

A new frontier for visualising the impact of stressors in honey bees: proteins in pictures

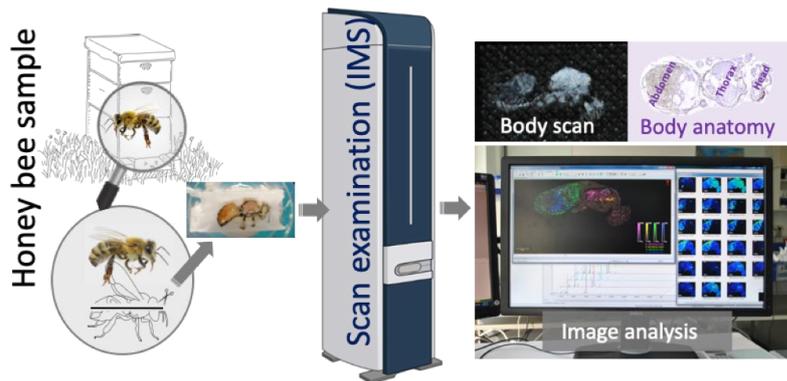
A cutting-edge technique of scanning opens perspectives for pathology research and bee health monitoring

In health care (animal and human), imaging techniques such as radiology, echography and scanning by magnetic resonance imaging (MRI) have contributed hugely to improving the prognosis and diagnosis of diseases by veterinarians and doctors.

Imaging mass spectrometry (IMS) provides unique opportunities for analysing tissues, organs, and even whole organisms at an unprecedented level of detail. We have adapted IMS for use in honey bees, enabling us to produce images of drugs/chemicals, metabolites, sugars, lipids (fats) and protein distributions across organs. This is illustrated below in scans of protein distribution in the body of honey bees that are infected, or not, by a fungal parasite, the causative agent of nosemosis.

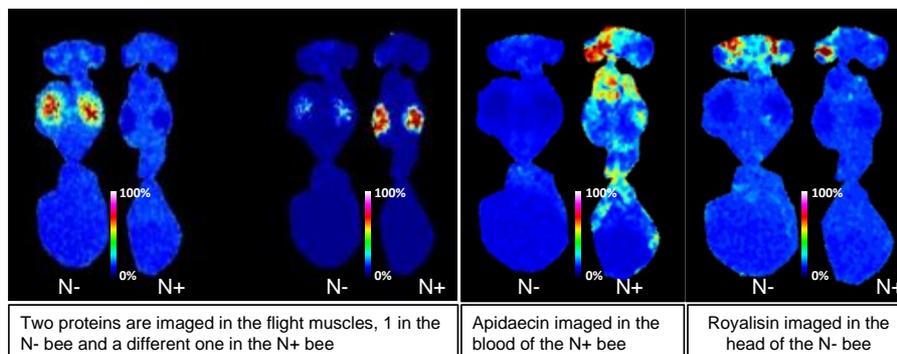
How to get imaged organs with protein distributions: just scan slices of a bee

The diagram below shows the work flow for producing IMS images, which bridge the gap between visual examination and targeted molecular analyses.



A cutting-edge technique demonstrated on bees inoculated with spores of the fungal parasite *Nosema*

IMS analysis of a non-infected bees (N-) and of a bee inoculated with *Nosema* spores (N+): examples of protein images; two that are differentially expressed in the flight muscles (left panel) and two others (right panel) in the bee blood (Apidaecin a marker of an activated immune response) and in the head (Royalisin, less present in the head of bees developing nosemosis), respectively. The absence or presence of a biomolecule is representative of a modification of the health status of the bee, confirming the impact of nosemosis on bee health.



Lessons to Learn from Pictures

- As Confucius, the Chinese Philosopher, said “a picture is worth a thousand words”. Just imagine a general practitioner facing a broken leg without the image provided by a radiogram
- The unique technique of IMS bridges the gap between visual examination and targeted molecular analyses.
- A new frontier to discover protein signatures of an organ and a body in response to stressors
- New generation of mass spectrometers are compatible for high-throughput screening of the spatial distribution of proteins, lipids, metabolites and drugs in any type of tissue or the entire body of a honey bee
- It is well known that nosemosis impacts gut morphology and physiology. When applied to a honey bee facing nosemosis, IMS also highlighted the nosemosis’ impact on the flight muscles located in the thorax, on the gland secreting the Royalisin protein, and on the immune response triggered by *Nosema* (presence of the Apidaecin protein) in bee blood
- A versatile technique applicable to other pollinators

Sources: [doi: 10.1002/pmhc.202100224](https://doi.org/10.1002/pmhc.202100224), <https://www.theses.fr/2020GRALV009>