Imaging mass spectrometry and microbial metabolomics on track of infectious diseases

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Introduction

- Mixed infections represent a diagnostic challenge for any microbiology laboratory.
- In this work high mass resolution spectrometry is introduced as extremely sensitive tool for early detecting *Aspergillus* and *Pseudomonas* infections in rat models.
- Microbial siderophores were studied as specific disease biomarkers and detected in urine, serum and tissues of infected animals.

Aspergillus fumigatus

Figure 1. Infection diagram indicating the progression of aspergillosis in the HD rat model with seven biological replicates. Fe-FC (ferri form of ferricrocin) concentration detected in rat urine is plotted on a logarithmic scale. An asterisk (*) denotes detectable signals with insufficient statistics for accurate quantification.

Figure 2. Thoracic coronal CT and PET/CT images of ⁶⁸Ga-TAFC (galium labeled triacetylfusarinine C) in infected (yellow arrow indicator) individual over time in experiments using high dose of conidia.

Figure 3. Comparison of Fe-FC concentration in the urine with beta-D-glucan test in corresponding rat serum taken on the last day of infection. Fe-FC concentration is plotted on a logarithmic scale. ND denotes for not detected.

Figure 4. The MALDI FTICR MSI illustrated the actual microbial ferricrocin distribution in the lung tissue and resolved the false-positive results obtained by the light microscopy and histological staining.

Pseudomonas aeruginosa

Figure 5. Scanned optical image in the first layer with annotated compounds and SEM navigation window introduced in the 2nd layer (top). 50x50 μm pixel dimension indicating the area irradiated by a laser pulse in MALDI-MSI. PyE (pyoverdine E) was visualized by MALDI-MSI in infected lung tissue (bottom). SEM image of the tissue with bacteria (red rectangle).

Conclusion

- Compared to standard diagnostic tools, mass spectrometric detection of **ferricrocin**, **triacetylfusarinine C** and **pyoverdine E** in urine represents an innovative non-invasive and early indication of *Aspergillus* and *Pseudomonas* infections in a host
- Our software **CycloBranch** can also be used for image fusion, here documented by SEMxMSI combination.