



Mycologic Forum

Nosemosis and the collapse of beehives[☆]

Nosemosis y el colapso de las colmenas

F. Javier Cabañes

Veterinary Mycology Group, Department of Animal Health and Anatomy, Veterinary School, Universitat Autònoma de Barcelona, Bellaterra, Spain



ARTICLE INFO

Article history:

Received 28 February 2020

Accepted 23 March 2020

Available online 21 June 2020

There are multiple causes related to the decline in bee populations. Among them, the destruction of their habitat and the use of certain pesticides play an important role and are putting at risk the pollination of different plants and crops, with serious environmental, agronomic and economic consequences. Among the common diseases of bees, some infestations, such as those caused by mites of the genus *Varroa*, have practically spread throughout the world and are affecting the beekeeping sector in a worrying way and being an important cause of the phenomenon known as colony collapse disorder.

However, in recent years, an unexpected increase in honeybee (*Apis mellifera*) mortality has been described in certain areas due to, among other causes, the infection of these animals with certain species of the genus *Nosema*. In Spain, the first cases were detected at the beginning of this century, being related for the first time with *Nosema ceranae* infections, that caused a loss of bee colonies much higher than those previously reported in many geographical areas.² Although the role of this pathogen remains controversial, it is being associated with the depopulation of hives globally.

Nosema is acquired through the ingestion of spores, which infect the epithelial cells of the ventricle of bees and damage the digestive system of these animals. There are two main species of *Nosema* that affect honey bees and their infection result in different pathologies. The classic *Nosema apis* causes nosemosis type A, which is characterized by the abundant presence of faecal spots in the hives. The recently introduced pathogen *N. ceranae* causes nosemosis type C, also associated with a reduction in honey production and an



Fig. 1. Epithelial cell of the ventriculus of a bee infested by *Nosema ceranae*. Photo courtesy of Mariano Higes (CIAPA-IRIAF).

increase in bee mortality. Both pathogens are obligate intracellular parasites included in the Microsporidia division. Until recently, these organisms were considered a group of primitive protozoa. However, they have recently been phylogenetically linked to fungi, although they still occupy an uncertain position in this kingdom.¹ Their spores have an infection apparatus, called polar tube, which allows them to inject their contents into the cytoplasm of host cells (Fig. 1). In their evolutionary process of adaptation to intracellular life, they have undergone a significant genomic reduction, some of the species having genomes of less than 3 Mbp, with the consequent elimination of essential metabolic pathways, and a type of gene-lacking residual mitochondria, called mitosomes. Currently, about 1400 species are known, some of them pathogens of insects, fish, rodents, rabbits and human beings.

[☆] These Mycology Forum articles can be consulted in Spanish on the Animal Mycology section on the website of the Spanish Mycology Association (<https://aemicol.com/micologia-animal/>).

E-mail address: javier.cabanes@uab.es

Conflict of interest

Author has no conflict of interest.

Acknowledgements

Financial support came from Servei Veterinari de Bacteriologia i Micologia of the Universitat Autònoma de Barcelona.

References

1. Han B, Weiss LM. Microsporidia: obligate intracellular pathogens within the fungal kingdom. *Microbiol Spectrum*. 2017;5. FUNK-0018-2016.
2. Martín-Hernández R, Bartolomé C, Chejanovsky N, Le Conte Y, Dalmon A, Dussaubat C, et al. *Nosema ceranae* in *Apis mellifera*: a 12 years postdetection perspective. *Environ Microbiol*. 2018;20:1302–29.