IR Biotyper®

Ready-to-use Classifier for *Legionella pneumophila*

Distinguishing *L. pneumophila* serogroup 1 by machine learning-based classification

Legionella pneumophila is the primary causative agent of Legionnaires' disease and remains one of the major concerns for water safety monitoring and public health authorities. Among the different serogroups, serogroup 1 (SG1) is responsible for the majority of human infections and therefore receives particular attention during outbreak investigations and routine environmental surveillance.

Traditional serogrouping methods rely on antibody testing, phenotypic characterization, or sequence-based approaches. These methods can be labor-intensive, time-consuming, and may require specialized expertise and reagents. Fourier-transform infrared (FTIR) spectroscopy, combined with the ML-based *Legionella pneumophila* Classifier for the IR Biotyper, provides a rapid and standardized alternative. The classifier enables automated differentiation of SG1 from serogroups 2-15 directly from colony material, delivering objective results in less than three hours and supporting routine water microbiology workflows while reducing operational complexity and cost.

Benefits of using Classifiers:

- Ready-to-use
- Immediate and clear result display by color coding and score values
- Easy and fast workflow improving lab efficiency
- Transparent, objective and standardized serogrouping results
- Reduces costs and manual labor
- Safe (no open slides) and animal-friendly workflow (no rabbit antibodies)

What's a Classifier?

An FTIR classifier is a software tool that learns from infrared spectra of known training classes and uses AI-based algorithms to confidently classify new, unknown spectra (Fig.1).

How was the *L. pneumophila* Classifier developed?

The *Legionella pneumophila* Classifier was developed using infrared spectra from well-characterized *L. pneumophila* isolates representing serogroup 1 and serogroups 2-15. Using the standardized IR Biotyper workflow, spectral data were used to train an artificial neural network capable of recognizing serogroup-specific molecular fingerprints.

The resulting model automatically differentiates *L. pneumophila* SG1 from all other serogroups and is integrated directly into the IR Biotyper software for routine laboratory use.

Researchers at the University of Bologna demonstrated that the IR Biotyper classifier differentiated serogroup 1 from serogroups 2-15 with 100% sensitivity and 98.35% specificity, while reducing laboratory costs compared with traditional agglutination-based methods.[1]

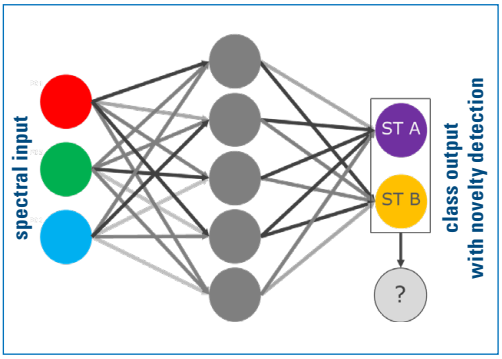

Fig. 1 Schematic depiction of a Classifier that can be applied to unknown samples for their classification (right side). Classifier creation involves a training set of isolates (left side) to establish a recognition network (middle).

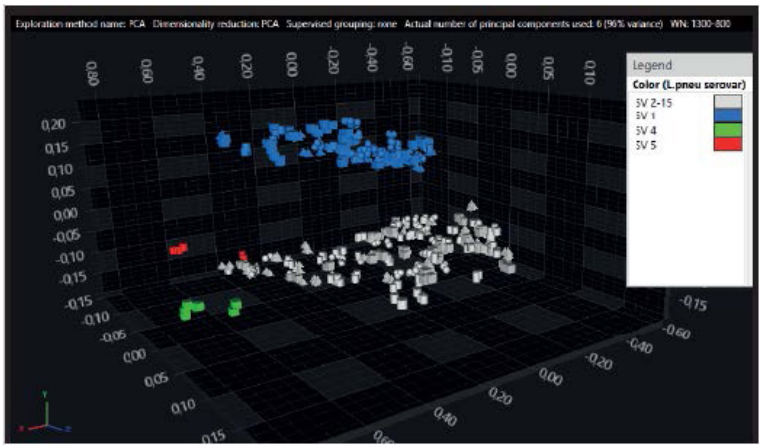

Fig. 2. 3D scatter plot for *Legionella pneumophila* serogroups. SG1 (blue) clearly discriminated from others.

References
1 M.R. Pascale, F. Bisognin, M. Mazzotta, L. Girolamini, F. Marino, P. Dal Monte, M. Cordovana, M. Scaturro, M.L. Ricci and S. Cristino, Use of Fourier-transform infrared spectroscopy with IR Biotyper® system for *Legionella pneumophila* serogroups identification, Frontiers in Microbiology, 2022 (published online); http://doi.org/10.3389/fmicb.2022.866426

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