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Rapid identification methods for zoonotic pathogens

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There is a zoonotic reservoir living amongst us

Rats, akin to mice, belong to the rodent family. Why are we putting them into the spotlight here? Well, both rats and mice frequently serve as unwitting hosts to parasites, such as fungi and bacteria. Originating from Asia, the house rat has traversed the globe through ships and trading vessels, inadvertently carrying microorganisms along. The animals serve as vectors for pathogenic microorganisms, which can be transmitted to humans in various ways, collectively termed as zoonotic pathogens.

Among the various reservoirs of zoonotic pathogens, rodents have garnered significant attention due to their ubiquitous presence not only in urban settings like metro stations, areas surrounding recycling/waste management facilities, as well as near water supply systems, but also in agricultural environments. This overlap in habitats with humans creates the risk to transfer microorganisms. Pathogenic bacteria are typically transmitted through exposure to various vectors like ticks, fleas, and

mosquitoes, or through contact with contaminated soil and water sources. Less commonly, humans may be affected through animal bites, scratches, or direct contact with infected animals.

A myriad of organisms require rapid microbiological techniques for fast identification and immediate initiation of proper countermeasures. Zoonotic bacteria include *Leptospira*, *Salmonella*, *Yersinia*, *E. coli*, MRSA, *Bartonella*, *Clostridium*, *Rickettsia* spp., *Coxiella*, *Campylobacter*, and more.¹ Rapidly identifying such pathogens can help to make quicker decisions and prevent further spreading in the first place by identifying contaminated environments or populations. Utilizing the MALDI Biotyper®, one can quickly identify reservoirs harboring different types of zoonotic microorganisms, starting from colony material obtained from animal or environmental samples.

Let's have a closer look on selected gram-negative bacteria

A recent study in Spain indicated that humans may contract *Bartonella* infection by contact with rodents in the Canary Islands.² *Bartonella* spp., especially *B. elizabethae* complex (sensu lato), is usually transmitted between rodents (such as rats) and humans by hematophagous insects such as fleas, sand flies, lice, cat fleas, and other routes. Using the MALDI Biotyper, one can identify zoonotic pathogens at the species level, including *Bartonella vinsonii*, *B. tribocorum*, *B. elizabethae*, and *B. alsatica*.

The genus *Campylobacter* encompasses over 20 species, with *C. jejuni* and *C. coli* being well-known for causing gastroenteritis in humans. Recent studies conducted in Europe showed the isolation of *Campylobacter* spp. from house rats and wild brown rats in organic farms,³ and the occurrence of *Campylobacter* in faeces, livers and carcasses of wild boars hunted in Tuscany, Italy.⁴ Consumption of contaminated milk, meat, fruits, and vegetables, particularly poultry meat, is the main route of transmission. Apart from gastrointestinal and food-borne infections, *Campylobacter* has been linked to a number of systemic diseases such as Guillain-Barré Syndrome (GBS) and Miller Fisher Syndrome (MFS).⁵

A prominent example of gram-positive bacteria in this context is *Clostridium* spp., for which MALDI-TOF offers an accurate way to identify to the species level. Moreover, during the last reference library updates, Bruker has provided an extensive increase of species coverage for *Clostridium* spp. Continuous improvement and expansion of the reference library over the last years provides more value to the users and could also enhance its performance in veterinary and food monitoring laboratories. In a recent study at a sheep and cattle slaughterhouse, commonly identified *Clostridium* species included *C. sporogenes*, *C. cadaveris*, *C. cochlearium*, and *C. perfringens*. It was also shown that the extended direct transfer method improved the identification of *Clostridium* spp.⁶

Another study has reported the prevalence of *C. perfringens*, its virulence profile and antimicrobial resistance in free-living rodents and shrews.⁷ Rodents and shrews can potentially contaminate food and the environment, infecting humans and livestock with multi-drug resistant *C. perfringens*. The MALDI Biotyper enables fast and easy microbial identification, but can also contribute to research projects with its negative ion mode offering the capability of lipidomics analysis.

It is important to mention that with constant updates also new veterinary-related species can be found in the Bruker MALDI-TOF MS library. The MALDI Biotyper allows to identify microorganisms to the species level as described above and to even go beyond identification and detect specific antibiotic resistance markers with the MBT HT Subtyping Module, or detect specific resistance mechanisms with the MBT HT STAR®-BL Module. Further strain discrimination of animal outbreak strains is possible with the IR Biotyper®, a complementary instrument based on Fourier transform infrared (FT-IR) spectroscopy.

References

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