Micro-Raman spectroscopic identification of Bacillus anthracis

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The rapid identification of *Bacillus* endospores is paramount because some members of this genus can interfere with human health. *B. cereus*, for example, is occasionally associated with food poisoning, whereas *B. anthracis* as the causal agent of anthrax gained notoriety by being a potential agent in biological warfare and bioterrorism [1].
Micro-Raman spectroscopy in combination with chemometric data evaluation has been suggested as a rapid, sensitive, and reliable technique for characterization and typing of vegetative cells and endospores [2, 3]. The measurements of single bacteria can be done without a lengthy pre-cultivation period, which is seen as a big benefit compared to other spectroscopy-based identification methodologies [4]. Cornerstone of this approach is, however, a comprehensive spectral database embracing preferably most of the bacterial genera and subgenera, from which the targeted microorganism needs to be discriminated.
We created a database of roughly 10,000 single Raman spectra of a wide variety of *Bacillus* endospores including several strains of the genetically similar *B. cereus* group to identify *B. anthracis* among *Bacillus* species. A cascade of classifiers structured the data tree-wise to allow us a distinction on different taxonomic ranks.
Furthermore we applied this approach to detect and identify endospores in artificially contaminated powdery substances like baking powder or gypsum. The samples were spiked with different kinds of *Bacillus* endospores including *Bacillus anthracis*. This should proof the applicability of this technique when it comes to real world samples such as endospores diluted in harmless hoax materials.
The identification rates for all the used *Bacillus* species exceeded 95% independent of the matrix out of which they have been isolated. Even endospores extracted from a specific matrix, which was not included into the model system beforehand, were correctly recognized.

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References

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