news digest #024

Key microbes identified in pharmaceutical routine monitoring

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Regular monitoring is essential for detecting and controlling microbial contamination, particularly in pharmaceutical environments. Since operators are a primary source of contamination, it's not surprising that many identified bacteria are familiar species, often transmitted through the air or by human contact. The frequency of bacterial contamination in these settings varies based on several factors, including the type of facility, ingredients, final products, batch processes, and the environmental control strategy in place. Here MALDI-TOF MS can help to improve rapid microbial identification and speed up processes by delivering identification results within minutes starting from colony material.

Pharmaceutical microbiology and bacterial identification are essential to ensure the safety and efficacy of pharmaceutical products. Accurately identifying and controlling bacterial contaminants helps companies to prevent infections, meet regulatory standards, and uphold product quality.

Historically, culturing on selective agar plates and performing biochemical tests, such as the Catalase, the Coagulase or the Oxidase test, have long been key tools in bacterial identification. Nowadays, instruments like the MALDI Biotyper® allow for fast, precise and cost-effective microbial identification, analyzing protein profiles directly from colony samples in just minutes. The beating heart of it is a reference library covering thousands of microorganisms, with the possibility of being complemented by a library of custom entries to accommodate site- or region-specific needs.

As mentioned above, there is a common theme for most bacterial contaminations being either air- or human-borne, resulting in a number of usual suspects, which we will highlight here. *Micrococcus* species, commonly found on human skin, are generally harmless but can be a significant source of contamination. *Micrococcus luteus* consistently ranks among the top three most detected microbes and according to a recent study, *M. luteus* accounts for approximately one out of four contamination cases in cleanrooms.[1]

Staphylococci are another prominent group of contaminants. *Staphylococcus aureus*, often present on human skin and in the respiratory tract, is a common contaminant that can cause a variety of infections. *S. epidermidis*, *S. hominis* and *S. warneri*, all part of the normal human skin flora, are known for biofilm formation and pose a risk of infection. *S. cohnii*, although often reported as a skin-derived contaminant, has also been associated with cases of meningitis.[2,3]

In addition to *Micrococcus luteus* and the three *Staphylococcus* species mentioned, many other bacterial species found in pharmaceutical environments are biofilm formers as well. *Pseudomonas aeruginosa*, for instance, is commonly found in water and moist environments and is closely monitored as a potential contaminant in sterile injectables. *Legionella*, known for its ability to form biofilms in water systems, presents another contamination risk in production facilities. Furthermore, *Klebsiella pneumoniae* can form biofilms that are particularly difficult to eliminate, and *Proteus mirabilis* is notorious for biofilm formation on urinary catheters. The persistence of biofilm formers presents an ongoing challenge in contamination control for pharmaceutical manufacturers. A recent MALDI-TOF study has presented statistical data of a broad microbial contaminant monitoring project focused on bacterial contaminations of sterile drug manufacturing facilities, and the group found that, besides the dominant *Staphylococci* and *Micrococci*, nearly 20% of the samples contained *Bacillus* spp., *Actinobacteria*, and *Paenibacillus* species.[3]

Last-but-not-least is *Burkholderia cepacia*, a biofilm-forming bacterium that is highly resistant to many disinfectants. This bacterium poses a considerable contamination risk for manufacturers of non-sterile, water-based pharmaceutical products, and the FDA has highlighted its significance in a recent report.[4]

In recent years the Bruker library has expanded significantly, including a range of industry relevant species such as *Moraxella osloensis*, *Mixta calida* (formerly *Pantoea calida*), *Cronobacter muytjensii*, *Ralstonia pickettii*, all gram-negative bacteria, and *Geobacillus stearothermophilus* (previously *Bacillus stearothermophilus*), *Peribacillus simplex*, *Kocuria rhizophila*, all gram-positive bacteria.

The MALDI Biotyper workflow not only identifies bacteria but also detects fungal contamination, impacting manufacturing and product quality. Notable fungi include *Candida albicans*, monitored e.g., in sterile injectables, and *Aspergillus niger*, both a contaminant and a key enzyme production species. Bruker's Mycelium Transfer (MyT) procedure streamlines sample prep, while the MBT HT Filamentous Fungi Module enables fast and accurate species-level identification of filamentous fungi.[5]

The MALDI Biotyper offers high precision and reliability for identifying both gram-positive and gram-negative bacteria as well as yeasts and molds. The extensive reference library coverage provides confidence even when facing rarer types of contamination. Its speed and cost-effectiveness make it particularly valuable for monitoring and rapid identification, as it delivers results within minutes and enables lower operational costs compared to traditional biochemical methods or sequencing.

References

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