolated superparamagnetic magnetite nanoparticles of about 15.8 nm in diameter are identified. Atomic force microscope/magnetic force microscope was also tried to locate the magnetic domain walls in iron-rich granules in trophocytes of honeybees. Furthermore, SDS-PAGE was used to study the proteins that involve in biomineralization process.